

**INSTALLATION RESTORATION
PROGRAM REMEDIAL
INVESTIGATION - INTERIM
REPORT**

**NAVAL BASE
NORFOLK, VIRGINIA
CONTRACT NO. N62470-83-C-6079**

**For The
Commander Naval Base
Norfolk, Virginia 23511**



**By
Malcolm Pirnie, Inc.
ENVIRONMENTAL ENGINEERS, SCIENTISTS AND PLANNERS**

March 1988

**MALCOLM
PIRNIE**

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

April 14, 1988

Commander, Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia 23511

Attention: Mr. Joseph Wallmeyer
Code 114

Re: Installation - Restoration Program
Remedial Investigation
Interim Report
Naval Base Norfolk
Contract N62470-83-C-6079

Gentlemen:

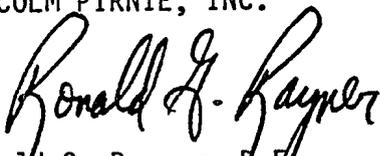
In accordance with the terms of our contract, please find enclosed 16 final copies (15 bound and 1 unbound) of the Installation Restoration Program, Remedial Investigation Interim Report for the Naval Base Norfolk, Virginia. Submitted concurrently are all original laboratory analytical data procured during this study.

This report completes all of the work at the Sewell's Point Naval Complex outlined under Contract No. N62470-83-C-6079, with the exception of the recommended remedial action at the P71 transformer storage area. This work effort is also addressed under the terms of the basic contract but as a separate and distinct change order (C.O. #7).

Should you have questions, please do not hesitate to contact us.

Sincerely yours,

MALCOLM PIRNIE, INC.


Ronald G. Rayner, P.E.
Project Manager

mfa
0746-01-1119

Enclosure

INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION - INTERIM REPORT

NAVAL BASE, NORFOLK, VIRGINIA

CONTRACT NO. N62470-83-C-6079

FOR:
COMMANDER NAVAL BASE
NORFOLK, VIRGINIA 23511

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MARCH, 1988

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1. EXECUTIVE SUMMARY

INSTALLATION RESTORATION (IR) PROGRAM
REMEDIAL INVESTIGATIONS - INTERIM REPORT

PURPOSE

- o This project was performed under the direction of the Environmental Quality Branch, Atlantic Division, Naval Facilities Engineering Command.
- o The initial objective was to determine whether or not specific toxic or hazardous materials from past disposal practices had contaminated the following five sites located at the Naval Base Norfolk, Virginia.
 - Site 1: Camp Allen Landfill Area
 - Site 2: NM Area Slag Pile
 - Site 3: Q Area Drum Storage Yard
 - Site 4: Transformer Storage Area P-71
 - Site 5: Pesticides Disposal Site V-95
- o The project objectives were expanded during the study to include determination of the extent of contamination, risk assessment, evaluation of remedial alternatives and recommended remedial action at specific sites.

BACKGROUND

- o The five sites are located within at the Naval Base Norfolk, Virginia.
- o An Initial Assessment Study (IAS), previously conducted at the Naval Base Norfolk, identified the referenced sites as areas where potential adverse impacts on human health or the environment may exist due to past activities.
- o Contract N62470-83-C-6079 was issued on September 30, 1983, authorizing Malcolm Pirnie to conduct this Remedial Investigation (RI). Subsequently, Change Order No. 4 dated June 18, 1984 and Change Order No. 6 dated May 28, 1986 were issued authorizing Pirnie to provide additional work regarding the study.

SITE 1 - CAMP ALLEN LANDFILL AREA

Findings

- o Analysis of organic compounds in ground water samples from nine well locations identified two locations; wells O1GW-04 and B-20W, with significant concentrations of several organics. These concentrations, however, have reduced with time.

- o A bright red, viscous liquid was observed during boring activities, about 50 feet south of well 01GW-04, at a depth of 6 to 10 feet below ground surface. Analysis of the liquid indicated significant concentrations of xylene, benzene and toluene. Total Volatile Organics within the actual sample were measured at 1.6 to 1.7%.
- o Surface water samples from four locations indicate that some leaching of organic compounds from the soil ground water matrix to the nearby surface drainage ditch has occurred. Concentrations diminished downstream of the surface water sample location.
- o Analyses of inorganic compounds in the ground water and surface water indicated elevated concentrations (for total metals) of cadmium, chromium, lead and zinc.
- o Special analyses indicated elevated concentrations of methyl ethyl ketone (MEK) and methyl isobutyl ketone (MIBK) were present in samples from well B-20W. MIBK was also identified at well 01GW-04.

Conclusions

- o Localized contamination of the ground water with organic compounds at wells 01GW-04 and B-20W has occurred.
- o Some organic constituents identified in 01GW-04 have also migrated to the surface drainage ditch adjacent to the well.
- o Cadmium, chromium, lead and zinc concentrations detected do not appear to present an environmental hazard, although concentrations did slightly exceed water quality criteria.

Recommendations

- o Three nested well systems should be installed and monitored in the vicinity of well 01GW-04 and three additional nested well systems installed and monitored in the vicinity of well B-20W to define the areal extent of contamination.
- o Two rounds of sampling from both existing and proposed wells, the previously sampled surface water locations, and two additional surface water locations are recommended.
- o Sample analyses should include only those constituents of concern and previously identified, including:
 - Volatile Organics
 - Acid Extractable Organics
 - Inorganics (total and soluble)
 - Xylene, MEK, MIBK

- o A Soil Gas Survey (vadose zone testing) to identify and locate other localized areas where high concentrations of volatile organics may exist along the landfill perimeter is recommended.
- o Remedial alternatives at locations O1GW-04 and B-20W, and other locations as appropriate, should be evaluated and implemented after the recommended sampling and analyses are complete.

SITE 2 - NM AREA SLAG PILE

Findings

- o Trace amounts of six inorganic constituents analyzed were present at the background soil sample location.
- o Inorganic constituent concentrations identified in the soil sample location in the slag pile area were significantly higher than background concentrations.
- o Surface water analyses indicated inorganic constituents analyzed are not entering the water column.
- o Sediment samples collected at the same locations as the surface water samples indicated elevated inorganic concentrations were present.
- o EP toxicity tests conducted indicated a minimal tendency for leaching of inorganics.

Conclusions

- o Disposed slag at the site does contain high concentrations of inorganics.
- o The inorganics have been mixed with and become enmeshed with the on-site soils and are only being transported via erosion.
- o Leaching of inorganics into the water column is not occurring.

Recommendations

- o Soil sampling should be performed to further identify the limits of the slag pile area.
- o The slag pile area should then be leveled and capped with a hard surface to minimize the potential for continued erosion.
- o Removal and/or other action is not warranted based on the data collected.

SITE 3 - Q AREA DRUM STORAGE YARDFindings

- o Significant concentrations of five organic constituents were identified in ground water from one monitoring well (03GW-01) located in the immediate vicinity of the leaking drum storage area.
- o Analytical results from three other monitoring wells indicated no significant concentrations of organics were present at these locations. However, based on ground water levels, all three wells appear to be upgradient of the leaking drum area.
- o Inorganic concentrations identified in the ground water are not considered significant.
- o Analyses of soils indicated elevated concentrations of trans - 1,2-dichloroethylene and trichloroethylene were present in the vicinity of the leaking drum storage area.
- o Slightly elevated concentrations of seven base-neutral extractable organics and three pesticides were also identified in various soil samples collected at locations adjacent to and outside the leaking drum area within the storage yard.
- o Regarding inorganics, only arsenic was found to be elevated in several soil samples.
- o Results of supplemental soil sampling conducted by Navy personnel indicated very high concentrations of oil and grease also exist near the leaking drum area within the storage yard.

Conclusions

- o Organic constituents identified in the soils and ground water in the immediate vicinity of the damaged drum area are the direct result of leaking drums.
- o Organic and inorganic constituents have been identified in several soil samples collected adjacent to and outside of the leaking drum area, but there is no evidence that these constituents have leached to the underlying ground water.
- o High oil and grease concentrations were identified by Navy personnel after a fire inspector observed oil-saturated soils were a potential fire hazard.

Recommendations

- o Three nested well systems should be installed downgradient of the leaking drum area and the ground water monitored to define

the extent of organic contamination present. Remedial alternatives should be evaluated after the data is collected.

- o Collect additional soil samples in selected areas known to be contaminated and analyze for metals, EP Toxicity, petroleum hydrocarbons and ignitability.
- o If the contaminated soil is confirmed not to be hazardous, the entire Q Area Drum Storage Yard should be capped with an impermeable surface to eliminate percolation of storm water and potential leaching of constituents, unless subsequent characterization efforts suggest otherwise.
- o An enclosed area where damaged and/or leaking drums can be stored and spillage contained and remediated should be designed and constructed.
- o An updated Spill Prevention and Countermeasure Control plan (SPCC) to minimize spillage and provide for emergency containment and clean-up should be prepared and implemented.
- o Periodic inspection of site operations and monitoring of the ground water to ensure the integrity of the impermeable surface should be implemented.
- o Establish appropriate run-on and run-off control measure for storm water from the entire storage area, regardless of what remediation alternative is chosen, to minimize infiltration potential and sediment transport.

SITE 4 - TRANSFORMER STORAGE AREA P-71

Findings

- o Approximately 250 cubic yards of soil, the majority of which is located in the top foot of soil at the site, was determined to contain PCB concentrations exceeding 50 ppm.

Conclusions

- o Remedial action to address the soil contaminated with PCB's is warranted.
- o Based on a review of various remedial alternatives, excavation and disposal of the contaminated soils is the most environmentally sound and cost-effective means of remediation available.

Recommendations

- o It is recommended that Plans and Specifications, including Quality Assurance documents, be prepared to remove and dispose

of contaminated soils having concentrations of PCB's greater than 50 ppm.

- o Concentrations less than 50 ppm will be left in place and excavated areas filled with clean soil.

SITE 5 - PESTICIDE DISPOSAL SITE V-95

Findings

- o Ground water analyses indicated no organic constituents, including pesticides, were detected and inorganic compounds identified were at insignificant concentrations.
- o Soil analyses indicated elevated concentrations of two pesticides, DDT and DDD, are present in the immediate vicinity of the french drain used to dispose of waste from the surface to a depth of 26-feet.
- o Soil analyses also indicated several base-neutral compounds were present in the top two feet of soil at various locations.

Conclusions

- o DDT and DDD have been absorbed by the soil matrix in the vicinity of the french drain used for waste disposal. These pesticides, which are generally not soluble in water, are not present in the ground water and have not migrated a significant distance from the disposal site.
- o The base-neutral compounds are the result of on-site activities unrelated to the french drain disposal operation.
- o Remedial action to eliminate the potential for accidental contact with soils containing pesticides is warranted.

Recommendations

- o Install an impermeable, hard surface over the entire work area to effectively remove the potential for surface exposure.
- o Extend existing security fencing to minimize the potential for unauthorized personnel entering the area.
- o Provide a sign identifying the pesticides present and warning against excavation in the area.
- o Evaluate on-site activities in order to minimize the potential for spillage and future contamination of base-neutral compounds.

- o Prepare a spill prevention and clean-up plan for on-site activities.

2. INTRODUCTION

2.1 INSTALLATION RESTORATION (IR) PROGRAM DESCRIPTION

The Department of the Navy completed the first phase of the Installation Restoration (IR) program at the Naval Base Norfolk, Virginia and summarized the results in an Initial Assessment Study (IAS), dated February, 1983. The purpose of the IAS was to collect and evaluate evidence indicating existence of pollutants that may have contaminated the installation or that pose an imminent health hazard for people located on or off the installation. The IAS was essentially equivalent to a Preliminary Assessment (PA) conducted by EPA under the Superfund program. Results of the IAS show that sufficient evidence exists to indicate the potential presence of contaminants which might pose a health or environmental threat on or off the facility. Six sites were recommended for investigation during phase two of the program, the Confirmation Study. (Note: LANTNAVFACENCOM performed an independent study of one site. Five sites are addressed in this Confirmation Study effort.)

The Confirmation Study was a sequentially phased effort to: determine the existence, concentration, extent, and rate of migration of previously identified contaminants of health and environmental concern; develop economically feasible alternatives to effect compliance with applicable health and environmental standards; and, as required, prepare detailed construction plans and specifications with cost estimates satisfactory for project advertisement and implementation.

As a result of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and subsequent to this contract effort, the Navy has changed both the terminology and the structure of the IR program to conform to that used by EPA. This report contains the results of extensive sampling that fulfilled one step of the Confirmation Study process but it does not meet the full requirements of a Remedial Investigation (RI). However, this data represents a decision-making point in the IR program for continuing or halting the RI at certain sites. It is presented as an interim RI for review and comment, with

the objective of incorporating it into a completed Remedial Investigation/Feasibility Study (RI/FS) document at a later date.

The sequential efforts of the Confirmation Study are termed Steps and include:

<u>Step</u>	<u>Description</u>
IA	Verification of existence of contamination (Remedial Investigation).
IB	Characterization of extent and rate of migration of contaminants, and of geohydrological, geophysical, and other factors (Remedial Investigation).
II	Evaluation of alternatives to achieve compliance, and preparation of cost estimates and project effectiveness of alternatives (Feasibility Study).
III	Preparation of plans, specifications, and government project documentation with cost estimates satisfactory for project funding requests (Remedial Design).

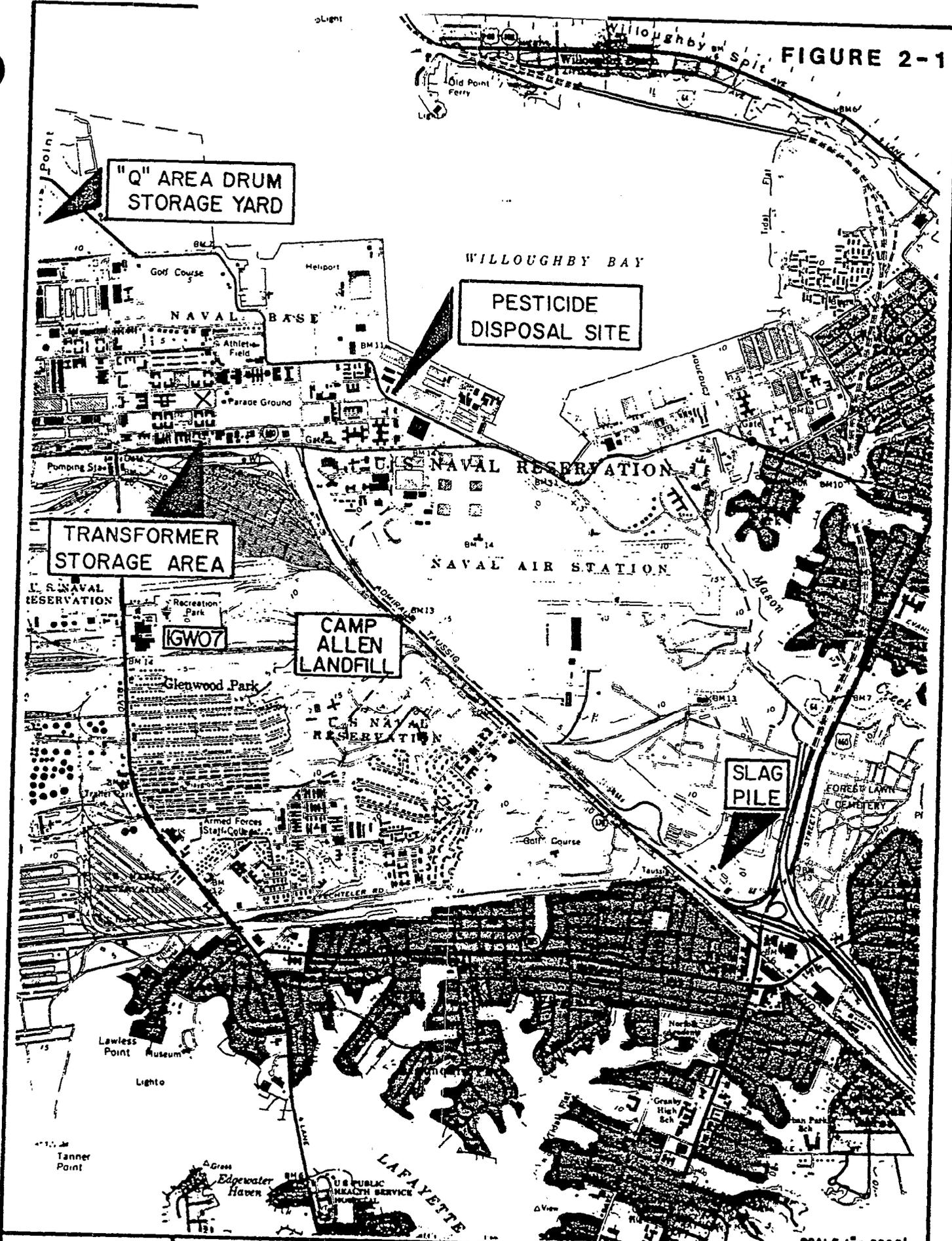
The sites investigated at Naval Base Norfolk, Virginia include:

- Site 1 - Camp Allen Landfill Area
- Site 2 - NM Area Slag Pile
- Site 3 - Q Area Drum Storage Yard
- Site 4 - Transformer Storage Area P-71
- Site 5 - Pesticide Disposal Site V-95

Figure 2-1 shows the location of each site.

2.2 OBJECTIVES

The IR Program Remedial Investigations were initiated at the five sites noted above. Work initially included identification and quantification of pollutant concentrations, estimation of the contamination extent at selected sites, and evaluation of pollutant migration potential for all sites, including an assessment of possible effects on human health and the environment. As the project proceeded, additional work regarding evaluation of remedial alternatives and recommended remedial action was also conducted at specific sites.



"Q" AREA DRUM STORAGE YARD

PESTICIDE DISPOSAL SITE

TRANSFORMER STORAGE AREA

CAMP ALLEN LANDFILL

SLAG PILE

MALCOLM PIRNIE

NAVAL BASE NORFOLK, VIRGINIA
LOCATION PLAN

MALCOLM PRINCE, INC.
MARCH 1988

2.3 BACKGROUND

The Department of the Navy initiated the NACIP program to identify, assess and control possible contamination from past hazardous material operations. The purpose of the program is to locate areas at Naval installations which may pose a potential threat to human health or the environment and implement corrective measures. As previously noted, the program consisted of three phases, which are more fully described below:

- I. Initial Assessment Study: This phase includes performing extensive record searches and personnel interviews to collect and evaluate all evidence supporting the existence of a contamination problem at an installation.
- II. Confirmation Study: In the Confirmation phase, an on-site investigation (Step IA - Verification) including physical and analytical monitoring, is performed to confirm or refute the existence of contamination. If contamination is present, a subsequent investigation (Step IB - Characterization) shall quantify the extent of the problem and, if necessary, recommend both interim and long-term corrective measures.
- III. Corrective Measures: This phase consists of the implementation of needed interim and/or long-term remedial measures to control and mitigate contamination.

As previously noted, the NACIP Program is now redesigned as the Installation Restoration (IR) Program, and the Confirmation Study is being modified to equal the EPAs Remedial Investigation/Feasibility Study (RI/FS).

In April of 1982, the Initial Assessment phase of the NACIP program began at the Naval Base Norfolk, Virginia. This phase culminated in the Initial Assessment Study (IAS) Report, NEESA 13-016, being submitted to the Department of the Navy in February, 1983. This report completed Phase I of the NACIP program at the Naval Base Norfolk, Virginia.

The IAS investigation identified eighteen (18) sites of concern with regard to potential contamination. Table 2-1, reprinted from the IAS report, lists the 18 disposal sites and provides a summary of the period of operation and type of waste disposed of at each site. Each of the 18 waste disposal sites identified were evaluated using a Confirmation Study Ranking System (CSRS) developed by the Naval Energy and Environmental Support Activity (NEESA).

Table 2-1

Disposal Sites Investigated at Naval Base Norfolk, Virginia

Site Number	Site Name	Map Coordinates*	Period of Operation	Type of Waste Disposed Of	Comments
1	Camp Allen Landfill	N225 E2643	1940s to 1974	Ash from solid waste incineration, coal fly and bottom ash, asbestos, waste oil, organic solvents, paint stripping wastes, metals plating sludges, overage chemicals, pesticides, scrap metal, construction and demolition debris	Total landfill area is about 45 acres; landfill currently covered with grassy areas, brig, and heliport
2	Slag Pile	N222 E2650	1950s to 1960s	Slag from aluminum smelting operation	Slag pile covers an area of about 2 acres
3	Q Area Drum Storage Yard	N234 E2636	1950s to present	Predominantly POL and various organic solvents; some pesticides, formaldehyde, acids	Unbermed earthen yard; numerous leaking drums; saturated soil in portion of yard where leaking drums are stored
4	Transformer Storage Area	N229 E2640	1940s to 1978	Transformer oil potentially containing PCBs	Open earthen storage yard; transformer oil reportedly drained onto ground surface; evidence of past spillage

Table 2-1
 Disposal Sites Investigated at Naval Base Norfolk, Virginia
 (Continued, Page 2 of 4)

Site Number	Site Name	Map Coordinates*	Period of Operation	Type of Waste Disposed Of	Comments
5	Pesticide Disposal Site	N231 E2643	Late 1960s to 1973	Pesticide rinsewater and concentrates	Approximately 100 gallons of rinsewater discharged to french drain weekly; intermittent discharges of pure strength pesticides; pesticides included dieldrin, malathion, and DDT
6	CD Landfill	N228 E2639	1974 to 1982	Construction debris, coal fly ash and bottom ash, and drums of cadmium dust	Significant quantities (up to 1,500 cubic yards) of cadmium dust generated by sand-blasting operation
7	Inert Chemical Landfill	N227 E2639	June 1979	84 pallets of inert chemicals; 1-foot clay base and 6-foot clay side berms	Mainly unused ion exchange resin; State-approved disposal
8	Asbestos Landfill	N227 E2639	June 1979	6,500 bags of asbestos (double bagged); 1-foot base and 6-foot clay side berms	Asbestos; State-approved disposal
9	Q Area Landfill	N235 E2636	1974 to 1978	Construction debris	Fill operation and burn dump; no evidence of hazardous waste disposal
10	Apollo Fuel Disposal Sites	N222 E2650 N224 E2651	1967 to 1969	Monomethylhydrazine	Waste fuel was poured on the ground surface at each site and allowed to percolate into soil

NBN-00102-3.13-03/01/88

Table 2-1
 Disposal Sites Investigated at Naval Base Norfolk, Virginia
 (Continued, Page 3 of 4)

Site Number	Site Name	Map Coordinates*	Period of Operation	Type of Waste Disposed Of	Comments
11	Instrument Repair Shop Drains	N231 E2644	1940s to 1956	Low-level radium waste	Unknown quantities flushed down sink, contaminating plumbing; site is currently being cleaned up, and contaminated materials are being hauled offsite for disposal
12	Alleged Mercury Disposal Site	N232 E2644	Late 1960s	Elemental mercury	150 glass containers (10 pounds each) reportedly dumped off seawall; no evidence of disposal found in probing bottom sediments or in chemical analysis of sediments
13	Past Industrial Wastewater Outfalls	N232 E2644	1940s to 1976	Metals plating solutions and rinsewaters, paint stripping solutions, degreasing compounds	Discharged to storm drains leading to Willoughby Bay; bottom sediment data indicate metals contamination; discharges currently routed to IWTP and then to sanitary sewer system
14	Underground Oil Spill—Piers 4, 5, and 7	N232 E2635	1979	Diesel oil	Oil seepage to Elizabeth River; french drains installed to collect oil; approximately 50,000 gallons of oil removed
15	Underground Oil Spills—Piers 20, 21, and 22	N226 E2636	1979	Diesel oil	Intermittent oil seepage to Elizabeth River; minor contamination of soil

NBN-00102-3.13-03/01/88

Table 2-1
 Disposal Sites Investigated at Naval Base Norfolk, Virginia
 (Continued, Page 4 of 4)

Site Number	Site Name	Map Coordinates*	Period of Operation	Type of Waste Disposed Of	Comments
16	Chemical Fire— Bldg. X-136	N233 E2637	18 Jul 1979	Calcium hypochlorite and acids	Reportedly caused by incompatible chemical storage; approximately 2 tons of calcium hypochlorite flushed down storm sewer leading to Elizabeth River; no reports of adverse water quality impacts
17	Chemical Fire— Bldg. SDA-215	N221 E2638	12 Aug 1981	Calcium hypochlorite and acids	Reportedly caused by incompatible chemical storage; considerable site contamination resulted; site was decontaminated; contaminated wastes were hauled offsite for disposal
18	Former NH Hazardous Waste Storage Area	N222 E2650	1975 to 1979	Numerous drums containing waste oil, metals plating solutions and sludges, organic solvents, paint stripping wastes	Considerable past leakage and spillage of hazardous wastes; a landfill permit has been obtained for this site from the Virginia SDH; the permit conditions include a continuing monitoring program

* Map coordinates correspond to State planar coordinates on Naval Facilities Engineering Command (NAVFACENCOM) Drawing No. 4066294 [Atlantic Division, NAVFACENCOM (LANINAVFACENCOM), 1981c].

POL = petroleum, oil, and lubricants.
 PCBs = polychlorinated biphenyls.
 IWTP = industrial waste treatment plant.
 SDH = State Department of Health.

Source: ESE, 1982.

Table 2-2, reprinted from the IAS, summarizes the results of the application of the CSRS to the 18 disposal sites. Based on this evaluation, 6 of the 18 sites were recommended for subsequent Confirmation Studies. The IAS investigation identified the six sites as possible locations where pollutants from past disposal practices may pose a threat to human health or the environment. Of the six sites, five of them, listed earlier, are included in this RI. The sixth site, CD landfill, was evaluated by Navy personnel. A brief review of the findings for these five sites, as discussed in the IAS, are presented below:

Site 1: Camp Allen Landfill Area

This area includes a large area of approximately 45 acres, consisting of Area A, about 43 acres in size, and Area B, which is located east of Area A, of about 2 acres in size. Figure 2-2 shows the two disposal areas within the Camp Allen Landfill Area.

Operations at the Camp Allen Landfill (Area A) were conducted from the early 1940's until about 1974 to dispose of a variety of materials. It was estimated that approximately 40,000 pounds of metal plating sludges, 60,000 pounds of parts cleaning sludges and 400,000 pounds of paint stripping residues were disposed. Other materials disposed of at this site included incinerator ash, fly and bottom ash from the Navy power plant, overage chemicals, chlorinated organic solvents, acids, caustics, paints, paint thinners, pesticides, asbestos, scrap metal, and construction and demolition debris.

In 1971, a fire in a salvage yard located between landfill Areas A and B occurred where waste lubricating oils, organic solvents, paints, paint thinners, acids, caustics and pesticides were stored. It was reported that the burned material, smoldering residue from the fire and residual waste, which was not burned, were buried just east of the salvage yard in Area B. The trenches used for landfilling in Area B were reportedly about 150 feet long, 6 to 8 feet deep and 10 feet wide.

At present, the majority of Area A and all of Area B is capped with a good grass cover to minimize surface erosion. Area A does include the Navy Brig facility in addition to a heliport built over a portion of the

Table 2-2
Site Recommendations

Site Number	Site Name	RI Recommended?	Reason for Not Recommending RI
1	Camp Allen Landfill	Yes	—
2	Slag Pile	Yes	—
3	Q Area Drum Storage Yard	Yes	—
4	Transformer Storage Area	Yes	—
5	Pesticide Disposal Site	Yes	—
6	OD Landfill	Yes	—
7	Inert Chemical Landfill	No	Approved by Virginia SDII; clay liner
8	Asbestos Landfill	No	Approved by Virginia SDII; clay liner
9	Q Area Landfill	No	No evidence of hazardous waste disposal
10	Apollo Fuel Disposal Sites	No	Waste biodegradable to form nonhazardous products
11	Instrument Repair Shop Drains	No	Cleanup of contamination has been completed
12	Alleged Mercury Disposal Site	No	Site previously investigated; no contamination detected
13	Past Industrial Wastewater Outfalls	No	Authorized under NPDES permit; contamination reduced significantly by segregation of process waste streams

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Table 2-2
 Site Recommendations
 (Continued, Page 2 of 2)

Site Number	Site Name	RI Recommended?	Reason for Not Recommending RI
14	Underground Oil Spill— Piers 4, 5, and 7	No	Contamination previously cleaned up; no further evidence of leakage
15	Underground Oil Spill— Piers 20, 21, and 22	No	Contamination previously cleaned up; no further evidence of leakage
16	Chemical Fire—Bldg. X-136	No	Contaminants flushed to Elizabeth River; no adverse water quality impacts observed
17	Chemical Fire—Bldg. SDA-215	No	Contamination previously cleaned up
18	Former NM Hazardous Waste Storage Area	No	A landfill permit has been obtained for this site from Virginia SDH; the permit conditions include a continuing monitoring program

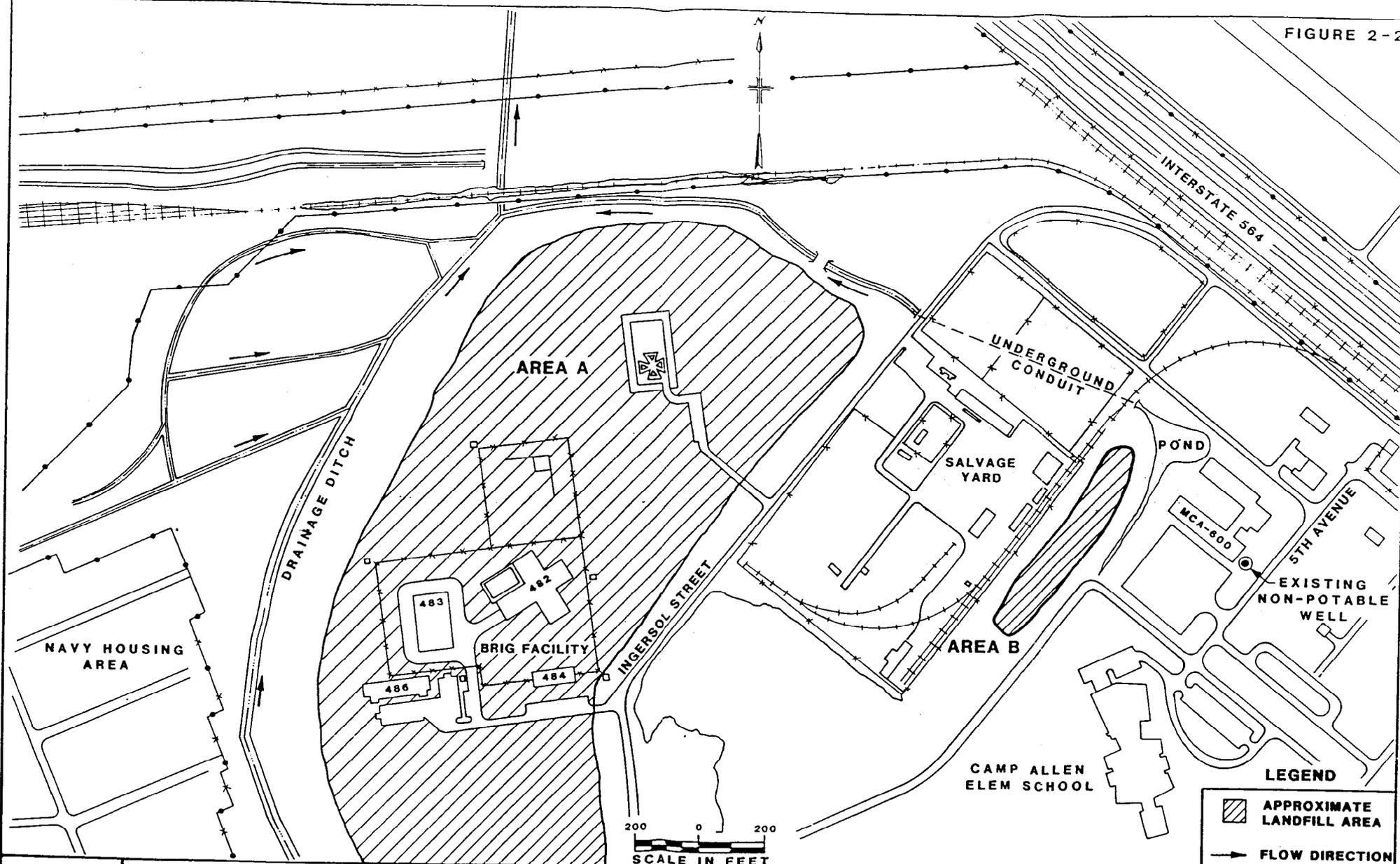
-- = Not applicable.

SDH = State Department of Health.

NPDES = National Pollutant Discharge Elimination System.

Source: ESE, 1982.

NBN-00102-3.13-03/01/88



**MALCOLM
PIRNIE**

**NAVAL BASE NORFOLK, VIRGINIA
CAMP ALLEN LANDFILL AREA (SITE 1)
SITE LOCATION**

**MALCOLM PIRNIE, INC.
MARCH 1988**

landfill (refer to Figure 2-2). Both areas are also adjacent to tidal drainage ditches which convey storm water runoff to the Elizabeth River.

Ground water monitoring results conducted from seven monitoring wells at the site prior to this RI effort indicated occasional violations of State Water Control Board (SWCB) ground water standards for chromium, zinc, silver, lead and phenols. These wells were constructed of galvanized steel and, therefore, were not appropriate for additional sampling events required as part of this RI.

A high potential for migration of contaminants from this landfill to off-site areas via the shallow ground water and surface water drainage ditches was identified in the IAS. Migration of contaminants to the Yorktown Aquifer was also suggested since no evidence of an aquitard, a layer of low permeability soil(s) which retards ground water flow, exists in the landfill area. An existing 110-foot non-potable water supply well near Building MCA-600, within 200 feet of Area B (see Figure 2-2), and two deep (about 100-foot) non-potable process water wells at the Sheller-Globe plant on Hampton Boulevard, within one mile of Area A (located off site), could potentially draw contaminants towards the Yorktown Aquifer. The two process wells draw approximately 90,000 to 100,000 gallons per day from the Yorktown Aquifer. The RI was recommended because of the potential for contaminant migration.

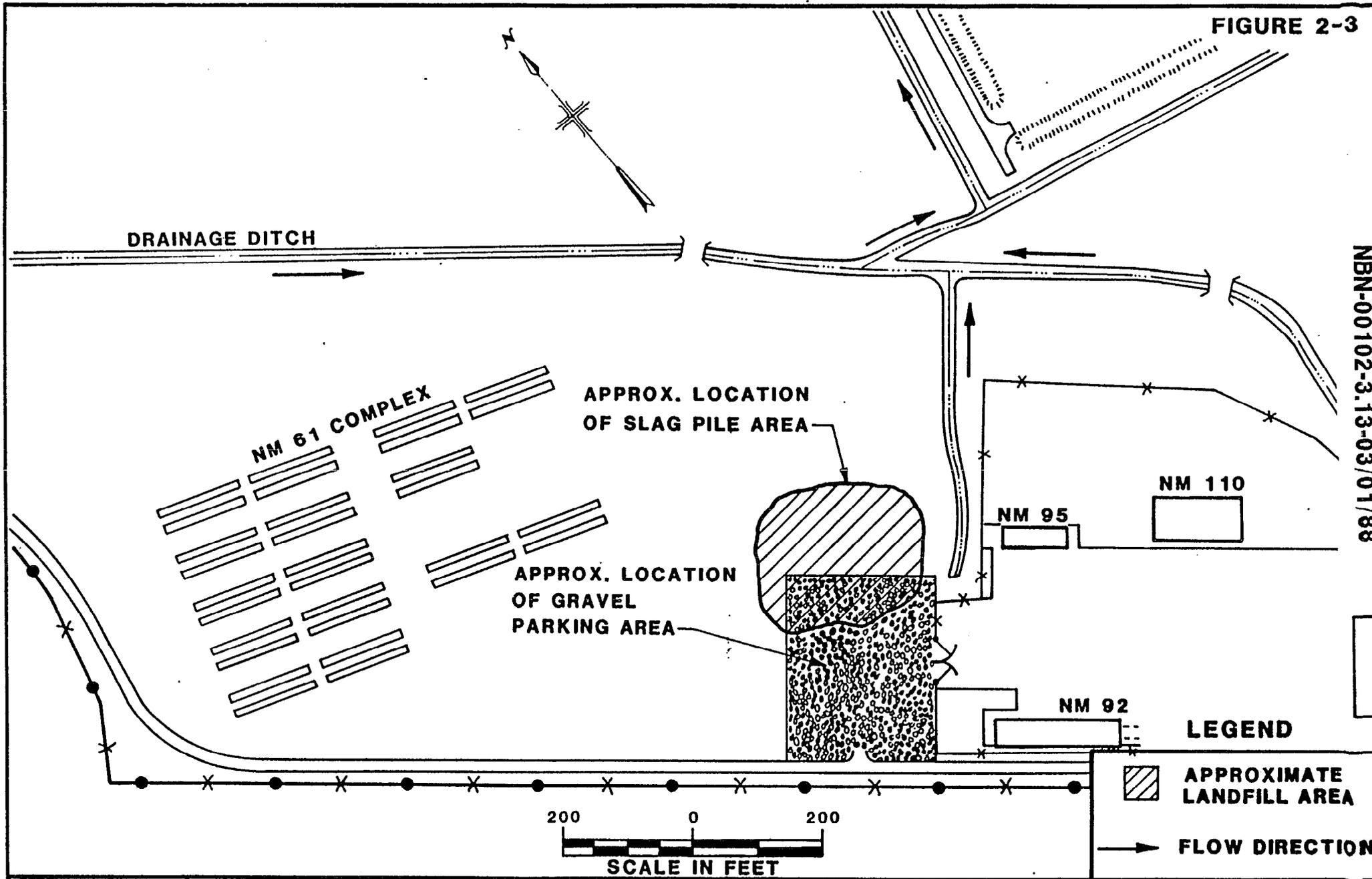
Site 2: NM Area Slag Pile

An aluminum smelting operation was conducted by the Navy in the 1950's and 1960's. Slag generated from this operation was disposed of in an area of approximately 2 acres in size, designated as the NM Area Slag Pile. Figure 2-3 is a site location map of the slag pile area. The slag pile area was generally well defined because of the absence of vegetation; however, good vegetation cover was observed surrounding the site.

The potential for ground water and surface water contamination from metals, primarily chromium, cadmium and zinc, was identified in the IAS. Consequently, the RI was recommended.

FIGURE 2-3

NBN-00102-3.13-03/01/88



**MALCOLM
PIRNIE**

**NAVAL BASE NORFOLK, VIRGINIA
NM AREA SLAG PILE (SITE 2)
SITE LOCATION**

**MALCOLM PIRNIE, INC.
MARCH 1988**

Site 3: Q Area Drum Storage Yard

This area is an open earth yard created by dredge spoils as part of a fill operation conducted in the early 1950's. It has been in use since the 1950's to store tens of thousands of drums. The majority of the drums, which were 55-gallon steel, contained new petroleum products, various chlorinated organic solvents, and paint thinners. Drums containing other chemicals, including formaldehyde and pesticides, were also observed in the area during the IAS investigation. The northwestern portion of the yard was used for storing leaking and damaged drums. Dark stains on the soil, in addition to saturated soils (with what appeared to be lubricating oil), were also observed. Figure 2-4 is a site location map of the Q Area.

The high potential for contaminants migrating via ground water and surface water runoff to Willoughby Bay and the Elizabeth River, with both water bodies being located within 1,000 feet of the site, was identified. Consequently, the IR was recommended.

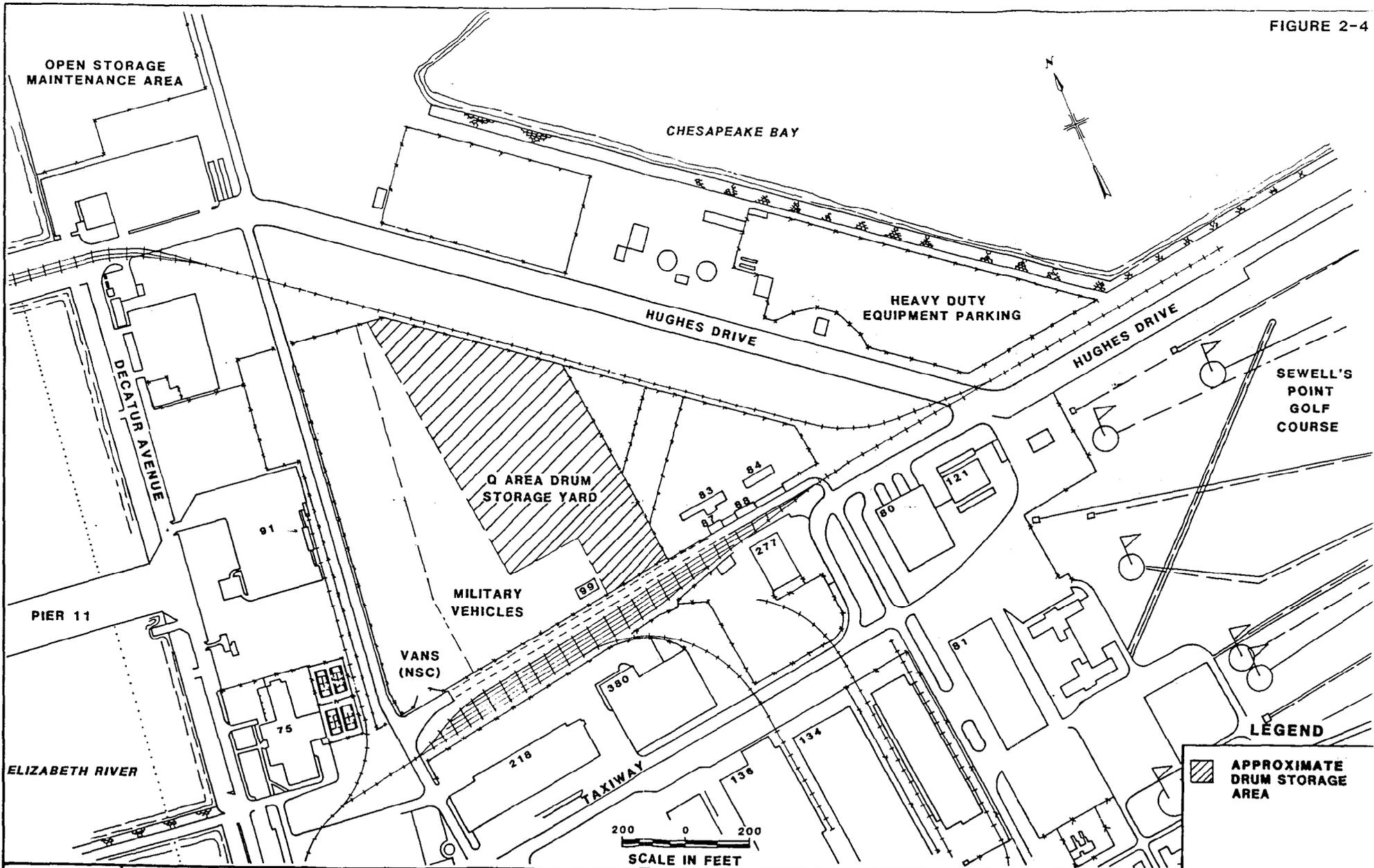
Site 4: Transformer Storage Area P-71

The area south of building P-71 was used to store new and out-of-service transformers from the 1940's until 1978. It was reported that oil, potentially containing PCB's, was drained from the out-of-service transformers onto the ground surface. Much of the area had been covered with gravel just before the IAS was conducted. However, soil in some areas was visible and exhibited dark stains, which is evidence of past spillage. Figure 2-5 is a site location map of the P-71 area.

