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# ASSEMBLY B RFI REPORT
# NAVAL SUPPPORT ACTIVITY MEMPHIS
# MILLINGTON, TENNESSEE

## RCRA FACILITY INVESTIGATION
## SWMU 4, 6, 10, 31, AND 38
## NORTHSIDE INDUSTRIAL DRAINAGE DITCHES

**Revision 2**

**CTO-094**
**Contract No. N62467-89-D-0318**

**Prepared for:**

**Department of the Navy**
**Southern Division**
**Naval Facilities Engineering Command**
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**January 3, 1997**

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## EXECUTIVE SUMMARY

The Assembly B Site Investigation Plans proposed a RCRA Facility Investigation (RFI) for Solid Waste Management Units (SWMUs) 4, 6, 10, 31, and 38, which comprise the Northside Industrial Drainage Ditches or associated SWMUs. The RFI consisted of collecting and analyzing 26 sediment samples from 18 locations throughout the drainage ditches and North Fork Creek. The objectives of the sediment sampling program were to confirm whether any contaminants were present in the sediment and their association with previous activities at SWMUs 4, 6, 10, 31, and 38, or any other SWMU on the NSA Memphis Northside. To evaluate the risk to human health and ecological receptors, the sediment sample results were used to prepare a Baseline Risk Assessment (BRA) and an Ecological Risk Assessment (ERA). Contaminant fate and transport were also evaluated.

Sediment contaminants consisting of volatile organic compounds, semivolatile organic compounds, total petroleum hydrocarbons, metals, pesticides, and herbicides were identified throughout the drainage ditches and in North Fork Creek. Based on the elevated concentrations of SVOCs, metals, and TPH detected, the contamination appeared to be related to the discharge of petroleum. Analytical data indicated the vertical extent of this contamination was mostly limited to sediment in the uppermost 6 inches of the ditch beds, except for those locations where the highest contaminant concentrations were identified in the 18 to 24 inch interval. Horizontally, most of the contaminated sediment was in the drainage gullies leading from SWMU 10 (the eastern portion of the Northside Landfill) into the SWMU 38 drainage ditch and directly below the outfalls. However, it is unclear whether contamination detected at the water line immediately below the gullies that drain SWMU 10 was a result of deposition from upstream sources or runoff from SWMU 10. Additional soil/sediment samples were collected on the landfill surface itself and within the gullies leading from the landfill during a confirmatory sampling investigation (CSI) at SWMU 10 in May 1996. The analytical results for these samples were reported in the SWMU 10 CSI Report.

The BRA evaluated the risk and hazard to human health using two exposure scenarios: The hypothetical reasonable maximum exposure to site workers and the hypothetical seasonal maximum exposure child (adolescent) trespasser scenario. Incidental ingestion and dermal contact exposure pathways were used to address potential future sediment exposure. Chemicals of concern (COCs) were identified for various exposure scenarios to determine whether they exceed an excess cancer risk of 1E-4 or a hazard index of 1. No COCs exceeded these thresholds, thus negating the necessity of calculating remedial goal options for the Northside Industrial Drainage Ditches. Based on the BRA, the property comprising the Northside Industrial Drainage Ditches is suitable for lease in either industrial or residential scenarios.

The ERA determined that the risk to ecological receptors resulting from contaminants identified within the drainage system was low. Although most inorganic concentrations were above USEPA Region IV sediment screening values (SSVs), a higher percentage were below the background reference concentrations (RC). A lack of a viable benthic or aquatic community within the drainage system further reduces any ecological risk potential. Based on the ERA, no further investigation of ecological parameters is recommended for the Northside Drainage Ditches or North Fork Creek.

The contaminant fate and transport evaluation concluded that contaminants detected in sediment had a low migration potential and appeared tightly bound to the clayey sediment in the ditches, so they are not likely to be dissolved in the water column or transferred to North Fork Creek.

Based on the BRA, ERA, and the evaluation of contaminant fate and transport, no further action is recommended for the Northside Industrial Drainage Ditches.