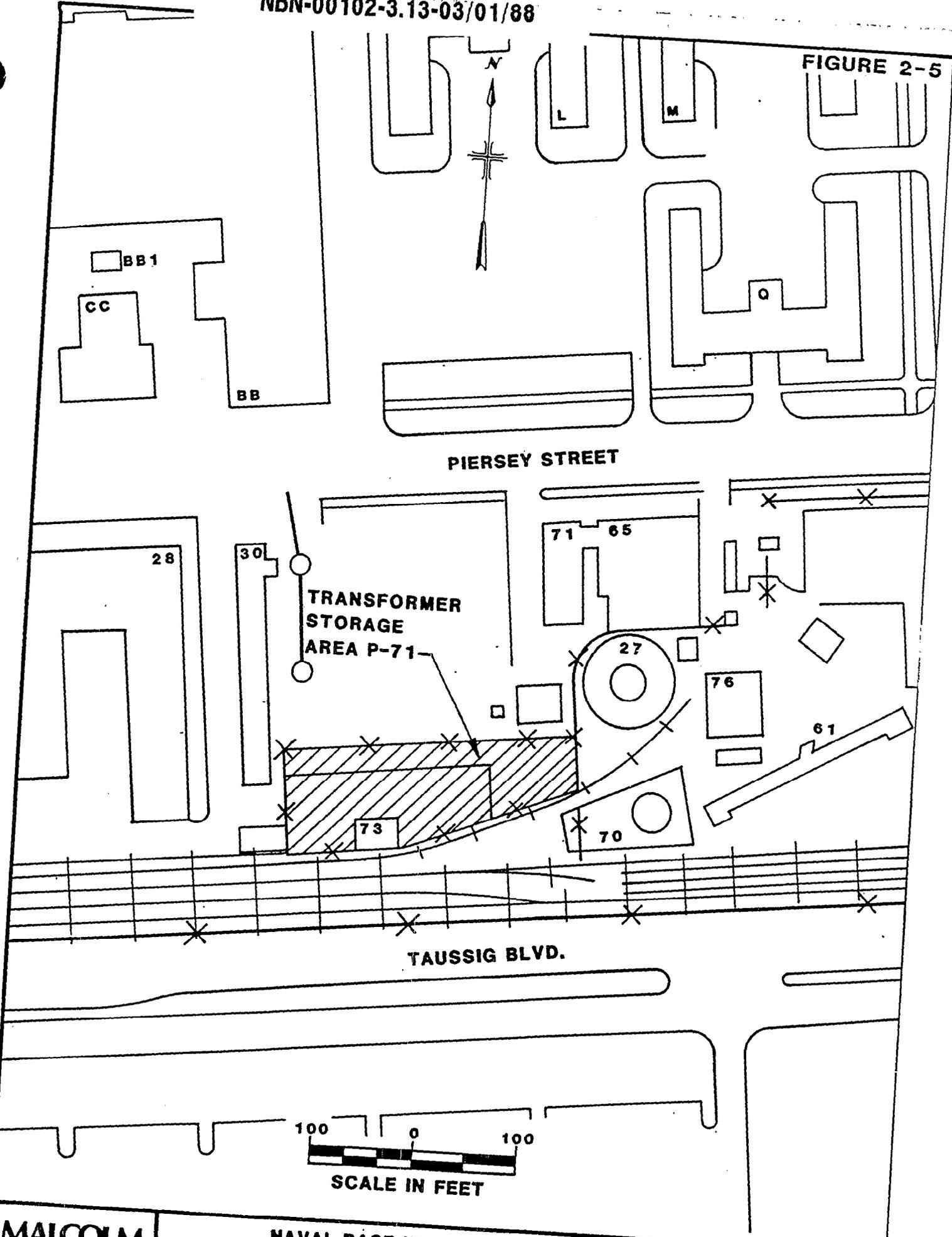
The potential for migration of contaminants, primarily PCB's, via the ground water and storm water runoff to Willoughby Bay, approximately 4,000 feet north of the site, was identified. Consequently, the IR was recommended.

Site 5: Pesticide Disposal Site V-95

A french drain was used to dispose of pesticide waste generated in the former pest control shop, building V-95, from the late 1960's until 1973. The french drain consists of a 28-inch diameter culvert placed vertically into a gravel-filled hole in the ground. It was reported



NAVAL BASE NORFOLK, VIRGINIA
 Q AREA DRUM STORAGE YARD (SITE 3)
 SITE LOCATION



**MALCOLM
PIRNIE**

NAVAL BASE NORFOLK, VIRGINIA
TRANSFORMER STORAGE AREA P-71 (SITE 4)
SITE LOCATION

MALCOLM PIRNIE, INC.

MARCH 1988

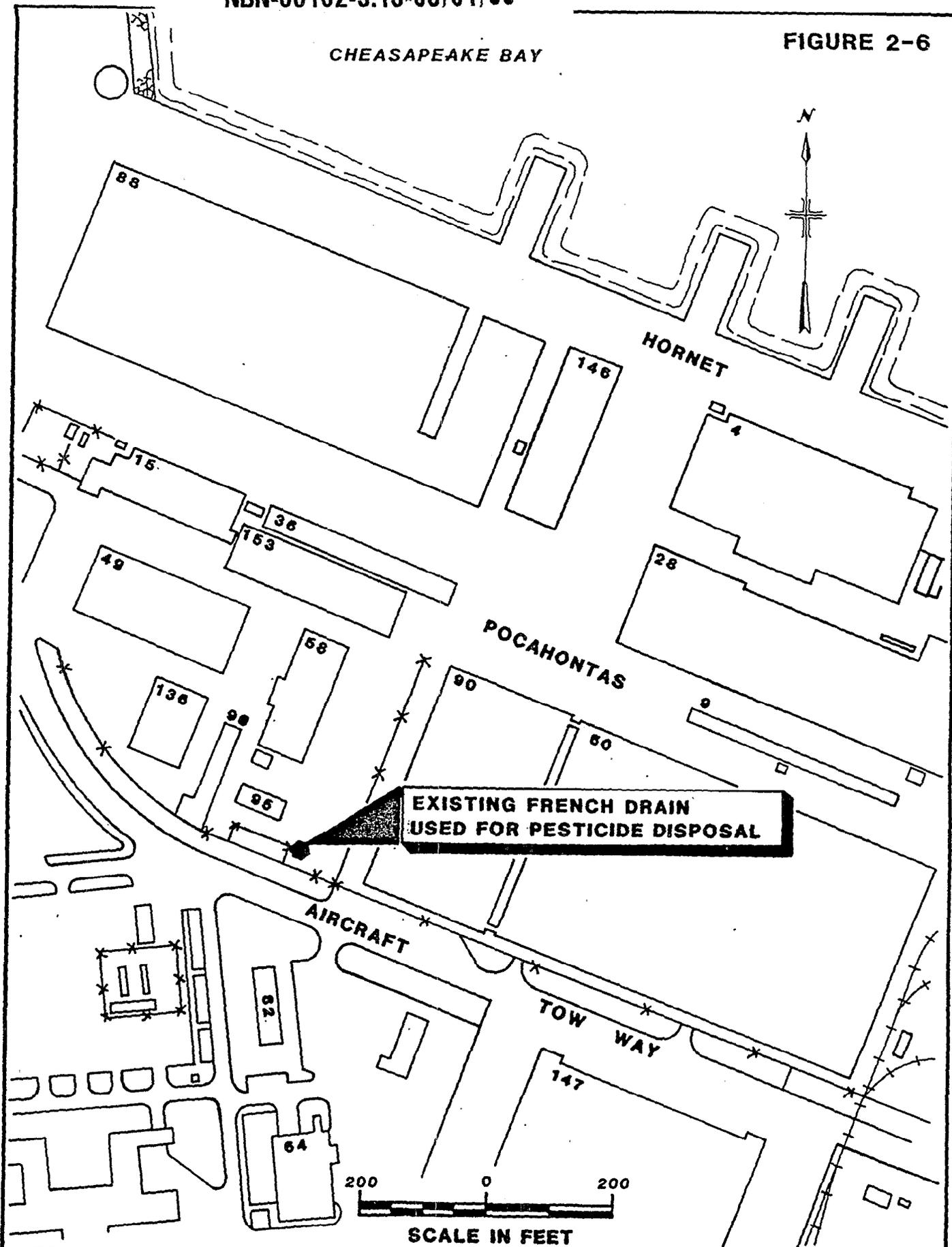
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that approximately 100 gallons per week of pesticide rinse water was disposed of using this french drain. Intermittent discharges of overage concentrated pesticides were also reported. Pesticides used in the pest control shop included chlordane, malathion and DDT. Figure 2-6 is a site location map of the Pesticide Site.

The potential for contamination of soils adjacent to the french drain with pesticides was evident. Potential migration of pesticides via the ground water to Willoughby Bay, about 1500 feet to the north, also was identified. Consequently, the IR was recommended.

CHEESAPEAKE BAY

FIGURE 2-6



**MALCOLM
PIRNIE**

**NAVAL BASE NORFOLK, VIRGINIA
PESTICIDE DISPOSAL AREA V-95 (SITE 5)
SITE LOCATION**

MALCOLM PIRNIE, INC.

MARCH 1988

3. SITE INVESTIGATION METHODOLOGY

The field investigation conducted at the five sites within this RI included soil borings with continuous soil sampling, development of boring logs, hand augered soil borings with grab samples, and installation of ground water monitoring wells. The monitoring wells were used to develop ground water contours and test ground water samples for a variety of pollutants. Surface water samples were also taken from drainage ditches in the vicinity of the Camp Allen Landfill site and NM Slag Pile area. The following sections provide a brief discussion of the installation and monitoring methods used.

3.1 MONITORING LOCATIONS

Prior to implementation of the field program, a reconnaissance of each site was conducted to determine the best location for the initial soil borings, installation of ground water monitoring wells, and soil sampling locations. The locations were selected so that verification of the presence of suspected pollutants could be made at the perimeter of the Camp Allen Landfill, NM Area Slag Pile, Q Area Drum Storage Yard and Pesticide Disposal Site. In addition, soil boring locations at the Transformer Storage Area were established so that the extent of PCB contamination, previously identified by the Navy, could be determined. Surface water sample locations at the Camp Allen Landfill and NM Area Slag Pile were selected to determine if any contaminants were migrating to the surface area drainage ditches adjacent to the disposal sites and migrating downstream of the site.

3.2 SOIL SAMPLING

Soil samples were collected continuously to a depth of 25-feet at each ground water monitoring well location. A 2-inch O.D. split-spoon capable of collecting a 2-foot long sample was used in accordance with the standard penetration test as specified in ASTM D-1586. Boring logs identifying subsurface soils were developed from the samples obtained. The boring logs are included in Appendix A.

Hand augered soil borings, with grab sampling, were performed at the Q Area Drum Storage Yard and Transformer Storage Area P-71. A two man power auger was used to bore to a maximum depth of 5 feet. Soil samples were taken using a new, stainless steel trowel at several depths in each boring and placed in appropriate containers for shipment to the laboratory. Surface soil and ditch sediment samples were also collected at Site 2, NM Slag Pile Area, using a new, stainless steel trowel. Decontamination procedures outlined in the Work and Safety Plan were followed after each sample was collected to eliminate the potential for cross-contamination.

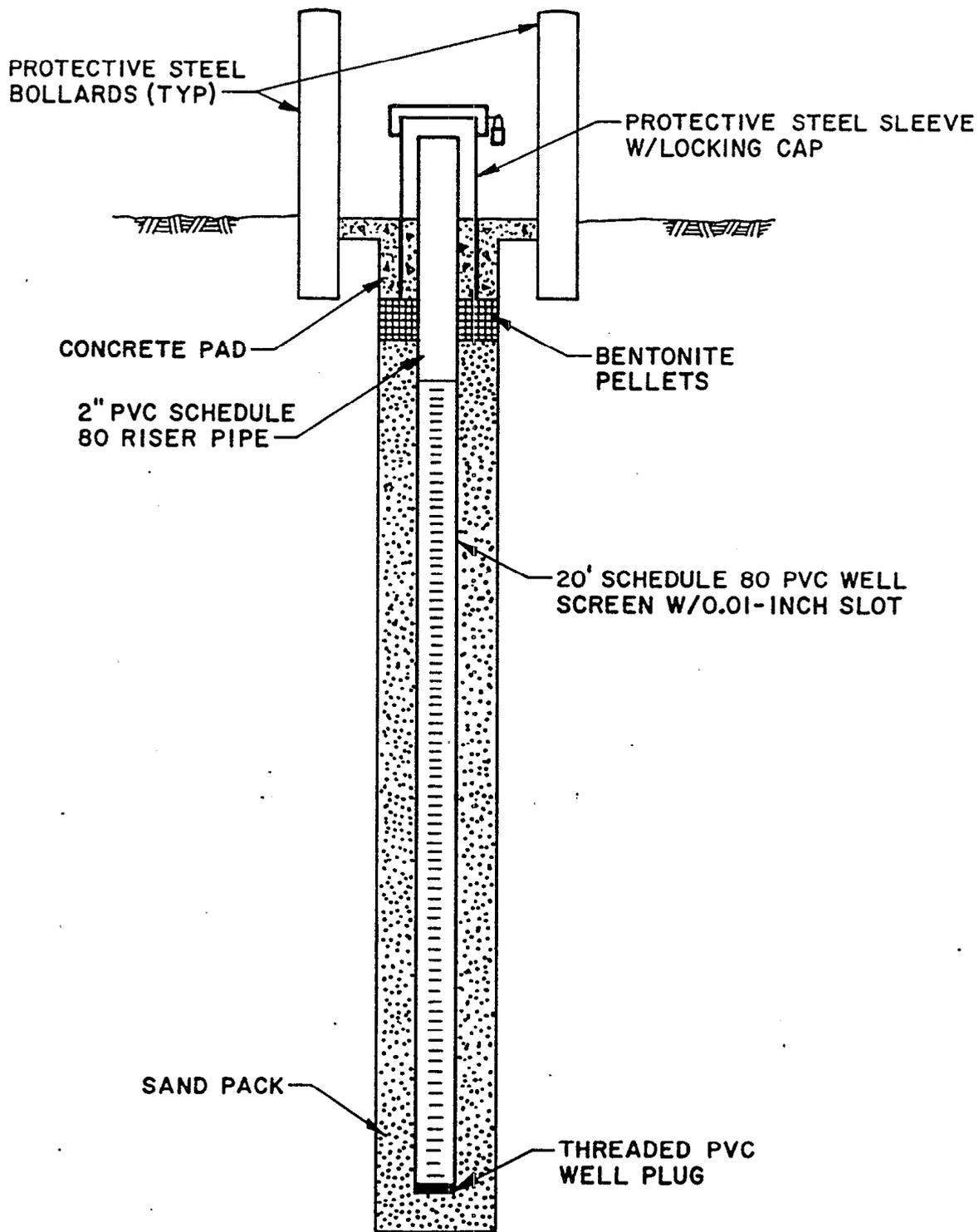
Soil samples were tested on-site using an organic vapor analyzer to determine if volatile organics were being released and, if so, in what concentrations. These field tests were routinely conducted as part of the safety program to monitor the release of volatile gases which could potentially have an adverse impact on field personnel.

3.3 GROUND WATER MONITORING WELLS

Ground water wells were installed at the Camp Allen Landfill, Q Area Drum Storage Yard and the Pesticide Disposal sites. These wells were used to take four rounds of ground water samples. A variety of analyses, including EPA's priority pollutants, were performed on selected samples to identify and quantify any pollutants which may exist in the ground water.

The wells were constructed of 2-inch, schedule 80 pvc pipe with threaded flush joints and a 20-foot, 0.01-inch slot well screen. The wells were set at an approximate depth of 24 feet below ground surface. A uniform sand between 0.01 and 0.03 inch in diameter was gradually placed in the annulus around the screen and to approximately 1 foot above the screen. A one-foot layer of bentonite pellets was then placed above the sand backfill. A protective casing with locking cap and four steel bollards were installed at each location for well protection. At the time of installation, each well was developed by the drilling contractor for a minimum of 15 minutes with a modified two-inch suction pump. Figure 3-1 shows a typical monitoring well construction.

FIGURE 3-1



NOT TO SCALE

Ground water samples were taken on four separate occasions from each monitoring well. Prior to sampling, the sampling crew removed three volumes of water within the well casing. Water samples were taken using dedicated 1½-inch by 4-foot pvc standard bailers. The sample water was poured into specially prepared bottles (supplied by the laboratory) and then refrigerated. The samples were delivered to CompuChem Laboratories, located in Research Triangle Park, North Carolina, within 24 hours of the sampling event for analysis.

3.4 ELEVATION SURVEY

A location and elevation survey was conducted so that ground water contours and flow direction could be determined at each site. This information was required to evaluate the potential for pollutant migration. Several rounds of water level measurements were made using an electronic water level indicator (manufactured by Slope Indicator Co.), or by using a water level indicator paste (McCabe Company).

3.5 ANALYTICAL METHODS

The analytical methods used for the water and soil analyses are based on those described by EPA. In general, the gas chromatography/mass spectrometry (GC/MS) analytical techniques were used for analysis of organic compounds, while atomic absorption spectrophotometry (AAS) was used for metals analysis. The following methods are listed for reference:

Volatile Organics	Method 624
Acid Extractables	Method 625
Base/Neutral Extractables	Method 625
Pesticides	Method 608
Inorganics	EPA: Analysis of Water and Waste Water (1974, 1979)

4. SITE 1 - CAMP ALLEN LANDFILL AREA

4.1 GENERAL

Malcolm Pirnie has conducted two separate but related investigations at the Camp Allen Landfill Area between 1983 and 1987. The investigations include this Remedial Investigation and a Site Suitability Assessment (SSA) for a proposed Brig facility expansion at the site, which was begun in 1983 and completed in 1984.

The primary focus of this chapter is on the RI. However, where applicable, data collected as part of the more specific Site Suitability Assessment has been included to provide a more complete data base and description of site conditions.

As a reference, the final report for the Site Suitability Assessment (SSA) was submitted to the Navy in June, 1984. The report was titled Site Suitability Assessment, Proposed Brig Expansion (P-977), Naval Station, Norfolk, Virginia.

4.2 WORK DESCRIPTION

The effort at Site 1, Areas A and B, was conducted to determine if any suspected contaminants, based on the IAS report, were present in the ground water or surface waters. The work included locating and installing ground water monitoring wells, obtaining subsurface geological information, determining ground water flow directions and conducting an extensive ground water and surface water sampling and analysis program. The following paragraphs describe in detail the work performed.

Three soil borings with continuous soil sampling were drilled to a depth of 25-feet along the northern perimeter of Area A. Three additional soil borings with continuous soil sampling to a depth of 25-feet were drilled around the perimeter of Area B. Ground water monitoring wells were installed within each boring and were screened from 4 to 24 feet below ground surface at each location. One deep well was also installed approximately 1 mile northwest of the site to determine if contaminants were being drawn towards two private deep

wells used to provide process water for a manufacturing operation. This 3-inch, pvc deep well was screened from 70 to 90 feet below ground surface. Figure 4-1 shows the location of each well, with typical designation GW-01.

Additionally, as part of the SSA, eleven ground water monitoring wells were also installed and screened from 4 to 24-feet. These wells were located throughout the southern portion of Area A. Due to time constraints for finalizing the SSA, only one sampling event of these wells was performed. Figure 4-1 also shows the location of each of the SSA wells, with typical designation B-1W.

The first round sampling and analysis event at Site 1 was conducted during December, 1983. It included sampling eight ground water wells in addition to taking four surface water samples. The seven monitoring wells installed as part of the RI, in addition to the existing 110-foot nonpotable well used for lawn watering at Building MCA-600, were sampled. The four surface water samples were located adjacent to and downstream of the landfill areas to provide data concerning potential surface water migration of contaminants (Figure 4-1). Additionally, the eleven monitoring wells installed as part of the SSA were sampled at this time.

All of the samples were analyzed for the 128 priority pollutants listed by EPA. Table 4-1 includes a list of these parameters. The ground water samples were also analyzed for xylene.

A second sampling event was conducted during August, 1984. Samples from the twelve locations previously sampled, exclusive of the eleven wells as part of the SSA, were repeated to verify analytical results. However, one monitoring well designated B-20W and installed by Pirnie as part of the SSA, was sampled. As a result of the one time sampling and analysis event of the eleven SSA wells in December of 1983, well B-20W was found to contain several organic constituents of concern. Consequently, well B-20W was included in the second and all subsequent sampling events conducted as part of the Camp Allen Landfill verification effort reported herein. The remaining 10 SSA wells were not sampled again by Pirnie during this Confirmation Study investigation.

NOTE: GW MONITORING WELL GW-07 IS LOCATED APPROXIMATELY 1 MILE NORTHWEST OF SITE 1 SEE FIGURE 2-1 FOR LOCATION.

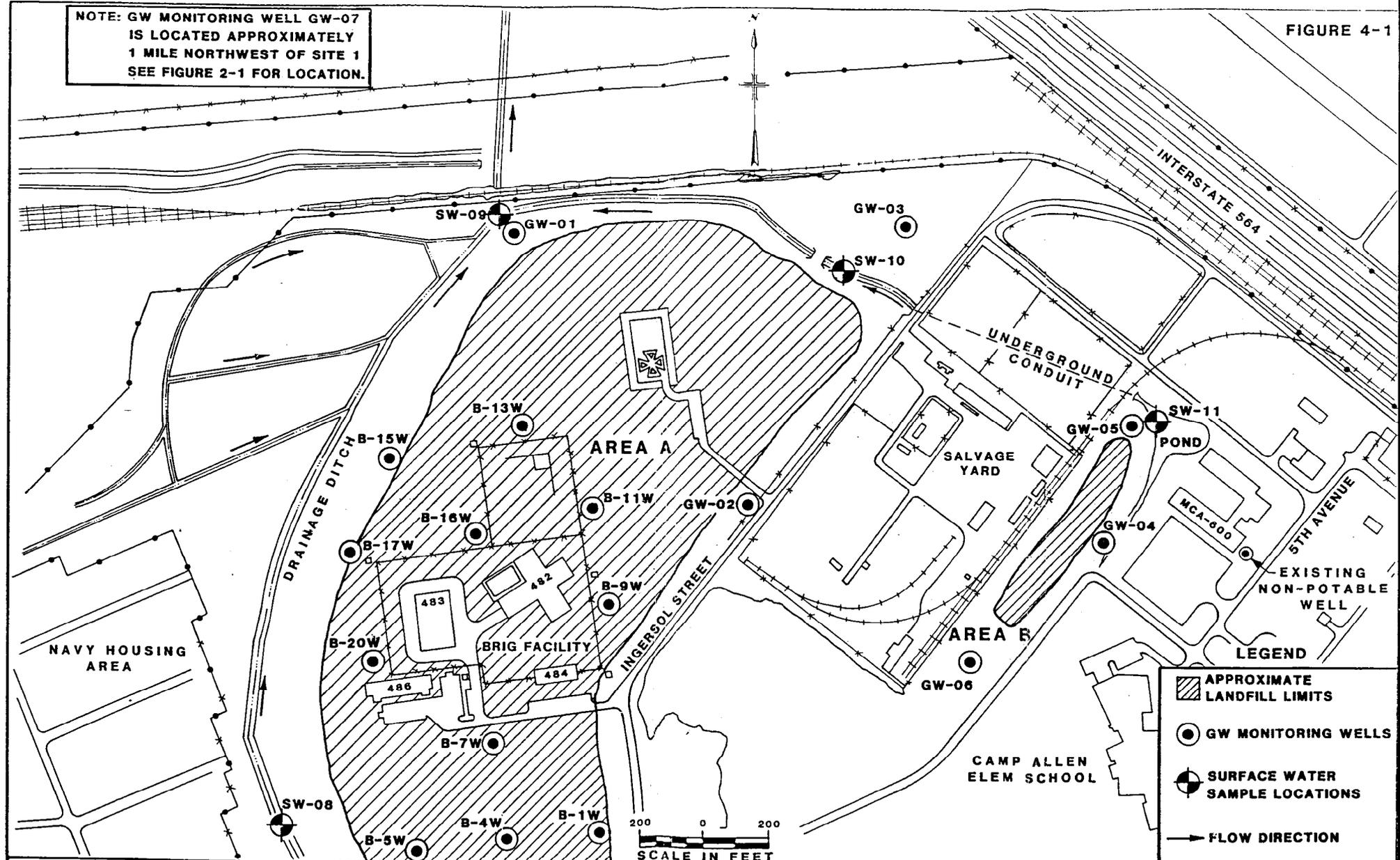


TABLE 4-1

EPA PRIORITY POLLUTANTS ANALYZED

VOLATILE ORGANICS

CHLOROMETHANE
 VINYL CHLORIDE
 CHLORETHANE
 BROMOMETHANE
 ACROLEIN
 ACRYLONITRILE
 METHYLENE CHLORIDE
 TRICHLOROFUOROMETHANE
 1,1-DICHLOROETHYLENE
 1,1-DICHLORETHANE
 TRANS-1,2-DICHLOROETHYLENE
 CHLOROFORM
 1,2-DICHLOROETHANE
 1,1,1-TRICHLOROETHANE
 CARBON TETRACHLORIDE
 BROMODICHLOROMETHANE
 1,2-DICHLOROPROPANE
 TRANS-1,2-DICHLOROPROPENE
 TRICHLOROETHYLENE
 BENZENE
 CIS-1,3-DICHLOROPROPENE
 1,1,2-TRICHLOROETHANE
 DIBROMOCHLOROMETHANE
 BROMOFORM
 1,1,2,2-TETRACHLOROETHYLENE
 1,1,2,2-TETRACHLOROETHANE
 TOLUENE
 CHLOROBENZENE
 ETHYLBENZENE
 2-CHLOROETHYL VINYL ETHER

BASE-NEUTRAL
EXTRACTABLE ORGANICS

N-NITROSODIMETHYLAMINE
 BIS (2-CHLOROETHYL) ETHER
 1,3-DICHLOROBENZENE
 1,4-DICHLOROBENZENE
 1,2-DICHLOROBENZENE
 BIS (2-CHLOROISOPROPYL) ETHER
 HEXACHLORETHANE
 N-NITROSODI-N-PROPYLAMINE
 NITROBENZENE
 ISOPHORONE
 BIS (2-CHLOROETHOXY) METHANE
 1,2,4-TRICHLOROBENZENE
 NAPHTHALENE
 HEXACHLOROBUTADIENE
 HEXACHLOROCYCLOPENTADIENE
 2-CHLORONAPHTHALENE
 DIMETHYLPHTHALATE
 ACENAPHTHYLENE
 2,6-DINITROTOLUENE
 ACENAPHTHENE
 2,4-DINITROTOLUENE
 DIETHYLPHTHALATE
 FLUORENE
 4-CHLOROPHENYL PHENYL ETHER
 DIPHENYLAMINE (N-NITROSO)
 1,2-DIPHENYLHYDRAZINE (AZOBENZENE)
 4-BROMOPHENYL PHENYL ETHER
 HEXACHLOROBENZENE
 PHENANTHRENE
 ANTHRACENE
 DI-N-BUTYLPHTHALATE
 FLUORANTHENE
 BENZIDINE
 PYRENE
 BUTYLBENZYLPHTHALATE
 BENZO (A) ANTHRACENE
 3,3'-DICHLOROBENZIDINE
 CHRYSENE
 BIS (2-ETHYLHEXYL) PHTHALATE
 DI-N-OCTYLPHTHALATE
 BENZO (B) FLUORANTHENE
 BENZO (K) FLUORANTHENE
 BENZO (A) PYRENE
 INDENO (1,2,3-C,D) PYRENE
 DIBENZO (A,H) ANTHRACENE
 BENZO (G,H,I) PERYLENE

TABLE 4-1 (CONTINUED)

EPA PRIORITY POLLUTANTS ANALYZED

PESTICIDES/PCB'S

 ALDRIN
 ALPHA-BHC
 BETA-BHC
 GAMMA-BHC
 DELTA-BHC
 CHLORDANE
 4,4'-DDT
 4,4'-DDE
 4,4'-DDD
 DIELDRIN
 ALPHA-ENDOSULFAN
 BETA-ENDOSULFAN
 ENDOSULFAN SULFATE
 ENDRIN
 ENDRIN ALDEHYDE
 HEPTACHLOR
 HEPTACHLOR EPOXIDE
 PCB-1242
 PCB-1254
 PCB-1221
 PCB-1232
 PCB-1248
 PCB-1260
 PCB-1016
 TOXAPHENE

INORGANICS

PRIORITY POLLUTANTS

 ANTIMONY, TOTAL
 ARSENIC, TOTAL
 BERYLLIUM, TOTAL
 CADMIUM, TOTAL
 CHROMIUM, TOTAL
 COPPER, TOTAL
 LEAD, TOTAL
 MERCURY, TOTAL
 NICKEL, TOTAL
 SELENIUM, TOTAL
 SILVER, TOTAL
 THALLIUM, TOTAL
 ZINC, TOTAL
 CYANIDE, TOTAL
 PHENOLS, TOTAL

ACID EXTRACTABLE ORGANICS

 PHENOL
 2-CHLOROPHENOL
 2-NITROPHENOL
 2,4-DIMETHYLPHENOL
 2,4-DICHLOROPHENOL
 P-CHLORO-M-CRESOL
 2,4,6-TRICHLOROPHENOL
 2,4-DINITROPHENOL
 4-NITROPHENOL
 4,6-DINITRO-O-CRESOL
 PENTACHLOROPHENOL
 2-CHLOROPHENOL
 2-NITROPHENOL
 2,4-DIMETHYLPHENOL
 2,4-DICHLOROPHENOL
 P-CHLORO-M-CRESOL
 2,4,6-TRICHLOROPHENOL
 2,4-DINITROPHENOL
 4-NITROPHENOL
 4,6-DINITRO-O-CRESOL
 PENTACHLOROPHENOL
 PHENOL
 2-CHLOROPHENOL
 2-NITROPHENOL
 2,4-DIMETHYLPHENOL
 2,4-DICHLOROPHENOL
 P-CHLORO-M-CRESOL
 2,4,6-TRICHLOROPHENOL
 2,4-DINITROPHENOL
 4-NITROPHENOL
 4,6-DINITRO-O-CRESOL
 PENTACHLOROPHENOL

The thirteen sampling locations, consisting of nine ground water and four surface water stations, included in the second sampling event, were analyzed for EPA's priority pollutants in August, 1984. A dioxin screen analysis was also included which evaluated the presence of 2,3,7,8-TCDD. Xylene was not included in this second round of analyses.

After evaluation of the analytical data from the first two sampling events and several discussions between Navy and Pirnie personnel, recommendations were presented and third and fourth round sampling events were authorized. The third sampling event was conducted in April 1986 and the fourth event in June, 1986. The thirteen sample locations previously designated were again included as sample locations.

The number of parameters analyzed were reduced, however, for the third and fourth round events. The third round analytical parameters included only those EPA priority pollutant groups which had a measurable value for at least one constituent within the group during previous analyses. Based on this criteria, the volatile organics, acid extractable organics, base-neutral organics and inorganics were included in the third round analysis. The priority pollutant pesticide/PCB group was not included. The third round analysis also included xylene which was included in the first, but not the second, sampling event. The analysis of methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and ethylene dibromide (EDB) were also performed per direction from the Navy EIC. These three solvents, similar to xylene, have been widely used at the Naval facility and, consequently, were considered important constituents, although not specifically listed on EPA's priority pollutant list.

The fourth round analytical parameters included only MEK, MIBK and EDB. These constituents were analyzed to verify the results of the previous analytical event. Table 4-2 summarizes the entire Confirmation Study sampling and analysis program conducted at Site 1, the Camp Allen Landfill.

4.3 GEOLOGY

Geological information for the Camp Allen Landfill site was developed from all available soil boring data collected during the CS

TABLE 4-2

SAMPLING AND ANALYSIS PROGRAM
CAMP ALLEN LANDFILL (Site 1)

<u>Sampling Event</u>	<u>Sample Date</u>	<u>Ground Water Samples</u>	<u>Surface Water Samples</u>	<u>Parameters Analyzed</u>
1	12/83	8	4	128 PP Xylene (GW only)
2	8/84	9	4	128 PP Dioxin Screen
3	4/86	9	4	AE VOA B/N Inorganics Xylene MEK, MIBK, EDB
4	6/86	9	4	MEK, MIBK, EDB

Notation:

- PP - EPA Priority Pollutants
- VOA - EPA PP Volatile Organics
- AE - EPA PP Acid Extractable Organics
- B/N - EPA PP Base Neutral Extractable Organics
- MEK - Methyl Ethyl Ketone
- MIBK - Methyl Isobutyl Ketone
- EDB - Ethylene Dibromide

and SSA. The area is underlain by gently dipping unconsolidated sediments; including remnant wetland organic matter, clays, silts, sands and occasionally gravel lenses. Shell hash lenses were observed at several locations. These sediments belong to the Sandbridge Formation which is of the Pleistocene age. It is reported (Siudyla et al, 1981) that the top layer of the formation consists of unconsolidated fine sand and silts, whereas the bottom 20 to 40 feet consist of relatively impermeable sediments, including silts, clays and sandy clays.

The geological boring logs for the Camp Allen Area generally support the description noted above for the Sandbridge Formation. The top 5 to 10 feet of sediments consist of organic matter and shell hash along with silts and traces of clay. These materials are indicative of previous wetlands or a quiescent shallow water environment. Occasionally, gravel lenses were also noted within this strata. These gravels probably represent discrete high energy storm deposits and/or tidal channel lag deposits.

The strata below the Sandbridge Formation consists of 10 to 15 feet of predominantly medium to fine silty sands. Occasional layers of organic matter and traces of clay are interspersed throughout the strata. The boring logs indicate lower portions of this strata are within the watertable aquifer.

Below the silty sand strata, the logs show a layer of clay and silty clay ranging from 3 to 15 feet thick. Occasional sand and gravel lenses are observed throughout this clay layer. These relatively impermeable clay sediments appear to be absent in the area below the Brig location. It is believed that the clays were eroded away from this location by the scouring action taking place in a former channel of Bousch Creek. The creek no longer exists because it was filled in during past construction activities. However, the logs show the presence of the clay in most areas surrounding the former creek channel.

Fine grained silty sand is found below the clay strata, with occasional layers of silty clay and organic matter. The borings end in this silty sand so that its total thickness is not known.

4.4 GROUND WATER FLOW

Ground water elevations were taken at the Camp Allen Landfill Site on December 13 and 21, 1983 and June 25, 1986. Table 4-3 gives the elevations of the top of the PVC well casings and actual water level elevations measured. Both the RI and SSA water level data are included to provide better definition of the ground water flow directions. Figure 4-2 provides a map of the ground water contours based on the data obtained.

4.5 ANALYTICAL RESULTS

Ground water and surface water samples for the RI were collected on December 1, 1983; August 29, 1984; April 29, 1986 and June 25, 1986. Table 4-2 lists the parameters analyzed during each event; Tables 4-4 and 4-5 summarize the ground water and surface water analytical results, respectively, for the organic compounds. Tables 4-6 and 4-7 summarize the ground water and surface water analytical results for the inorganic compounds and Tables 4-8 and 4-9 summarize the special analyses conducted. The notation utilized to identify each sample location is as follows:

- o The first two digits represent the site number;
- o The following letters indicate the type of sample; ground water (GW) or surface water (SW); and
- o The last two digits following the hyphen represent the specific location number for that particular site.

NOTE: Sampling locations are as shown in Figure 4-1.

The summary includes those priority pollutant constituents where a measurable value was identified for at least one well location and all of the special analyses conducted. All laboratory reports have been stored at Pirnie's regional office in Newport News and are available for Navy use upon request.

In addition to the analytical results obtained from the scheduled sampling events, circumstances during the drilling operation at one specific monitoring well location (01GW-04) resulted in additional analyses. Initially, a soil boring was begun approximately 50 feet

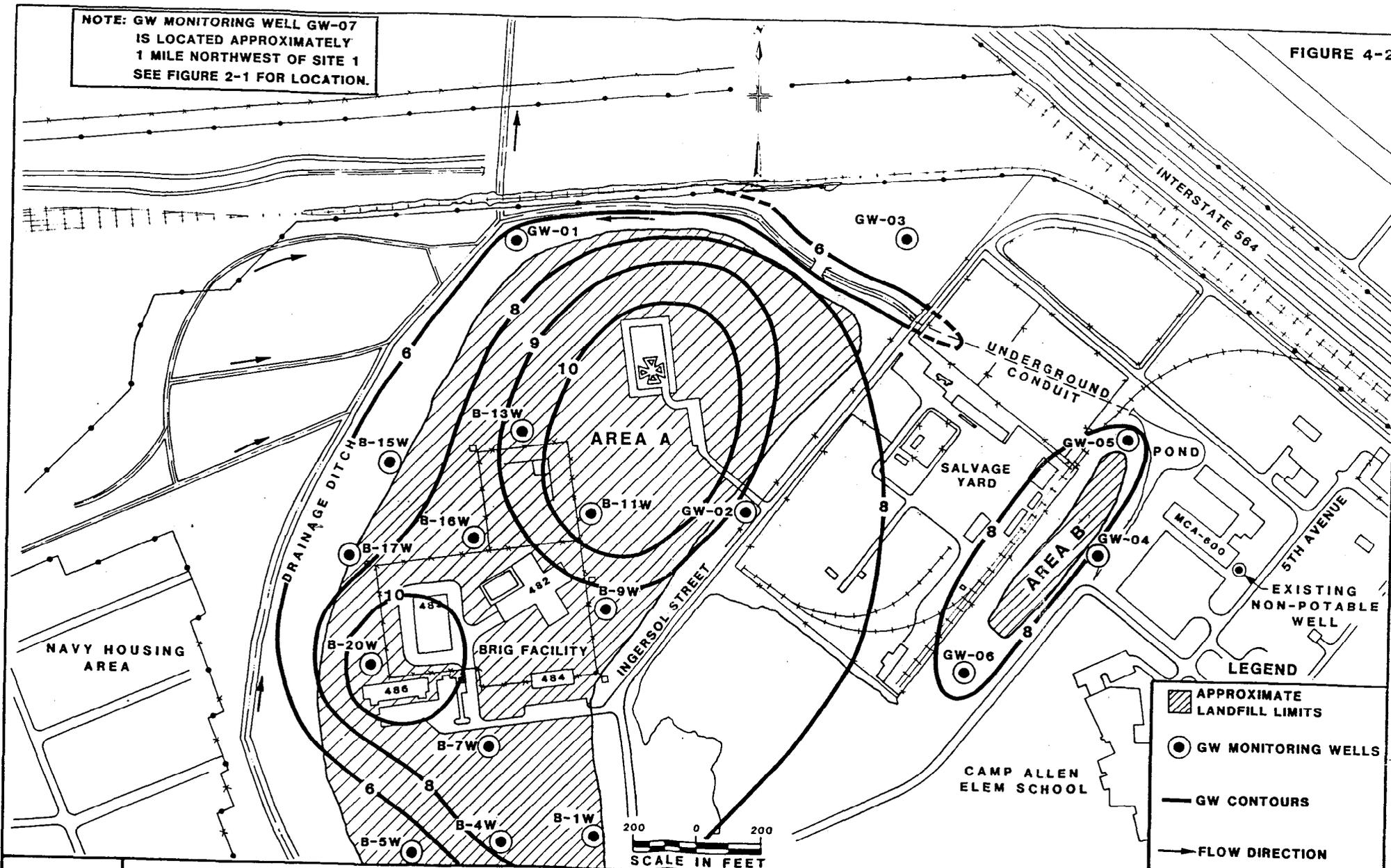
TABLE 4-3

GROUND WATER LEVEL DATA
CAMP ALLEN LANDFILL (Site 1)

MONITORING WELL -----	ELEVATION TOP OF PVC (FT.) -----	WATER LEVEL ELEVATION		
		12/13/83 -----	12/21/83 -----	6/25/86 -----
CONFIRMATION STUDY -----				
01GW-01	13.53	-	6.73	3.71
01GW-02	15.06	-	8.56	6.76
01GW-03	14.31	-	6.51	5.06
01GW-04	11.37	-	6.97	5.05
01GW-05	12.76	-	9.13	5.76
01GW-06	11.29	-	8.29	5.01
SITE SUITABILITY ASSESSMENT -----				
B-1W	13.54	9.1	8.3	-
B-4W	14.32	8.7	8.1	-
B-5W	11.97	5.8	5.5	-
B-7W	14.42	8.8	8.4	-
B-9W	15.33	8.9	8.7	-
B-11W	17.43	13.3	11.9	-
B-13W	17.87	10.4	9.8	-
B-15W	10.15	7.7	7.5	-
B-16W	15.38	8.7	8.6	-
B-17W	13.4	8.1	7.7	-
B-20W	15.24	12.7	12.3	-

NOTE: ALL ELEVATIONS BASED ON USGS MEAN SEA LEVEL DATUM.