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## 1.0 INTRODUCTION

As part of the U.S. Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report has been prepared for Solid Waste Management Units (SWMUs) 4, 6, and 38, the Northside Industrial Drainage Ditches; SWMU 31, the Aircraft Wash Rack at Fourth Avenue, which drains through a sewer into SWMU 6; and that portion of the SWMU 38 ditch bordering the western boundary of SWMU 10, the Northside Landfill, Eastern Portion. These SWMUs are located at the Naval Support Activity (NSA) Memphis in Millington, Tennessee. As a result of the Base Closure and Realignment Act of 1990, portions of the former Naval Air Station Northside that includes these industrial drainage ditches and other sites will be closed and prepared for transfer to the City of Millington. The drainage ditches comprise part of the 15 SWMUs within the Northside requiring full RFIs because of known or suspected releases of hazardous substances. These RFI SWMUs have been categorized into three assemblies (Assemblies A, B, and E) according to their Base Realignment and Closure (BRAC) status. SWMUs 4, 6, 10, 31, 38, and 40 (former Salvage Yard No 1) are the Assembly B SWMUs.

The RFI, undertaken by EnSafe/Allen & Hoshall (E/A&H), adhered to the requirements of the Hazardous and Solid Waste Amendments portion of RCRA Permit No. TN2-170-022-600 and applicable regulations. The report summarizes activities conducted during the investigation and the resulting findings and conclusions.

SWMUs 4, 6, 10, 31, and 38 are parts of or associated with a drainage ditch and sewer system that begins as SWMUs 4, 6, and 31, and drains through SWMU 38 into North Fork Creek which borders the activity to the west. Sample locations along the SWMUs were grouped by proximity to each other, or to a particular SWMU (in the case of SWMUs 10 and 31). Figure 1-1 provides a map of SWMUs 4, 6, 10, 31, and 38 and their associated sample locations.



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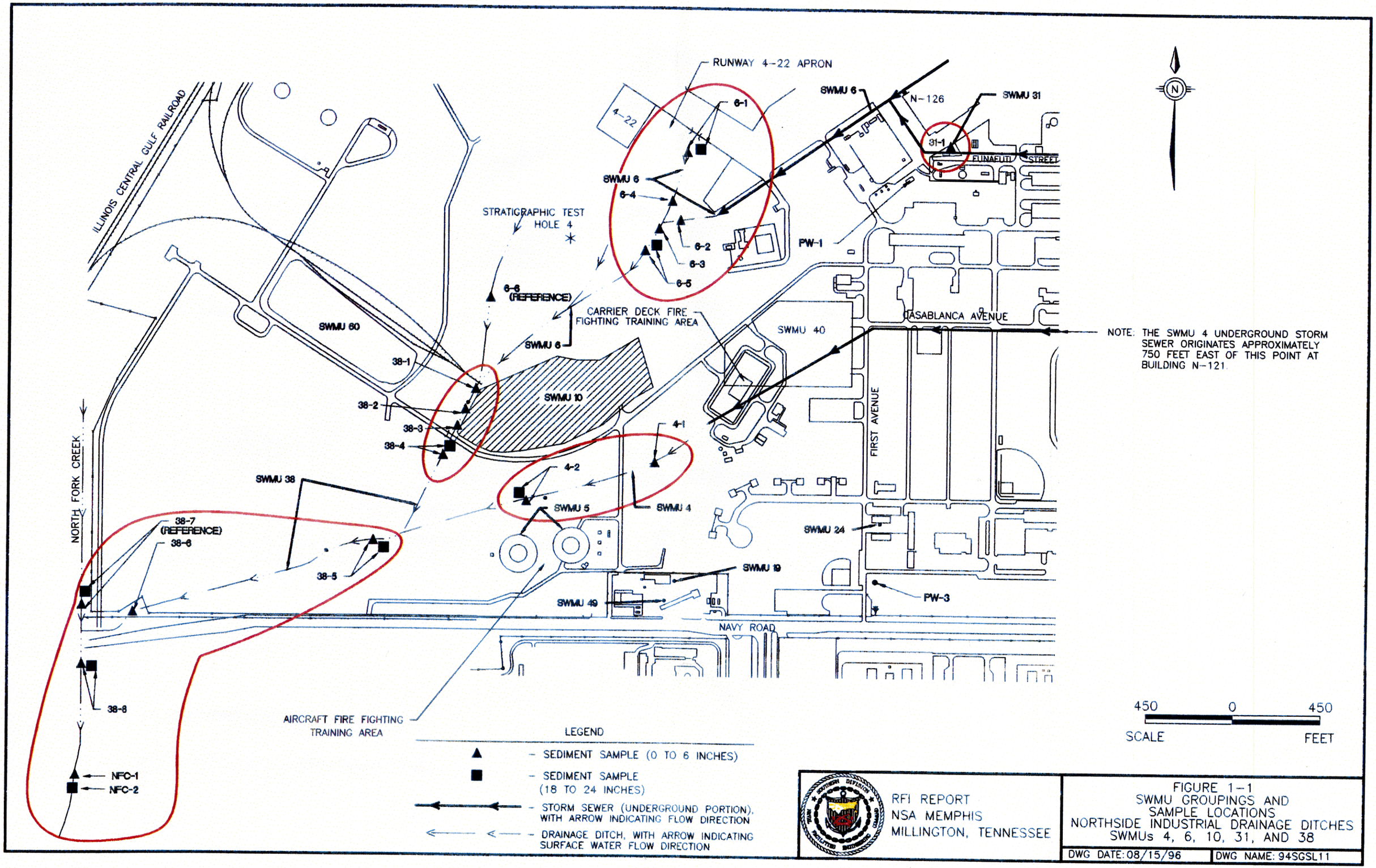
RUNWAY 4-22 APRON
4-22
6-1
SWMU 6
6-4
6-2
6-3
6-5
SWMU 6
N-126
SWMU 31
31-1
FUNAFUTI STREET
PW-1
ILLINOIS CENTRAL GULF RAILROAD
STRATIGRAPHIC TEST HOLE 4
6-6 (REFERENCE)
CARRIER DECK FIRE FIGHTING TRAINING AREA
SWMU 6
SWMU 60
38-1
38-2
38-3
38-4
SWMU 10
SWMU 40
CASABLANCA AVENUE
NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.
FIRST AVENUE
4-1
4-2
SWMU 38
SWMU 5
SWMU 4
NORTH FORK CREEK
38-7 (REFERENCE)
38-6
38-5
SWMU 24
SWMU 19
SWMU 49
PW-3
NAVY ROAD
38-8
AIRCRAFT FIRE FIGHTING TRAINING AREA
NFC-1
NFC-2
LEGEND
- SEDIMENT SAMPLE (0 TO 6 INCHES)
- SEDIMENT SAMPLE (18 TO 24 INCHES)
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION
450 0 450
SCALE FEET
RFI REPORT
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 1-1
SWMU GROUPINGS AND SAMPLE LOCATIONS
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38
DWG DATE: 08/15/96
DWG NAME: 94SGSL11