NOTE: GW MONITORING WELL GW-07 IS LOCATED APPROXIMATELY 1 MILE NORTHWEST OF SITE 1 SEE FIGURE 2-1 FOR LOCATION.



LEGEND

- APPROXIMATE LANDFILL LIMITS
- GW MONITORING WELLS
- GW CONTOURS
- FLOW DIRECTION

**MALCOLM
PIRNIE**

NAVAL BASE NORFOLK, VIRGINIA
CAMP ALLEN LANDFILL AREA (SITE 1)
GROUND WATER CONTOURS

MALCOLM PIRNIE, INC.
MARCH 1988

TABLE 4-4

GROUND WATER ANALYTICAL RESULTS
ORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION LIMIT			01GW-01			01GW-02			01GW-03			01GW-04			01GW-05		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
VOLATILE ORGANICS																		
VINYL CHLORIDE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	79	BDL	18	BDL	BDL	BDL
METHYLENE CHLORIDE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	24000	17000	96	BDL	BDL	BDL
TRICHLOROFUOROMETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2300	1700	BDL	BDL	BDL	BDL
1,1-DICHLOROETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20	BDL	BDL	170	39	17
TRANS-1,2-DICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	340	BDL	16	BDL	BDL	BDL
1,2-DICHLOROETHANE	10	10	10	BDL	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	74	TRACE	11	BDL	BDL	BDL
1,1,1-TRICHLOROETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	24	BDL	BDL	95	BDL	BDL
TRICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	480	640	34	BDL	BDL	BDL
BENZENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	260	390	29	BDL	BDL	BDL
1,1,2,2-TETRACHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TOLUENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	180	290	23	BDL	BDL	BDL
ETHYLBENZENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	430	410	12	BDL	BDL	BDL
ACID EXTRACTABLE ORGANICS																		
PHENOL	25	25	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	44	67	BDL	BDL	BDL	BDL
2,4-DIMETHYLPHENOL	25	25	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	170	190	BDL	BDL	BDL	BDL
PENTACHLOROPHENOL	25	25	50	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	110	BDL	BDL	BDL	BDL	BDL
BASE-NEUTRAL EXTRACTABLE ORGANICS																		
NAPHTHALENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120*	BDL	BDL	BDL	BDL	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	10	10	10	BDL	BDL	BDL	97	BDL	BDL	15	BDL	BDL	BDL*	BDL	BDL	BDL	BDL	BDL
PESTICIDES/PCB'S																		
ALL VALUES BELOW DETECTION LIMIT																		

NOTES: All values for ORGANICS in ug/l.

* = Sample detection limit is 100 ug/l using a 1:10 dilution.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 4-4 (CONT.)

GROUND WATER ANALYTICAL RESULTS
ORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION LIMIT			01GW-06			01GW-07			01GW-EW			01GW-B20W		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
VOLATILE ORGANICS															
VINYL CHLORIDE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2000	4200	540*
METHYLENE CHLORIDE	10	10	10	BDL	BDL	BDL	17	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
TRICHLOROFUOROMETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
1,1-DICHLORETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
TRANS-1,2-DICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	46000	46000	1400*
1,2-DICHLOROETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	270	110*
1,1,1-TRICHLOROETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
TRICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5600	620	BDL*
BENZENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	380	280	120*
1,1,2,2-TETRACHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
TOLUENE	10	10	10	BDL	BDL	BDL	18	BDL	BDL	BDL	BDL	BDL	18000	8600	3400*
ETHYLBENZENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL*
ACID EXTRACTABLE ORGANICS															
PHENOL	25	25	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5100**	7200	360
2,4-DIMETHYLPHENOL	25	25	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1100**	450	410
PENTACHLOROPHENOL	25	25	50	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL***	BDL	BDL
BASE-NEUTRAL EXTRACTABLE ORGANICS															
NAPHTHALENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	79	82	36
BIS(2-ETHYLHEXYL)PHTHALATE	10	10	10	BDL	BDL	BDL	52	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
PESTICIDES/PCB'S															
ALL VALUES BELOW DETECTION LIMIT															

NOTES: All values for ORGANICS in ug/l.

* = Sample detection limit is 125 ug/l using a 1:12.5 dilution.

** = Sample detection limit is 200 ug/l using a 1:20 dilution.

*** = Sample detection limit is 1000 ug/l using a 1:20 dilution.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983

02 = SECOND ROUND - AUG. 29, 1984

03 = THIRD ROUND - APR. 14, 1986

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TABLE 4-5

SURFACE WATER ANALYTICAL RESULTS
ORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION LIMIT			01SW-08			01SW-09			01SW-10			01SW-11		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
VOLATILE ORGANICS															
VINYL CHLORIDE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	33	11
METHYLENE CHLORIDE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	14	BDL	BDL	12	BDL	BDL
TRICHLOROFUOROMETHANE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	16	BDL
1,1-DICHLOROETHANE	10	10	10	BDL	BDL	BDL									
TRANS-1,2-DICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	17	BDL	24	BDL	82	19
1,2-DICHLOROETHANE	10	10	10	BDL	BDL	BDL									
1,1,1-TRICHLOROETHANE	10	10	10	BDL	BDL	BDL									
TRICHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	15	BDL	18	BDL	52	16
BENZENE	10	10	10	BDL	BDL	BDL									
1,1,2,2-TETRACHLOROETHYLENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	13	BDL	20	BDL	BDL	BDL
TOLUENE	10	10	10	BDL	BDL	BDL									
ETHYLBENZENE	10	10	10	BDL	BDL	BDL									
ACID EXTRACTABLE ORGANICS															
PHENOL	25	25	10	BDL	BDL	BDL	66	66	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-DIMETHYLPHENOL	25	25	10	BDL	BDL	BDL									
PENTACHLOROPHENOL	25	25	50	BDL	BDL	BDL									
BASE-NEUTRAL EXTRACTABLE ORGANICS															
NAPHTHALENE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	BD	BDL	BDL	BDL	BDL	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL	13	BDL	BDL	15	BDL	BDL
PESTICIDES/PCB'S															
ALL VALUES BELOW DETECTION LIMIT															

NOTES: All values for ORGANICS in ug/l.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 4-6

GROUND WATER ANALYTICAL RESULTS
INORGANICS
CAMP ALLEN LANDFILL (SITE 1)

INORGANICS	DETECTION LIMIT			01GW-01			01GW-02			01GW-03			01GW-04			01GW-05		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
ANTIMONY, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	BDL	BDL	BDL	1.80	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
ARSENIC, TOTAL	0.05	0.05	0.05	0.30	BDL	BDL	0.33	BDL	BDL	0.90	BDL	BDL	BDL	BDL	BDL	0.36	BDL	BDL
CADMIUM, TOTAL	0.02	0.01	0.01	0.02	BDL	0.03	0.05	BDL	0.03	0.54	0.12	0.1	0.05	BDL	BDL	0.02	BDL	0.08
CHROMIUM, TOTAL	0.10	0.05	0.05	0.10	2.30	0.13	0.12	BDL	BDL	117.00	0.06	0.19	1.70	1.00	BDL	1.60	0.07	BDL
COPPER, TOTAL	0.10	0.10	0.10	0.14	0.10	0.21	0.62	0.10	BDL	1.30	0.12	0.22	0.21	BDL	BDL	0.10	BDL	BDL
LEAD, TOTAL	0.20	0.05	0.05	0.40	0.05	0.32	1.70	0.14	0.17	5.80	1.10	0.99	1.88	BDL	BDL	0.50	0.11	0.25
MERCURY, TOTAL	0.0002	0.0002	0.0002	BDL	BDL	0.0014	0.0003	BDL	BDL	BDL	BDL	BDL	BDL	0.0004	BDL	BDL	0.0002	0.00041
NICKEL, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	0.10	BDL	BDL	0.30	BDL	0.16	0.10	BDL	BDL	BDL	BDL	BDL
SELENIUM, TOTAL	0.05	0.01	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
THALLIUM, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	0.06	BDL	BDL	0.42	BDL	BDL	0.27	BDL	BDL	0.10	BDL	BDL
ZINC, TOTAL	0.02	0.02	0.02	0.30	0.02	0.49	2.50	0.24	0.44	7.70	2.50	1.4	0.90	0.09	BDL	0.50	0.05	BDL
CYANIDE, TOTAL	0.01	0.01	0.01	BDL	BDL	---	BDL	BDL	---	BDL	BDL	---	0.12	0.92	0.15	BDL	BDL	---
PHENOLS, TOTAL	0.01	0.01	0.01	0.01	0.044	---	0.01	0.018	---	BDL	BDL	---	1.30	1.80	0.28	0.01	BDL	---

NOTES: All values for INORGANICS in mg/L.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 4-6 (CONT.)

GROUND WATER ANALYTICAL RESULTS
INORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION LIMIT			01GW-06			01GW-07			01GW-EW			01GW-B20W		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
INORGANICS															
ANTIMONY, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
ARSENIC, TOTAL	0.05	0.05	0.05	0.06	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.09	0.04	0.057
CADMIUM, TOTAL	0.02	0.01	0.01	0.02	BDL	0.06	BDL	BDL	0.03	BDL	BDL	BDL	0.04	0.01	0.08
CHROMIUM, TOTAL	0.10	0.05	0.05	BDL	BDL	BDL	0.10	BDL	BDL	0.30	0.40	BDL	BDL	0.07	BDL
COPPER, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	0.20	BDL	BDL	BDL	BDL	BDL	0.13	0.12	BDL
LEAD, TOTAL	0.20	0.05	0.05	0.20	BDL	0.29	BDL	0.12	0.14	BDL	0.12	BDL	0.27	0.18	0.29
MERCURY, TOTAL	0.0002	0.0002	0.0002	BDL	BDL	0.00049	BDL	BDL	BDL	0.0003	BDL	BDL	BDL	BDL	BDL
NICKEL, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	0.10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
SELENIUM, TOTAL	0.05	0.01	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.034	BDL
THALLIUM, TOTAL	0.05	0.05	0.05	0.18	BDL	BDL	0.10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
ZINC, TOTAL	0.02	0.02	0.02	0.20	0.05	BDL	0.36	0.04	BDL	0.23	0.72	2.6	0.57	0.63	BDL
CYANIDE, TOTAL	0.01	0.01	0.01	BDL	BDL	---	BDL	0.014	---	BDL	BDL	---	0.09	0.38	0.06
PHENOLS, TOTAL	0.01	0.01	0.01	BDL	BDL	---	0.01	BDL	---	BDL	BDL	---	BDL	60.00	13

NOTES: All values for INORGANICS in mg/l.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 4-7

SURFACE WATER ANALYTICAL RESULTS
INORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION			01SW-08			01SW-09			01SW-10			01SW-11		
	LIMIT			01	02	03	01	02	03	01	02	03	01	02	03
INORGANICS	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
ANTIMONY, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
ARSENIC, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	0.07	BDL	BDL	0.50	BDL	BDL	0.34	BDL	BDL
CADMIUM, TOTAL	0.02	0.01	0.01	BDL	BDL	0.02	BDL	BDL	0.03	0.08	0.03	0.02	0.18	0.01	0.03
CHROMIUM, TOTAL	0.10	0.05	0.05	BDL	0.40	BDL	0.22	0.07	0.09	0.10	0.15	BDL	0.18	0.05	BDL
COPPER, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	BDL	BDL	0.1	0.60	0.30	0.14	0.95	BDL	BDL
LEAD, TOTAL	0.20	0.05	0.05	BDL	BDL	0.05	BDL	0.12	0.33	1.30	0.53	0.31	2.10	0.20	BDL
MERCURY, TOTAL	0.0002	0.0002	0.0002	BDL	BDL	BDL	BDL	BDL	0.0009	BDL	BDL	0.0003	BDL	BDL	0.0003
NICKEL, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	BDL	BDL	BDL	0.10	BDL	BDL	0.10	BDL	BDL
SELENIUM, TOTAL	0.05	0.01	0.01	BDL	BDL	BDL	BDL	BDL	BDL	0.10	BDL	BDL	BDL	BDL	BDL
THALLIUM, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	BDL	BDL	BDL	0.24	BDL	BDL	BDL	BDL	BDL
ZINC, TOTAL	0.02	0.02	0.02	0.05	0.06	0.08	0.05	0.02	0.25	1.80	1.34	0.84	4.70	0.27	BDL
CYANIDE, TOTAL	0.01	0.01	0.01	BDL	BDL	---	BDL	0.022	BDL	0.02	0.014	BDL	0.04	0.06	BDL
PHENOLS, TOTAL	0.01	0.01	0.01	0.01	0.024	---	0.01	0.018	0.04	0.01	BDL	BDL	0.01	0.24	BDL

NOTES: All values for INORGANICS in mg/l.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

TABLE 4-8

GROUND WATER ANALYTICAL RESULTS
SPECIAL ANALYSIS
CAMP ALLEN LANDFILL (SITE 1)

	DETECTION		01GW-01		01GW-02		01GW-03	
	LIMIT							
SPECIAL ANALYSIS	03	04	03	04	03	04	03	04
m-XYLENE	10	---	BDL	---	BDL	---	BDL	---
o,p-XYLENE	10	---	BDL	---	BDL	---	BDL	---
METHYLETHYLKETONE	10	10	BDL	BDL	BDL	BDL	BDL	BDL
METHYLISOBUTYLKETONE	10	10	BDL	BDL	BDL	BDL	BDL	BDL
1,2-DIBROMOETHANE	0.015	0.015	BDL	BDL	BDL	BDL	BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE	0.015	0.015	---	BDL	---	BDL	---	BDL

	DETECTION		01GW-04		01GW-05		01GW-06	
	LIMIT							
SPECIAL ANALYSIS	03	04	03	04	03	04	03	04
m-XYLENE	10	---	39	---	BDL	---	BDL	---
o,p-XYLENE	10	---	28	---	BDL	---	BDL	---
METHYLETHYLKETONE	10	10	BDL	BDL	BDL	BDL	BDL	BDL
METHYLISOBUTYLKETONE	10	10	1100	57	BDL	BDL	BDL	BDL
1,2-DIBROMOETHANE	0.015	0.015	BDL	BDL	BDL	BDL	BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE	0.015	0.015	---	BDL	---	BDL	---	BDL

	DETECTION		01GW-07		01GW-EW		01GW-B20W	
	LIMIT							
SPECIAL ANALYSIS	03	04	03	04	03	04	03	04
m-XYLENE	10	---	BDL	---	BDL	---	120*	---
o,p-XYLENE	10	---	BDL	---	BDL	---	150*	---
METHYLETHYLKETONE	10	10	BDL	BDL	BDL	BDL	6300*	BDL**
METHYLISOBUTYLKETONE	10	10	BDL	BDL	BDL	BDL	18000*	5800**
1,2-DIBROMOETHANE	0.015	0.015	BDL	BDL	BDL	BDL	BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE	0.015	0.015	---	BDL	BDL	BDL	---	BDL

NOTES: All values for SPECIAL ANALYSIS in ug/l.

* = Sample detection limit is 125 ug/l using a 1:12.5 dilution.

** = Sample detection limit is 500 ug/l using a 1:50 dilution.

--- = Analysis not performed.

LEGEND: 03 = THIRD ROUND - APR. 14, 1986

04 = FOURTH ROUND - JUN. 25, 1986

TABLE 4-9

SURFACE WATER ANALYTICAL RESULTS
SPECIAL ANALYSIS
CAMP ALLEN LANDFILL (SITE 1)

SPECIAL ANALYSIS	DETECTION LIMIT		01SW-08		01SW-09	
	03	04	03	04	03	04
m-XYLENE	10	---	BDL	---	BDL	---
o,p-XYLENE	10	---	BDL	---	BDL	---
METHYLETHYLKETONE	10	10	BDL	BDL	BDL	BDL
METHYLISOBUTYLKETONE	10	10	BDL	BDL	BDL	BDL
1,2-DIBROMOETHANE	0.015	0.015	BDL	BDL	BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE	0.015	0.015	---	BDL	---	BDL

SPECIAL ANALYSIS	DETECTION LIMIT		01SW-10		01SW-11	
	03	04	03	04	03	04
m-XYLENE	10	---	BDL	---	BDL	---
o,p-XYLENE	10	---	BDL	---	BDL	---
METHYLETHYLKETONE	10	10	BDL	BDL	BDL	BDL
METHYLISOBUTYLKETONE	10	10	BDL	BDL	BDL	BDL
1,2-DIBROMOETHANE	0.015	0.015	BDL	BDL	BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE	0.015	0.015	---	BDL	---	BDL

NOTES: --- = Analysis not performed.

LEGEND: 03 = THIRD ROUND - APR. 14, 1986
04 = FOURTH ROUND - JUN. 25, 1986

southwest of the existing 01GW-04 well location. At a depth of about 4 feet, the air monitoring equipment (Century OVA) used to analyze the volatile organic gases discharging from the bore hole jumped from background level to greater than 1000 ppm total volatiles. After upgrading personnel protection to the appropriate level, additional boring was conducted. A bright red, viscous liquid was observed on the hollow-stem auger during the boring operation from about 6 to 10 feet below ground surface. A sample of the red liquid was taken and delivered to the Navy EIC for analysis. After taking the sample, the bore hole was filled and the well location moved about 50 feet north to its present location. Relocation of the well was advised since the purpose of the well monitoring program was to define contaminant levels at the perimeter of the disposal site and, based on the red liquid observed, the initial location was believed to be within the disposal area rather than at the perimeter. This decision was made jointly by the Navy EIC and Malcolm Pirnie.

The Navy EIC had the red liquid analyzed by CENTEC Analytical Services. Results of the analysis indicated the following:

Benzene	170 ug/g
Toluene	94.3 ug/g
p- and m- Xylene	14,300 ug/g
o- Xylene	2,000 ug/g
Total Volatile Organics	1.6 to 1.7 %
Aroclor 1242	less than 1 ug/L
Aroclor 1254	4 ug/L
Aroclor 1260	less than 1 ug/L

The results of the Navy's analysis, in conjunction with field observations, indicate a localized pocket of highly concentrated waste was present. The source of this waste is believed to be from a leaking buried drum(s) which would account for the localized and highly concentrated liquid observed.

4.6 WATER QUALITY STANDARDS/CRITERIA

The ground water and surface water analytical results were compared with EPA Drinking Water Standards, State Water Control Board Ground

Water Standards, and other available standards and guidelines. These standards and/or criteria are listed in Tables 4-10 through 4-14, with organic constituents listed in Tables 4-10 and 4-11 and inorganic constituents listed in Table 4-12 through 4-14. Only those organic and inorganic constituents identified at Site 1 are shown. Information from the following sources are included:

Organics

- Table 4-10 - EPA Water Quality Criteria Documents, November, 1980.
- Table 4-11 - EPA Maximum Contaminant Level Goals (MCLG's), November, 1985.

Inorganics

- Table 4-12 - EPA Water Quality Criteria Documents, November, 1980.
- Table 4-13 - EPA Water Quality Criteria Documents, July, 1985.
- Table 4-14 - EPA MCL's and State Water Control Board (SWCB) Water Quality Standards and Criteria.

EPA's Water Quality Criteria values reported in the Federal Register of November, 1980 (Table 4-10 for organics and 4-12 for inorganics) indicate pollutant concentration levels which have been observed to cause acute and chronic toxicity to fresh water and salt water aquatic life. The criteria also addresses the toxicity or carcinogenic risk due to human ingestion through drinking water and/or by eating aquatic life containing the listed constituents. The criteria documents are an update to the "Red Book" Water Quality Criteria published by EPA in 1976.

The EPA Water Quality Criteria (July, 1985) listed in Table 4-13 are an EPA update for certain inorganic compounds listed in the criteria documents of 1980 and identified at Site 1. In this update, however, only toxicity criteria for fresh and salt water aquatic life is presented. It amends the criteria listed previously as "24-hour average" and "not to exceed" to "continuous concentrations for four-day average" and "maximum concentrations for one-hour average", respectively; however, the criteria are not equivalent. This current criteria, which is based on a more extensive data base, was used in evaluating the inorganic compounds found at Site 1. The 1980 Water

TABLE 4-10

EPA WATER QUALITY CRITERIA - 1980
 ORGANICS
 CAMP ALLEN LANDFILL (SITE 1)

PARAMETER	TOXICITY TO AQUATIC LIFE				HUMAN HEALTH	
	FRESH WATER		SALT WATER		INGESTION	
	ACUTE (UG/L)	CHRONIC (UG/L)	ACUTE (UG/L)	CHRONIC (UG/L)	WATER (UG/L)	AQUATIC (UG/L)
VOLATILE ORGANICS						
VINYL CHLORIDE	NA	NA	NA	NA	2	525
METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA
TRICHLOROFLUOROMETHANE	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHYLENE	11,600	NA	NA	NA	0.33	18.5
1,2-DICHLOROETHANE	118,000	20,000	113,000	NA	0.94	243
1,1,1-TRICHLOROETHANE	NA	NA	31,200	NA	18400	NA
TRICHLOROETHYLENE	45,000	NA	NA	NA	27	807
BENZENE	5,300	NA	5,100	NA	0.66	40
1,1,1,2-TETRACHLOROETHYLENE	5,280	840	10,200	450	0.8	8.85
TOLUENE	17,500	NA	6,300	5,000	14300	424000
ETHYLENE	32,000	NA	430	NA	1400	328000
ACID EXTRACTABLE ORGANICS	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)
PHENOL	10200	2560	3500	3500	NA	NA
2,4-DIMETHYLPHENOL	2120	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	55	3.2	53	34	NA	NA
BASE-NEUTRAL EXTRACTABLE ORGANICS	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)
NAPHTHALENE	2350	620	2350	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA

CRITERIA PUBLISHED IN FEDERAL REGISTER NOVEMBER 28, 1980.
 RISK FACTOR OF 1:100,000 SHOWN

TABLE 4-11

EPA MAXIMUM CONTAMINANT LEVEL GOALS
ORGANICS
CAMP ALLEN LANDFILL (SITE 1)

PARAMETER	ANALYTICAL PARAMETERS STANDARDS/CRITERIA				
	FED. REG. 11/13/85 (1) MCLG (ppb)	FED. REG. 6/13/86 (2) RfD (ppb)	FED. REG. 6/13/86 (3) RSD (ppb)	FED. REG. 6/13/86 (4) PMCL (ppb)	1986 (5) CA DHS (ppb)
VOLATILE ORGANICS					
VINYL CHLORIDE	0	--	--	1	2
METHYLENE CHLORIDE	--	--	600	--	40
TRICHLOROFLUOROMETHANE	--	--	--	--	3400
1,1-DICHLOROETHANE	--	--	--	--	20
TRANS-1,2-DICHLOROETHYLENE	70	--	--	--	16
1,2-DICHLOROETHANE	0	--	--	5	1
1,1,1-TRICHLOROETHANE	200	--	--	200	200
TRICHLOROETHYLENE	0	--	--	5	5
BENZENE	0	--	--	5	0.7
1,1,2,2-TETRACHLOROETHYLENE	--	--	20	--	--
TOLUENE	2000*	10000	--	--	100
ETHYLENE	--	--	--	--	--
ACID EXTRACTABLE ORGANIC					
PHENOL	--	--	--	--	--
2,4-DIMETHYLPHENOL	--	--	--	--	--
PENTACHLOROPHENOL	--	--	--	--	--
BASE-NEUTRAL EXTRACTABLE ORGANIC					
NAPHTHALENE	--	--	--	--	--
BIS (2-ETHYLHEXYL) PHTHALATE	--	--	--	--	--

NOTES:

- | | |
|--|---|
| 1. MAXIMUM CONTAMINANT LEVEL GOALS | 4. PROPOSED MAXIMUM CONTAMINANT LEVEL |
| 2. REFERENCE DOSE (for non-carcinogenic compounds) | 5. CALIFORNIA DEPARTMENT OF HEALTH SERVICES |
| 3. RISK SPECIFIC DOSE (for carcinogenic compounds) | * PROPOSED MCLG |

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TABLE 4-12

EPA WATER QUALITY CRITERIA - 1980
 INORGANICS
 CAMP ALLEN LANDFILL (SITE 1)

PARAMETER	TOXICITY TO AQUATIC LIFE				HUMAN HEALTH	
	FRESH WATER		SALT WATER		INGESTION	
	ACUTE (MG/L)	CHRONIC (MG/L)	ACUTE (MG/L)	CHRONIC (MG/L)	WATER (MG/L)	AQUATIC (MG/L)
INORGANICS						
ARSENIC, TOTAL	0.44	0.03	0.508	NA	0.000022	0.000175
CADMIUM, TOTAL	0.003	0.00003	0.059	0.0045	0.01	NA
CHROMIUM, TOTAL	0.021	0.00029	0.26	0.018	0.05	NA
COPPER, TOTAL	0.022	0.0056	0.023	0.004	0.001	NA
CYANIDE, TOTAL	0.052	0.0035	0.03	0.002	0.20	NA
LEAD, TOTAL	0.17	0.0038	0.668	0.025	0.05	NA
MERCURY, TOTAL	0.0000017	0.00000057	0.0037	0.000025	0.000144	0.000146
NICKEL, TOTAL	1.84	0.096	0.14	0.0071	0.0134	0.10
ZINC, TOTAL	0.32	0.047	0.17	0.058	5.0	NA
PHENOLS, TOTAL	10.2	2.56	0.8	NA	0.0035	NA

CRITERIA PUBLISHED IN FEDERAL REGISTER NOVEMBER 28, 1980.

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TABLE 4-13

WATER QUALITY CRITERIA - 1985
 INORGANICS
 CAMP ALLEN LANDFILL (SITE 1)

	EPA WATER QUALITY CRITERIA DOCUMENTS			
	TOXICITY TO AQUATIC LIFE			
	FRESH WATER		SALT WATER	
	CMC (MG/L)	CCC (MG/L)	CMC (MG/L)	CCC (MG/L)
INORGANICS				
ARSENIC, TOTAL	0.36	0.19	0.069	0.036
CADMIUM, TOTAL	0.0039	0.0011	0.043	0.0093
CHROMIUM, TOTAL	0.016	0.011	1.10	0.05
COPPER, TOTAL	0.018	0.012	0.029	NA
CYANIDE, TOTAL	0.022	0.0052	0.001	NA
LEAD, TOTAL	0.083	0.0032	0.14	0.0056
MERCURY, TOTAL	0.0024	0.000012	0.0021	0.000025

CMC = Criterion maximum concentration for one hour
 CCC = Criterion continuous concentration for four day average (chronic toxicity).
 Criteria published in Federal Register July 29, 1985

TABLE 4-14

EPA MAXIMUM CONTAMINANT LEVELS AND
STATE WATER CONTROL BOARD WATER QUALITY STANDARDS AND CRITERIA
INORGANICS
CAMP ALLEN LANDFILL (SITE 1)

	EPA		SWCB (1)	
	MCL'S (MG/L)	GW STANDARDS (MG/L)	SW (2) STANDARDS (MG/L)	WATER QUALITY CRITERIA FOR SURFACE WATERS (3) (UG/L)
INORGANICS				
ARSENIC, TOTAL	0.05	0.05	0.05	63
CADMIUM, TOTAL	0.01	0.0004	0.01	12
CHROMIUM, TOTAL	0.05	0.05	0.05	(4)
COPPER (ACTIVE)	1.00	1.00	1.00	2
CYANIDE, TOTAL	---	0.005	---	0.57
LEAD, TOTAL	0.05	0.05	0.05	8.6
MERCURY, TOTAL	0.002	0.00005	0.002	0.1
NICKEL, TOTAL	---	NA	---	7.1
ZINC, TOTAL	5.00	0.05	5.00	58
PHENOLS, TOTAL	---	0.001	0.001	1.0

NOTES:

(1) Water Quality Standards, revised edition, June, 1986.

(2) denotes Surface Public Water Supplies

(3) Values shown represent Chronic criteria for Salt Water.

(4) State criteria for Salt Water addresses Hexavalent(dissolved) only.

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Quality Criteria was used for comparison of the remaining inorganic compounds not listed in Table 4-13.

The EPA Maximum Contaminant Levels (MCL) and/or Maximum Contaminant Level Goals (MCLG's) are listed in Table 4-11 for organics and 4-14 for inorganics. The MCL's (Primary Standards) are enforceable drinking water standards established under the Safe Drinking Water Act. The MCL's are set based on health considerations, treatment technologies, costs, analytical methods and other incidental factors such as air pollution and waste disposal methodologies. The MCLG's (formerly known as Recommended Maximum Contaminant Levels, RMCL's) and Secondary Drinking Water Standards are nonenforceable health goals and are set at levels at which "no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety."

The SWCB Water Quality Standards (revised edition, dated June, 1986) includes limits designed to protect and conserve the natural quality of ground and surface waters and to provide guidance for preventing ground and surface water pollution. Ground water and surface water standards developed by the SWCB are shown in Table 4-14. Also listed are water quality criteria for surface water (saltwater only) which represent "recommended stream limits on concentration of substances that, when not exceeded, should generally protect the water environment for aquatic life." These criteria are based on criteria promulgated by EPA under Section 304 of the Federal Water Pollution Control Act.

For comparative purposes, it should be noted from the onset that both EPA's Water Quality Criteria and the site specific analytical results for inorganic constituents are both based on total values, not soluble or dissolved. However, although both are based on total, a direct comparison between the two without a qualified judgement can lead to misleading results and erroneous conclusions. While movement of particulates in ground water is highly restricted, samples from ground water monitoring wells often have high suspended solids, derived from sediment adjacent to the well screen. By including particulates in the analyses, the resulting concentrations do not necessarily represent what is readily assimilated by any particular aquatic species.

Standards and criteria from the Office of Drinking Water (ODW) and the National Academy of Sciences (NAS) were also considered for comparison. However, insufficient data was available for the pollutants identified.

4.7 DATA EVALUATION

The evaluation of organic compounds identified (Table 4-4 and 4-5) indicate monitoring wells 01GW-04 and B-20W contained concentrations of several organic compounds which greatly exceeded the referenced criteria. The volatile organics and phenols, which increase slightly from sample event 1 (December, 1983) to sample event 2 (August, 1984), do appear to be decreasing at both well locations between sample event 2 and sample event 3 (April, 1986). This trend may be due to a limited source of contamination, natural degradation processes and ground water attenuation mechanisms.

Based on the results of the one time analysis of the red liquid found during the drilling operations and four subsequent sampling events of well 01GW-04, it is apparent that significant concentrations of organics were present in the ground water in the vicinity of the well. Furthermore, it would appear based on analytical data from 01SW-11 that some leaching of the contaminants to the surface water drainage ditch, adjacent to 01GW-04, is also occurring. Table 4-15 provides a comparison of the maximum concentration of volatile organics identified at 01GW-04 and 01SW-11. The concentrations of contaminants present at 01SW-11 were significantly less than at monitoring well 01GW-04 and diminish further downstream of the sample location. The third round sampling event also indicated a decrease in contaminant concentration.

The identification of the highly concentrated red liquid also suggests additional drums, randomly disposed throughout the landfill area, may be present and creating localized contamination. The limited number of monitoring wells may not be adequate to identify each localized area.

No significant contamination was present at the remaining wells in Area B, 01GW-05 and 01GW-06. At well 01GW-05, 1,1-Dichlorethane was

TABLE 4-15

COMPARISON OF VOLATILE ORGANICS IDENTIFIED
AT 01GW-04 AND 01SW-11

<u>Constituent</u>	<u>01GW-04</u>	<u>01SW-11</u>
	<u>Max. Conc. (Event)</u> (ug/L)	<u>Max. Conc. (Event)</u> (ug/L)
Vinyl Chloride	79 (1)	33 (2)
Methylene Chloride	24000 (1)	12 (1)
Trichlorofluoromethane	2300 (1)	16 (2)
1,1 -Dichloroethane	20 (1)	BDL
Trans-1, 2-Dichloroethylene	340 (1)	82 (2)
1, 2-Dichloroethane	74 (1)	BDL
1,1,1-Trichloroethane	24 (1)	BDL
Trichloroethylene	640 (2)	52 (2)
Benzene	390 (2)	BDL
Toluene	290 (2)	BDL
Ethylbenzene	430 (1)	BDL

identified during all three sampling events but at concentrations that showed a marked decrease that approached limits of detection for the third sampling event; the decrease is likely attributable to natural degradation processes and ground water attenuation mechanisms. The compound was not detected in the adjacent surface water. The existing non-potable deep well, 01GW-EW, also located in the vicinity of Area B, showed no sign of contamination.

Regarding Area A, only analytical results from B-20W showed significant levels of volatile compounds. Analytical data at this location also indicated a decrease in concentration between rounds 2 and 3. Further investigation by the Navy after the results were obtained identified a former waste oil and solvent dumping site about one hundred feet east of well location B-20W. This underground dump site is the probable source of the volatile organics identified. No evidence was found, however, to indicate that these organic constituents have migrated to the adjacent surface water.

Inorganic compounds (Tables 4-6 and 4-7) were identified in both ground water and surface water samples taken from each well location in Areas A and B. The analyses however, were for total metals, which comprise both the inorganics in solution as well as any suspended solids and those absorbed into the sediment. Regarding the ground water data, cadmium, chromium and lead were the most significant compounds present based on concentration: Cadmium was found to exceed both EPA's MCL's (National Primary Drinking Water Standards) and SWCB ground water criteria at six (01, 02, 03, 05, 06, B20W) locations during more than one sampling event. Similarly, chromium exceeded both criteria at five well locations (01, 03, 04, 05, EW) and lead at seven locations (01, 02, 03, 05, 06, 07, B20W). Arsenic also exceeded both criteria at B20W. SWCB criteria for zinc were also exceeded at eight locations (01, 02, 03, 04, 05, 06, EW, B20W).

Regarding the surface water samples analyzed, the upstream samples taken at location 01SW-08 showed no inorganic compounds were present which exceeded MCL's or SWCB surface water criteria. Additionally, only one inorganic compound, zinc, was detected on more than one sampling event. However, analytical data of surface water samples from locations

01SW-10 and 01SW-11 indicated cadmium, chromium and lead exceeded both MCL's and SWCB surface water criteria on more than one occasion. At sample location 01SW-09, adjacent to monitoring well 01GW-01 and downstream of locations 08, 10 and 11, chromium and lead exceeded the referenced criteria on more than one occasion.

The special analyses conducted (Tables 4-8 and 4-9) indicated well location B-20W had significant concentrations of MEK and MIBK during both sampling events. MIBK was also found during both sampling events at well location 01GW-04. No special analysis compounds were identified in any surface water samples analyzed.

4.8 CONCLUSIONS AND RECOMMENDATIONS

The analyses of organic constituents in the ground water and surface waters at Site 1, the Camp Allen Landfill, indicate significant localized contamination at well locations 01GW-04 and B-20W. This contamination, however, appears to have been reduced over time. The analytical results for surface waters at 01SW-11 also indicate a limited number of contaminants at 01GW-04 are migrating to the surface drainage ditch adjacent to the well.

The analysis of inorganic constituents at Site 1 (Camp Allen Landfill) indicate elevated concentrations of cadmium, chromium, lead and zinc are present at many well locations and surface water locations. However, these values represent total values, not dissolved, and therefore the magnitude of ground and surface water contamination can not be predicted. Many additional inorganic compounds were present at concentrations below the referenced criteria.

Based upon evaluation of the analytical data, additional investigative efforts and additional monitoring wells (as a component of the Characterization phase) is recommended. However, to better determine the placement of any additional monitoring wells, it is recommended that a soil gas survey be conducted initially to identify and locate other localized areas where high levels of volatile organics may exist. This survey would require vadose zone testing for volatile compounds at defined intervals along the site perimeters of both Areas A

and B. Subsequent to the soil gas survey, monitoring wells should be installed at locations identified as having high volatile concentrations to identify the specific compounds and corresponding concentration.

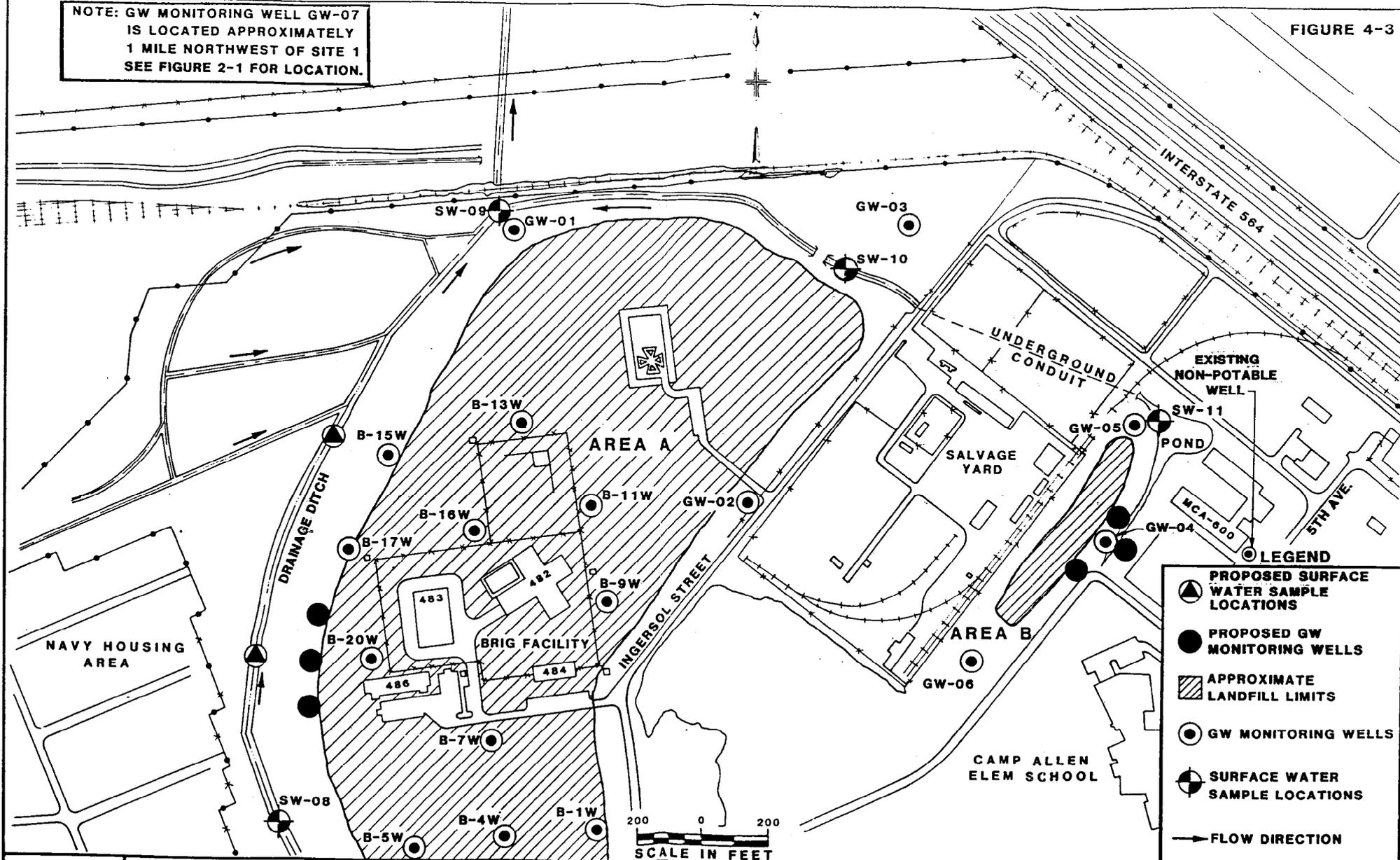
In attempting to anticipate the results from the soil gas survey, we have developed a concept (albeit hypothetical) that presents our recommendations for the placement of additional monitoring wells. At well location 01GW-04, it is recommended that three nested well systems, with system consisting of two or three distinct wells, be installed and monitored to define the extent of organic and inorganic contamination, both horizontally and vertically. A symbolic location for the three nested wells is shown in Figure 4-3. One location considered important is across the drainage ditch from well 01GW-04 to determine if contaminants are migrating under the drainage ditch towards building MCA-600. A nested well configuration having screened intervals at two or three isolated vertical zones (i.e. from 4 to 9 feet, 12 to 17 feet and 20 to 25 feet) is recommended to isolate specific zones and determine the tendency of the contaminants to diffuse.

It is also recommended that a similar cluster of nested wells be installed in the vicinity of well B-20W to define the extent of organic and inorganic contamination. These proposed well locations are also shown in Figure 4-3. The well locations were selected radially outward and down gradient from the reported location of the waste oil and solvent dumping site.

Soil sampling at 5-foot intervals during well installation of one deep well for each nested well location is recommended to provide data for boring logs. Continuous sampling, which was performed during installation of the existing monitoring wells, is not necessary for the proposed wells since good subsurface information has already been developed.

A sampling program requiring two additional rounds of sampling is recommended. The existing Site 1 monitoring wells and surface water sample locations, originally included as part of the CS, as well as the proposed nested wells and two additional surface water sampling locations, are recommended to identify and verify ground water quality and the potential for migration to the surface water drainage system.

NOTE: GW MONITORING WELL GW-07 IS LOCATED APPROXIMATELY 1 MILE NORTHWEST OF SITE 1 SEE FIGURE 2-1 FOR LOCATION.