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# 2.0 SITE DESCRIPTION AND BACKGROUND INFORMATION

## 2.1 Site Description

SWMUs 4, 6, 10, 31, and 38 are in the northwest quadrant of NSA Memphis. The drainage ditches and associated other SWMUs receive influent from surface runoff, storm sewers, and formerly, wastewater discharges from various buildings in the central and southwestern portions of the NSA Memphis Northside. Figure 1-1 shows the locations of the drainage ditches and associated SWMUs.

The general topography of the SWMU areas consists of a subtle downward slope of 1% to 3% to the west. The SWMUs drain southwest, entering North Fork Creek from SWMU 38 at the southwest corner of NSA Memphis Northside.

## 2.2 Site History

The original design of several buildings at NSA Memphis (circa 1943) included floor drains which discharged to storm-sewer drains. By 1980, most floor drains had been eliminated or re-routed to the sanitary sewer as buildings were remodeled or replaced. Substances such as solvents, degreasers, oils, and paints may have been discharged to the drainage ditches. Each of the individual SWMUs is described below.

**SWMU 4 — Building N-121 Plating Shop Storm Sewer and Drainage Ditch**

SWMU 4 originates as a storm sewer at Building N-121 and runs westerly along Casablanca Street to First Avenue, then southwesterly to a section of open drainage ditch which discharges into SWMU 38. Building N-121, at the northwest corner of the intersection of Eighth and Casablanca Avenues, housed a plating shop where cadmium, chromium, copper, nickel, and cyanide-based solutions were used. The Building N-121 Plating Shop Dry Well (SWMU 3) was reportedly used for disposal of small quantities of concentrated plating solutions and plating-tank overflow. Previous reports state that up to 17,000 gallons per day of dilute



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wastewater was discharged into the storm sewer and drainage ditch from operations at Building N-121 (Harmon, 1983).

Sections of the culverted portion of SWMU 4 were investigated in 1988, before the Carrier Deck Fire Training Area (Figure 1-1) was constructed (SOUTHDIV, 1988). The interior joints of the storm sewer were photographed to determine where leaks could occur. Soil samples were collected around any pipe joints suspected of leaking. Analytical data did not identify any storm sewer releases in these areas. Total petroleum hydrocarbon (TPH) concentrations ranging from 32.1 milligrams per kilogram (mg/kg) to 660 mg/kg were identified in sediment sampled from an unculverted reach of SWMU 4, upstream and adjacent to SWMU 5, and southwest of the Carrier Deck Fire Training Area during an Interim Measures (IM) investigation conducted on October 1992 (SOUTHDIV, 1993).