- LEGEND**
- ▲ PROPOSED SURFACE WATER SAMPLE LOCATIONS
 - PROPOSED GW MONITORING WELLS
 - ▨ APPROXIMATE LANDFILL LIMITS
 - GW MONITORING WELLS
 - ⊕ SURFACE WATER SAMPLE LOCATIONS
 - FLOW DIRECTION

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NAVAL BASE NORFOLK, VIRGINIA
 CAMP ALLEN LANDFILL AREA (SITE 1)
PROPOSED NESTED WELLS AND SURFACE WATER SAMPLING LOCATIONS

MALCOLM PIRNIE, INC.
MARCH 1988

Figure 4-3 shows the surface water sampling locations recommended. The sampling events should be approximately 60 days apart.

Analytical parameters to be tested should include:

- o Volatile organics
- o Acid extractable organics
- o Inorganics (total and soluble)
- o Xylene
- o MEK
- o MIBK

Both total and soluble inorganics should be tested to identify the concentration of constituents in solution and to provide a correlation between total (analyzed during the previous sampling events) and dissolved constituents (recommended for future analyses).

Remedial measures at locations O1GW-04 and B-20W, and other locations as appropriate, should be evaluated after the recommended sampling and analysis is completed. Suggested remedial alternatives include capping and long-term monitoring, in-situ bioreclamation and excavation.

5. SITE 2 - NM AREA SLAG PILE

5.1 GENERAL

The investigation at Site 2 was conducted to determine if any suspected inorganic constituents, based on the IAS report, were present in the soil and surface waters (storm water drainage ditch) adjacent to the site. Soil, surface water and sediment samples were collected and analyzed for various inorganics (metals) identified in the IAS. The following sections discuss the work performed, analytical results, data evaluation, and conclusions and recommendations for further action at Site 2.

5.2 WORK DESCRIPTION

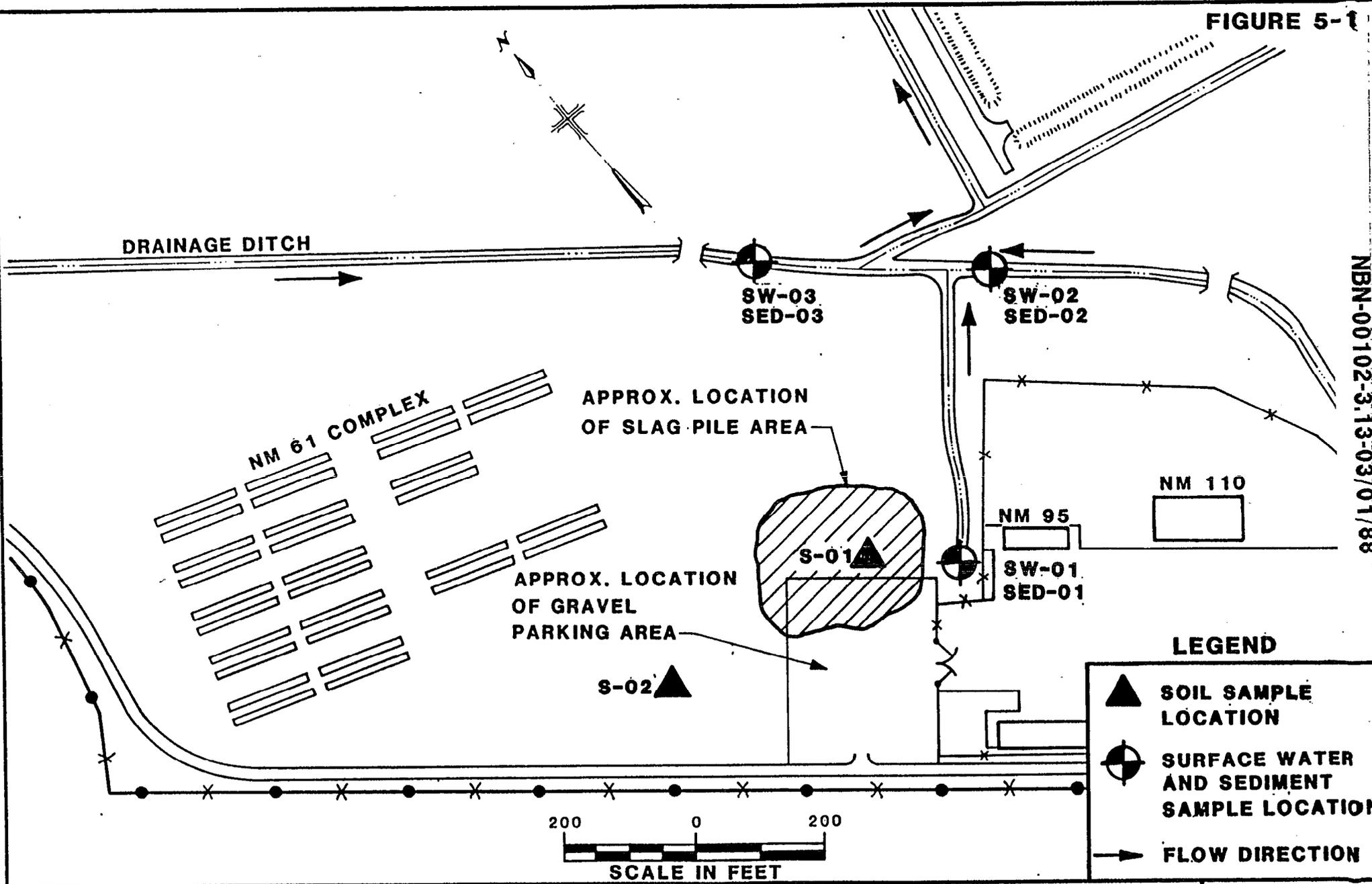
Due to the nature of the wastes disposed at Site 2, consisting largely of slag from aluminum smelting operations, the recommended sampling activities at Site 2 were minimal in scope, as suggested by the IAS. The first sampling and analysis event was conducted in December, 1983. It included taking one surface soil sample from the slag pile area (S-01) and one surface water sample from the nearby drainage ditch (SW-01). The samples were analyzed for beryllium, cadmium, chromium, copper, nickel and zinc. Figure 5-1 shows the sample locations.

A second sampling event was conducted in August, 1984. A sample was collected from each of the designated locations for the first events, as well as a sediment sample (SED-01) from the bottom of the drainage ditch at the same surface water sample location. Analysis for the metals previously listed was performed.

After evaluation of the data collected from the two sampling events and discussions between Navy and Pirnie personnel, one additional sampling event was authorized and conducted in April, 1986. The third sampling event included collecting surface water and sediment samples from the locations previously sampled plus two additional locations of the drainage ditch downstream (SW-02 & 03 and SED-02 & 03). Also included was a background soil sample taken several hundred feet away from the site (S-02), plus an additional soil sample in the slag pile.

FIGURE 5-1

NBN-00102-3.13-03/01/88



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NAVAL BASE NORFOLK, VIRGINIA
 NM AREA SLAG PILE (SITE 2)
 SOIL, SURFACE WATER, AND SEDIMENT SAMPLE LOCATIONS

MALCOLM PIRNIE, INC.

MARCH 1988

The third sampling event was conducted during a rain storm so that the effect of surface runoff on contaminant concentrations could be evaluated. The three surface water samples and the background soil sample were again analyzed for beryllium, cadmium, total and hexavalent chromium, copper, lead, nickel and zinc. The three sediment samples were analyzed for the above constituents plus EP toxicity for cadmium, chromium and lead. The soil sample collected from the slag pile (initial sample location) was also analyzed for EP Toxicity for cadmium, chromium and lead. The EP Toxicity tests were included to evaluate the potential for leaching of the constituents identified into the surface water and ground water regimens.

Table 5-1 summarizes the entire sampling and analysis program conducted at Site 2, the NM Area Slag Pile. It is important to note that Navy personnel had regraded the area and added gravel to the slag pile (to provide automobile parking for adjacent facilities) between sampling events two and three. This activity likely mobilized and relocated some of surface slag material to the edges of existing parking area. There was no evidence that this activity generated a significant change in the general site area or caused excessive erosion of sediments. The soil sample analytical results from the on-site location, however, may have been influenced by this activity.

TABLE 5-1

SAMPLING AND ANALYSIS PROGRAM
NM AREA SLAG PILE (Site 2)

<u>Sampling Event</u>	<u>Sample Date</u> *	<u>Surface Water Samples</u>	<u>Soil Samples</u>	<u>Sediment Samples</u>	<u>Parameters</u>
1	12/83	1	1	-	Be, Cd, Cr, Cu, Ni, Zn
2	8/84	1	1	1	Be, Cd, Cr, Cu, Ni, Zn
3	4/86	3	1	3	Be, Cd, Cr, (total and hexavalent) Cu, Pb, Ni, Zn
3	4/86	-	1	3	EP Toxicity (Cd, Cr, Pb only)

* To determine specific locations, refer to Figure 5-1 and Table 5-2.

5.3 ANALYTICAL RESULTS

The results of the surface water, soil and sediment analyses at Site 2 are as shown in Table 5-2. The notation utilized to identify each sample location is as follows:

- o The first two digits represent the site number;
- o The following letters indicate the type of sample; surface water (SW), soil (S), or sediment (SED); and
- o The last two digits following the hyphen represent the specific location number for that particular site.

5.4 SOIL CONCENTRATION GUIDELINES

Concentrations of selected inorganics typically found in soils and sediments were prepared for comparison with Site 2 analytical data. Specific standards or established criteria, relative to the concentration of inorganics in soil or sediment for determining the extent of contamination are not available; thus, a comparison must be made in more abstract terms. The numerical values presented in Table 5-3 do offer some insight and general guidance on what levels are acceptable from different parts of the country. The data offered provides a list of the median composition of inorganics in natural soils; EPA Region V guidelines for nonpolluted, moderately polluted and heavily polluted inorganic concentrations in sediments; EPA Region V screening level concentrations requiring EP Toxicity testing of sediments; and allowable concentrations in soil for the State of New Jersey. These values were utilized to identify soil and sediment concentrations of concern.

5.5 DATA EVALUATION

The analytical data collected at Site 2 indicates only trace or relatively small amounts of inorganic constituents were present at the background soil sample location 02S-02. The constituent concentrations, however are significantly higher at sample location 02S-01, which is

TABLE 5-2

SURFACE WATER, SEDIMENT, AND SOIL ANALYTICAL RESULTS
NM AREA SLAG PILE (SITE 2)

INORGANICS PRIORITY POLLUTANTS	DETECTION LIMIT (MG/L OR UG/G)	SURFACE WATER								SEDIMENT				SOIL			
		02SW-01			02SW-02	02SW-03	02SED-01	02SED-01	02SED-02	02SED-03	ON SITE			BACKGROUND			
		01	02	03	03	03	02	03	03	03	01	02	03	03			
BERYLLIUM, TOTAL	0.02	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL	2	3.10	----	BDL			
CADMIUM, TOTAL	0.02	BDL	BDL	BDL	BDL	BDL	0.24	8.2	0.36	BDL	57	1.40	----	2.2			
CHROMIUM, TOTAL	0.10	BDL	BDL	BDL	BDL	BDL	0.46	47	21	9.9	180	320	----	5.2			
COPPER, TOTAL	0.10	BDL	0.23	BDL	BDL	BDL	900	1300	30	4.6	3500	810	----	30			
LEAD, TOTAL	0.05	----	----	BDL	BDL	0.12	----	200	250	17	----	----	----	42			
NICKEL, TOTAL	0.10	BDL	BDL	BDL	BDL	BDL	43	51	2.6	1.9	650	1200	----	1.6			
ZINC, TOTAL	0.02	0.23	0.30	0.23	0.21	0.11	510	290	250	19	2900	3000	----	41			
HEXAVALENT CHROMIUM	0.03	----	----	BDL	BDL	BDL	----	BDL	BDL	BDL	----	----	----	BDL			
E.P. LEACHATE	(MG/L)																
CADMIUM, TOTAL	0.01	----	----	----	----	----	----	BDL	BDL	BDL	----	----	BDL	----			
CHROMIUM, TOTAL	0.05	----	----	----	----	----	----	BDL	BDL	BDL	----	----	BDL	----			
LEAD, TOTAL	0.05	----	----	----	----	----	----	BDL	0.11	BDL	----	----	0.28	----			

NOTES: All surface water values in mg/l.
All soil and sediment values in ug/g.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 30, 1986
---- = NO ANALYSIS PERFORMED

TABLE 5-3
 TYPICAL SOIL/SEDIMENT CONCENTRATIONS
 NM AREA SLAG PILE (SITE 2)

PARAMETER	MEDIAN COMPOSITION OF NATURAL SOILS		EPA REGION V GUIDELINES			SUGGESTED EP TOXICITY SCREENING LEVELS (MG/KG)	NEW JERSEY ALLOWABLE CONC. IN SOIL (MG/KG)
	RANGE (MG/KG)	TYPICAL MEDIUM (MG/KG)	NONPOLLUTED (MG/KG)	MODERATELY POLLUTED (MG/KG)	HEAVILY POLLUTED (MG/KG)		
Beryllium	0.01 - 40	0.3	NA	NA	NA	NA	NA
Cadmium	0.01 - 7	0.5	*	*	>6	20.0	3
Chromium	5 - 3,000	100	<25	25-75	>75	100.0	100
Copper	2 - 250	30	<25	25-50	>50	---	170
Lead	LT 1 - 888	29	<40	40-60	>60	100.0	100
Nickel	0.1 - 1,530	50	<20	20-50	>50	---	100
Zinc	1 - 2,000	90	<90	90-200	>200	---	350

- NOTE: 1) References:
1. Bowen, H.J.M., "ENVIRONMENTAL CHEMISTRY OF THE ELEMENTS." ACADEMIC PRESS, NEW YORK.
 2. Ragaini, R.C., ET. AL., "ENVIRONMENTAL TRACE CONTAMINATION IN KELLOG IDAHO NEAR LEAD SMELTING COMPLEX." ENVIR. SCI. & TECHNOL. 11 773-780 1977
 3. Lisk, D.J., " TRACE METALS IN SOILS, PLANTS, AND ANIMALSD." ADV. AGRON. 24 267-311, 1972
 4. "GEOCHEMISTRY OF SOME ROCKS, SOIL, PLANT AND VEGETABLES IN THE CONTERMINOUS UNITED STATES", GEOL. SRVY. PROF. PAPER 574 F 1975
 5. Ure, A.M., ET. AL., "ELEMENTAL CONSTITUENTS OF SOILS" ENVIR. CHEM. VOL. 2 94-204 ED. H.J.M. BOWEN, ROYAL SOC. OF CHEM., BURLINGHOUSE, LONDON, U.K. 1983
 6. Parr, J.F., ET. AL. "LAND TREATMENT OF HAZARDOUS WASTES," AGRI. ENVIR. QUAL. INST., AGRI. RESH. SER., USDA, BELTSVILLE, MD., NOYES DATA CORP., PARK RIDGE, N.J., 1983.
 7. Shaklette, H.T., ET. AL., "ELEMENTAL COMPOSITION OF SURFACIAL MATERIAL IN THE CONTERMINOUS UNITED STATES," USGS PROF. PAPER 574-D, 1971.
 8. Lechler, T.J., ET. AL., "MAJOR AND TRACE METAL ANALYSIS OF 12 REFERENCE SOILS BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY." SOIL SCIENCE 130 238-241 1980.

2) New Jersey allowable concentrations in soil were established to evaluate proposed clean-up plans associated with property transfers.

* Limits not established.

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within the disposal area. The concentrations of constituents at location 02S-01 are also significantly higher than typical values for these compounds, as listed in Table 5-3.

Results of the surface water analyses indicate the inorganic constituents do not remain suspended within the water column. This is confirmed by the analytical values, which demonstrate minimal surface erosion at the time of sampling, in addition to the results of the EP toxicity tests performed, which indicate a minimal tendency for leaching of cadmium, chromium and lead.

The sediment samples analyzed indicate the inorganic constituents associated with the sediments are being eroded into the drainage ditch and transported further downstream, particularly 02SED-02. The absence of significant concentrations of inorganics in the surface water of the drainage ditch reinforces the assumption that the migration of constituents has been caused by the erosion of sediments.

5.6 CONCLUSIONS AND RECOMMENDATIONS

The analytical data collected at Site 2 indicates the disposed slag from the aluminum smelting operation does contain high concentrations of metals. However, the metals have been mixed with and become enmeshed with the soils and are only being transported via surface erosion. Leaching of the metals into the water column does not appear to be a problem.

It is recommended that the slag pile area be leveled and capped with a hard surface to minimize the potential for continued erosion. Additional sampling prior to the capping operation should be performed to identify the specific area to be capped. Erosion control measures at the edge of the drainage ditch may also be needed to minimize the erosion of sediment between the paved area and the ditch. Removal and/or other action is not warranted based on the data collected and the absence of significant evidence suggesting adverse environmental affects.

6. SITE 3 - Q AREA DRUM STORAGE YARD

6.1 GENERAL

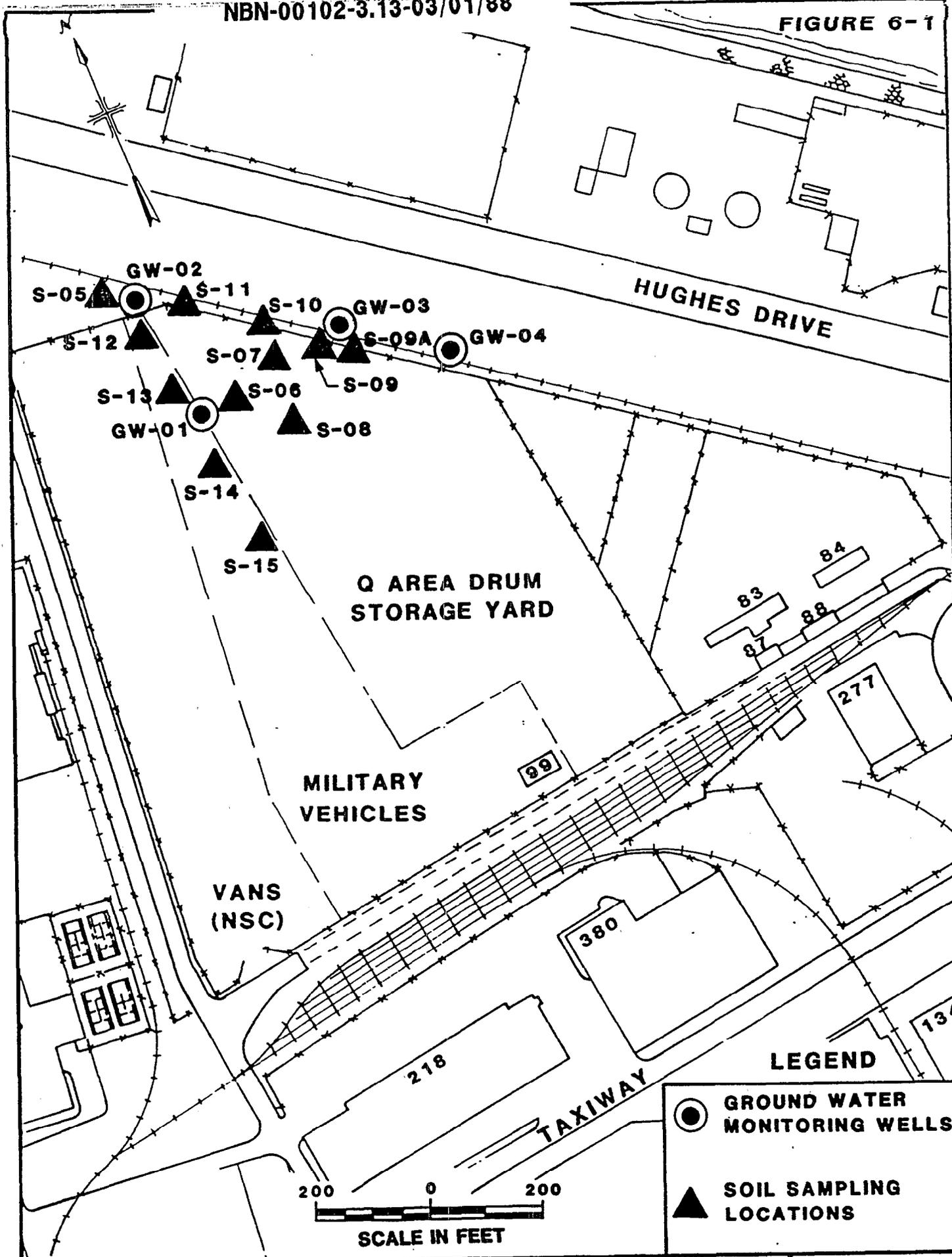
The investigation at Site 3 was conducted to determine if any suspected constituents, based on the IAS report, were present in the ground water or area soils. Monitoring wells were installed and ground water and soil sampling analyses were performed to evaluate site conditions. The following sections discuss the work performed, site geology, ground water flow patterns, analytical results, data evaluation, and conclusions and recommendations for further action at Site 3.

6.2 WORK DESCRIPTION

The initial site investigation performed at the Q Area Drum Storage Yard was conducted in November and December, 1983. The work included:

- o performing four soil borings with continuous soil sampling to a depth of 25-feet,
- o installation of a ground water monitoring well at each boring location, being screened from 4 to 24-feet below ground surface, and
- o conducting four hand augered soil borings, with grab samples taken from each boring at a depth of 0-1 feet, 1-2 feet and 2-3 feet.

Ground water samples from the four monitoring wells and twelve soil samples (four locations, S-05 through S-08) were analyzed the EPA's priority pollutants (previously listed in Table 4-1) plus oil and grease. Figure 6-1 shows the location of the ground water monitoring wells and first round soil samples. Monitoring well 03GW-01 and soil sample 03S-06 were located in an area used to store leaking 55 gallon drums containing various liquids. The remaining three monitoring wells were located along the perimeter of the storage yard. This location was determined in what was believed at the time, due to a very flat gradient and tidal activity, an assumed downgradient direction. Concerning soil sampling, two of the four soil sampling locations (03S-07 and 03S-08) were located radially outward from the leaking drum area within the storage yard. One soil sample (03S-05) was located in a slight depression which may receive some surface runoff from the storage yard.



LEGEND

-  GROUND WATER MONITORING WELLS
-  SOIL SAMPLING LOCATIONS

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**NAVAL BASE NORFOLK, VIRGINIA
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GW AND SOIL SAMPLING LOCATIONS**

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A second round sampling event conducted in August, 1984 included only ground water samples from each monitoring well. The samples were again analyzed for EPA's priority pollutants and oil and grease. A dioxin screen (2,3,7,8-TCDD) was also included in the second round analysis.

After discussions between Navy and Pirnie personnel regarding the analytical results of the first two sampling events, a third and fourth round of sampling was authorized and conducted. The third sampling event included sampling and analysis of the four ground water monitoring wells for selected EPA priority pollutant fractions, consisting of volatile organics, base-neutral extractables and inorganics. The acid extractable and pesticide/PCB groups were not analyzed as they had not been detected in the first two rounds of sampling. Also included were oil and grease, Xylene, MEK, MIBK and EDB. In addition, twenty-one soil samples (seven locations S-09 through S-15 at 0-1 ft., 1-2 ft. and 2-3 ft. depths) were also collected during the third round event and analyzed for the EPA priority pollutant volatile organics, acid extractables, base-neutral extractables organic, plus oil and grease, Xylene, MEK and MIBK. The surface soil samples (7 total) were also analyzed for EP Toxicity (Cd and Cr only). Figure 6-1 also shows the locations of the third round soil samples collected (S-09 through S-15 plus S-09A).

A fourth round sampling event included collecting only ground water samples from each well and analyzing the samples for Xylene, MEK, MIBK and EDB. These parameters were analyzed to verify the results of the previous analytical event. No soil sampling was conducted during this last sampling event.

Subsequent to Pirnie's first three rounds of sampling at Site 3, Navy personnel collected additional soil samples for analysis in the Q Area Drum Storage Yard. This sampling event was initiated by a fire inspector's concern regarding oil-saturated soils. As a result of the Navy's sampling activity, removal of the most contaminated soil (based on oil and grease and residual volatile organics) is planned as part of a FY-89 Military Construction project. The analytical results and

findings of the Navy's investigation are also discussed herein. Figure 6-2 shows the approximate locations of the Navy's soil samples.

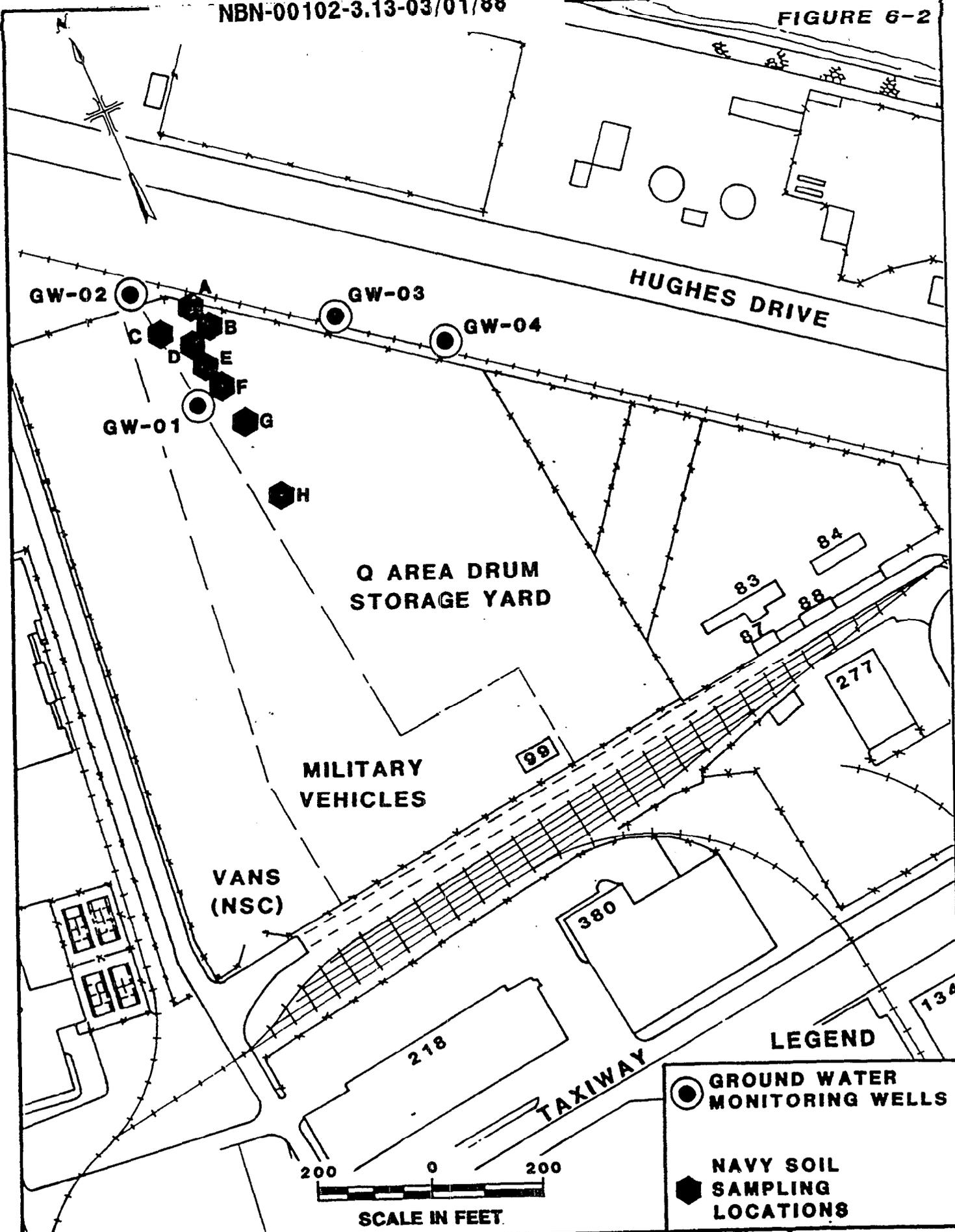
Table 6-1 summarizes the entire sampling and analysis program conducted at Site 3, the Q Area Drum Storage Yard.

6.3 GEOLOGY

Geological boring logs from the monitoring well installations provide the data utilized to interpret subsurface conditions at the site. The logs all show silts, silty sand, sands and shell fragments for the entire 24-foot depth for each of the borings. The individual soil types noted in the logs are in a random order as the material represents and is a compilation of previous dredging and filling activities. This area is located at the northern edge of the Naval Base and is reported to be the disposal site of dredged materials excavated from Willoughby Bay. The presence of the dredge material explains the composition and depositional sequence noted in each of the logs. All logs indicate that the water table is about 8 to 10 feet below the ground surface. The boring logs are included in Appendix A.

6.4 GROUND WATER FLOW

Ground water elevations were taken at the Q Area Drum Storage Yard on December 21, 1983; August 29, 1984; April 18, 1986 and June 25, 1986. Table 6-2 lists the elevations of the top of the PVC well casing and actual water level elevations measured. Figure 6-3 illustrates the ground water contours based on the data obtained. Although the ground water gradient is slight, it would appear that the three perimeter wells at the site are not in the downgradient direction, as assumed prior to the monitoring well installation. Consequently, the migration of any constituents identified in the water column at well 03GW-01 can not be evaluated without additional monitoring wells.



LEGEND

- GROUND WATER MONITORING WELLS
- NAVY SOIL SAMPLING LOCATIONS

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**NAVAL BASE NORFOLK, VIRGINIA
Q AREA DRUM STORAGE YARD (SITE 3)
NAVY SOIL SAMPLING LOCATIONS**

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TABLE 6-1
 SAMPLING AND ANALYSIS PROGRAM
 Q DRUM STORAGE YARD (SITE 3)

SAMPLING EVENT	SAMPLE DATE	GROUND WATER SAMPLES	SOIL SAMPLES	PARAMETERS
1	11/83 - 12/83	4	12	128 PP OIL & GREASE
2	8/84	4	--	128 PP OIL & GREASE DIOXIN SCREEN
3	4/86	4	21	VOA AE (SOIL ONLY) B/N PP METALS (WATER ONLY) OIL & GREASE XYLENE MEK, MIBK EDB (WATER ONLY) EP TOXICITY: Cd, Cr ONLY (SURFACE SOILS ONLY)
4	6/86	4	--	XYLENE MEK, MIBK, EDB
NAVY	4/86	--	8	EPTox METALS (As, Ba, Cd, Cr, Pb, Hg, Se, Ag) pH OIL & GREASE TOX

NOTATION: PP - EPA PRIORITY POLLUTANTS
 VOA - EPA PP VOLATILE ORGANICS
 AE - EPA PP ACID EXTRACTABLE ORGANICS
 B/N - EPA PP BASE- NEUTRAL EXTRACTABLE ORGANICS
 MEK - METHYL ETHYL KETONE
 MIBK - METHYL ISOBUTYL KETONE
 EDB - ETHYLENE DIBROMIDE

Table 6-2

GROUND WATER LEVEL DATA
Q AREA DRUM STORAGE YARD (SITE 3)

<u>Monitoring Well</u>	<u>Elevation Top of PVC (ft.)</u>	<u>12/21/83</u>	<u>8/29/84</u>	<u>4/18/86</u>	<u>6/25/86</u>
03GW-01	12.27	3.7	2.8	3.1	2.7
03GW-02	11.63	3.9	3.3	3.1	3.1
03GW-03	12.03	4.1	3.2	3.2	3.1
03GW-04	12.87	4.1	3.2	3.3	2.9

Datum: USC&GS; Mean Sea Level = 0.00

6.5 ANALYTICAL RESULTS

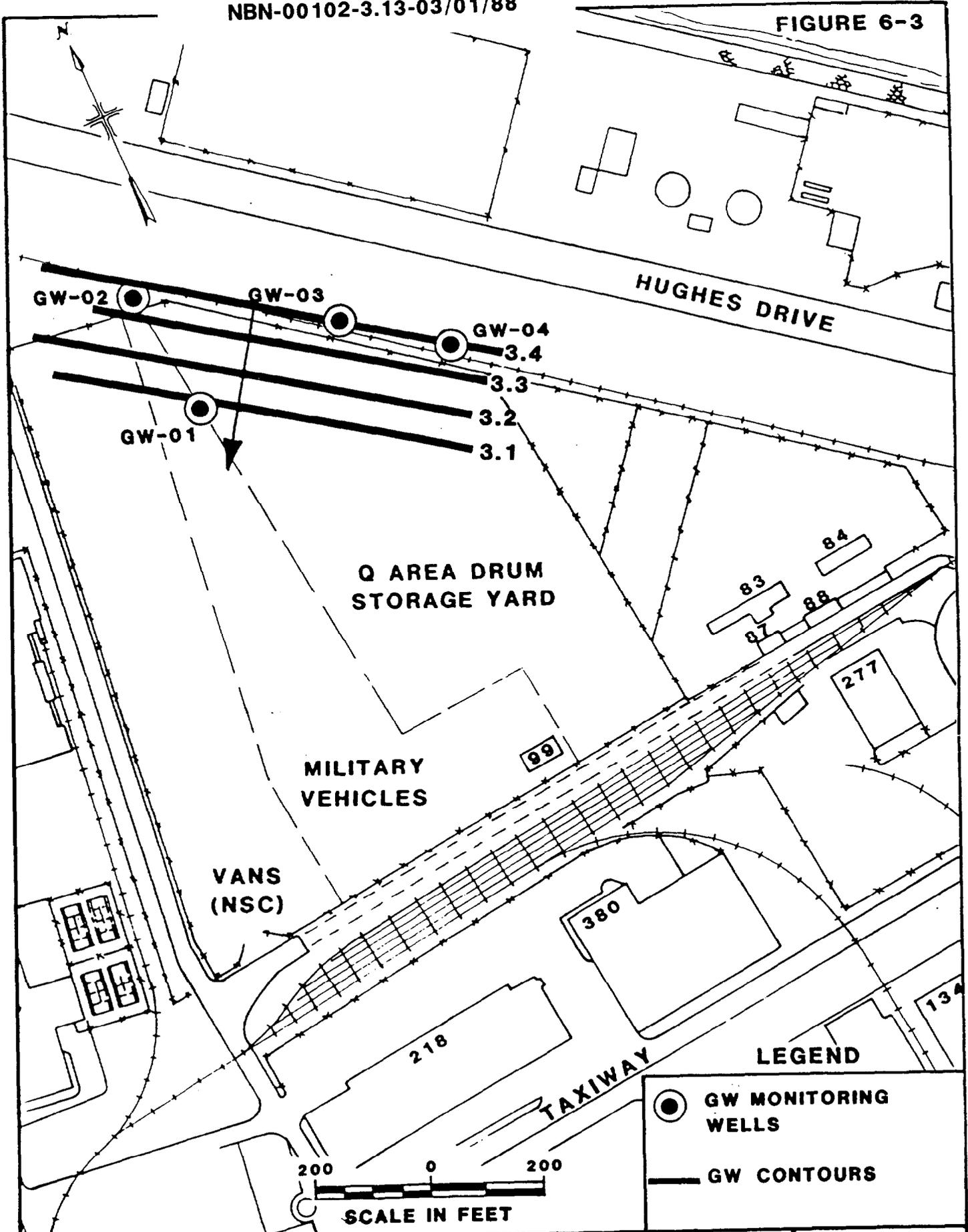
The results of the ground water analyses at Site 3 for organic, inorganic and special analysis compounds are summarized in Tables 6-3, 6-4 and 6-5, respectively. Results of the soil analysis for the first round event are shown in Tables 6-6 and 6-7 for organics and inorganics, respectively. Table 6-8 shows the third round soil analytical results. Table 6-9 shows the results of the Navy's additional soil sampling event conducted on April 28, 1986. The notation utilized to identify each sample location utilized by Pirnie is as follows:

- o The first two digits represent the site number;
- o The following letters indicate the type of sample; ground water (GW) and soil (S); and
- o The last two digits following the hyphen represent the specific location number for that particular site.

The data summary presented in Tables 6-3 through 6-9 includes only those constituents where a measurable value was identified for at least one location.

6.6 WATER QUALITY STANDARDS/CRITERIA

The ground water analytical results were compared with EPA Drinking Water Standards, EPA Water Quality Criteria, State Water Control Board Ground Water Standards, and other available standards and guidelines.



LEGEND

- GW MONITORING WELLS
- GW CONTOURS

MALCOLM PIRNIE

**NAVAL BASE NORFOLK, VIRGINIA
 Q AREA DRUM STORAGE YARD (SITE 3)
 GROUND WATER CONTOURS**

MALCOLM PIRNIE, INC.

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TABLE 6-3

GROUND WATER ANALYTICAL RESULTS - ORGANICS
Q DRUM STORAGE YARD (SITE 3)

	DETECTION LIMITS			03GW-01			03GW-02			03GW-03			03GW-04		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
VOLATILE ORGANICS															
VINYL CHLORIDE	10	10	10	BDL	24	BDL*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
METHYLENE CHLORIDE	10	10	10	10	BDL	BDL*	26	NDB**	BDL	14	14	BDL	14	NDB**	BDL
1,1-DICHLOROETHANE	10	10	10	115	140	BDL*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TRANS-1,2-DICHLOROETHYLENE	10	10	10	8000	9000	5600*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-TRICHLOROETHANE	10	10	10	45	42	BDL*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TRICHLOROETHYLENE	10	10	10	6000	1800	1000*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2-TETRACHLOROETHYLENE	10	10	10	12	19	BDL*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TOLUENE	10	10	10	23	BDL	BDL*	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
ACID EXTRACTABLE ORGANICS															
ALL ACID EXTRACTABLE ORGANICS WERE BELOW DETECTION LEVEL															
BASE-NEUTRAL EXTRACTABLE ORGANICS															
DI-N-BUTYLPHTHALATE	10	10	10	11	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
PYRENE	10	10	10	13	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	10	10	10	130	BDL	BDL	25	25	BDL	18	18	BDL	24	BDL	BDL
PESTICIDES/PCB'S															
ALL PESTICIDES/PCB'S WERE BELOW DETECTION LEVEL															

NOTES: All values for ORGANICS in ug/l.

* = Sample detection limit is 125 ug/l using a 1:12.5 dilution.

NDB** = Compound was also detected in the blank at a concentration greater than
1/2 the sample concentration and 1/2 the detection limit.LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 6-4

GROUND WATER ANALYTICAL RESULTS - INORGANICS
Q DRUM STORAGE YARD (SITE 3)

INORGANICS PRIORITY POLLUTANTS	DETECTION LIMITS			03GW-01			03GW-02			03GW-03			03GW-04		
	01	02	03	01	02	03	01	02	03	01	02	03	01	02	03
ANTIMONY, TOTAL	0.05	0.05	0.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.30	BDL	BDL
ARSENIC, TOTAL	0.05	0.05	0.05	0.20	BDL	BDL	0.13	BDL	BDL	0.20	BDL	BDL	0.50	BDL	BDL
CADMIUM, TOTAL	0.02	0.01	0.01	0.02	0.01	0.02	0.02	BDL	0.02	0.02	BDL	0.09	BDL	BDL	BDL
CHROMIUM, TOTAL	0.10	0.05	0.05	0.10	0.10	BDL	0.10	0.22	BDL	0.45	0.25	BDL	140.00	0.13	0.10
COPPER, TOTAL	0.10	0.10	0.10	0.10	BDL	BDL	0.10	BDL	BDL	0.10	BDL	BDL	0.10	BDL	BDL
LEAD, TOTAL	0.20	0.05	0.05	0.30	BDL	BDL	0.23	BDL	BDL	0.32	BDL	0.24	BDL	BDL	BDL
MERCURY, TOTAL	0.0002	0.0002	0.0002	BDL	BDL	BDL	0.0007	0.0003	BDL	0.001	BDL	BDL	BDL	BDL	0.0007
NICKEL, TOTAL	0.10	0.10	0.10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.10
SELENIUM, TOTAL	0.05	0.01	0.01	0.10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
THALLIUM, TOTAL	0.05	0.05	0.05	0.12	BDL	BDL	BDL	BDL	BDL	0.06	BDL	BDL	0.15	BDL	BDL
ZINC, TOTAL	0.02	0.02	0.02	0.30	0.17	BDL	0.30	0.13	0.04	0.40	0.13	BDL	0.30	0.05	0.10
PHENOLS	0.01	0.01	0.01	BDL	0.10		BDL	BDL		BDL	BDL		0.01	BDL	

NOTES: All values for INORGANICS in mg/l.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986

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TABLE 6-5

GROUND WATER ANALYTICAL RESULTS - SPECIAL ANALYSIS
Q DRUM STORAGE YARD (SITE 3)

SPECIAL ANALYSIS	DETECTION LIMITS				03GW-01				03GW-02			
	01	02	03	04	01	02	03	04	01	02	03	04
OIL AND GREASE (mg/l)	0.05	2.00	2.00		80	BDL	BDL		74	BDL	BDL	
m-XYLENE			10.00	5.0			BDL*	BDL			BDL	BDL
o,p-XYLENE			10.00	5.0			BDL*	BDL			BDL	BDL
METHYLETHYLKETONE			10.00	10.00			BDL*	BDL			BDL	BDL
METHYLISOBUTYLKETONE			10.00	10.00			BDL*	BDL			BDL	BDL
1,2-DIBROMOETHANE			0.015	0.015			BDL	BDL			BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE				0.015				BDL				BDL

SPECIAL ANALYSIS	DETECTION LIMITS				03GW-03				03GW-04			
	01	02	03	04	01	02	03	04	01	02	03	04
OIL AND GREASE (mg/l)	0.05	2.00	2.00		40	BDL	BDL		110	7	610	
m-XYLENE			10.00	5.0			BDL	BDL			BDL	BDL
o,p-XYLENE			10.00	5.0			BDL	BDL			BDL	BDL
METHYLETHYLKETONE			10.00	10.00			BDL	BDL			BDL	BDL
METHYLISOBUTYLKETONE			10.00	10.00			BDL	BDL			BDL	BDL
1,2-DIBROMOETHANE			0.015	0.015			BDL	BDL			BDL	BDL
1,2-DIBROMO-3-CHLOROPROPANE				0.015				BDL				BDL

NOTES: All values for SPECIAL ANALYSIS in ug/l.

* =Sample detection limit is 125 ug/l using a 1:12.5 dilution.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986
04 = FOURTH ROUND - JUN. 25, 1986

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TABLE 6-6

SOIL ANALYTICAL RESULTS - ORGANICS
 FIRST ROUND SAMPLING EVENT
 Q DRUM STORAGE YARD (SITE 3)

	DETECTION LIMIT	03S-05			03S-06			03S-07			03S-08		
		(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')
VOLATILE ORGANICS													
METHYLENE CHLORIDE	10	BDL	BDL	BDL	BDL	BDL	BDL	27	BDL	BDL	12	BDL	BDL
TRANS-1,2-DICHLOROETHYLENE	10	BDL	BDL	BDL	1100	180	16	83	BDL	BDL	BDL	BDL	BDL
1,1,1-TRICHLOROETHANE	10	BDL	BDL	BDL	27	BDL							
TRICHLOROETHYLENE	10	BDL	BDL	BDL	7000	3600	1100	BDL	BDL	BDL	BDL	BDL	BDL
ACID EXTRACTABLE ORGANICS													
PHENOL	500	BDL	BDL	BDL	3400	2200	BDL						
2,4-DIMETHYLPHENOL	500	BDL	BDL	BDL	720	BDL	BDL	4800	BDL	BDL	BDL	BDL	BDL
BASE-NEUTRAL EXTRACTABLE ORGANICS													
1,4-DICHLOROBENZENE	200	BDL	2000	BDL	BDL								
N-NITROSODI-N-PROPYLAMINE	200	BDL	10000	BDL	BDL								
1,2,4-TRICHLOROBENZENE	200	BDL	2000	BDL	BDL								
ACENAPHTHENE	200	BDL	2000	BDL	BDL								
2,4-DINITROTOLUENE	200	BDL	1800	BDL	BDL								
PHENANTHRENE	200	600	BDL	BDL	BDL	BDL	380	BDL	BDL	BDL	BDL	BDL	BDL
DI-N-BUTYLPHTHALATE	200	BDL	2000	BDL	BDL								
FLUORANTHENE	200	700	BDL										
PYRENE	200	520	BDL	1800	BDL	BDL							
BENZO(A)ANTHRACENE	200	260	BDL										
CHRYSENE	200	260	BDL										
PESTICIDES/PCB'S													
4,4'-DDT	2.0	BDL	2.1	BDL	BDL	BDL	BDL						
4,4'-DDE	2.0	BDL	BDL	BDL	BDL	BDL	BDL	5.4	5.7	BDL	BDL	BDL	BDL
4,4'-DDD	2.0	BDL	BDL	BDL	BDL	BDL	BDL	130	160	3.7	BDL	BDL	BDL
ENDOSULFAN SULFATE	2.0	BDL	21	800									

ALL RESULTS ARE IN ug/kg; SAMPLES WERE TAKEN IN DECEMBER, 1983

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TABLE 6-7

SOIL ANALYTICAL RESULTS - INORGANICS
 FIRST ROUND SAMPLING EVENT
 Q DRUM STORAGE YARD (SITE 3)

INORGANICS PRIORITY POLLUTANTS	DETECTION LIMIT	03s-05			03s-06			03s-07			03s-08		
		(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')
ANTIMONY, TOTAL	0.05	BDL											
ARSENIC, TOTAL	0.05	23	BDL	14	21	5.3	8.4	6.5	14	4.7	32	6.2	21
BERYLLIUM, TOTAL	0.02	BDL											
CADMIUM, TOTAL	0.02	2	1.4	1.2	1	0.5	0.6	1.3	0.5	1.3	1	1	1
CHROMIUM, TOTAL	0.10	16.00	10.00	8.00	20.00	9.70	8.40	12	6.4	12	17	16	8.4
COPPER, TOTAL	0.10	5.10	5.60	1.2	5.20	0.50	0.60	4.7	2	1.3	11	1.8	1.9
LEAD, TOTAL	0.20	28.00	34	7.6	23.00	8.30	5.40	32	13	13	21	9.2	7
MERCURY, TOTAL	0.0002	0.08	0.14	0.06	0.03	0.06	0.08	0.11	0.24	0.03	0.03	0.025	0.045
NICKEL, TOTAL	0.10	5.10	3.30	2.4	4.20	1.40	1.20	5.1	1.5	1.7	22	1.8	2.4
SELENIUM, TOTAL	0.05	BDL											
SILVER, TOTAL	0.06	BDL	BDL	BDL	1	BDL	0.30	BDL	BDL	BDL	BDL	BDL	BDL
THALLIUM, TOTAL	0.05	22	2	12	16	2.80	2.50	2	6	2	21	9	6.6
ZINC, TOTAL	0.02	53.00	42.00	11.00	28.00	9.70	9.10	30	12	11	30	15	10

Note: All values taken in ug/g.

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TABLE 6-8

SOIL ANALYTICAL RESULTS
THIRD ROUND SAMPLING EVENT
Q DRUM STORAGE AREA (SITE 3)

		03S-09		03S-9A		03S-10			03S-11			03S-12			03S-13			03S-14			03S-15				
	DETECTION	-----																							
	LIMIT	(0-1')	(1-2')	(0-1')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')	(0-1')	(1-2')	(2-3')
VOLATILE ORGANICS		-----																							
METHYLENE CHLORIDE	10	BDL	BDL	BDL	BDL	BDL	10	BDL	13*	BDL	16	14	15	14	BDL	17									
BASE-NEUTRAL EXTRACTABLES		-----																							
BUTYLBENZYLPHTHALATE	330	BDL	530	BDL																					
ACID EXTRACTABLES	- ALL BELOW DETECTION LIMIT																								
SPECIAL ANALYSIS		-----																							
METHYLETHYLKETONE	10	BDL																							
METHYLISOBUTYLKETONE	10	BDL																							
m-XYLENE	10	BDL																							
o,p-XYLENE	10	BDL																							
OIL & GREASE	25	140	300	BDL	140	BDL																			
E.P. TOXICITY (mg/l)		-----																							
CADMIUM	0.01	BDL	---	---	0.01	---	---	0.01	---	---	0.01	---	---	BDL	---	---	0.01	---	---	0.08	---	---	---	---	---
CHROMIUM	0.05	BDL	---	---	---	---	---																		

NOTES: All concentrations are in mg/kg.

* = Compound was also detected in the blank at a concentration greater than 1/2 the sample concentration and 1/2 the detection limit.

--- No analysis conducted.

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TABLE 6-9

NAVY SOIL ANALYTICAL RESULTS
 APRIL 28, 1986
 Q DRUM STORAGE YARD (SITE 3)

PARAMETER	DETECTION LIMIT	SAMPLE LOCATION							
		A	B	C	D	E	F	G	H
Arsenic	5	38	11	5	5	<5	<5	10	12
Barium	20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	1	4.0	1.8	<1	<1	2.7	2.3	1.5	<1
Lead		15	14	48	42	20	26	34	7
Mercury	0.1	0.17	<0.1	<0.1	0.22	<0.1	<0.1	<0.1	<0.1
Selenium	2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Silver	1	<1	<1	<1	<1	<1	<1	<1	<1
pH		7.3	7.4	7.6	9.3	8.0	7.7	7.8	8.1
Oil & Grease		6,785	21,300	10,100	18,800	54,100	51,500	30,000	4,120
TOX	100	120	100	190	<100	140	715	135	<100
EP TOX Pb	60	<60	<60	<60	<60	<60	<60	<60	<60

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Note: All detection limits in mg/kg except EP TOX Pb which is in ug/l.

FIGURE 6-2 indicates approximate locations of NAVY soil samples.

These standards and/or criteria, which are listed in Tables 6-10 through 6-14, is identical to the information presented earlier in Section 4. Information from the following sources are included:

Organics

- Table 6-10 - EPA Water Quality Criteria Documents, November, 1980.
- Table 6-11 - EPA Maximum Contaminant Levels Goals (MCLG's), November, 1985.

Inorganics

- Table 6-12 - EPA Water Quality Criteria Documents, November, 1980.
- Table 6-13 - EPA Water Quality Criteria Documents, July, 1985.
- Table 6-14 - EPA MCL's and State Water Control Board (SWCB) Water Quality Standards and Criteria.

Because these standards and criteria are the same as previously discussed in Chapter 4, a detailed explanation of each is not included herein.

6.7 SOIL CONCENTRATION GUIDELINES

Concentrations of selected inorganics typically found in soils and sediments were prepared for comparison with Site 3 analytical data. Specific standards or established criteria, relative to the concentration of inorganics in soil or sediment for determining the extent of contamination are not available; thus, a comparison must be made in more abstract terms. The numerical values presented in Table 6-15 do offer some insight and general guidance on what levels are acceptable from different parts of the country. The data offered provides a list of the median composition of inorganics in natural soils; EPA Region V guidelines for nonpolluted, moderately polluted and heavily polluted inorganic concentration(s) in sediments; EPA Region V screening level concentrations requiring EP Toxicity testing of sediments; and allowable concentrations in soils for the State of New Jersey. These values were utilized to identify soil and sediment concentrations of concern.

TABLE 6-10

EPA WATER QUALITY CRITERIA DOCUMENTS - 1980
 ORGANICS
 Q DRUM STORAGE YARD (SITE 3)

PARAMETER	TOXICITY TO AQUATIC LIFE				HUMAN HEALTH	
	FRESH WATER		SALT WATER		INGESTION	
	ACUTE (UG/L)	CHRONIC (UG/L)	ACUTE (UG/L)	CHRONIC (UG/L)	WATER (UG/L)	AQUATIC (UG/L)
VOLATILE ORGANICS						
VINYL CHLORIDE	NA	NA	NA	NA	2	525
METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHYLENE	11,600	NA	NA	NA	0.33	18.5
1,1,1-TRICHLOROETHANE	NA	NA	31,200	NA	18400	NA
TRICHLOROETHYLENE	45,000	NA	NA	NA	27	807
1,1,2,2-TETRACHLOROETHYLENE	5,280	840	10,200	450	0.8	8.85
TOLUENE	17,500	NA	6,300	5,000	14300	424000
BASE-NEUTRAL EXTRACTABLE ORGANICS	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)	(UG/L)
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA	NA	NA
BIS (2-ETHYLHEXYL) PHTHALATE	NA	NA	NA	NA	NA	NA

CRITERIA PUBLISHED IN FEDERAL REGISTER NOVEMBER 28, 1980.
 RISK FACTOR OF 1:100,000 SHOWN

TABLE 6-11

EPA MAXIMUM CONTAMINANT LEVEL GOALS
ORGANICS
Q DRUM STORAGE AREA (SITE 3)

PARAMETER	ANALYTICAL PARAMETERS STANDARDS/CRITERIA				
	FED. REG. 11/13/85 (1) MCLG (ppb)	FED. REG. 6/13/86 (2) RfD (ppb)	FED. REG. 6/13/86 (3) RSD (ppb)	FED. REG. 6/13/86 (4) PMCL (ppb)	1986 (5) CA DHS (ppb)
VOLATILE ORGANICS					
VINYL CHLORIDE	0	--	--	1	2
METHYLENE CHLORIDE	--	--	600	--	40
1,1-DICHLOROETHANE	--	--	--	--	20
TRANS-1,2-DICHLOROETHYLENE	70	--	--	--	16
1,1,1-TRICHLOROETHANE	200	--	--	200	200
TRICHLOROETHYLENE	0	--	--	5	5
1,1,2,2-TETRACHLOROETHYLENE	--	--	20	--	--
TOLUENE	2000*	10000	--	--	100
BASE-NEUTRAL EXTRACTABLE ORGANIC					

NOTES:

1. MAXIMUM CONTAMINANT LEVEL GOALS
 2. REFERENCE DOSE (for non-carcinogenic compounds)
 3. RISK SPECIFIC DOSE (for carcinogenic compounds)
 4. PROPOSED MAXIMUM CONTAMINANT LEVEL
 5. CALIFORNIA DEPARTMENT OF HEALTH SERVICES
- * PROPOSED MCLG

TABLE 6-12

EPA WATER QUALITY CRITERIA
INORGANICS
Q DRUM STORAGE YARD (SITE 3)

PARAMETER	EPA WATER QUALITY CRITERIA DOCUMENTS - 1980					
	TOXICITY TO AQUATIC LIFE				HUMAN HEALTH	
	FRESH WATER		SALT WATER		INGESTION	
	ACUTE (MG/L)	CHRONIC (MG/L)	ACUTE (MG/L)	CHRONIC (MG/L)	WATER (MG/L)	AQUATIC (MG/L)
INORGANICS						
ANTIMONY, TOTAL	9.00	1.6	NA	NA	0.146	45.0
ARSENIC, TOTAL	0.44	0.03	0.508	NA	0.000022	0.000175
CADMIUM, TOTAL	0.003	0.00003	0.059	0.0045	0.01	NA
CHROMIUM, TOTAL	0.021	0.00029	1.26	0.018	0.05	NA
COPPER, TOTAL	0.022	0.0056	0.023	0.004	0.001	NA
CYANIDE, TOTAL	0.052	0.0035	0.03	0.002	0.2	NA
LEAD, TOTAL	0.17	0.0038	0.668	0.025	0.05	NA
MERCURY, TOTAL	0.0000017	0.00000057	0.0037	0.000025	0.000144	0.000146
NICKEL, TOTAL	1.84	0.096	0.140	0.0071	0.0134	0.1
SELENIUM, TOTAL	0.76	NA	0.41	NA	0.01	NA
THALLIUM, TOTAL	1.40	0.04	2.13	NA	0.013	0.048
ZINC, TOTAL	0.32	0.047	0.17	0.058	5.0	NA
PHENOLS, TOTAL	10.2	2.56	5.80	NA	0.0035	NA
CRITERIA PUBLISHED IN FEDERAL REGISTER NOVEMBER 28, 1980.						

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TABLE 6-13

WATER QUALITY CRITERIA - 1985
 INORGANICS
 Q DRUM STORAGE YARD (SITE 3)

INORGANICS	EPA WATER QUALITY CRITERIA DOCUMENTS			
	TOXICITY TO AQUATIC LIFE			
	FRESH WATER		SALT WATER	
	CMC (MG/L)	CCC (MG/L)	CMC (MG/L)	CCC (MG/L)
CADMIUM, TOTAL	0.0039	0.0011	0.043	0.0093
CHROMIUM, TOTAL	0.016	0.011	1.10	0.05
COPPER, TOTAL	0.018	0.012	0.029	NA
CYANIDE, TOTAL	0.022	0.0052	0.001	NA
LEAD, TOTAL	0.083	0.0032	0.14	0.0056
MERCURY, TOTAL	0.0024	0.000012	0.0021	0.000025

CMC = Criterion maximum concentration for one hour
 CCC = Criterion continuous concentration for four day average (chronic toxicity).
 Criteria published in Federal Register July 29, 1985

TABLE 6-14

EPA MAXIMUM CONTAMINANT LEVELS AND
STATE WATER CONTROL BOARD WATER QUALITY STANDARDS AND CRITERIA
INORGANICS
Q DRUM STORAGE YARD (SITE 3)

INORGANICS	EPA	SWCB (1)		
	MCL'S (MG/L)	GW STANDARDS (MG/L)	SW (2) STANDARDS (MG/L)	WATER QUALITY CRITERIA FOR SURFACE WATERS (3) (UG/L)
ANTIMONY, TOTAL	---	---	---	---
ARSENIC, TOTAL	0.05	0.05	0.05	63
CADMIUM, TOTAL	0.01	0.0004	0.01	12
CHROMIUM, TOTAL	0.05	0.05	0.05	(4)
COPPER (ACTIVE)	1.0	1.0	1.0	2
LEAD, TOTAL	0.05	0.05	0.05	8.6
MERCURY, TOTAL	0.002	0.00005	0.002	0.1
NICKEL, TOTAL	---	---	---	7.1
SELENIUM, TOTAL	0.045(RMCL)	---	---	---
THALLIUM, TOTAL	---	---	---	---
ZINC, TOTAL	5.0	0.05	5.0	58
PHENOLS, TOTAL	---	0.001	0.001	1.0

NOTES:

- (1) Water Quality Standards, revised edition, June, 1986.
- (2) denotes Surface Public Water Supplies
- (3) Values shown represent Chronic criteria for Salt Water.
- (4) State criteria for Salt Water addresses Hexavalent(dissolved) only.

TABLE 6-15
TYPICAL SOIL/SEDIMENT CONCENTRATIONS
INORGANICS
Q DRUM STORAGE YARD (SITE 3)

PARAMETER	MEDIAN COMPOSITION OF NATURAL SOILS (1)		EPA REGION V GUIDELINES			SUGGESTED EP TOXICITY SCREENING LEVELS (MG/KG)	NEW JERSEY ALLOWABLE CONC. IN SOIL(2) (MG/KG)
	RANGE (MG/KG)	TYPICAL MEDIAN (MG/KG)	NONPOLLUTED (MG/KG)	MODERATELY POLLUTED (MG/KG)	HEAVILY POLLUTED (MG/KG)		
Antimony	0.2 - 150	6	---	---	---	---	---
Arsenic	0.1 - 194	11	<3	3-8	>8	100.0	20
Beryllium	0.01 - 40	0.3	---	---	---	---	---
Cadmium	0.01 - 7	0.5	*	*	>6	20.0	3
Chromium	5 - 3,000	100	<25	25-75	>75	100.0	100
Copper	2 - 250	30	<25	25-50	>50	---	170
Lead	LT 1 - 888	29	<40	40-60	>60	100.0	100
Mercury	0.01 - 4.6	0.098	---	---	>=1	4.0	---
Nickel	0.1 - 1,530	50	<20	20-50	>50	---	100
Selenium	0.1 - 38	0.4	---	---	---	20.0	20.0
Silver	0.01 - 8	0.4	---	---	---	100.0	---
Thallium	0.1 - 0.8	0.2	---	---	---	---	---
Zinc	1 - 2,000	90	<90	90-200	>200	---	350
Oil & Grease	---	---	<1000	1000 - 2000	>2000	---	---

- NOTE: 1) References:
1. Bowen, H.J.M., "ENVIRONMENTAL CHEMISTRY OF THE ELEMENTS." ACADEMIC PRESS, NEW YORK.
 2. Ragaini, R.C., ET. AL., "ENVIRONMENTAL TRACE CONTAMINATION IN KELLOG IDAHO NEAR LEAD SMELTING COMPLEX." ENVIR. SCI. & TECHNOL. 11 773-780 1977
 3. Lisk, D.J., " TRACE METALS IN SOILS, PLANTS, AND ANIMALSD." ADV. AGRON. 24 267-311, 1972
 4. "GEOCHEMISTRY OF SOME ROCKS, SOIL, PLANT AND VEGETABLES IN THE CONTERMINOUS UNITED STATES", GEOL. SRVY. PROF. PAPER 574 F 1975
 5. Ure, A.M., ET. AL., "ELEMENTAL CONSTITUENTS OF SOILS" ENVIR. CHEM. VOL. 2 94-204 ED. H.J.M. BOWEN, ROYAL SOC. OF CHEM., BURLINGHOUSE, LONDON, U.K. 1983
 6. Parr, J.F., ET. AL. "LAND TREATMENT OF HAZARDOUS WASTES," AGRI. ENVIR. QUAL. INST., AGRI. RESH. SER., USDA, BELTSVILLE, MD., NOYES DATA CORP., PARK RIDGE, N.J., 1983.
 7. Shaklette, H.T., ET. AL., "ELEMENTAL COMPOSITION OF SURFACIAL MATERIAL IN THE CONTERMINOUS UNITED STATES," USGS PROF. PAPER 574-D, 1971.
 8. Lechler, T.J., ET. AL., "MAJOR AND TRACE METAL ANALYSIS OF 12 REFERENCE SOILS BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY." SOIL SCIENCE 130 238-241 1980.

2) New Jersey allowable concentrations in soil were established to evaluate proposed clean-up plans associated with property transfers.

* Limits not established.

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6.8 DATA EVALUATION

The evaluation of organic constituents identified in the ground water (Table 6-3) indicate significant concentrations of several volatile organics at monitoring well 03GW-01. A significant concentration is defined as a value which exceeds one or more of the referenced criteria. Monitoring well 03GW-01 is located in the immediate vicinity of the leaking drum storage area; an area still being used to store damaged 55 gallon drums. Some of the drums had been damaged and were observed by Navy personnel during normal yard operations to be leaking fluids. Table 6-16 summarizes the constituents and concentrations identified in the ground water which exceeded some (or all) of the water quality criteria presented.

Analytical results from the three remaining ground water monitoring locations indicate no significant concentrations of constituents were present. These three wells, however, are all located (in what appears to be) upgradient of the leaking drum area based on the ground water elevations measured during this study. Consequently, the extent to which the volatile constituents identified at well location 03GW-01 may have migrated downgradient is not known.

TABLE 6-16

SIGNIFICANT ORGANIC CONSTITUENTS IDENTIFIED IN GROUND WATER
Q AREA DRUM STORAGE YARD (SITE 3)

<u>SAMPLE LOCATION</u>	<u>EVENT</u>	<u>CONSTITUENT</u>	<u>ANALYTICAL VALUE(S) (ug/l)</u>
03GW-01	2	Vinyl Chloride	24
	1,2,3	Trans 1, 2-Dichloroethylene	8000;9000;5600
	1,2,3	Trichloroethylene	6000;1800;1000
	1,2	1,1,2,2-Tetrachloroethylene	12;19
	1	BIS (2-Ethylhexyl) Phthalate	130

Inorganic constituents (Table 6-4) were identified in ground water samples from all four monitoring wells. The concentrations reported, in

many cases, slightly exceeded the referenced water quality criteria (in at least one analytical event), although not all exceedances were repeated in other sampling events. Because the samples collected generally contained suspended solids (field filtering was not performed), the concentrations reported are believed to be higher than the concentrations in the ground water only. Furthermore, the ground water at the site is not used as either a potable or non-potable water source. Consequently, the values reported for the inorganics are not considered significant.

The concentration of total chromium reported during the first event at well location 03GW-04 is considered invalid since the concentration was not repeated in subsequent analyses. The specific reason for the high value reported has not been determined.

Regarding the special analyses results reported (Table 6-5), no significant concentrations of these constituents in the ground water were identified.

Concerning the results from soil sampling (Table 6-6), twelve samples (four locations at three depths) were analyzed during the first sampling event. Elevated concentrations of trans-1, 2-dichloroethylene (1100 ug/kg) and trichloroethylene (7000 ug/kg) were identified in the surface soil sample collected at location 03S-06 in the leaking drum storage area. The concentrations of these constituents, as expected, diminished somewhat with depth. However, both of these compounds were also identified at significant concentrations in the ground water samples collected at this location (03GW-01). The concentration of phenol (acid extractable) was also elevated in soil sample 03S-06 (sample depths of 0-1 and 1-2 feet), but phenol was not identified in the ground water samples analyzed. No criteria is available for comparison of organics with the organic constituents identified in the soil matrix. However, it is apparent the constituents found are the result of spillage from leaking drums stored in the area.

Seven base-neutral extractable organics were identified at location 03S-08 and five at location 03S-05 in the 0 to 1 foot soil sample depth only. These constituents were not identified in significant concentrations in any of the ground water analytical results. The constituents

found are also believed to be the result of localized leakage of drums stored at the yard.

Three pesticides were identified at soil sample location 03S-07 at various depths sampled (Table 6-6). The pesticides identified included 4,4'-DDT (1-2 ft.), 4,4'-DDE (0-1 ft. and 1-2 ft.) and 4,4'-DDD (0-1 ft., 1-2 ft. and 2-3 ft.). But these pesticides were not identified in any of the ground water analyses conducted. Again, the pesticides found are believed to be the result of localized leakage of drums stored at the yard.

Several inorganics were also identified in each soil sample analyzed during the first soil sampling event (Table 6-7). Comparison of the concentrations reported with the EPA Region V guidelines presented in Table 6-15 indicate only arsenic concentrations were elevated. Arsenic, which is used in both insecticides and herbicides, is highly toxic by ingestion and inhalation and is also a known carcinogen.

In six soil samples, concentrations of arsenic indicate heavily polluted soils and in five additional samples, moderately polluted soils based on using EPA Region V guidelines. In addition, the New Jersey allowable concentration in soil for arsenic was exceeded in four soil samples and the typical medium value reported was exceeded in six samples. Note the typical medium value for arsenic would be considered heavily polluted based on EPA Region V guidelines. Table 6-17 summarizes the comparison of arsenic to the referenced guidelines.

The twenty-one soil samples collected and analyzed as part of the third round event (Table 6-8), located along the north and west perimeter of the yard, indicated no significant concentrations of the parameters analyzed were present. In addition, the analyses for EP Toxicity of cadmium and chromium indicated no significant leaching of these two metals was occurring.

Results of the Navy surface soil analyses (8 samples) were presented in Table 6-9. These samples were taken along the most northwestern edge of the yard. Comparison of this Navy data with the soil concentration guidelines in Table 6-15 indicate concentrations of arsenic are considered heavily polluted (EPA Region V guidelines) at

TABLE 6-17

COMPARISON OF ARSENIC IN SOIL WITH GUIDELINES
 FIRST ANALYTICAL EVENT
 Q DRUM STORAGE YARD (SITE 3)

LOCATION	CONCENTRATION (UG/G)	EPA REGION V GUIDELINES			EXCEEDANCES	
		NONPOLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED	NEW JERSEY ALLOWABLE CONC. IN SOIL	TYPICAL MEDIUM VALUE
03S-05						
o 0-1 Ft.	23			*	*	*
o 1-2 Ft.	BDL	*				
o 2-3 Ft.	14			*		*
03S-06						
o 0-1 Ft.	21			*	*	*
o 1-2 Ft.	5.3		*			
o 2-3 Ft.	8.4		*			
03S-07						
o 0-1 Ft.	6.5		*			
o 1-2 Ft.	14			*		*
o 2-3 Ft.	4.7		*			
03S-08						
o 0-1 Ft.	32			*	*	*
o 1-2 Ft.	6.2		*			
o 2-3 Ft.	21			*	*	*

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four locations; A, B, G and H. These samples were taken at the northern and southern extremes of the Navy sampling area. Arsenic concentrations are considered moderately polluted at two additional locations; C and D. Concentrations of lead also are considered moderately polluted at locations C and D, based on the EPA Region V guidelines. Sample locations C and D are in a drainage swale which routes surface water away from the leaking drum area in a northerly direction.

Concentrations of oil and grease identified through the Navy sampling indicate concentrations at all sample locations are considered heavily polluted based on the EPA Region V guidelines. Measurement of pH on each soil sample also indicated elevated levels (defined as 8 or above) at three locations; D, E and H. EP toxicity analyses for lead, however, indicated that the lead present in the soil matrix is not exhibiting the potential for leaching.

6.9 CONCLUSION AND RECOMMENDATIONS

Soil and ground water analytical results from sample locations 03S-06 and 03GW-01, collected near the area used to store damaged 55 gallon drums, indicate significant concentrations of five organics (Table 6-16) are present in the soils and are leaching into the ground water. These organics have been identified by EPA as having potential carcinogenic effects in humans and/or animals. The existence of these constituents is the direct result of leakage from damaged drums stored in the area. The extent of migration of these constituents could not be determined due to the absence of downgradient monitoring wells.

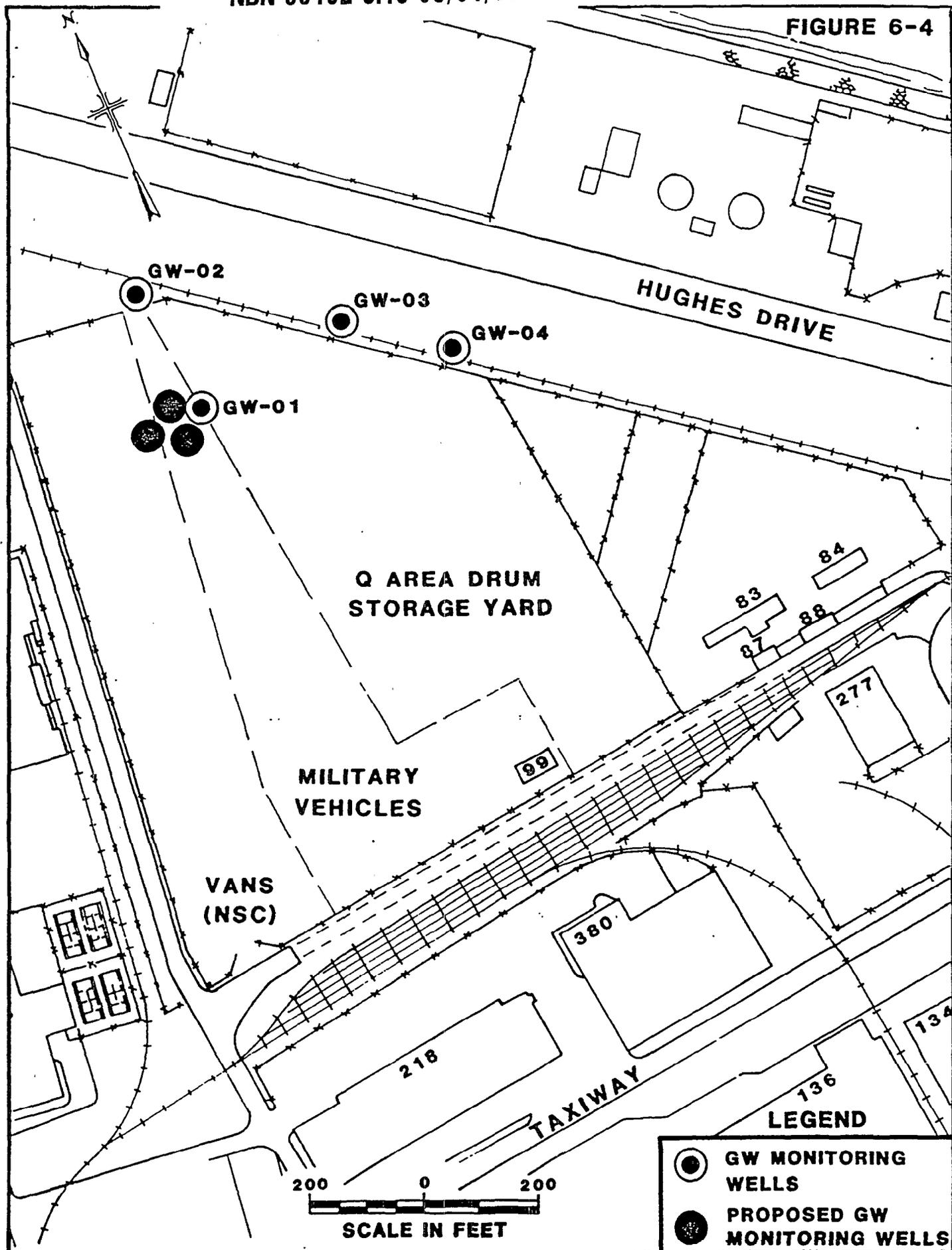
Based upon evaluation of the analytical data, additional investigative efforts and monitoring wells are recommended. It is recommended that two nested monitoring well systems be installed approximately 50 to 100 feet downgradient and that one additional nested well system be installed 100 to 150 feet downgradient (due west) of well 03GW-01. This will enable a determination if significant migration of contaminants is occurring. The nested well system proposed is intended to intercept and differentiate between shallow and deep contaminant migration.

• Each nested well system should consist of two distinct wells, with one well screened from about 2 feet above to 8 feet below the ground water surface (10-foot screen interval), with a second well having the top of a 10-foot screen located 10 feet below the bottom of the first screen. This will allow for an assessment of the vertical as well as horizontal migration of the organics. Figure 6-4 shows the proposed well locations. Dependent on the depth to water table determined at the time of well installation, it may well be beneficial to install several piezometers for the sole purpose of better defining the ground water gradient in the area. In this manner, the impact of tidal flushing, relative to diurnal changes in elevation and the corresponding effects it will have on the ground water gradient, can be more accurately determined over a much larger area.

Regarding soil analyses conducted at Site 3, elevated concentrations of arsenic are present at many of the sample locations from the ground surface to a depth of 3-feet. Although samples were spread out over a relatively large area along the western portion of the storage yard, estimates of the horizontal and vertical extent of elevated arsenic levels in the soil was not determined due to the absence of a uniform grid pattern for establishing sampling locations. There is no evidence, however, to suggest arsenic is leaching into the underlying ground water.

High concentrations of oil and grease were also identified at all of the Navy soil sampling locations. Oil and grease concentrations, based on Pirnie's analyses at somewhat different locations, were not significant. As a result of the Navy's findings, a memo dated October 10, 1986 from the Commander, Atlantic Division, Naval Facilities Engineering Command recommended remedial action. Although the soils were not classified as hazardous waste, the recommended action was to "excavate soil to a depth of six inches and haul to either a sanitary landfill or to the sludge farm at Craney Island." The removal of oil contaminated soils is scheduled for FY89. This excavation and removal operation is intended to remove the most contaminated soil on the basis of contaminant concentrations, not volume of soil.

FIGURE 6-4



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**NAVAL BASE NORFOLK, VIRGINIA
Q AREA DRUM STORAGE YARD (SITE 3)
PROPOSED WELL LOCATIONS**

MALCOLM PIRNIE, INC.

MARCH 1988

It is recognized that the source of all contaminants found in the Q Area Drum Storage Yard is from damaged and leaking containers. The permeable sand and gravel yard may absorb some of the volatile constituents spilled, but does appear to be absorbing the inorganic constituents leaked from drums stored at the yard. This is largely substantiated by the sampling results at the site. The volume of drums handled make these spills and leaks inevitable. Consequently, clean-up through excavation of contaminated soils, without implementing proper precautionary measures and providing adequate protection from future spills, is not a practical nor recommended long-term solution.

Conversation with NAVFAC personnel has confirmed that the Q Area Drum Storage Yard is still in active use for the storage of petroleum products and raw materials, including some hazardous substances; however, it is not and can not be used for the storage of hazardous wastes. Since the Q Area is planned for continued use as a drum storage area for approximately the next five years, the area should be divided and segregated into areas for petroleum products and hazardous substances, in addition to areas for intact (non-leaking) and damaged (leaking) drums.

Operating procedures, safety measures, periodic inspections and emergency containment should also be provided for, as required through a Spill Prevention Control and Countermeasure Plan (SPCC), to ensure proper handling of drums in the future. The following items are presented as recommended guidelines for proper facility operations:

- o Evaluate the existing SPCC document and determine applicability. Update the SPCC document, if deemed necessary.
- o Evaluate yard operations to identify and modify practices which contribute to drum spillage.
- o Design and construct an enclosed area (cement pad and roof cover as a minimum) where damaged and/or leaking drums can be stored and spillage can be contained and remediated.
- o The SPCC plan, which is intended to minimize spillage and to enact quick clean-up procedures, should be reviewed annually and up-dated every three years.

- o Periodically inspect site operations and monitor ground water to ensure the integrity of the impermeable surface.

Implementation of these measures will have two tangible benefits;

- o Future spillage from any leaking drums will not seep into the underlying soils, and
- o Storm water, which will be minimal, will not percolate downward through the soils and leach contaminants into the ground water.

Excavation of soils, as currently proposed by the Navy, may be required prior to installation of an impermeable surface in order to remove the oil saturated soils identified and reduce the potential for a fire. This decision should be based on the material selected to cap the site, the areal extent of capping and the recommendations presented below. Conceivably, installation of only a hard surface (asphalt or concrete) may eliminate the fire potential identified and, consequently, no excavation would be needed.

Based on the numerous recommendations presented herein, in addition to the lengthy scheduling time often required to perform the work, the following is a synopsis of recommendations for the Q Area Drum Storage Yard:

1. Collect additional soil samples in selected areas known to be contaminated and analyze for metals, EP Toxicity, petroleum hydrocarbons (which is different from oil and grease) and ignitability. If the contaminated soil is confirmed not to be a hazardous waste by virtue of its characteristics, then it is recommended to be left in place, unless subsequent characterization efforts suggest otherwise.
2. Concurrently with soil sampling, install additional (nested) ground water monitoring wells plus several piezometers to better define the limits of contamination and more accurately determine ground water gradients.
3. Perform additional ground water sampling, monitor the piezometers for soil gas vapors (organics) and provide final recommendations for either excavation and removal of the contaminated soil or capping with an impermeable liner in place.

4. Establish appropriate run-on and run-off control measures for storm water from the entire storage area, regardless of what remediation alternative is chosen, to minimize infiltration potential and sediment transport.

7. SITE 4 - TRANSFORMER STORAGE AREA P-71

7.1 GENERAL

Information received from the Navy EIC prior to Pirnie's field investigation at Site 4 indicated that PCB contamination of soils already existed at the site. Based on this information, a Step 1B - Characterization effort was initiated in November, 1983. The following sections discuss the work effort, analytical results, data evaluation, and conclusions and recommendations for remedial action at Site 4.

7.2 WORK DESCRIPTION

The work at Site 4 initially included conducting twenty-seven hand augered soil borings with grab sampling to a depth of 5-feet during November, 1983. A total of 60 soil samples were taken from the 27 borings and analyzed for PCBs (Aroclor 1260). Aroclor 1260 is the specific PCB compound used in transformer oils.

Subsequent review of the data with Navy personnel indicated specific areas where the extent of PCB contamination was not properly identified. Consequently, additional sampling was recommended.

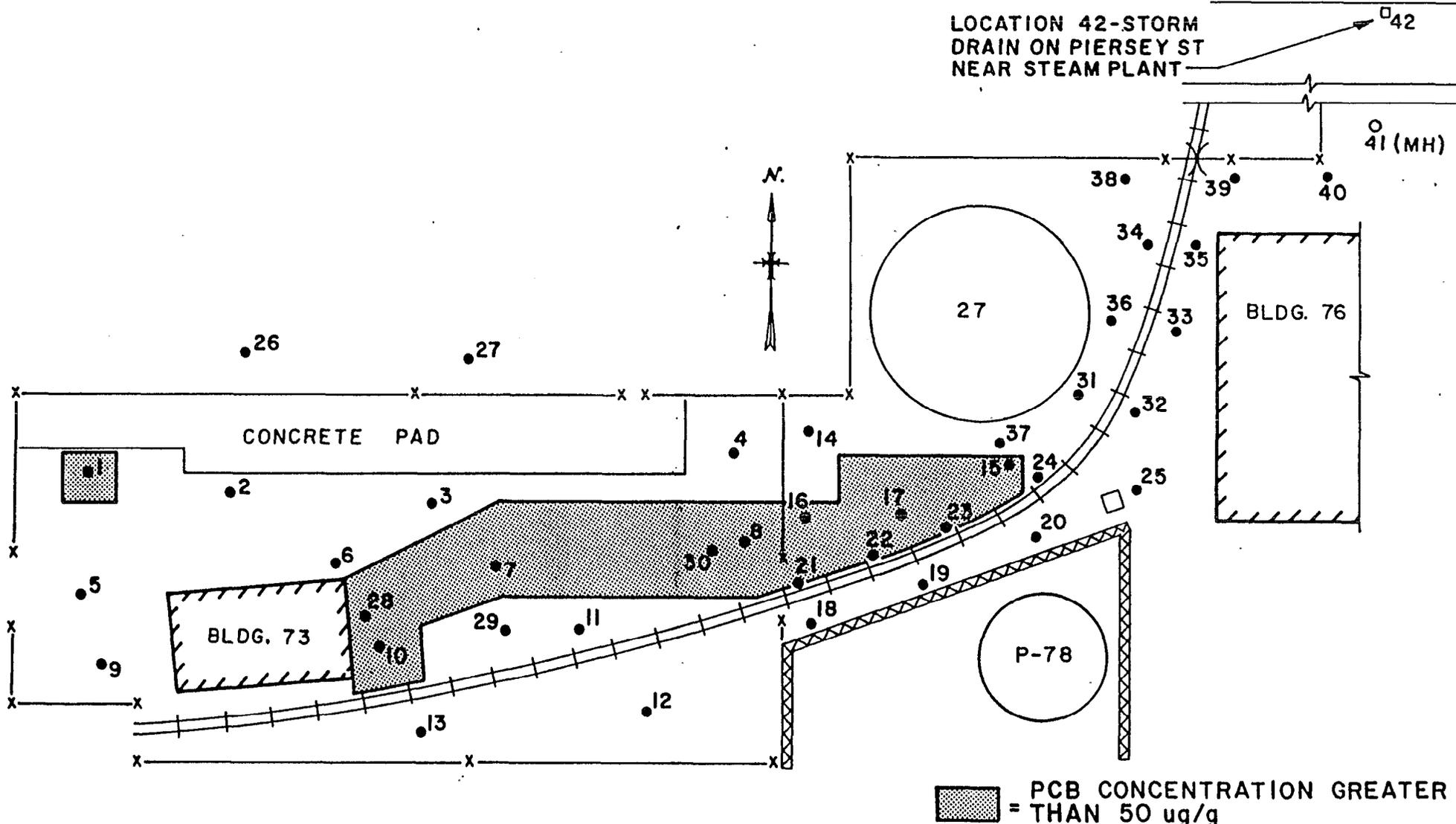
A second soil sampling event was conducted in August, 1984 to further determine the extent of PCB contamination. This second sampling event included collection and analysis of 65 additional soil samples at 18 boring locations up to a depth of 5-feet. Table 7-1 summarizes the sampling and analysis program conducted and Figure 7-1 illustrates the soil sampling locations.

Table 7-1

SAMPLING AND ANALYSIS PROGRAM
TRANSFORMER STORAGE AREA P-71 (Site 4)

<u>Sampling Event</u>	<u>Sample Date</u>	<u>Soil Samples</u>	<u>Parameters</u>
1	11/83	60	PCB's
2	8/84	65	PCB's

FIGURE 7-1
- PIERSEY STREET -



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7.3 ANALYTICAL RESULTS

Results of the soil sampling analyses for PCB contaminated soils were submitted to the Navy in a letter report dated January 14, 1985. Concentrations of PCBs were found to range from BDL to 7800 ug/g in the soil samples analyzed. The data generated adequately defined the extent of PCBs contaminated soils in the area. Table 7-2 lists the concentrations of PCBs and Figure 7-1 illustrates the area in which PCB concentrations exceeded 50 ug/g in addition to showing sampling locations.

7.4 DATA EVALUATION

Current EPA regulations, established under the Toxic Substances Control Act (TSCA), indicate PCB concentrations in soils exceeding 50 ug/g which resulted from spills, leaks and other uncontrolled discharges must be disposed of in accordance with Federal/State regulations. No guidelines for PCBs are currently available in the State of Virginia; consequently, EPA Region III policy (1986) was adopted. This policy states that soils containing PCBs exceeding 50 ug/g were identified as areas subject to remedial action.

The areas at Site 4 where PCB concentrations were greater than 50 ug/g were determined from soil analyses and are outlined in Figure 7-1. The volume of contaminated soils (without any contingency) was determined to be approximately 250 cubic yards. The majority of contamination was located in the top foot of material. Two locations, however, did have PCB concentrations exceeding 50 ug/g below the top soil layer. At sample location 10, a PCB concentration of 66 ug/g was found at a depth of 3 feet and at location 21, PCB concentrations of 7200 and 7800 ug/g were found at depths of 4 feet and 5 feet, respectively. No samples were taken below a depth of 5 feet.

7.5 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented herein are reprinted from the January 14, 1985 letter report. The Navy has reviewed and approved removal of the PCB contaminated soils with concentrations greater than 50 ppm. A preliminary review of alternative remedial measures was conducted to develop a practical and cost-effective

TABLE 7-2
 SOIL ANALYTICAL RESULTS
 CONCENTRATIONS OF AROCLOR 1260 (ug/g-ppm)
 TRANSFORMER STORAGE AREA P - 71 (SITE 4)

SAMPLE LOCATION	SAMPLE DEPTH (FEET)				
	0-1	1-2	2-3	3-4	4-5
04S-01	59	--	2	--	<1 NT
04S-02	9/23	--	--	--	--
04S-03	20	4	--	--	--
04S-04	4	--	1	--	1
04S-05	2	3	--	--	--
04S-06	40	--	6	--	<1 NT
04S-07	93	--	16	--	<1 NT
04S-08	160	--	<1 NT	--	<1 T
04S-09	2	--	<1 NT	--	1
04S-10	440	--	66	--	2
04S-11	2	--	2	--	<1 NT
04S-12	6	--	<1 NT	--	<1 NT
04S-13	11	--	<1 NT	--	<1 NT
04S-14	23	--	1	--	<1 NT
04S-15	52	12	--	--	--
04S-16	16	--	1	--	<1 NT
04S-17	57	--	1	--	<1 NT
04S-18	<1 NT	--	<1 NT	--	<1 NT
04S-19	45	42	--	--	--
04S-20	17	--	--	--	--
04S-21	88/45	85	<1 T	7200	7800
04S-22	890/29	300	<1 NT	<1 T	<1 NT
04S-23	770/160	1	1	<1 NT	<1 NT
04S-24	35	--	--	--	--
04S-25	--	2	--	--	--
04S-26	1	--	--	--	--
04S-27	2	--	--	--	--
04S-28	240	<1 T	<1 T	<1 T	<1 NT
04S-29	7	15	<1 NT	1	<1 NT
04S-30	200	6	1	1	<1 NT
04S-31	2	1	<1 NT	<1 NT	<1 NT
04S-32	1	<1 T	<1 T	--	--
04S-33	2	1	<1 NT	<1 NT	<1 NT
04S-34	<1 T	<1 NT	<1 NT	<1 NT	<1 NT
04S-35	<1 T	<1 T	<1 NT	<1 NT	<1 NT
04S-36	1	1	--	--	--
04S-37	34	5	--	--	--
04S-38	<1 T	<1 T	--	--	--
04S-39	<1 T	<1 T	--	--	--
04S-40	<1 T	<1 T	--	--	--
04S-41	<1 NT	--	--	--	--
04S-42	<1 NT	--	--	--	--

NOTATION : NT = NO TRACE
 T = TRACE
 -- = NO SAMPLE TAKEN
 9/23 = TWO SAMPLES TAKEN

approach for remediation of the contaminated areas. As a result of this preliminary review, two options were selected for more detailed study; encapsulation and removal.

Option 1 was to encapsulate the contaminated area. Encapsulation would require installation of an impermeable surface and possibly an impermeable slurry trench wall to isolate the area of concern. Construction of a slurry wall would be difficult, however, because of the existing railroad tracks, buildings and other physical obstacles. In addition, the area is heavily used by Navy personnel and the potential would exist for human exposure to PCB in connection with future construction or other on-site activities. Because of the human health concerns, and difficulty in construction of a containment wall, this option was not considered acceptable.

Option 2 requires excavation and disposal of all PCB contaminated soils with concentrations greater than 50 ug/g with disposal at an approved hazardous waste landfill. This option would lower PCB levels at the site below the EPA regulatory limit of 50 ug/g. Prior to implementation of this option, the recommended clean-up level of 50 ug/g should be confirmed with both Federal and State authorities.

Option 2 is the recommended action by Pirnie. This option completely removes highly contaminated material from the site and eliminates the potential for future exposure. A preliminary cost estimate of \$233,800 was developed for this option as part of the January 1985 letter report. This preliminary cost estimate has been revised to reflect March 1987 costs as shown in Table 7-3. This estimate assumes the soil will be disposed of at an acceptable EPA approved chemical waste landfill. Hazardous waste landfills in Model City, New York and Emelle, Alabama have been contacted and both are permitted to accept PCB contaminated soils. The estimated quantity of material to be removed, 500 cubic yards, includes an over excavation of one foot to insure removal of all contaminated soils. Figure 7-2 shows the proposed depths of excavation.

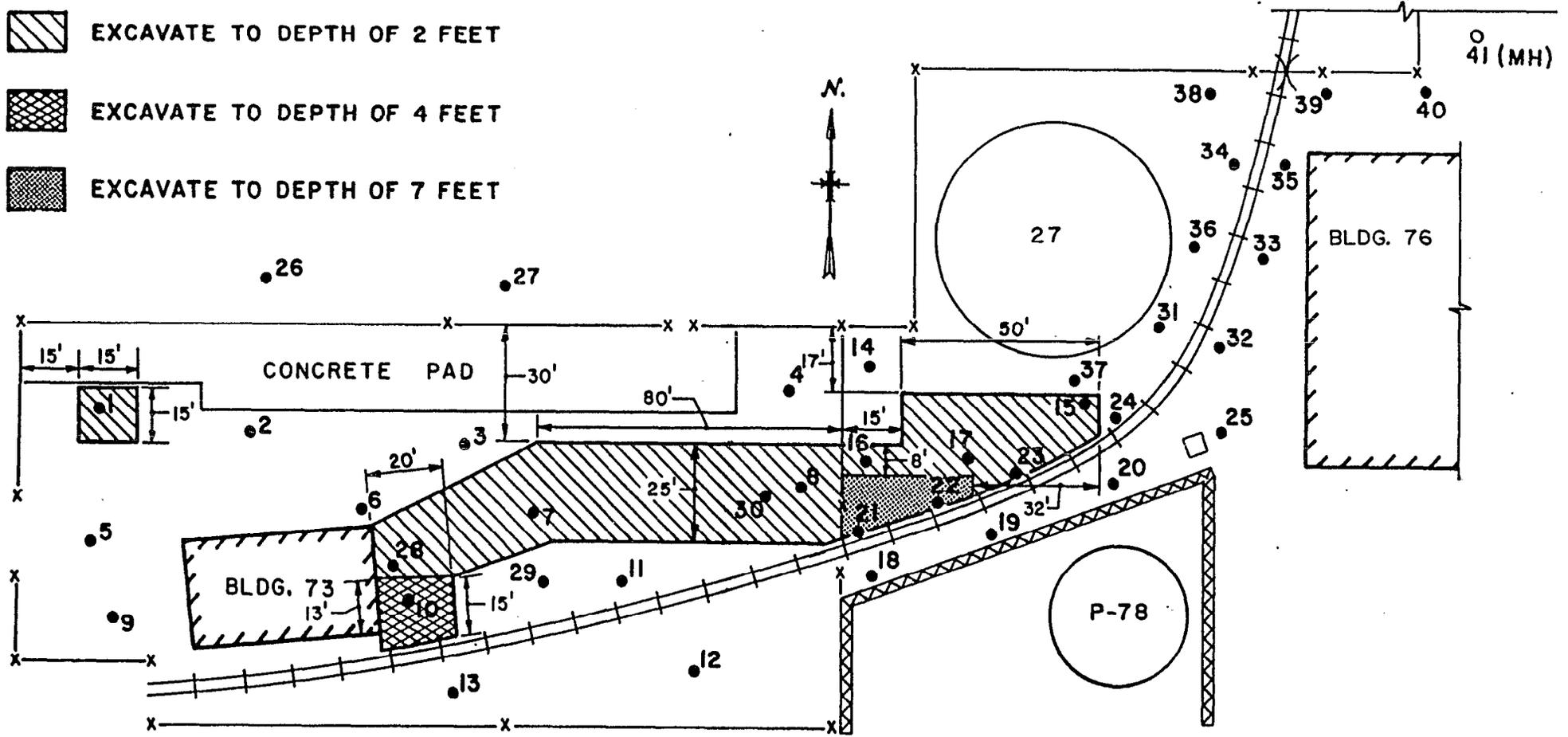
Remedial actions for areas with contaminant levels less than 50 ppm are not proposed unless State or EPA regulations require it in the future. Should clean-up levels be significantly lowered, then other

FIGURE 7-2
- PIERSEY STREET -

LEGEND

- APPROXIMATE BORING LOCATION
- ▨ EXCAVATE TO DEPTH OF 2 FEET
- ▩ EXCAVATE TO DEPTH OF 4 FEET
- ▧ EXCAVATE TO DEPTH OF 7 FEET

LOCATION 42-STORM DRAIN ON PIERSEY ST NEAR STEAM PLANT



NBN-00102-3.13-03/01/88

SCALE: 1" = 40'

remedial measures, such as in-situ treatment in addition to conventional excavation and removal, should be considered for implementation. A monitoring program for sampling in-situ soils remaining after excavation is also necessary to insure compliance with any established limit.

8. SITE 5 - PESTICIDE DISPOSAL SITE V-95

8.1 GENERAL

The initial Site 5 investigation was conducted to determine if any suspected constituents, based on the IAS report, were present in the ground water or soils at the site. Ground water and soil sampling was performed in the immediate vicinity of the 28-inch diameter vertical french drain used to discharge pesticide type wastes. Based on the findings of the first sampling event, additional soil sampling was conducted over a larger area to better define the extent of the contamination present and the source of the various contaminants. Not all constituents identified were found to be related to the french drain disposal site. The following sections discuss the work effort, geology, analytical results, data evaluation, conclusions and recommendations for additional work at the site.

8.2 WORK DESCRIPTION

The work effort at Site 5 initially included performing three soil borings with continuous soil sampling to a depth of 25-feet and installation of one ground water monitoring well screened from 4 to 24-feet below ground surface in one of the borings. Ten soil samples from various depths were collected from the remaining two borings and one ground water sample was collected from the well. All of the samples were analyzed for the 128 priority pollutants previously listed in Chapter 4. A 5-peak base-neutral library search to identify up to 5 additional pollutants (not included in the priority pollutant list) was also performed. The 5-peak library search identifies base-neutral organic constituents which during analysis exhibited peaks greater than 25 percent of the internal standard.

The information obtained from the initial sampling verified the existence of pesticides in the soils immediately adjacent to the french drain at the site. The pesticides were not present, however, in the water column. After reviewing the data with Navy personnel, the site investigation was expanded. Eight additional borings with continuous sampling to a depth of 10-feet were performed to identify the limits of

contamination. Soil samples were collected at 2-foot increments from each boring and analyzed for the EPA priority pollutant base-neutral extractable organics, pesticides/PCB and a 5 - peak base-neutral library search. A total of 40 soil samples were collected. The ground water was sampled from the existing well a second time and analyzed for the 128 priority pollutants, the 5 - peak base-neutral library search and a dioxin screen.

Based on the results of the first two sampling events, a third event was conducted which required one additional ground water sample to be analyzed for the EPA priority pollutant base-neutral extractable organics, pesticides/PCB's, inorganics, and xylene, MEK and MIBK. Ten surface soil samples (0 - 2 ft. depth) were also collected and analyzed for the EPA priority pollutant base-neutral extractable organics.

A fourth round sampling event included collection of a ground water sample and analyzing the sample for Xylene, MEK and MIBK. These parameters were analyzed to verify the results of the previous analytical event.

Table 8-1 summarizes the sampling and analysis program conducted at Site 5, the Pesticide Disposal Site V-95. Figure 8-1 shows the ground water and soil sampling locations.

8.3 GEOLOGY

Geological logs from the initial soil borings were used to outline the subsurface conditions at this location. All borings were within approximately 10 feet of each other and also within 10 feet of the french drain used to dispose of pesticide waste. The logs depict the same geological conditions due to their close proximity.

The top 15 feet of sediments are composed of fine to medium sand, silty sand, silt and shell fragments. No organic material was observed. Some gravels and pebbles, however, were noted throughout the strata. The boring logs indicated that the sediments are saturated with ground water beginning at about 5 feet below the ground surface.

The next deeper strata consists of about 2 feet of generally impermeable clay or sandy clay. The geological logs show that this material is moist.

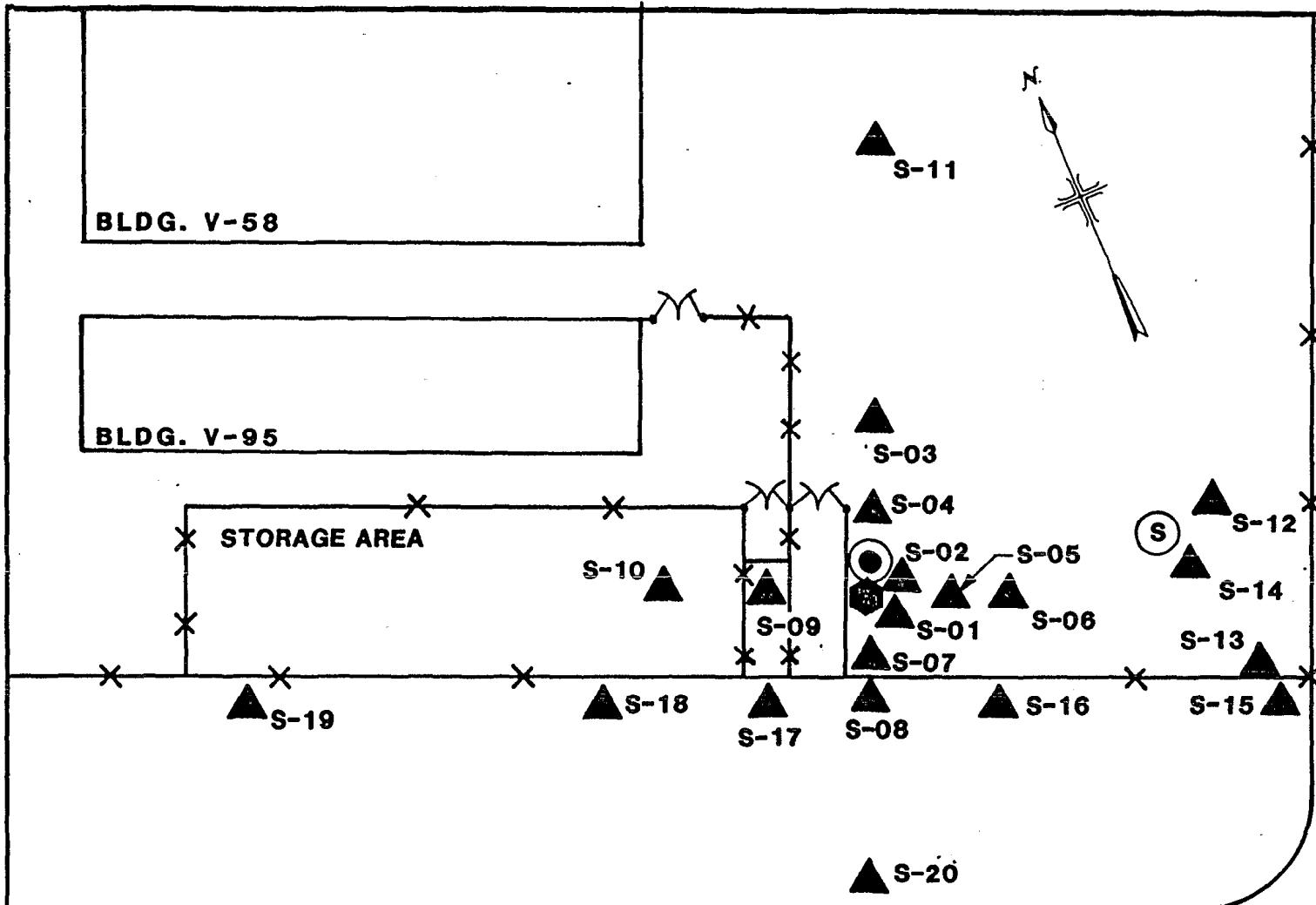
TABLE 8-1

SAMPLING AND ANALYSIS PROGRAM
 SITE 5 - PESTICIDE DISPOSAL SITE V-95

<u>Sampling Event</u>	<u>Sample Date</u>	<u>Ground Water Samples</u>	<u>Soil Samples</u>	<u>Parameters</u>
1	12/83	1	10	128 PP 5-peak Library Search
2	8/84	1	40	128 PP (Water Only) B/N (Soil Only) Pesticides/PCB (Soil Only) 5-peak Library Search (Soil Only) Dioxin Screen (Water Only)
3	4/86	1	10	B/N (Soil Only) Pesticides/PCB (Water Only) Inorganics (Water Only) Xylene (Water Only) MEK, MIBK (Water Only)
4	6/86	1	--	Xylene MEK, MIBK

FIGURE 8-1

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LEGEND

-  STORM DRAIN INLET
-  SOIL SAMPLING LOCATIONS
-  EXISTING FRENCH DRAIN
-  GW MONITORING WELL

AIRCRAFT TOW WAY

SCALE: 1" = 30'-0"

**MALCOLM
PIRNIE**

NAVAL BASE NORFOLK, VIRGINIA
PESTICIDE DISPOSAL AREA V-95 (SITE 5)
GROUND WATER AND SOIL SAMPLING LOCATIONS

MALCOLM PIRNIE, INC.

MARCH 1988

31075

Below the clay strata the logs show approximately 8 feet of fine to medium grained sand with occasional silts and silty sand layers. The logs show that these sediments also are saturated with ground water for the entire depth of the borehole. The total thickness of the strata is not known since the boring is completed within this material.

8.4 ANALYTICAL RESULTS

The results of the ground water analyses at Site 5 for inorganics, special analysis and the 5-peak library search of the base-neutral fraction are summarized in Table 8-2. All organic priority pollutant constituents analyzed were found to be below detection limits and, therefore, are not shown.

The soil analyses results from the first sampling event are shown in Tables 8-3 and 8-4. Table 8-3 summarizes the priority pollutant constituents identified in at least one of the soil samples. Table 8-4 summarizes those constituents identified as part of the base-neutral organic 5 - peak library search performed on the soil samples. Results of the second round soil analysis for selected priority pollutant groups and the 5 - peak library search are summarized in Tables 8-5 and 8-6, respectively. Table 8-7 summarizes the results of the third round soil analyses for base-neutral priority pollutants.

The notation utilized to identify each sample location is as follows:

- o The first two digits represent the site number;
- o The following letters indicate the type of sample; ground water (GW) and soil (S); and
- o The digits following the hyphen represent the specific location number.

The summary includes only those constituents where a measurable value was identified for at least one location. All laboratory reports have been stored at Pirnie's regional office in Newport News and are available for Navy use upon request.

8.5 WATER QUALITY STANDARDS/CRITERIA

The ground water analytical results at Site 5 were compared with EPA Drinking Water Criteria, EPA Water Quality Criteria, State Water

TABLE 8-2
GROUND WATER ANALYTICAL RESULTS
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

INORGANICS AND SPECIAL ANALYSES								
INORGANICS PRIORITY POLLUTANTS (All values in mg/l)	DETECTION LIMIT				05GW-01			
	01	02	03	04 *	01	02	03	04
ARSENIC	0.05	0.05	0.05	---	0.64	BDL	BDL	---
CADMIUM	0.02	0.02	0.01	---	0.04	BDL	0.02	---
CHROMIUM, TOTAL	0.10	0.10	0.10	---	0.26	0.05	BDL	---
COPPER, TOTAL	0.10	0.10	0.10	---	0.24	BDL	BDL	---
LEAD, TOTAL	0.20	0.20	0.20	---	0.72	BDL	0.17	---
MERCURY, TOTAL	0.0002	0.0002	0.0002	---	0.0004	BDL	0.00041	---
NICKEL, TOTAL	0.10	0.10	0.10	---	0.13	BDL	BDL	---
THALLIUM	0.05	0.05	0.05	---	0.45	BDL	BDL	---
ZINC, TOTAL	0.02	0.02	0.02	---	1.30	0.24	0.04	---
PHENOLS, TOTAL	0.01	0.01	0.01	---	0.01	0.01	---	---
SPECIAL ANALYSIS								
(All values in ug/l)								
m-XYLENE	---	---	10.0	5.0	---	---	BDL	BDL
o,p-XYLENE	---	---	10.0	5.0	---	---	BDL	BDL
METHYLETHYLKETONE	---	---	10.0	10.0	---	---	BDL	BDL
METHYLISOBUTYLKETONE	---	---	10.0	10.0	---	---	BDL	BDL

5 PEAK BASE-NEUTRAL COMPOUNDS IDENTIFIED FIRST ROUND EVENT		
COMPOUND NAME	% PURITY	ESTIMATE CONC.(ug/l)
Benzene,Ethyl-	99	9.2
Benzene,1,3-Dimethyl-	97	11
1H-Indene,2,3-Dihydro-	98	8.9
Naphthalene,1,2-Dimethyl-	54	22
Heptadecane,2,6,10,15-Tetramethyl-	78	27

* Fourth round analysis conducted for Special Analysis only.

LEGEND: 01 = FIRST ROUND - DEC. 1, 1983
02 = SECOND ROUND - AUG. 29, 1984
03 = THIRD ROUND - APR. 14, 1986
04 = FOURTH ROUND - JUN. 25, 1986

NOTE: 1) All ground water analytical values for priority pollutants Volatile Organics, Acid Extractable Organics, Base-Neutral Extractable Organics and Pesticides/PCBs at Site 5 were below detectable limits.
2) % Purity is an index comparing the sample spectrum to a reference compound spectrum. A high purity (>80%) indicates a high probability the sample compound was correctly identified. Compound identifications with a purity less than 50% are not considered reliable.

TABLE 8-3

SOIL ANALYTICAL RESULTS
FIRST ROUND EVENT
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

DETECTION LIMIT	05S-01					05S-02				
	(4'-6')	(8'-10')	(12'-14')	(18'-20')	(24'-26')	(2'-4')	(6'-8')	(10'-12')	(14'-16')	(20'-22')
VOLATILE ORGANICS (UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)
ETHYLBENZENE 10	110.0	BDL	BDL	BDL	BDL	83	BDL	BDL	BDL	BDL
ACID EXTRACTABLE ORGANICS (UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)
ALL VALUES BELOW DETECTABLE LIMITS										
BASE-NEUTRAL EXTRACTABLE ORGANICS (UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)
NAPHTHALENE 200	-----	BDL	BDL	BDL	BDL	1200.0	BDL	BDL	BDL	BDL
2000	7200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
PESTICIDES/PCB'S (UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)	(UG/KG)
4,4'-DDT 2.0	-----	20.0	2.0	8.7	3.80	-----	-----	30.0	48.0	120.0
100.0	-----	-----	-----	-----	-----	12000	-----	-----	-----	-----
2000.0	8900.0	-----	-----	-----	-----	-----	BDL	-----	-----	-----
4,4'-DDD 2.0	-----	89.0	15.0	35.0	17.00	-----	-----	220.0	270.0	24.0
100.0	-----	-----	-----	-----	-----	35000	-----	-----	-----	-----
2000.0	36000.0	-----	-----	-----	-----	-----	20000.0	-----	-----	-----
INORGANICS PRIORITY POLLUTANTS (UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)	(UG/G)
CHROMIUM, TOTAL 0.10	3.40	0.31	1.50	1.40	1.40	2.30	1.30	0.80	2.80	1.60
COPPER, TOTAL 0.10	1.10	BDL	0.74	BDL	0.72	0.46	BDL	BDL	2.30	1.10
LEAD, TOTAL 0.20	BDL	0.62	1.90	0.90	1.80	5.50	1.30	0.40	4.60	1.60
MERCURY, TOTAL 0.0002	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02
NICKEL, TOTAL 0.10	1.10	BDL	1.10	0.90	0.72	BDL	0.84	0.80	1.80	0.90
ZINC, TOTAL 0.02	3.40	1.20	4.10	4.50	3.60	5.50	4.20	3.20	10.00	4.10

SAMPLES COLLECTED IN DECEMBER, 1983.

NBN-00102-3.13-03/01/88

TABLE 8-4

5-PEAK LIBRARY SEARCH
 BASE-NEUTRAL FRACTION
 SOIL ANALYTICAL RESULTS
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

SAMPLE LOCATION 05S-01			
DEPTH OF SAMPLE	COMPOUND	% PURITY	ESTIMATE CONC. (ug/kg)
4 - 6 FT.	Tridecane, 7-Methyl-	79	50,000
	Heptadecane 2,6,10,14-Tetramethyl-	81	42,000
	Heptadecane 2,6,10,14-Tetramethyl-	82	65,000
	Pentadecane 2,6,10,14-Tetramethyl-	82	50,000
	Eicosane	83	24,000
8 - 10 FT.	Ethane,1,1,2-Trichloro-	96	200
	Ethane,1,1,2,2-Tetrachloro-	88	280
12-14 FT.	Cyclopentanol,2-Methyl-,Cis-	89	330
	Ethane,1,1,2,2-Tetrachloro-	86	470
	Cyclohexanone,2-Chloro-	86	360
18-20 FT.	Cyclopentanol,2-Methyl-,Cis-	91	240
	Cyclohexanone,2-Chloro-	87	220
No constituents were identified as part of library search for the sample collected at a depth of 24-26 ft. at location 05S-01.			

NOTE: % Purity - an index comparing the sample spectrum to a reference compound spectrum. A high purity (>80%) indicates a high probability the sample compound was correctly identified. Compound identification with a purity less than 50% are not considered reliable.

TABLE 8-4 (cont.)

5-PEAK LIBRARY SEARCH
 BASE-NEUTRAL FRACTION
 SOIL ANALYTICAL RESULTS
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

SAMPLE LOCATION 05S-02			
DEPTH OF SAMPLE	COMPOUND	% PURITY	ESTIMATE CONC. (ug/kg)
2 - 4 FT.	Benzene,1,3-Dimethyl-	94	320
	Undecane	87	290
	Napthalene,2-Methyl-	89	220
	Hexadecane,2,6,10-Trimethyl-	85	380
	Benzene,1-Chloro-2-(2,2-Dichloro-1-(4-Chlorophenyl)Ethyl)-	82	350
6 - 8 FT.	Phenol,4-(2,2,3,3-Tetramethylbutyl)-	83	5,100
	Ethanol,2-(Hexadecyloxy)-	49	3,600
	Tridecanol	52	5,600
	Benzene,1-Chloro-2-(2,2,Dichloro-2-(4-Chlorophenyl)Ethyl)	80	3,000
	Benzene,1-Chloro-2-(2,2-Dichloro-1-(4-Chlorophenyl)Ethyl)-	81	8,000
No constituents were identified as part of library search for the samples collected at depths of 10-12 ft., and 20-22 ft. at location 05S-02.			

TABLE 8-5

SOIL ANALYTICAL RESULTS
SECOND ROUND
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION					
	LIMIT (UG/KG)	*3S-01 (0'-2')	*3S-02 (2'-4')	*3S-03 (4'-6')	*3S-04 (6'-8')	*3S-05 (8'-10')
CHRYSENE	200	BDL	BDL	BDL	BDL	470
BIS(2-ETHYLHEXYL)PHTHALATE	200	BDL	BDL	380	BDL	BDL

PESTICIDES/PCB'S (UG/KG)

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION					
	LIMIT (UG/KG)	*4S-1 (0'-2')	*4S-2 (2'-4')	*4S-3 (4'-6')	*4S-4 (6'-8')	*4S-5 (8'-10')
BIS(2-ETHYLHEXYL)PHTHALATE	200	250	BDL	BDL	BDL	BDL
DI-N-OCTYLPHTHALATE	200	BDL	1600	440	BDL	BDL

PESTICIDES/PCB'S (UG/KG)

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION					
	LIMIT (UG/KG)	*5S-01 (0'-2')	*5S-2 (2'-4')	*5S-3 (4'-6')	*5S-4 (6'-8')	*5S-5 (8'-10')
NAPHTHALENE	200	BDL	200	BDL	BDL	BDL
FLUORENE	200	540	BDL	BDL	BDL	BDL
PHENANTHRENE	200	440	BDL	BDL	BDL	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	200	BDL	BDL	BDL	BDL	530

PESTICIDES/PCB'S (UG/KG)

CHLORDANE	200	6300	BDL	BDL	BDL	BDL
4,4'-DDD	200	2100	BDL	BDL	BDL	BDL
DIELDRIN	200	8300	BDL	BDL	570	2200

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION					
	LIMIT (UG/KG)	*6S-1 (0'-2')	*6S-2 (2'-4')	*6S-3 (4'-6')	*6S-4 (6'-8')	*6S-5 (8'-10')
DI-N-BUTYLPHTHALATE	200	BDL	BDL	BDL	200	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	200	BDL	BDL	420	BDL	BDL

PESTICIDES/PCB'S (UG/KG)

DIELDRIN	200	1100	BDL	BDL	BDL	BDL
----------	-----	------	-----	-----	-----	-----

TABLE 8-5 (CONT.)

SOIL ANALYTICAL RESULTS
SECOND ROUND
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION LIMIT (UG/KG)	*7S-1 (0'-2')	*7S-2 (2'-4')	*7S-3 (4'-6')	*7S-4 (6'-8')	*7S-5 (8'-10')
PHENANTHRENE	200	BDL	380	BDL	BDL	BDL
FLUORANTHENE	200	BDL	300	BDL	BDL	BDL
PYRENE	200	BDL	250	BDL	BDL	BDL

PESTICIDES/PCB'S

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION LIMIT (UG/KG)	*8S-1 (0'-2')	*8S-2 (2'-4')	*8S-3 (4'-6')	*8S-4 (6'-8')	*8S-5 (8'-10')
--------------------------------------	----------------------------	------------------	------------------	------------------	------------------	-------------------

EXTRACTABLE ORGANICS, BELOW DETECTION LEVEL

PESTICIDES/PCB'S

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION LIMIT (UG/KG)	*9S-1 (0'-2')	*9S-2 (2'-4')	*9S-3 (4'-6')	*9S-4 (6'-8')	*9S-5 (8'-10')
ACENAPHTHENE	200	890	BDL	BDL	BDL	BDL
2,4-DINITROTOLUENE	200	BDL	BDL	BDL	BDL	BDL
FLUORENE	200	770	BDL	BDL	BDL	BDL
PHENANTHRENE	200	8300	BDL	BDL	BDL	BDL
ANTHRACENE	200	1500	BDL	BDL	BDL	BDL
FLUORANTHENE	200	6100	BDL	BDL	BDL	BDL
PYRENE	200	4200	BDL	BDL	BDL	BDL
BENZO(A)ANTHRACENE	200	1700	BDL	BDL	BDL	BDL
CHRYSENE	200	1700	BDL	BDL	BDL	BDL
BENZO(B)FLUORANTHENE	200	2300	BDL	BDL	BDL	BDL
BENZO(K)FLUORANTHENE	200	2300	BDL	BDL	BDL	BDL
BENZO(A)PYRENE	200	1400	BDL	BDL	BDL	BDL
BENZO(G,H,I)PERYLENE	500	1500	BDL	BDL	BDL	BDL

PESTICIDES/PCB'S

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

BASE-NEUTRAL EXTRACTABLE ORGANICS	DETECTION LIMIT (UG/KG)	*10S-2 (0'-2')	*10S-2 (2'-4')	*10S-3 (4'-6')	*10S-4 (6'-8')	*10S-5 (8'-10')
PHENANTHRENE	200	710	BDL	BDL	BDL	BDL
FLUORANTHENE	200	570	BDL	BDL	BDL	BDL
PYRENE	200	750	BDL	BDL	BDL	BDL
BENZO(A)ANTHRACENE	200	1600	BDL	BDL	BDL	BDL
CHRYSENE	200	1100	BDL	BDL	BDL	BDL
BIS(2-ETHYLHEXYL)PHTHALATE	200	BDL	BDL	BDL	250	BDL
BENZO(B)FLUORANTHENE	200	2100	BDL	BDL	BDL	BDL
BENZO(K)FLUORANTHENE	200	1600	BDL	BDL	BDL	BDL

PESTICIDES/PCB'S

COMPOUND PESTICIDES/PCB'S BELOW DETECTION LEVEL

TABLE 8-6
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 3														
	0'-2'			2'-4'			4'-6'			6'-8'			8'-10'		
	% PURITY	EST. CONC. (UG/KG)		% PURITY	EST. CONC. (UG/KG)		% PURITY	EST. CONC. (UG/KG)		% PURITY	EST. CONC. (UG/KG)		% PURITY	EST. CONC. (UG/KG)	
		ASSESS	CONC.		ASSESS	CONC.		ASSESS	CONC.		ASSESS	CONC.		ASSESS	CONC.
CYCLOTTRISILOXANE,HEXAMETHYL	89.3	OI	500	89.0	OI	600	87.9	RS	1500	88.2	OI	2000	---	---	
ANILINE,N-(3',3'-DIPHENYLSPIRO/ FLUORENE-9,2'-OXETAN/	30.8	UK	240	32.1	UK	230	30.3	OI	1100	30.1	UK	1200	---	---	
1H-1,2,4-TRIAZOL-3-AMINE,1-METHYL-	---	---	---	71.4	UK	320	69.9	UK	710	---	---	---	---	---	
ACETICACID,/BIS/(TRIMETHYLSILYL) OXY/PHOSPHINYL/-,TRI	---	---	---	---	---	---	40.0	UK	650	40.1	UK	1100	---	---	
1,3-DIOXOLANE-4-METHANOL,2- PENTADECYL-,ACETATE	---	---	---	---	---	---	25.0	UK	770	---	---	---	---	---	
CYCLOTETRAILOXANE,OCTAMETHYL-	---	---	---	---	---	---	---	---	---	94.2	OI	520	---	---	
SILANE,/BICYCLO/4.2.0/OCTA-3,7- DIENE-7,8-DIYLBIS(OXY	---	---	---	---	---	---	---	---	---	41.7	UK	630	---	---	
TETRADECANE,1-CHLORO-	---	---	---	---	---	---	---	---	---	---	---	---	87.0	OI	520

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY

OI - ISOMER OR SIMILAR COMPOUND

UK - UNKNOWN, NOT IN NBS LIBRARY

% PURITY - AN INDEX COMPARING THE SAMPLE SPECTRUM TO A REFERENCE COMPOUND SPECTRUM. A HIGH PURITY (>80) INDICATES A HIGH PROBABILITY THE SAMPLE COMPOUND WAS CORRECTLY IDENTIFIED. COMPOUND IDENTIFICATIONS WITH A PURITY LESS THAN 50% ARE NOT CONSIDERED RELIABLE.

SAMPLES COLLECTED IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 4														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')			(8'-10')		
	%	EST.		%	EST.		%	EST.		%	EST.		%	EST.	
		PURITY	ASSESS		(UG/KG)	PURITY		ASSESS	(UG/KG)		PURITY	ASSESS		(UG/KG)	PURITY
1,3-CYCLOPENTANEDIONE	71.7	OI	370	---	---	---	---	---	---	---	---	---	---	---	---
1-HEXANOL,2-ETHYL-	94.8	OI	290	---	---	---	---	---	---	---	---	---	---	---	---
DECANE,1-CHLORO-	82.7	OI	260	---	---	---	---	---	---	---	---	---	---	---	---
HEPTADECANE,2,6,10,14-TETRAMETHYL	86.2	OI	390	---	---	---	---	---	---	---	---	---	---	---	---
ETHANE,1,1-BIS(P-ETHYLPHENYL)-	45.1	UK	230	---	---	---	---	---	---	---	---	---	---	---	---
TETRADECANE,1-CHLORO-	---	---	---	85.7	OI	1100	86.9	OI	330	NO COMPOUND GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD					
	---	---	---	86.1	OI	480	---	---	---	---	---	---	---	---	---
1,2-BENZENEDICARBOXYLICACID, DIPENTYLESTER	---	---	---	68.6	OI	590	---	---	---	---	---	---	---	---	---
	---	---	---	66.7	OI	1600	---	---	---	---	---	---	---	---	---

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND
 UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLES COLLECTED IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 5														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')			(8'-10')		
	%	EST.CONC.		%	EST.CONC.		%	EST.CONC.		%	EST.CONC.		%	EST.CONC.	
PURITY	ASSESS	(UG/KG)	PURITY	ASSESS	(UG/KG)	PURITY	ASSESS	(UG/KG)	PURITY	ASSESS	(UG/KG)	PURITY	ASSESS	(UG/KG)	
OCTADECANE	79.0	OI	11000	---	---	---	---	---	---	---	---	---	---	---	
	77.2	OI	10000												
PENTADECANE,2,6,10,14-TETRAMETHYL-	80.1	OI	21000	---	---	---	---	---	89.5	OI	11000	---	---	---	
HEXADECANE,2,6,10,14-TETRAMETHYL-	81.0	OI	15000	---	---	---	---	---	---	---	---	---	---	---	
EICOSANE	80.8	OI	5500	---	---	---	---	---	---	---	---	84.9	OI	490	
1,4-METHANONAPHTHALENE,1,4-DIHYDRO	---	---	---	86.9	OI	130	---	---	---	---	---	---	---	---	
TRIDECANE,5-PROPYL-	---	---	---	84.4	OI	190	---	---	---	---	---	---	---	---	
3,7,11-TRIDECATRIENENITRILE, 4,8,12-TRIMETHYL-	---	---	---	49.6	UK	260	---	---	---	---	---	---	---	---	
CYCLOTRISILOXANE,HEXAMETHYL-	---	---	---	---	---	---	89.4	OI	430	---	---	---	---	---	
1H-1,2,4-TRIAZOL-3-AMINE,1-METHYL-	---	---	---	---	---	---	70.5	OI	670	---	---	---	---	---	
HYDROXYLAMINE,O-DECYL-	---	---	---	---	---	---	73.3	OI	230	---	---	83.1	OI	750	
PHENOL,4-(1,1,3,3-TETRAMETHYLBUTYL)-	---	---	---	---	---	---	82.8	OI	230	---	---	---	---	---	
HEPTADECANE,2,6,10,14-TETRAMETHYL-	---	---	---	---	---	---	85.2	OI	630	89.2	OI	5400	82.6	OI	500
												86.9	OI	1500	
1-HEXANOL,2-ETHYL-	---	---	---	---	---	---	---	---	94.2	OI	4700	---	---	---	
2,7:3,6-DIMETHANONAPHTH/2,3- B/OXIRENE,3,4,5,6,9,9-HE	---	---	---	---	---	---	---	---	---	---	---	51	UK	960	

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY

OI - ISOMER OR SIMILAR COMPOUND

UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLES COLLECTED IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 6														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')			(8'-10')		
	% PURITY	EST. CONC. (UG/KG)	ASSESS	% PURITY	EST. CONC. (UG/KG)	ASSESS	% PURITY	EST. CONC. (UG/KG)	ASSESS	% PURITY	EST. CONC. (UG/KG)	ASSESS	% PURITY	EST. CONC. (UG/KG)	ASSESS
HEXADECANE	91.2	OI	4100	---	---										
OCTADECANE	84.4	OI	4700	---	---										
PENTADECANE,2,6,10,14-TETRAMETHYL-	85.8	OI	12000	---	---										
OCTADECANE	91.6	OI	4100	---	---	NO COMPOUND						NO COMPOUND			
EICOSANE	83.5	OI	3500	---	---	FOUND						FOUND			
ACETICACID,/BIS/(TRIMETHYLSILYL) OXY/PHOSPHINYL/- , TRI	---	---	---	42.4	UK	1500	GREATER					GREATER			
SILANE,/BICYCLO/4.2.0/OCTA-3,7-DIENE-7,8-DIYLBIS(OXY	---	---	---	34.3	UK	1500	THAN 25%					THAN 25%			
2,5-CYCLOHEXADIEN-1-ONE,2,5-DIMETHYL-4-/(2,4,5-TRIME	---	---	---	30.1	UK	2400	OF THE					OF THE			
4H-1-BENZOPYRAN-4-ONE,2-(2,6-DIMETHOXYPHENYL)-5,6-DI	---	---	---	27.8	UK	1500	CLOSEST					CLOSEST			
SILANE,TRIMETHYLPHENYL-/	---	---	---	38.4	UK	3200	INTERNAL					INTERNAL			
ETHANE,1,1,2,2-TETRACHLORO-	---	---	---	---	---	---	STANDARD					STANDARD			
												60.3	UK	240	

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLE TAKEN IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 7														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')			(8'-10')		
	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)
2,6,10-DODECATRIEN-1-OL,3,7,11- TRIMETHYL-, (2,E)-	69.2	UK	830	NO COMPOUND FOUND			---	---	---	NO COMPOUND FOUND			---	---	---
HEPTADECANE,2,6,10,14- TETRAMETHYL-	---	---	---	GREATER THAN 25 %			80.3	OI	400	GREATER THAN 25 %			92.9	OI	230
ETHANE,1,1,2-TRICHLORO-	---	---	---	OF THE CLOSEST INTERNAL STANDARD			---	---	---	OF THE CLOSEST INTERNAL STANDARD			87.1	OI	380

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND
 UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLE TAKEN IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	0 5 S - 0 8											
	(0'-2')		(2'-4')		(4'-6')		(6'-8')		(8'-10')			
	%	EST. CONC. (UG/KG)	%	EST. CONC. (UG/KG)	%	EST. CONC. (UG/KG)	%	EST. CONC. (UG/KG)	%	EST. CONC. (UG/KG)		
	PURITY	ASSESS (UG/KG)	PURITY	ASSESS (UG/KG)	PURITY	ASSESS (UG/KG)	PURITY	ASSESS (UG/KG)	PURITY	ASSESS (UG/KG)		
1H-1,2,4-TRIAZOL-3-AMINE,1-METHYL-	NO	COMPOUND	NO	COMPOUND	69.8	UK	570	NO	COMPOUND	71.7	OI	300
7-AZABICYCLO[4.1.0]HEPTANE,1-METHYL	FOUND		FOUND		58.8	UK	310	FOUND		---		---
	GREATER		GREATER					GREATER				
	THAN 25%		THAN 25%					THAN 25%				
	OF THE		OF THE					OF THE				
	CLOSEST		CLOSEST					CLOSEST				
	INTERNAL		INTERNAL					INTERNAL				
	STANDARD		STANDARD					STANDARD				

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND
 UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLE TAKEN IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	05S - 09														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')		(8'-10')			
	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)	% PURITY	EST. ASSESS	EST. CONC. (UG/KG)
ACETICACID,/BIS/(TRIMETHSILYL) OXY/PHOSPHINYL/-, TRI	42.3	UK	2700	NO COMPOUND FOUND			NO COMPOUND FOUND			NO COMPOUND FOUND		---	---	---	---
SILANE,/BICYCLO/4.2/OCTA-3,7- DIENE-7,8-DIYLBIS(OXY	36.7	UK	2300	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		---	---	---	---
2,5-CYCLOHEXADIEN-1-ONE,2,5- DIMETHYL-4-/(2,4,5-TRIME	31.1	UK	3200	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		---	---	---	---
SILANE,/1,3,5-BENZENETRIYLTRIS (OXY)/TRIS/TRIMETHYL-	21.3	UK	1400	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		---	---	---	---
PHENOL,4-(1,1;3;3-TETRAMETHYLBUTYL)	40.9	UK	2900	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		---	---	---	---
ETHANE,1,1,2-TRICHLORO-	---	---	---	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		92.7	OI	220	---
ETHANE,1,1,2,2-TETRACHLORO-	---	---	---	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		89.0	OI	430	---
1H-1,2,4-TRIAZOL-3-AMINE,1-METHYL-	---	---	---	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		71.0	UK	310	---
UNDECANE	---	---	---	GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD			GREATER THAN 25% OF THE CLOSEST INTERNAL STANDARD		88.6	OI	230	---

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND
 UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLE TAKEN IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-6 (CONT.)
 5-PEAK BASE-NEUTRAL LIBRARY SEARCH
 SOIL SAMPLE ANALYTICAL RESULTS
 SECOND ROUND EVENT
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

COMPOUND NAME	O 5 S - 1 0														
	(0'-2')			(2'-4')			(4'-6')			(6'-8')			(8'-10')		
	%	EST. CONC. (UG/KG)	ASSESS	%	EST. CONC. (UG/KG)	ASSESS	%	EST. CONC. (UG/KG)	ASSESS	%	EST. CONC. (UG/KG)	ASSESS	%	EST. CONC. (UG/KG)	ASSESS
ACETICACID, (BIS)(TRIMETHYSILYL) OXY(PHOSPHINYL)-	41.7	UK	3200	---	---	---	---	NO COMPOUND	---	---	---	---	---	---	---
SILANE, (BICYCLO(4.2.0)OCTA-3,7-DIENE-7,8-DIYLBIS(OXY	39.2	UK	2800	---	---	---	---	FOUND	---	---	---	---	---	---	---
HEXADECANE	89.0	OI	3700	---	---	---	---	GREATER THAN 25%	---	---	---	---	---	---	---
ANILINE, N-(3',3'-DIPHENYLSPIRO (FLUORENE-9,2'-OXETAN)	33.0	UK	3000	---	---	---	---	OF THE CLOSEST	---	---	---	---	---	---	---
2-PROPENAMIDE, N-(4-ACETYLMETHYL AMINO)BUTYL(3-3-	23.8	UK	5700	---	---	---	---	INTERNAL	---	---	---	---	---	---	---
ETHANE, 1,1,2-TRICHLORO-	---	---	---	93.0	OI	300	---	STANDARD	---	---	---	---	---	---	---
1-HEXANOL, 2-ETHYL-	---	---	---	---	---	---	---	---	---	---	---	95.3	OI	310	---

NOTE: RS - REASONABLE IDENTIFICATION, RETENTION TIME COMPATIBILITY
 OI - ISOMER OR SIMILAR COMPOUND
 UK - UNKNOWN, NOT IN NBS LIBRARY

SAMPLE TAKEN IN AUGUST, 1984.

NBN-00102-3.13-03/01/88

TABLE 8-7

SOIL ANALYTICAL RESULTS
THIRD ROUND SAMPLING EVENT
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

BASE NEUTRAL EXTRACTABLE ORGANICS	DETECTION	05S-11	05S-12	05S-13	05S-14*	05S-15	05S-16	05S-17	05S-18	05S-19	05S-20
	LIMIT									(0-1')	(0-1')
FLUORANTHENE	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	530	540
PYRENE	330	BDL	BDL	BDL	BDL	340	BDL	BDL	BDL	400	510
BUTYLBENZYLPHTHALATE	330	BDL	3500	BDL	160000	BDL	BDL	BDL	BDL	BDL	BDL
BENZO(A)ANTHRACENE	330	BDL	BDL	BDL	26000	BDL	BDL	BDL	BDL	BDL	720
BIS(2-ETHYLHEXYL)PHTHALATE	330	BDL	580	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CHRYSENE	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	360	670
BENZO(B)FLUORANTHENE	330	BDL	BDL	BDL	BDL	630**	BDL	BDL	BDL	BDL	1300**
BENZO(K)FLUORANTHENE	330	BDL	BDL	BDL	BDL	630**	BDL	BDL	BDL	BDL	1300**
BENZO(A)PYRENE	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	710
INDENO(1,2,3-C,D)PYRENE	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	390
BENZO(G,H,I)PERYLENE	330	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	360

NOTES: All values for BASE NEUTRAL EXTRACTABLE ORGANICS in ug/kg.

All samples from THIRD ROUND - APR. 14, 1986

* = Due to the sample matrix, the Base/Neutral fraction of this sample could not be concentrated to the routine final volume and a 10:1 dilution was required in order to achieve accurate and discernible results by GC/MS analysis.

** = Indistinguishable Isomers.

Control Board Ground Water Standards, and other available standards and guidelines. These standards and/or criteria are listed in Tables 8-8 through 8-10. Criteria for organic constituents are not listed since none were identified above detection limits. Information from the following sources are included:

Inorganics

Table 8-8 - EPA Water Quality Criteria Document, 1980.

Table 8-9 - EPA Water Quality Criteria Document, 1985.

Table 8-10 - EPA MCL's and State Water Control Board (SWCB) Water Quality Standards and Criteria.

These standards and criteria are the same as previously discussed in Chapter 4 and, therefore, a detailed explanation of each is not included herein.

8.6 SOIL CONCENTRATION GUIDELINES

Concentrations of selected inorganics typically found in soils and sediments were prepared for comparison with Site 5 analytical data. Specific standards or established criteria, relative to the concentration of inorganics in soil or sediment for determining the extent of contamination are not available; thus, a comparison must be made in more abstract terms. The numerical values presented in Table 8-11 do offer some insight and general guidance on what levels are acceptable from different parts of the country. The data offered provides a list of the median composition of inorganics in natural soils; EPA Regional V guidelines for nonpolluted, moderately polluted and heavily polluted inorganic concentration in sediments; EPA Region V screening level concentrations requiring EP Toxicity testing of sediments; and allowable concentrations in soils for the State of New Jersey. These values were utilized to identify soil and sediment concentrations of concern.

8.7 DATA EVALUATION

Results of the ground water analyses at well 05GW-01 indicate no priority pollutant organic constituents exceeded the analytical detection limits during any of the three sampling and analytical events. Regarding inorganics, several constituents were identified which

TABLE 8-8

EPA WATER QUALITY CRITERIA
INORGANICS
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

EPA WATER QUALITY CRITERIA DOCUMENTS - 1980						
PARAMETER	TOXICITY TO AQUATIC LIFE				HUMAN HEALTH	
	FRESH WATER		SALT WATER		INGESTION	
	ACUTE (MG/L)	CHRONIC (MG/L)	ACUTE (MG/L)	CHRONIC (MG/L)	WATER (MG/L)	AQUATIC (MG/L)
INORGANICS						
ARSENIC, TOTAL	0.44	0.03	0.508	NA	0.000022	0.000175
CADMIUM, TOTAL	0.003	0.00003	0.059	0.0045	0.01	NA
CHROMIUM, TOTAL	0.021	0.00029	1.26	0.018	0.05	NA
COPPER, TOTAL	0.022	0.0056	0.023	0.004	0.001	NA
LEAD, TOTAL	0.17	0.0038	0.668	0.025	0.05	NA
MERCURY, TOTAL	0.0000017	0.00000057	0.0037	0.000025	0.000144	0.000146
NICKEL, TOTAL	1.84	0.096	0.140	0.0071	0.0134	0.1
THALLIUM, TOTAL	1.40	0.04	2.13	NA	0.013	0.048
ZINC, TOTAL	0.32	0.047	0.17	0.058	5.0	NA
PHENOLS, TOTAL	10.2	2.56	5.80	NA	0.0035	NA
CRITERIA PUBLISHED IN FEDERAL REGISTER NOVEMBER 28, 1980.						

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TABLE 8-9

WATER QUALITY CRITERIA - 1985
 INORGANICS
 PESTICIDE DISPOSAL SITE V-95 (SITE 5)

	EPA WATER QUALITY CRITERIA DOCUMENTS			
	TOXICITY TO AQUATIC LIFE			
	FRESH WATER		SALT WATER	
	CMC (MG/L)	CCC (MG/L)	CMC (MG/L)	CCC (MG/L)
INORGANICS				
CADMIUM, TOTAL	0.0039	0.0011	0.043	0.0093
CHROMIUM, TOTAL	0.016	0.011	1.10	0.05
COPPER, TOTAL	0.018	0.012	0.029	NA
LEAD, TOTAL	0.083	0.0032	0.14	0.0056
MERCURY, TOTAL	0.0024	0.000012	0.0021	0.000025

CMC = Criterion maximum concentration for one hour
 CCC = Criterion continuous concentration for four day average (chronic toxicity).
 Criteria published in Federal Register July 29, 1985

TABLE 8-10

EPA MAXIMUM CONTAMINANT LEVELS AND
STATE WATER CONTROL BOARD WATER QUALITY STANDARDS AND CRITERIA
INORGANICS
PESTICIDE DISPOSAL V-95 (SITE 5)

INORGANICS	EPA	SWCB (1)		
	MCL'S (MG/L)	GW STANDARDS (MG/L)	SW (2) STANDARDS (MG/L)	WATER QUALITY CRITERIA FOR SURFACE WATERS (3) (UG/L)
ARSENIC, TOTAL	0.05	0.05	0.05	63
CADMIUM, TOTAL	0.01	0.0004	0.01	12
CHROMIUM, TOTAL	0.05	0.05	0.05	(4)
COPPER (ACTIVE)	1.0	1.0	1.0	2
LEAD, TOTAL	0.05	0.05	0.05	8.6
MERCURY, TOTAL	0.002	0.00005	0.002	0.1
NICKEL, TOTAL	---	---	---	7.1
THALLIUM, TOTAL	---	---	---	---
ZINC, TOTAL	5.0	0.05	5.0	58
PHENOLS, TOTAL	---	0.001	0.001	1.0

NOTES:

- (1) Water Quality Standards, revised edition, June, 1986.
- (2) denotes Surface Public Water Supplies
- (3) Values shown represent Chronic criteria for Salt Water.
- (4) State criteria for Salt Water addresses Hexavalent(dissolved) only.

TABLE 8-11
TYPICAL SOIL/SEDIMENT CONCENTRATIONS
INORGANICS
PESTICIDE DISPOSAL SITE V-95 (SITE 5)

PARAMETER	MEDIAN COMPOSITION OF NATURAL SOILS		EPA REGION V GUIDELINES			SUGGESTED EP TOXICITY SCREENING LEVELS (MG/KG)	NEW JERSEY ALLOWABLE CONC. IN SOIL (MG/KG)
	RANGE (MG/KG)	TYPICAL MEDIAN (MG/KG)	NONPOLLUTED (MG/KG)	MODERATELY POLLUTED (MG/KG)	HEAVILY POLLUTED (MG/KG)		
Chromium	5 - 3,000	100	<25	25-75	>75	100.0	100
Copper	2 - 250	30	<25	25-50	>50	---	170
Lead	LT 1 - 888	29	<40	40-60	>60	100.0	100
Mercury	0.01 - 4.6	0.098	---	---	>=1	4.0	---
Nickel	0.1 - 1,530	50	<20	20-50	>50	---	100
Zinc	1 - 2,000	90	<90	90-200	>200	---	350
Oil & Grease	---	---	<1000	1000 - 2000	>2000	---	---

- NOTE: 1) References:
1. Bowen, H.J.M., "ENVIRONMENTAL CHEMISTRY OF THE ELEMENTS." ACADEMIC PRESS, NEW YORK.
 2. Ragaini, R.C., ET. AL., "ENVIRONMENTAL TRACE CONTAMINATION IN KELLOG IDAHO NEAR LEAD SMELTING COMPLEX." ENVIR. SCI. & TECHNOL. 11 773-780 1977
 3. Lisk, D.J., " TRACE METALS IN SOILS, PLANTS, AND ANIMALSD." ADV. AGRON. 24 267-311, 1972
 4. "GEOCHEMISTRY OF SOME ROCKS, SOIL, PLANT AND VEGETABLES IN THE CONTERMINOUS UNITED STATES", GEOL. SRVY. PROF. PAPER 574 F 1975
 5. Ure, A.M., ET. AL., "ELEMENTAL CONSTITUENTS OF SOILS" ENVIR. CHEM. VOL. 2 94-204 ED. H.J.M. BOWEN, ROYAL SOC. OF CHEM., BURLINGHOUSE, LONDON, U.K. 1983
 6. Parr, J.F., ET. AL. "LAND TREATMENT OF HAZARDOUS WASTES," AGRI. ENVIR. QUAL. INST., AGRI. RESH. SER., USDA, BELTSVILLE, MD., NOYES DATA CORP., PARK RIDGE, N.J., 1983.
 7. Shaklette, H.T., ET. AL., "ELEMENTAL COMPOSITION OF SURFACIAL MATERIAL IN THE CONTERMINOUS UNITED STATES," USGS PROF. PAPER 574-D, 1971.
 8. Lechler, T.J., ET. AL., "MAJOR AND TRACE METAL ANALYSIS OF 12 REFERENCE SOILS BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY." SOIL SCIENCE 130 238-241 1980.

2) New Jersey allowable concentrations in soil were established to evaluate proposed clean-up plans associated with property transfers.

slightly exceeded some of the referenced water quality criteria during one or more analytical events. These values are not considered significant, however, since the ground water in the Site 5 area is not used as a supply source and concentrations reported were for total metals (field filtering was not performed) which represents the total concentration of the metal in solution and bound by sediments. Ground water flow direction was not determined since only one well was installed. However, it is assumed the ground water is flowing northward to the Chesapeake Bay.

Soil samples collected and analyzed during the site investigation indicate elevated concentrations of two pesticides, DDT and DDD, are present at several depths in the immediate vicinity of the french drain. Concentrations of DDD ranged from 20 to 36 mg/kg near the ground surface (2 to 8 feet) and diminished with depth. Elevated concentrations of chlordane and dieldrin were also identified in localized areas.

Several base-neutral compounds were also identified in the surface soils at many sample locations during the second and third round soils analyses. These elevated concentrations of base-neutral organics are not believed to be from the french drain, but rather from surface runoff from above ground operations in the area which include scraping and refinishing the surfaces of small (30 to 40 feet long) Navy vessels.

8.8 CONCLUSIONS AND RECOMMENDATIONS

Soil samples collected within 5 feet of the french drain during sampling event one indicated significant concentrations of two pesticides; DDT and DDD. Concentrations of both pesticides were highest in soil near the ground surface and gradually decreased with depth. These pesticides were not detected in the ground water column, however, which substantiates the fact DDT and DDD are not soluble in water.

Second round soil sampling also indicated that DDT and DDD had not migrated far from the disposal site. DDD was identified in a surface to 2 foot sample collected about 15 feet east of the french drain, but was not found below this depth. Chlordane and dieldren were also identified

15-feet east of the french drain. No pesticides were identified in soil 15 feet to the north, west or south of the french drain.

The dangers related to DDT and DDD are well documented. Both pesticides are considered toxic by ingestion, inhalation and skin absorption. A total threshold limit concentration of 1.0 mg/kg in soil for DDT and DDD has been set in the California Administrative Code (January 12, 1985). Additionally, both pesticides are not biodegradable and, consequently, concentrations identified will not diminish with time.

Remedial action is recommended at Site 5 to insure accidental exposure to DDT and DDD does not occur. Based on the analytical data, it is apparent the pesticides are fixed to the soil matrix and are not migrating via ground water off-site. Consequently, exposure is only possible if the Navy decides to excavate soils in the area. The industrial nature of the site and existing Navy security make the potential for this type of activity very remote. However, to further reduce the risk of exposure the following remedial actions are recommended:

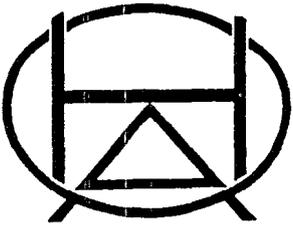
- o Install an impermeable, hard surface over the entire area to effectively remove the potential for surface exposure.
- o Extend existing security fencing with locked gate to minimize the potential for unauthorized personnel entering the area.
- o Place a sign at the locked gate entrance identifying the pesticides present in the underlying soils and warning against excavation in the area.

Base-neutral extractable organics were also identified at several sample locations at the site, primarily in the surface to 2 foot depth. The presence of these organics are assumed to be the result of spillage from the existing boat repair activities taking place at the site. None of the base-neutral constituents were identified in the ground water column and consequently, no imminent threat of migration exists.

The installation of an impermeable, hard-surface to isolate the pesticide contamination will also be effective in containing the base-neutrals. The extent of hard-surface installation should be increased, however, to fully pave the entire work and storage area.

Additionally, it is recommended that on-site activities be evaluated in order to minimize future contamination. Spill prevention and clean-up plans should also be developed and implemented.

APPENDIX A
SOIL BORING LOGS



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TEST BORINGS AND WELL INSTALLATIONS

FOR

CAMP ALLEN LAND FILL AREA

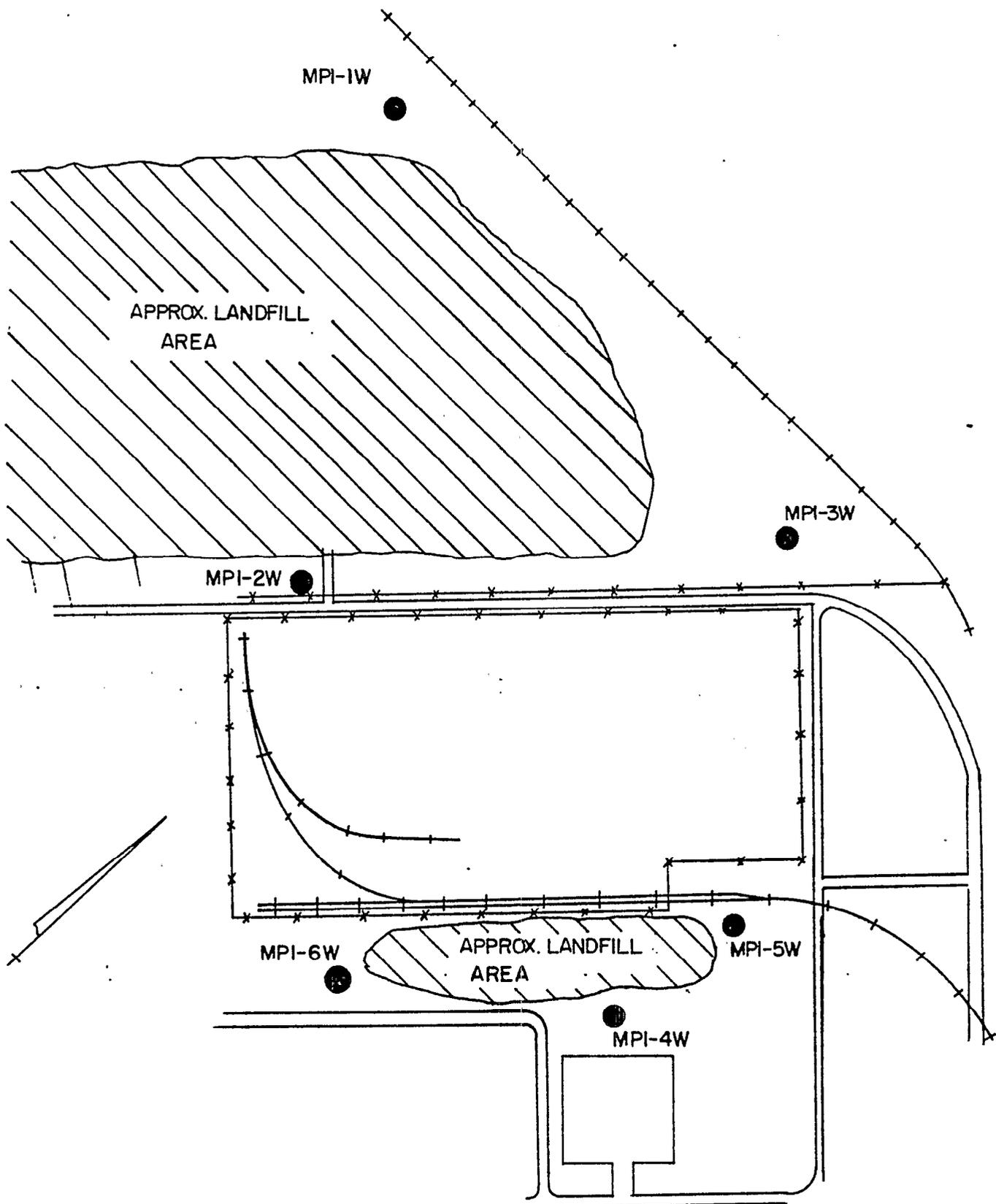
PESTICIDE DISPOSAL SITE

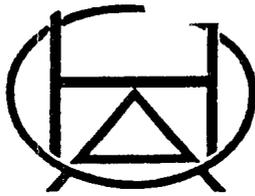
"Q" AREA DRUM STORAGE YARD

FIRE FIGHTING SCHOOL

NORFOLK, VIRGINIA

December 1983





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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN (NACIP) LOCATION Norfolk, Va.

BORING NO. MPI - 1W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

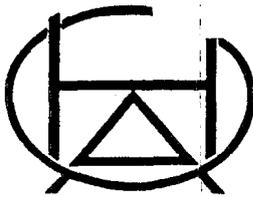
DATE STARTED 11/10/83 DATE COMPLETED 11/10/83 DRILLER P.Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER AA LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	2-11	Dark brown silt with shell hash, organics & gravel	S-1
	28-23		
	32-30		
4	25-16	Brown silty sand, Damp	S-2
	10-8	Brown silty sand, Damp	S-3
6	8-4		
	H-H	Brown sand, silt - wet	S-4
8	H-1		
	5-4	Light gray silty sand, saturated	S-5
	14-15		
	14-15		
12	16-16	Light gray silty sand, saturated	S-6
	8-9	Light brown silty sand, wet	S-7
14	10-10		
	4-6	Mottled light brown silt with gray clay, moist	S-8
16	4-2		
	3-3		
18	4-5	Mottled light brown silt with alternating gray and sandy clay - moist	S-9
	6-8	Mottled light brown silt with alternating gray and sandy clay - moist	S-10
20	9-10		
	8-10	Light brown silty sand - wet	S-11
22	11-11	Light brown silty sand - wet	S-12
	13-13		
24	16-16		
26		Bottom of boring 24.0'	
		Screen 24'4" - 4'4"	
28		Stand pipe 4'4" - 0"	
		Stick up 2'8"	
30		Sand 25' - 3'	
		Bentonite 3' - 1'7"	
32			
34			
38			
40			

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall.
 Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar products.



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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (NACIP) LOCATION Norfolk, Va.

BORING NO. MPI-2 W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

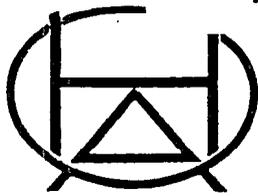
DATE STARTED 11/14/83 DATE COMPLETED 11/14/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
1	4-30	Brown silt with organics, brick & concrete hash	S-1
2	21-13		
3	6-10	Brown silt with gray shell hash	S-2
4	10-8		
5	7-5	Red shell hash - silty	S-3
6	2-2		
7	2-1	Gray shell hash, wet, silty	S-4
8	2-2		
9	3-0	Gray shell hash, wet, silty	S-5
10	1-2		
11	7-8	Olive gray silty sand	S-6
12	9-9		
13	5-6		
14	8-7		
15	7-6		
16	7-7		
17	2-2		
18	4-6		
19	8-7		
20	8-9		
21	7-7		
22	7-5		
23	7-9		
24	13-16	Light gray silty sand - wet	S-12
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall.
 Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar products.



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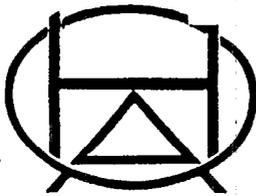
LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (NACIP) LOCATION Norfolk, Va.
 BORING NO. MPI-3W TYPE DRILL Acker TH CLIENT Malcolm Pirnie
 DATE STARTED 11/14/83 DATE COMPLETED 11/14/83 DRILLER P. Herbert
 CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 9' AFTER --- HRS. ---
 TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	3-6	Dark gray silt with organics and concrete	S-1
4	15-11	Brown silt with glass, concrete hash & sand	S-2
6	10-11	Brown silt with glass, concrete hash, sand & organics	S-3
8	10-7	Brown silt with glass	S-4
10	7-4	Glass	S-5
12	3-2	Light brown silty sand - wet	S-6
14	2-0	Light brown silty sand - wet	S-7
16	0-1	Light brown silty sand - wet	S-8
18	3-3	Gray sandy silt - wet	S-9
20	4-6	Gray sandy silt - wet	S-10
22	7-4	Gray silty sand, wet with gravel	S-11
24	6-4	Gray silty sand - wet	S-12
26	6-6	Bottom of boring 24.0'	
28	3-1	Screen 24'4" - 4'4"	
30	1-1	Standpipe 4'4" - 0'	
32	6-4	Stick up 2'8"	
34	8-9	Sand 25' - 3'	
36	5-5	Bentonite 3' - 2'	
38	9-11		
40	22-23		
	25-34		
	4-13		
	24-36		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall. Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar products.



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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (NACIP) LOCATION Norfolk, Virginia

BORING NO. MP-I-4W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

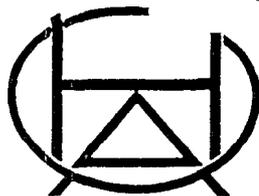
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 4.0' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2" OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	3-4	Brown fine sand and silt	S-1
4	2-3	Brown fine sand and silt	S-2
6	2-3	Brown sand with little silt *Red fluid leaking out of spoon	S-3
8	2-2	Grading to gray sand	S-4
10	3-3	Gray sand	S-5
12	4-4	Gray sand	S-6
14	4-4	Gray sand	S-7
16	2-3	Gray sand	S-8
18	5-4	Gray sand	S-9
20	4-4	Gray sand	S-10
22	7-8	Gray sand	S-11
24	7-9	Gray sand	S-11
	8-7		
	11-11		
	15-14		S-12
26		*NOTE: Red fluid - looks like hydraulic fluid, went to respirators	
28		Screen 24'6" - 4'6"	
30		Stand Pipe 4'6" - 0	
32		Stick-up 2'6"	
34		Sand 3'	
36		Bentonite 3' - 2'	
38			
40		Bottom of boring 24.0'	

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (NACIP) LOCATION Norfolk, Va.

BORING NO. MPI-5W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

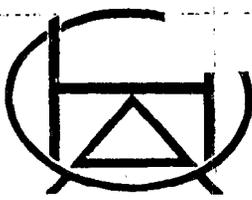
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P.Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 6.0' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH -- DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
3-3		Brown silt with organics	S-1
4-4			
4-4		Brown & dark gray sandy silt	S-2
4-5			
5-4		Black sandy silt, saturated	
1-1		Olive gray silty clay and peat, Moist	S-3
1-0			
1-1		S-4	
0-2			
0-1		Brown sandy silt, wet	S-5
H-H			
2-2		Light gray sandy silt, staurated	S-6
1-3			
1-2		Light gray silty sand, saturated	S-7
3-5			
5-6		Light gray silty sand, saturated	S-8
3-4			
4-6		Light brown silty sand, saturated	S-9
5-9			
9-9		Light brown silty sand, saturated	S-10
4-5			
4-4		Light brown silty sand, saturated	S-11
7-9			
11-12		Light brown silty sand, saturated	S-12
24			
26		Bottom of boring 24.0'	
28		Screen 24'6" - 4'6"	
30		Stand Pipe 4'6" - 0	
32		Stick-up 2'6"	
		Sand 25' - 3'	
		Bentonite 3' - 2'	
34			
38			
40			

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LOG OF BORING

FILE NO. 83- 3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (NACIP) LOCATION Norfolk, Va.

BORING NO. MPI-6W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

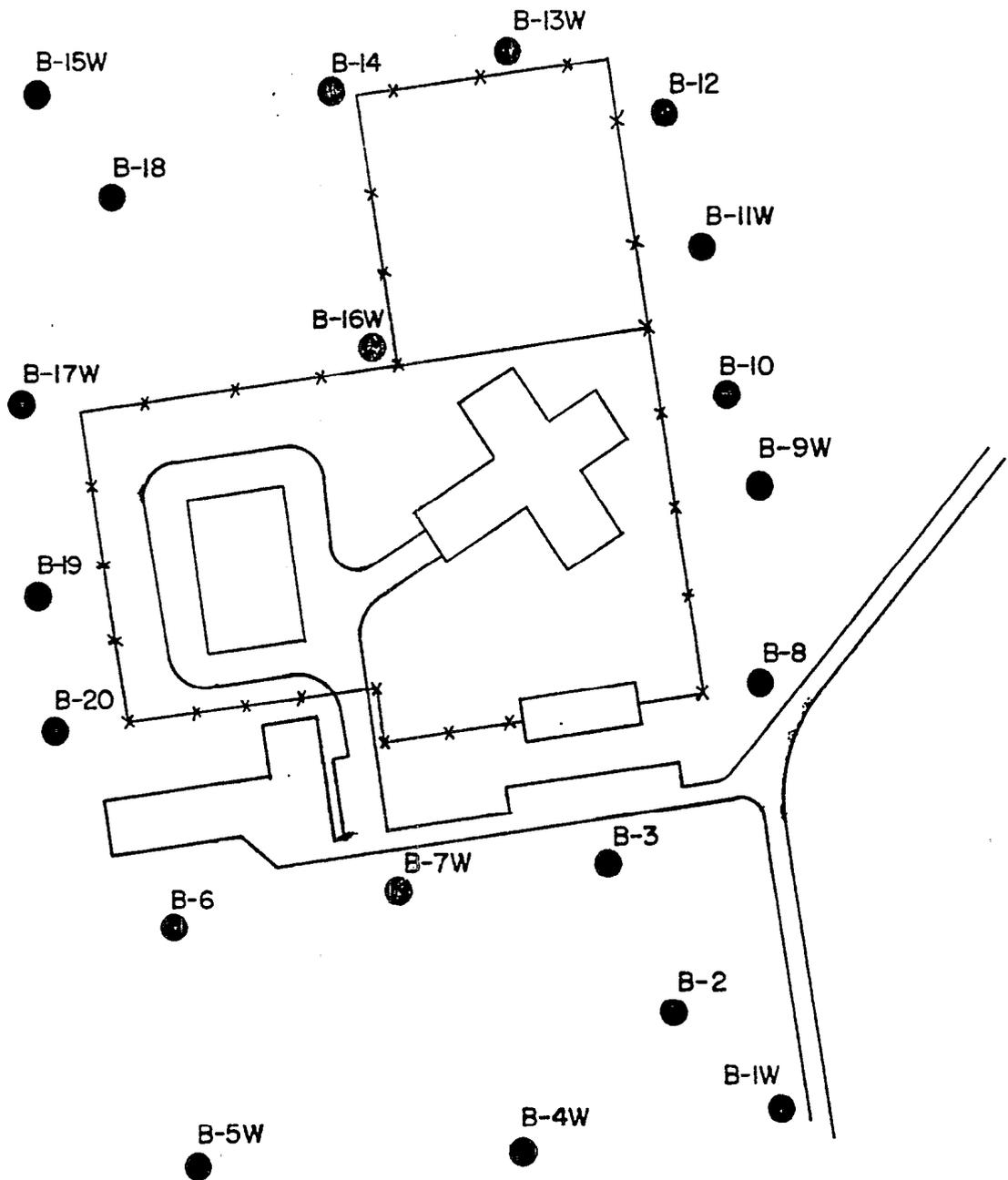
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 4.0' AFTER --- HRS ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	2-5 7-7	Dark gray silt with sand and organics	S-1
4	10-9 10-2	Light brown silty sand	S-2
6	5-5 7-7	Brown sandy silt Brown sandy silt, wet	S-3
8	2-2 7-4	Brown and gray silty sand - Wet	S-4
10	4-3 1-1	Brown and gray silty sand - Wet	S-5
12	4-4 5-6	Light brown silty sand, Wet	S-6
14	7-7 7-8	Light brown silty sand, Wet	S-7
16	4-4 6-5	Light brown silty sand, Wet	S-8
18	6-6 7-8	Light brown silty sand, Wet	S-9
20	6-6 6-6	Light brown silty sand, Wet	S-10
22	11-12 13-13	Light brown silty sand, Wet	S-11
24	7-5 4-2	Light brown silty sand, Wet	S-12
26		Bottom of boring 24.0'	
28		Screen 23'11" - 3'11"	
30		Stand Pipe 3'11" - 0	
32		Stick-up 3'1"	
34		Sand 24' - 3'	
36		Bentonite 3' - 2'	
38			
40			

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VIRGINIA BEACH, VA

CAMP ALLEN LANDFILL
AREA -BORING LOCATIONS-

JOB- 83-3545
DECEMBER 29, 1983



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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Virginia

BORING NO. B-1W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

DATE STARTED 11/14/83 DATE COMPLETED 11/14/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
1	1-5	Dark brown silt with gravel	S-1
2	1-8		
3	8-5	Brown silt with traces of clay	S-2
4	4-3		
5	5-4	Brown silt with traces of clay	S-3
6	3-3		
7	3-3	Light brown silty sand - Wet	S-4
8	4-3		
9	2-2		
10	2-5		
11	3-4		
12	5-4		
13	5-5		
14	6-5		
15	5-9		
16	10-10		
17	6-6		
18	4-5		
19	7-6	Light brown silty sand - Wet	S-9
20	8-8		
21	5-8	Light brown silty sand - Wet	S-10
22	8-8		
23	9-11	Light brown silty sand - Wet	S-11
24	9-9		
25	11-19	Light brown silty sand - Wet	S-12
26			
27			
28			
29			
30			
31			
32			
33		Bottom of boring 24.0'	
34		Screen 24' - 4'	
35		Stand Pipe 4' - 0'	
36		Stick-up 3'	
37		Sand 25' - 3'	
38		Bentonite 3' - 2'	
39			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-2 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

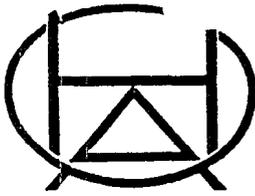
DATE STARTED 11/83 DATE COMPLETED 11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 6' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	2-8	Fill material - tan silty sand with gravels of concrete & slag - Medium to fine grain sand	S-1
	18-22		
4	5-5	Light brown sandy silt with some clay properties	S-2
	7-11		
6	4-5	Light brown sandy silt	S-3
	9-10		
8	2-4	Light brown silty sand - Wet - Medium to fine grain	S-4
	5-7		
10	3-4	Light brown sand with silt - Saturated - Medium to fine grain	S-5
	5-5		
12	1-1	Light brown sand with silt - Saturated - Medium to fine grain	S-6
	3-4		
14	7-5	Light brown sand with silt - Saturated - Medium to fine grain	S-7
	8-7		
16	7-7	Light brown sand with silt - Saturated - Medium to fine grain	S-8
	8-9		
18	5-8	Light brown sand with silt - Saturated - Medium to fine grain	S-9
	11-11		
20	7-13	Light brown silty sand, pebble in matrix - Wet	S-10
	10-19		
22	13-14	Light brown to light gray sand with silt - Medium to fine grain - Wet	S-11
	15-16		
24	12-12	Light gray to light brown sand with silt, pebbles in matrix - Saturated	S-12
	14-18		
26		Bottom of boring 24.0'	
28		Below surface 7'2"	
30		Stick up 2'10"	
32			
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Virginia

BORING NO. B-3 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

DATE STARTED 11/83 DATE COMPLETED 11/83 DRILLER P. Herbert

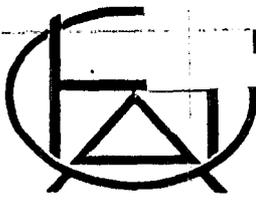
CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER -- HRS.

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
1	7-8	Light brown sandy silt - Moist	S-1
2	5-5		
3	3-4	Light brown silt with sand - Moist	S-2
4	5-5		
5	4-5	Light brown silty sand - Moist	S-3
6	4-5		
7	2-2	Light brown sand with silt - Wet - Medium to fine grain	S-4
8	4-3		
9	2-4	Light brown sand with silt - Saturated - Medium to fine grain	S-5
10	5-5		
11	4-4	Light brown sand with silt - Saturated - Medium to fine grain	S-6
12	4-5		
13	7-7	Light brown silty sand - Wet - Medium to fine grain	S-7
14	6-8		
15	5-5	Light brown silty sand - Saturated - Medium to fine grain	S-8
16	9-10		
17	12-12	Light brown silty sand - Saturated - Medium to fine grain	S-9
18	10-12		
19	10-10	Light brown silty sand - Saturated - Medium to fine grain	S-10
20	11-12		
21	10-12	Mottled gray & light brown sand with silt - Wet - Medium to fine grain	S-11
22	13-25		
23	10-12	Mottled gray and light brown sand with silt - Wet - Medium to fine grain	S-12
24	8-10		
26		Bottom of boring 24.0'	
28		Below surface 7'0"	
30		Stick up 3'0"	
32			
34			
38			
40			

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FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Virginia

BORING NO. B-4W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

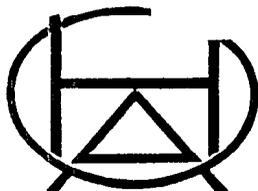
DATE STARTED 11/83 DATE COMPLETED 11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 9' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"0D SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	5-7	Dark brown fill, sand silt with pebbles and concrete	S-1
4	11-15	Dark brown fill, sand silt with pebbles and concrete	S-2
6	25-8	Dark brown fill, sand silt with pebbles and concrete	S-3
8	11-13	Dark brown fill, sand silt with pebbles and concrete	S-4
10	23-12	Olive gray silty clay with organics, Moist	S-5
12	11-8	Mottled brown to gray silty sand with pebbles, Wet	S-6
14	5-4	Gray silty sand, medium to fine grain - Wet	S-7
16	4-5	Gray silty sand, medium to fine grain - Wet	S-8
18	5-7	Mottled gray & brown silty sand, medium to fine grain - Wet	S-9
20	12-15	Light brown silty sand, fine grained - Wet	S-10
22	10-8	Light brown silty sand, fine grained - Wet	S-11
24	7-7	Light brown & yellow brown silty sand, fine grain - Wet	S-12
26	4-7	Light brown & yellow brown silty sand, fine grain - Wet	
28	8-18	with pebbles in matrix	
30	--14	Bottom of boring 24.0'	
32	12-12	Screen 24'2" - 2'2"	
34	12-12	Stand Pipe 2'2" - 0	
36	8-8	Stick-up 2'0"	
38	13-17	Sand 25' - 3'	
40	30-30	Bentonite 3' - 2'	

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FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Va.

BORING NO. B5W TYPE DRILL Acker Th CLIENT Malcolm Pirnie

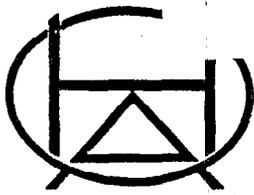
DATE STARTED 11/83 DATE COMPLETED 11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 20' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	6-100 49-157	Dark brown fill sandy silt with pebbles and concrete	S-1
4	6-10 14-8	Dark brown fill sandy silt with pebbles and concrete	S-2
6	10-23 70-5	Dark brown fill sandy silt with pebbles and concrete	S-3
8	85-40 61-20	Dark brown silt sand silt with pebbles and concrete	S-4
	94-100/0"	No Sample	
12	1-1 1-0	Olive gray silty clay, moist with trace of organics & sand	S-6
14	1-1 1-1	Olive gray silty clay, moist with trace of organics & sand	S-7
16	2-2 2-1	Olive gray silty clay, moist with trace of organics & sand	S-8
18	2-1 1-1	Olive gray silty clay, moist with trace of organics, sand & pebbles	S-9
20	2-1 2-1	Olive gray silty clay, moist with trace of organics, sand & pebbles	S-10
22	2-1 1-1	Olive gray silty clay with trace of organics, sand and pebbles - Wet	S-11
24	1-1 2-2	Olive gray silty clay with trace of organics, sand and pebbles - Wet	S-12
26	2-1	Olive gray silty clay with trace of organics, sand and pebbles - Wet	S-13
28		Bottom of boring 26.0'	
30		Screen 22'7" - 2'7"	
32		Stand Pipe 2'7" - 0	
34		Stick-up +2'5"	
		Sand 25' - 3'	
		Bentonite 3' - 2'	
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-6 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

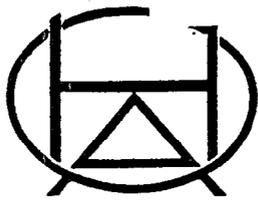
DATE STARTED 11/8/83 DATE COMPLETED 11/8/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 10' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	7-11	Brown and black sandy silt	S-1
4	8-7		
	4-5	Black silt - Damp	S-2
6	5-5		
	3-1	Dark gray silty clay - Moist	S-3
8	1-1		
	1-2	Dark gray silty clay - Moist	S-4
10	2-1		
	WOH - PUSH	Dark gray silty clay - Moist	S-5
	PUSH		
12	Wt. of Rod	Dark gray silty clay - Wet	S-6
	PUSH	Dark gray silty clay with organics - Wet	S-7
14	2-2		
	2-4	Alternating olive green & dark gray silty sands - Moist	S-8
16	4-3		
	1-3	Mottled light brown & gray silty sand - Moist - fine grain	S-9
18	1-4		
	10-12	Mottled light brown & gray silty sand - Saturated - Medium to fine grain	S-10
20	10-9		
	10-10	Light brown silty sand - Saturated - medium to fine grain	S-11
22	12-20		
	24-30	Light brown & gray silty sand - Saturated - Medium to fine grain	S-12
24	23-18		
26		Bottom of boring 24.0'	
28			
30		Below surface 7'2" Stick up 2'10"	
32			
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Virginia

BORING NO. B7W TYPE DRILL Acker Th CLIENT Malcolm Pirnie

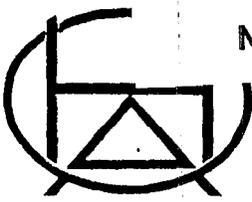
DATE STARTED 11/8/83 DATE COMPLETED 11/8/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLER NO
0			
2	3-3	Brown sandy silt with concrete & metal fragments	S-1
4	7-30		
4	13-13	Brown sandy silt with concrete & metal fragments	S-2
4	52-65		
6	11-4	Brown sandy silt with concrete hash	S-3
6	7-15		
8	6-4	Brown sandy silt with pebbles & concrete, Wet	S-4
8	6-11		
10	4-7		S-5
10	9-9	Gray sand with silt, medium to fine grain, Wet	
10	5-6		S-6
12	7-5	Gray sand with silt, medium to fine grain, Wet	
14	3-4		S-7
14	3-5	Light brown silty sand, medium to fine grain, Saturated	
16	12-13		S-8
16	15-19	Light brown silty sand, medium to fine grain, Saturated	
18	5-5		S-9
18	6-5	Light brown silty sand, medium to fine grain, Saturated	
20	5-6		S-10
20	9-15	Light brown silty sand, medium to fine grain, Saturated	
22	6-7	Mottled light brown & light gray silty sand, Medium to fine grain - Saturated	S-11
22	8-7		
24	16-25	Mottled light brown & light gray silty sand, Medium to fine grain - Saturated	S-12
24	30-35		
26		Bottom of boring 24.0'	
28		Screen 23'8" - 3'8"	
30		Stand Pipe 3'8" - 0"	
32		Stick-up 3'4"	
34		Sand 25' - 3'	
36		Bentonite 3' - 2'	
38			
40			

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall. Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar products.



NBN-00102-3.13-03/01/88

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Virginia

BORING NO. B-8 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

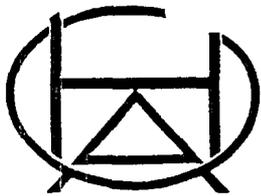
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	8-20	Brown sandy silt with organics, glass & pebbles	S-1
	56-14		
4	1-6	No sample	S-2
	4-3		
6	3-3	No sample	S-3
	3-2		
8	4-4	Brown sandy silt with organics and gravel - Moist	S-4
	4-5		
10	3-4	Light brown silty sand - Wet	S-5
	5-5	Light brown silty sand - Wet	S-6
12	4-3		
	5-5	Light brown silty sand - Wet	S-7
14	5-6		
	5-7	Light brown silty sand - Wet	S-8
16	8-10		
	6-6	Light brown sandy silt - Wet	S-9
18	9-12		
	11-8	Light brown sandy silt - wet	S-10
20	9-9		
	11-12	Light brown silty sand - Wet	S-11
22	11-9		
	9-11	Light brown silty sand - Wet	S-12
24	9-11		
26		Bottom of boring 24.0'	
28		Below surface 6'9"	
30		Stick up 3'3"	
32			
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDIFLL (Brig) LOCATION Norfolk, Va.

BORING NO. B-9W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

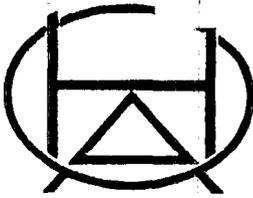
DATE STARTED 11/11/83 DATE COMPLETED 11/11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 10' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH -- DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
1	4-19	Brown silt with gravel & organics	S-1
2	16-12		
3	6-9	Dark brown silt with glass and organics	S-2
4	9-16		
5	22-41	No Sample	S-3
6	8-4	Light brown and dark brown sandy silt - Moist	S-4
7	1-1		
8	2-3	Light brown and light gray silty sand - Moist	S-5
9	5-4		
10	3-3	Light gray silty sand - Wet	S-6
11	5-5		
12	4-4	Gray silty sand - Wet	S-7
13	6-6		
14	5-5	Light gray silty sand - Wet	S-8
15	6-6		
16	5-8	Light brown and gray silty sand - Wet	S-9
17	5-4		
18	4-5	Light brown and gray silty sand - Wet	S-10
19	8-7		
20	6-7	Light brown and gray silty sand - Wet	S-11
21	4-5		
22	5-7	Light brown and gray silty sand - Wet	S-12
23	6-12		
24	15-14		
25		Bottom of boring 24.0'	
26		Screen 22'7" - 2'7"	
27		Stand pipe 2'7" - 0	
28		Stick up 2'5"	
29		Sand 23' - 3'	
30		Bentonite 3' - 2'	
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-10 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

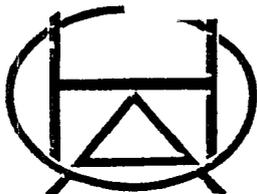
DATE STARTED 11/11/83 DATE COMPLETED 11/11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 10' AFTER --- HRS ---

TYPE SAMPLER SS LENGTH 30" DIA. 2" OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	3-6		
	18-27	Dark brown & dark gray silt with organics, pebbles & glass	S-1
	15-11		
4	15-21	Dark gray sandy silt with concrete hash	S-2
	9-5		
6	4-2		S-3
	1-1		
8	1-1	Olive gray silty clay with sand lenses	S-4
	1-1		
10	1-2	Olive gray silty clay with sand lenses and gravel	S-5
	9-7		
12	6-6	Gray silty sand - Wet	S-6
	5-5		
14	4-5	Light brown and gray silty sand - Wet	S-7
	6-5		
16	5-5	Light brown and gray silty sand - Wet	S-8
	4-4		
18	4-3	Light brown and gray silty sand - Wet	S-9
	5-3		
20	2-5	Light brown silty sand - Wet	S-10
	11-13		
22	17-11	Light brown silty sand - Wet	S-11
	5-7		
24	6-10	Light brown silty sand - Wet	S-12
26		Bottom of boring 24.0'	
28			
30		Below surface 7'6"	
		Stick up 2'6"	
32			
34			
36			
38			
40			

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FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-11W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

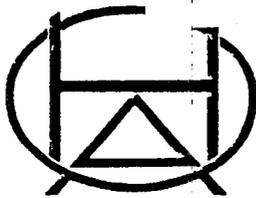
DATE STARTED 11/11/83 DATE COMPLETED 11/11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	2-3	Brown silt with organics and pebbles	S-1
	4-5		
4	3-1	Rope fiber	S-2
	0-1		
6	2-3	Black silt with slag, gravels	S-3
	8-27		
8	7-9	Dark brown silt - Wet - with concrete hash	S-4
	3-3		
10	3-3	Brown & olive gray sandy silt (with a bolt)	S-5
	2-1	Dark brown silt - Wet - with gravel & coarse sand	S-6
12	1-3		
14	5-5	Light gray silty sand - Saturated	S-7
	6-6		
16	4-5	Gray silty sand - Saturated	S-8
	6-6		
18	5-7	Gray to light brown silty sand - Saturated	S-9
	7-7		
20	4-4	Gray to light brown silty sand - Saturated	S-10
	3-2		
22	2-4	Light brown sandy silt - Wet	S-11
	8-9		
24	6-8	Light brown sandy silt - Wet	S-12
	8-8		
26		Bottom of boring 24.0'	
28		Screen 22'4" - 2'4"	
		Stand pipe 2'4" - 0	
30		Stick up 2'8"	
		Sand 23' - 3'	
32		Bentonite 3' - 2'	
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Va.

BORING NO. B-12 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

DATE STARTED 11/83 DATE COMPLETED 11/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	2-14 46-7	Dark brown & dark gray silt with plastic, glass & organics	S-1
4	2-8 1-4	No sample	S-2
6	1-2 4-5	No Sample	S-3
8		No Sample	S-4
10	1-10 73-40	Dark brown silt with gravels, sand & glass	S-5
12	1-2 3-3	Dark brown & dark gray silt with concrete	S-6
14	3-2 3-4	Dark gray & olive green silt - Wet - organic layer	S-7
16	4-3 4-3	Olive gray silt grading to olive green sandy silt - Wet	S-8
18	2-2 2-3	Olive gray & dark gray silt - wet	S-9
20	4-6 7-9	Olive gray & dark gray silt - Wet (piece of wire)	S-10
22	11-9 11-13	Light brown silty sand - Wet	S-11
24	12-13 15-16	Light brown silty sand - Wet	S-12
26		Bottom of boring 24.0'	
28		Below surface 7'0"	
30		Stick up 3'0"	
32			
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-13W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

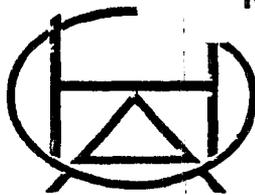
DATE STARTED 11/10/83 DATE COMPLETED 10/10/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	7-14	Dark brown silt with glass, wood and gravels	S-1
4	15-12	Dark brown silt with glass, wood and gravel	S-2
6	10-14	Dark brown silt with glass, wood, gravel and metal	S-3
8	17-23	Dark brown silt with glass, wood, gravel and metal	S-4
10	30-89	Dark brown silt with glass, wood and gravels - Wet	S-5
12	68-80	no sample	S-6
14	50-94	Dark gray to gray silty clay - Moist	S-7
16	86-32	Dark gray to gray silty clay with organics - moist	S-8
18	-9	Gray silty clay with organics - Moist	S-9
20	8-7	Gray silty sand - Wet	S-10
22	8-6	Gray alternating silty sand and silty clay - Moist	S-11
24	5-4	Gray alternating silty sand and silty clay - Moist	S-12
26	2-2	Bottom of boring 24.0'	
28	1-1	Screen 24'3" - 4'3"	
30	PUSH	Standpipe 4'3" - 0	
32	P-2	Stick up 2'9"	
34	P-2	Sand 25' - 3'	
36	2-2	Bentonite 3' - 2'	
38	2-3		
40	5-8		

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-14 TYPE DRILL Acker Th CLIENT Malcolm Pirnie

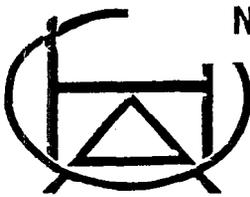
DATE STARTED 11/10/83 DATE COMPLETED 11/10/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"00 SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	3-6	Black & dark brown silt with organics & glass	S-1
4	2-2	Black silt with metal fragment	S-2
6	2-2	Black silt with organics, wet	S-3
8	1-2	Olive gray clayey silt with organics & shell hash, Damp	S-4
10	1-1	Olive gray clayey silt with dense layers of shell hash, wet	S-5
12	2-3	Dark brown sandy silt with organics, saturated	S-6
14	4-3	Dark brown sandy silt with organics, glass & pebbles, Wet	S-7
16	2-1	Dark brown sandy silt with organics, glass & pebbles, Wet	S-8
18	1-1	Light gray sand with silt - wet	S-9
20	9-12	Light gray sand with silt - wet	S-10
22	12-7	Light brown silty sand - Wet	S-11
24	5-5	Light brown silty sand - Wet	S-12
26	5-5		
28	5-8		
30	7-7		
32	5-4		
34	5-9		
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-15W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

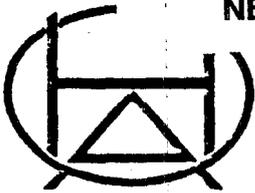
DATE STARTED 11/9/83 DATE COMPLETED 11/9/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 10' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	8-16 24-37	Brown silt with gravel, concrete, sand & organics	S-1
4	19-7 8-9	Brown silt with gravel, concrete, sand & organics	S-2
6	5-5 5-5	Gray & brown sandy silt - Moist	S-3
8	1-2 2-1	Brown silt with gravels	S-4
10	1-1 1-1	Gray silt with organics - Moist	S-5
12	PUSH	Gray silt with organics - Moist	S-6
14	2-1 2-2	Gray silt with organics - Moist	S-7
16	2-3 2-3	Gray silt with organics - Moist	S-8
18	3-2 3-2	Gray silt with organics - Moist	S-9
20	8-16 24-38	Light gray silty sand - Wet - fine grain	S-10
22	25-26 21-20	Light gray silty sand - Saturated - fine grain	S-11
24	14-16 16-14	Light brown silty sand - Saturated - fine grain	S-12
26		Bottom of boring 24.0'	
28		Screen 24'3" - 4'3"	
30		Standpipe 4'3" - 0	
32		Stick up 2'9"	
34		Sand 25' - 3'	
36		Bentonite 3' - 2'	
38			
40			

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FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (BRIG) LOCATION Norfolk, Va.

BORING NO. B-16W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

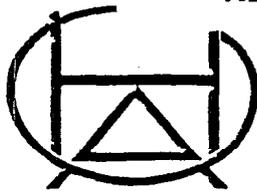
DATE STARTED 11/9/83 DATE COMPLETED 11/9/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	4-6	Dark brown silt with gravels, concrete & organics	S-1
	2-7		
4	4-4	Dark gray silt with organics & shells - Moist	S-2
	12-15		
6	5-2	Dark brown silt - moist	S-3
	1-1		
8	1-0	Dark brown silt - Wet	S-4
	1-0		
10	1-0	Dark brown silt - Wet	S-5
	1-1		
12	1-6	Gray silty sand - Wet - Medium to fine grain	S-6
	10-12		
14	12-10	Gray to light gray silty sand - Wet - Medium to fine grain	S-7
	8-7		
16	5-5	Gray to light gray silty sand - Wet - Medium to fine grain	S-8
	6-9		
18	10-9	Gray to light brown silty sand - Wet - Medium to fine grain	S-9
	5-8		
20	9-10	Light brown silty sand, fine grain - Wet	S-10
	10-10		
22	6-7	Light brown & gray silty sand, fine grain - Wet	S-11
	2-3		
24	3-4	Mottled light brown, gray & dark brown silty clay - Wet	S-12
26		Bottom of boring 24.0'	
28		Screen 24'4" - 4'4"	
		Stand pipe 4'4" - 0	
30		Stick up 2'8"	
		Sand 25' - 3'	
32		Bentonite 3' - 2'	
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-17W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

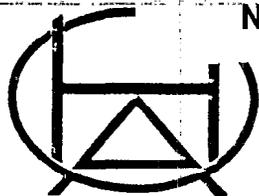
DATE STARTED 11/9/83 DATE COMPLETED 11/9/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	4-12	Dark brown fill material, sandy silt -	
	8-20	Concrete, pebbles & metal	S-1
4	12-14	No sample	S-2
	14-14	Concrete	S-3
6			
8	6-12		
	2-2	Olive green sandy silt with metal & pebbles - Moist	S-4
	1-2	Olive green sandy silt - Wet	S-5
10	2-1		
	1-1	Olive gray silty clay with organics & sand	S-6
12	1-1		
	1-2	Piece of slag blocked spoon opening	S-7
14	1-1		
	4-4	Olive gray silty clay - Moist	S-8
16	3-3		
	3-2	Olive gray silty clay with organics & sand - Moist	S-9
18	3-2		
	4-3	Dark gray silt with sand & organics - Moist	S-10
20	2-2		
	3-3	Dark gray sandy silt - Moist	S-11
22	7-3		
	5-3	Mottled dark gray, light brown & gray sandy silt	S-12
24	3-6		
26		Bottom of boring 24.0'	
28		Screen 23'8" - 3'8"	
		Standpipe 3'8" - 0	
30		Stick up 3'4"	
		Sand 24' - 3'	
32		Bentonite 3' - 2'	
34			
36			
38			
40			

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall.
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NBN-00102-3.13-03/01/88

Herbert and Associates, Ltd.
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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-18 TYPE DRILL Acker TH. CLIENT Malcolm Pirnie

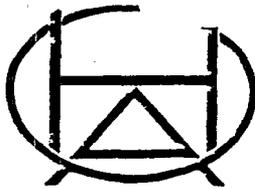
DATE STARTED 11/9/83 DATE COMPLETED 11/9/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0	7-100		
2	15-20	Dark brown silt with organics, glass, pebbles & cement	S-1
4	8-9		
4	4-5	Dark brown silt with pebbles - Dry	S-2
6	4-6		
6	5-7	Dark brown clayey silt with sand - Damp	S-3
8	3-5		
8	6-4	Light brown silty sand - Moist	S-4
10	7-5		
10	6-4	Brown silty sand - Wet - fine grain	S-5
12	3-5		
12	4-5	Light brown silty sand - Wet - fine grain	S-6
14	6-6		
14	5-5	Light gray silty sand - Wet - fine grain	S-7
16	2-3		
16	5-6	Light brown silty sand - Wet - fine grain	S-8
18	5-5		
18	6-6	Light brown silty sand - Wet - fine grain	S-9
20	2-3		
20	5-5	Light brown silty sand - Wet - fine grain	S-10
22	8-8		
22	8-6	Light brown silty sand - Wet - fine grain	S-11
24	8-2		
24	4-8	Light brown silty sand - Wet - fine grain	S-12
26		Bottom of boring 24.0'	
28			
30		Below surface 7'6"	
32		Stick up 2'6"	
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.

BORING NO. B-19 TYPE DRILL Acker TH CLIENT Malcolm Pirnie

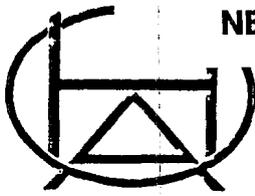
DATE STARTED 11/9/83 DATE COMPLETED 11/9/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 10' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	12-20 18-28	Dark gray fill material, sandy silt with concrete, Medium to fine grain sand	S-1
4	11-5 5-5	Dark gray sandy silt, fine grain - Damp	S-2
6	3-2 3-2	Dark gray silt with trace sands - Damp	S-3
8	3-2 4-3	Dark gray silt with trace sands - Damp	S-4
10	2-1 0-1	Alternating layer of dark gray silt and yellow-green silty sand	S-5
12	PUSH	Dark gray silt with sand - Wet	S-6
14	PUSH	Olive gray clayey silt - Wet	S-7
16	PUSH	Olive gray clayey silt - Wet	S-8
18	PUSH	Olive gray clayey silt - Wet	S-9
20	PUSH	Olive gray clayey silt with organics - Wet	S-10
22	PUSH 1-3	Gray sandy silt with pebbles - Wet	S-11
24	3-2 2-1	Gray sandy silt with pebbles - Wet	S-12
26	2-2 2-2	Gray silty sand - Wet - Medium to fine grain	S-13
28		Bottom of boring 26.0'	
30			
32		Below surface 7'3"	
34		Stick up 2'9"	
36			
38			
40			

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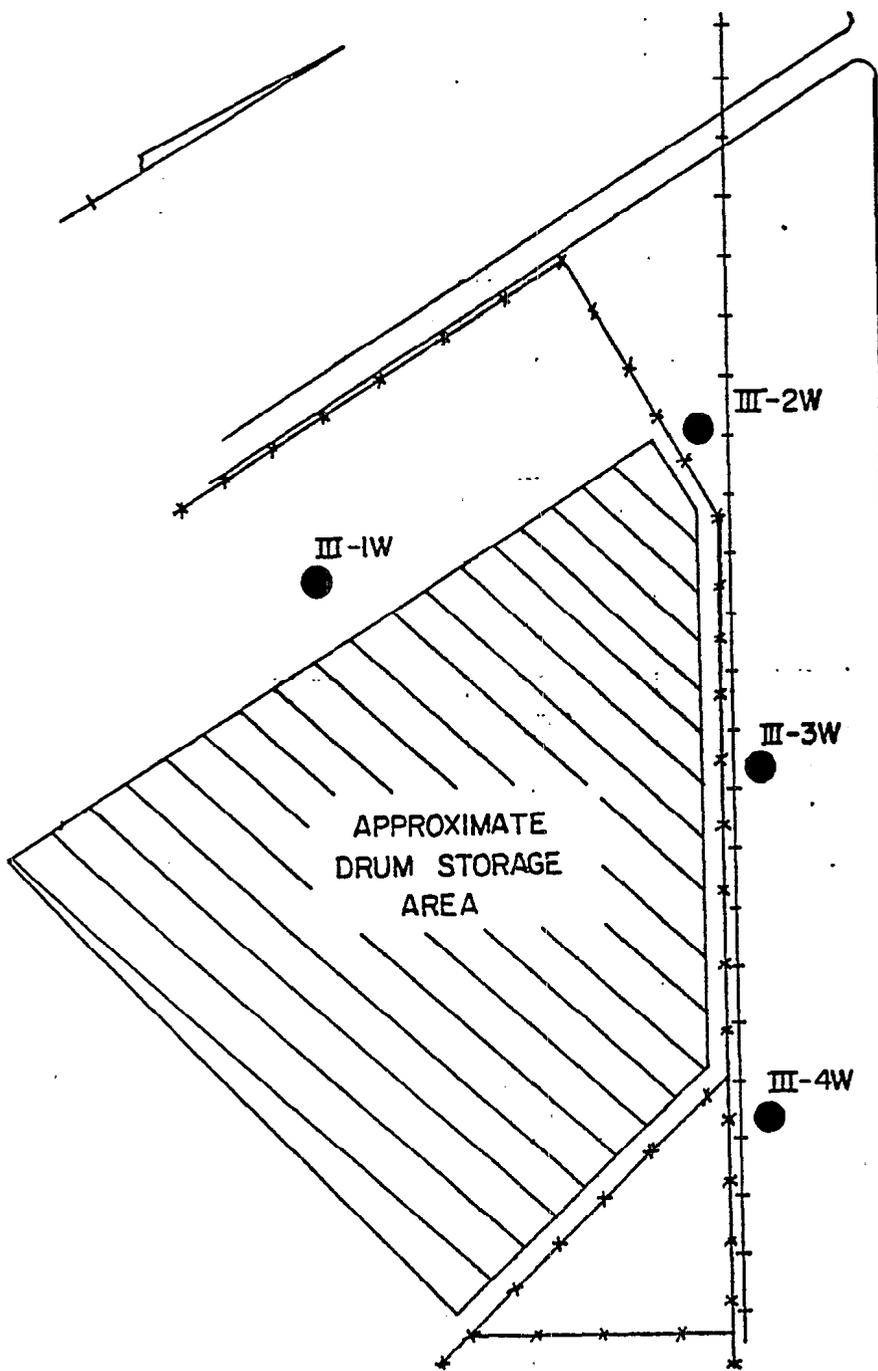
LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION CAMP ALLEN LANDFILL (Brig) LOCATION Norfolk, Va.
 BORING NO. B-20W TYPE DRILL Acker TH CLIENT Malcolm Pirnie
 DATE STARTED 11/14/83 DATE COMPLETED 11/14/83 DRILLER P. Herbert
 CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 5' AFTER --- HRS. ---
 TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	2-7	Dark gray silt with organics	S-1
4	9-9		
4	8-5	Tan & dark gray silt	S-2
6	4-5		
6	4-3	Dark gray silt - Wet	S-3
8	2-3		
8	1-0	Dark gray silt - Wet	S-4
10	1-0		
10	1-1	Dark gray clayey silt - Wet	S-5
12	1-0		
12	PUSH	Dark gray silty clay	S-6
14	PUSH	Dark gray silty clay	S-7
16	PUSH	Dark gray silty clay with organics	S-8
18	PUSH	Dark gray silty clay	S-9
20	PUSH	Dark gray silty clay	S-10
22	PUSH	Dark gray silty clay	S-11
24	PUSH	Dark gray silty clay	S-12
26	PUSH	Dark gray silty clay	S-13
28		Bottom of boring 26.0'	
30		Screen 22'2" - 2'2"	
32		Standpipe 2'2" - 0	
34		Stick up 2'10"	
36		Sand 23' - 3'	
38		Bentonite 3' - 2'	
40			

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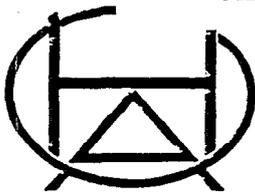


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VIRGINIA BEACH, VA

"Q" AREA DRUM STORAGE YARD
-BORING LOCATIONS-

JOB: 83-3545

DECEMBER 29, 1983



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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION "0" AREA DRUM STORAGE YARD LOCATION Norfolk, Va.

BORING NO. III-1W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

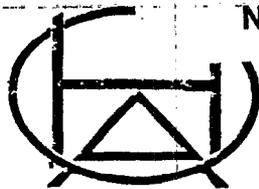
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER -- HRS. --

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	5-2	Light brown silty sand with shell hash - Damp	S-1
	9-14	Brown clay lens - 2" thick	
4	13-14	Light brown silty sand with shell hash & gravel - Damp	S-2
	15-12		
6	11-8	Light brown silty sand with shell hash & gravel - Damp	S-3
	7-7		
	7-8	Light brown silty sand with shell hash - Wet	S-4
8	6-4	Light brown silty sand with shell hash - Wet	S-5
	3-5		
10	4-3	Gray sandy with silt & some shell fragments - Wet	S-6
	6-5	Gray sand with silt & shell fragments - Wet	S-7
12	2-3	Gray sand with silt & shell fragments - Wet	S-8
	5-5		
14	1-1	Gray sand with silt & shell fragments - Wet	S-9
	1-2	Gray sand with silt & shell fragments - Wet	S-10
16	4-4	Gray sand with silt & shell fragments - Wet	S-11
	3-6		
18	8-11	Gray sand with silt & shell fragments - Wet	S-12
	14-11		
20	11-10	Green sand with silt & shell fragments - Wet	
	8-6		
22	9-12	Green sand with silt & shell fragments - Wet	
	10-10		
24	7-6	Green sand with silt & shell fragments - Wet	
26		Bottom of boring 24.0'	
28			
30		Screen 24' - 4'	
		Standpipe 4' - 0	
		Stick Up 3'	
32		Sand 25' - 3'	
		Bentonite 3' - 2'	
34			
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION "Q" AREA DRUM STORAGE YARD LOCATION Norfolk, Va.

BORING NO. III - 2W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

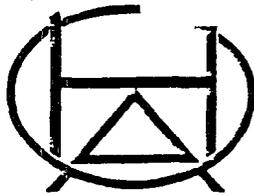
CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 7' AFTER --- HRS. ---

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. ---

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0		Dark brown silty topsoil with organics	
2	4-9	Light brown silty sand with shell hash	S-1
4	13-15	Light brown silty sand with shell hash	S-2
6	17-16	Light brown silty sand with shell hash	S-3
8	17-20	Light brown silty sand with shell hash	S-4
10	13-12	Light brown silty sand with shell hash - Wet	S-5
12	11-14	Gray silt with sand & sandy layers, shell fragments - Wet	S-6
14	8-9	Gray silt with sand & sandy layers, shell fragments - Wet	S-7
16	17-14	Gray sand with silt & shell fragments - Wet	S-8
18	6-6	Gray sand with silt & shell fragments - Wet	S-9
20	9-10	Gray sand with silt & shell fragments - Wet	S-10
22	7-10	Gray sand with silt & shell fragments - Wet	S-11
24	12-15	Gray sand with silt & shell fragments - Wet	S-12
26	8-10	Green silty sand with shell hash - Wet	
28	12-15	Green silty sand with shell hash - Wet	
30	5-4		
32	4-3		
34	2-7		
36	24-19		
38	12-16		
40	12-8		
	7-5		
	4-4		
	2-3		
	3-3		
		Bottom of boring 24.0'	
		Screen 24'2" - 4'2"	
		Standpipe 4'2" - 0	
		Stick Up 2'10"	
		Sand 25' - 3'	
		Bentonite 3' - 1'6"	

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION "Q" AREA DRUM STORAGE YARD LOCATION Norfolk, Va.

BORING NO. III - 3W TYPE DRILL Acker TH CLIENT Malcolm Pirnie

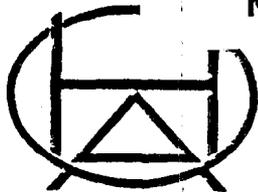
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P.Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER HRS.

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV.

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
	3-10		
2	14-20	Light brown silty sand with shell hash - Moist	s-1
	11-11		
4	15-19	Light brown silty sand with shell hash - Moist	S-2
	12-14		
6	14-16	Light brown silty sand with shell hash & clay lens - Moist	S-3
	5-7		
8	8-8	Light brown silty sand with shell hash - Wet	s-4
	5-7		
10	8-8	Light brown silty sand with shell hash - Wet	s-5
	5-8		
12	10-12	Gray sand with silt & shell fragments - Wet	S-6
	8-5	Gray sand with silt & shell fragments - Wet	S-7
14	13-19		
	7-7	Light brown silty sand with shell hash - Wet	S-8
16	4-5		
	3-5	Light brown silty sand with shell hash - Wet	S-9
18	5-6		
	4-4	Gray sand with silt & shell fragments - Wet	s-10
20	5-4		
	5-6		
22	6-6	Light brown silty sand with shell hash - Wet	S-12
	5-4		
24	6-5		
26		Bottom of boring 24.0'	
28			
30		Screen 24'4" - 4'4"	
		Standpipe 4'4" - 0	
32		Stick Up 2'3"	
		Sand 25' - 3'	
34		Bentonite 3' - 1'6"	
36			
38			
40			

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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION "Q" AREA DRUM STORAGE YARD LOCATION Norfolk, Va.

BORING NO. III - 4W TYPE DRILL Acker Th CLIENT Malcolm Pirnie

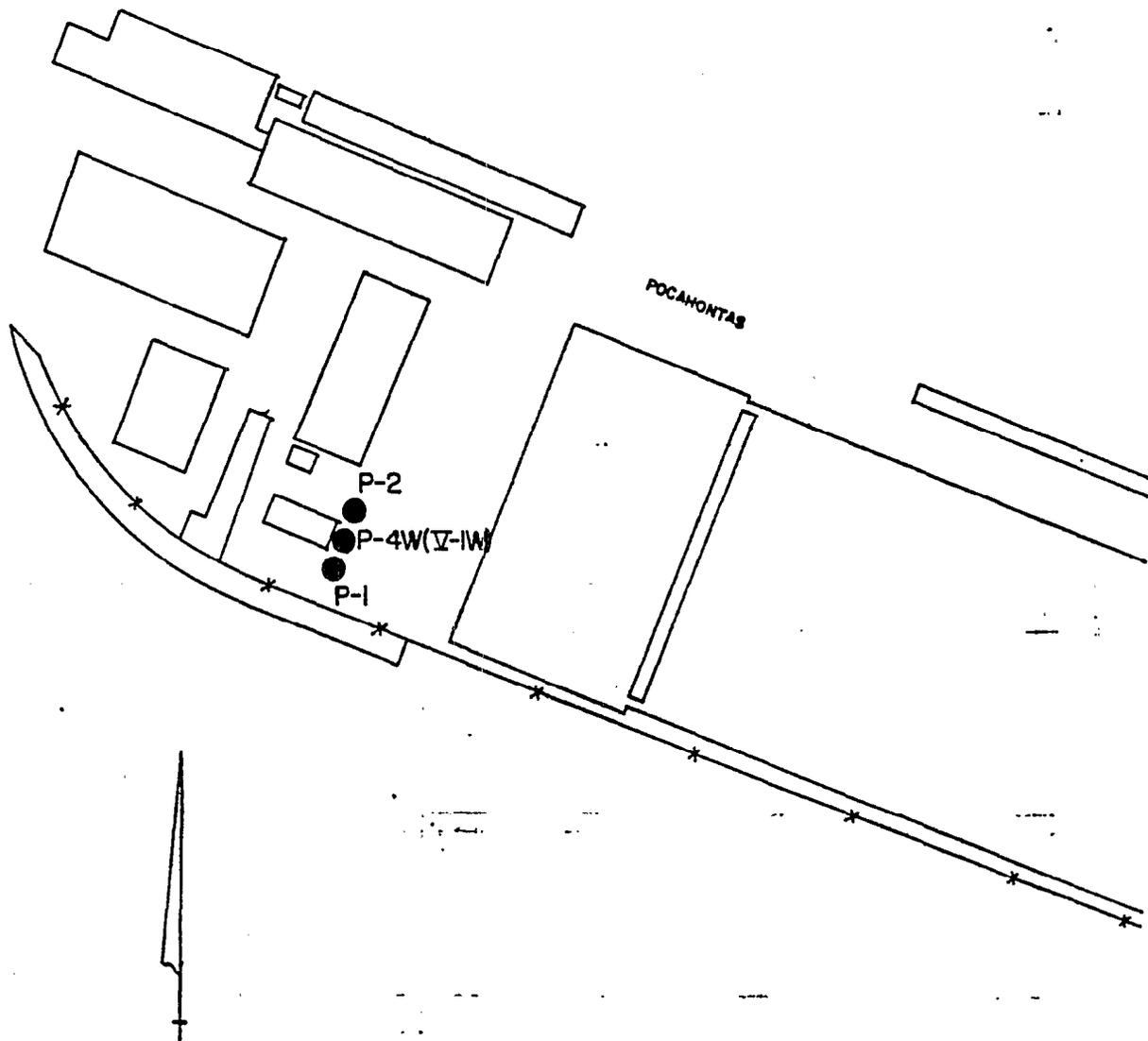
DATE STARTED 11/12/83 DATE COMPLETED 11/12/83 DRILLER P. Herbert

CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE 8' AFTER -- HRS. --

TYPE SAMPLER Ss LENGTH 30" DIA. 2"OD SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	4-7	Brown sand with silt & shell hash - Moist	S-1
4	11-13 13-11	Brown sand with silt & shell hash - Moist	S-2
6	14-13 13-14	Brown sand with silt & shell hash - Moist	S-3
8	11-13 10-12	Brown sand with silt & shell hash - Moist	S-4
10	10-9 6-6	Brown sand with silt & shell hash - Wet	S-5
12	7-8 5-5	Brown sand with silt & shell hash - Wet	S-6
14	4-3 2-2	Brown sand with silt & shell hash - Wet	S-7
16	2-1 2-6	Gray sand with silt & shell fragments - Wet	S-8
18	1-6 7-5	Gray sand with silt & shell fragments - Wet	S-9
20	5-6 5-6	Gray sand with silt & shell fragments - Wet	S-10
22	8-9 6-6	Gray sand with silt & shell fragments - Wet	S-11
24	9-7 9-7	Gray sand with silt & shell fragments - Wet	S-12
26		Bottom of boring 24.0'	
28			
30		Screen 23'3" - 3'3"	
32		Standpipe 3'3" - 0'	
34		Stick Up 3'9"	
36		Sand 24' - 3'	
38		Bentonite 3' - 2'	
40			

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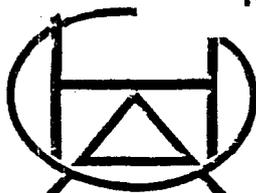


HERBERT &
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VIRGINIA BEACH, VA

PESTICIDE DISPOSAL SITE V-95
-BORING LOCATIONS-

JOB: 83- 3545

DECEMBER 29, 1983



Herbert and Associates, Ltd.
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LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION PESTICIDE SITE LOCATION Norfolk, Va.

BORING NO. P-1 TYPE DRILL CME-45B CLIENT Malcolm Pirnie

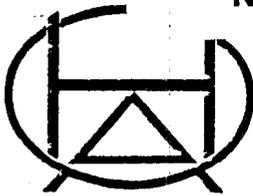
DATE STARTED 11/16/83 DATE COMPLETED 11/16/83 DRILLER R. Seage

CASING LENGTH _____ DIA. _____ WATER ELEV: IMMEDIATE 7' AFTER _____ HRS. _____

TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. _____

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2	10-11	Olive green & brown sandy silt with metal - Damp	S-1
4	17-16	Olive green graded to silty sand - Damp	S-2
6	13-17	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-3
8	16-22	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-4
10	20-22	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-5
12	24-25	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-6
14	9-16	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-7
16	20-27	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-8
18	10-10	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-9
20	14-12	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-10
22	4-5	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-11
24	9-12	Gray sand with silt (pebbles) - Wet - Medium to fine grain	S-12
26	4-5	Gray sand with silt (pebbles) - Wet - Medium to fine grain	
28	6-1	Green sandy clay - Moist	
30	1-1		
32	1-1		
34	2-0	Olive green sand with silt - Wet - fine to medium grain	
36	2-1	Olive green sand with silt - Wet - fine to medium grain	
38	2-1	Olive green sand with silt - Wet - fine to medium grain	
40	0-1	Olive green sand with silt - Wet - fine to medium grain	
	WOR-1	Olive green sand with silt - Wet - fine to medium grain	
	1-1	olive green silty sand - Wet - fine grain	
	1-1		
	1-0		
26		Bottom of boring 24.0'	
28			
30			
32			
34			
38			
40			

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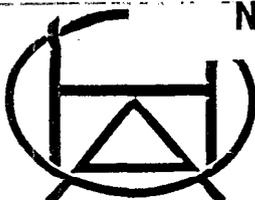
LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION PESTICIDE SITE LOCATION Norfolk, Va.
 BORING NO. P-2 TYPE DRILL CME-45B CLIENT Malcolm Pirnie
 DATE STARTED 11/16/83 DATE COMPLETED 11/16/83 DRILLER R. Seage
 CASING LENGTH _____ DIA. _____ WATER ELEV: IMMEDIATE 5' AFTER _____ HRS. _____
 TYPE SAMPLER SS LENGTH 30" DIA. 2"OD SURF. ELEV. _____

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO
0			
2	6-9	Brown & olive green sandy silt with gravel - Damp - fine grain	S-1
4	13-21	Olive gray silty sand with shell fragments & pebbles - Damp fine grain	S-2
6	18-14	Olive gray silty sand with shell fragments & pebbles - Wet fine grain	S-3
8	18-22	Olive gray silty sand with shell fragments & pebbles - Wet fine grain	S-4
10	20-28	Olive gray silty sand with shell fragments & pebbles - Wet Medium to fine grain	S-5
12	30-33	Olive gray silty sand with shell fragments & pebbles - wet Medium to fine grain	S-6
14	16-15	Olive gray silty sand with shell fragments & pebbles - wet Medium to fine grain	S-7
16	21-27	Olive gray silty sand with shell fragments & pebbles - Wet Medium to fine grain	S-8
18	9-8	Olive green clay - Wet	S-9
20	3-2	Olive gray silty sand with shell fragments - wet - Medium to fine grain	S-10
22	1-3	Olive gray silty sand with shell fragments - Wet - Medium to fine grain	S-11
24	5-7	Olive gray silty sand with shell fragments - Wet - Medium to fine grain	S-12
26	5-7	Olive gray silty sand with shell fragments - Wet - Medium to fine grain	
28	5-9		
30	2-2		
32	1-1		
34	3-2		
36	2-0		
38	3-0		
40	1-0		
	Wt. of hammer		
	2-0		
	1-0		
	2-1		
	0-1		
28		Bottom of boring 26.0'	
30			
32			
34			
36			
38			
40			

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED, utilizing a 140 pound hammer with a 30 inch fall.
 Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar products.



Herbert and Associates, Ltd.
 TESTING • ENGINEERING • INSPECTING
 POST OFFICE BOX 64758 • VIRGINIA BEACH, VA. 23464 • PHONE (804) 420-2797

LOG OF BORING

FILE NO. 83-3545

PROJECT IDENTIFICATION PESTICIDE DISPOSAL SITE LOCATION Norfolk, Va.
 BORING NO. P-4W (V-1W) TYPE DRILL Acker Th CLIENT Malcolm Pirnie
 DATE STARTED 11/16/83 DATE COMPLETED 11/16/83 DRILLER R. Seage
 CASING LENGTH -- DIA. -- WATER ELEV: IMMEDIATE -- AFTER -- HRS. --
 TYPE SAMPLER -- LENGTH -- DIA. -- SURF. ELEV. --

DEPTH	STD. PEN. (N)*	SAMPLE DESCRIPTION	SAMPLE NO.
0			
2		NOTE: Monitoring Well Only	
4			
6			
8			
10			
12		Screen: 24'3" - 4'3"	
14		Stand Pipe: 4'3" - 0'	
16		Stick UP: 2'9"	
18		Sand: 25' - 3'	
20		Bentonite: 3' - 2'	
22			
24			
26			
28			
30			
32			
34			
36			
38			
40			

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