**SWMU 6 — Building N-126 Battery Shop Storm Sewer and Drainage Ditch**

SWMU 6 (Figure 1-1) originates as an underground storm sewer at Building N-126 and as an open drainage ditch just south of the Runway 4-22 apron. The underground portion of SWMU 6 at Building N-126 flows southwesterly to the end of the apron along Runway 4-22, where it turns due west and becomes an open drainage ditch, intersecting the open drainage ditch south of the Runway 4-22 apron. The open drainage ditch portion of SWMU 6 continues southwest to a point between SWMU 60 (Northside Landfill, Western Portion) and SWMU 10 (Northside Landfill, Eastern Portion), where it empties into the SWMU 38 drainage ditch.

Building N-126 is located in the flight operations area. A battery shop in the northeast corner of the building operated from 1955 until 1981 and reportedly discharged liquid battery wastes through drains into SWMU 6. SWMU 6 is part of the storm sewer system which currently drains the N-126 area. When the battery shop in Building N-126 was operating, approximately 100 gallons per day of a diluted and neutralized acid mixture reportedly was discharged into the



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storm sewer. Electrolyte spills and drippings also were discharged into Building N-126 floor drains. These floor drains were connected to 3- and 4-inch acid-resistant pipes which emptied into the storm sewer. The sewer reportedly has been damaged by the acid releases. Substantial erosion also has been identified where the storm sewer discharges into the ditch west of Building N-126.

**SWMU 10 — Northside Landfill, Eastern Portion**

SWMU 10 is north of SWMU 5, the Aircraft Fire Fighting Training Facility (AFFTF, see Figure 1-1) and south of the main runway (Runway 4-22). Although the boundaries of the landfill are not known exactly, it is suspected to cover 13 to 20 acres. The area originally was a ravine reportedly used for construction debris disposal. The only documented description of waste disposal at the site is found in several 1980 contract documents which required contractors to use the area for disposal of rubbish and construction debris (i.e., construction materials, paper, metal scrap, leaves, and ash associated with paper incineration). SWMU 10 originally was designated as a "No Further Action" site because of the presumed nature of its contents. Visual inspections along the banks of SWMU 6, where it flows past SWMU 10, have identified erosion and debris in the banks of the ditch on the landfill side. Because of this and the planned transfer of this property to the City of Millington, SWMU 10 was partially assessed during this RFI by sampling the bank sediments of SWMUs 6 and 38 to determine whether contaminants are leaching from the landfill.

**SWMU 31 — Aircraft Wash Rack At Fourth Avenue**

SWMU 31 is at Funafuti Street and Fourth Avenue, just southeast of Building N-126 (Figure 1-1). It is connected to the underground storm sewer portion of SWMU 6. The wash rack, a paved area that slopes to a catch basin in the parking lot, was first used in 1956 to rinse treatment chemicals from aircraft. According to Public Works Office personnel, the unit is structurally sound and is presently serviceable, but has not been used to wash aircraft for at least



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10 years. Aluminum parts on aircraft were reportedly treated with chromic acid ("alodine") before arriving at the wash rack. The aircraft then were washed with a high-pressure detergent to remove the acid. Wastewater on the concrete slab collected in the catch basin connected to the storm sewer leading to SWMU 6.

**SWMU 38 — Miscellaneous Drainage Ditches in the Industrial Areas of NSA Memphis**

SWMU 38 consists of miscellaneous ditches draining the industrial areas in the northern portion and a small part of the southern portion of the base. The open drainage ditches constituting SWMU 38 in the NSA Memphis Northside flow to the southwest, where they eventually discharge into North Fork Creek. SWMU 38 is intersected by SWMU 6 south of Runway 4-22, and SWMU 4 northwest of the AFFTF (SWMU 5). Only the ditches in the northern portion of the base are being investigated as part of Assembly B because of closure of this side of the base under BRAC. NSA Memphis Southside ditches comprising the other part of SWMU 38 will be addressed later during the Assembly E RFIs.

Surface-water runoff and numerous other outfalls from the north side of the base also discharge into SWMU 38. Most wastes entering the drainage ditch would be transported downstream with flow. However, some contaminants such as metals may reside in sediments near the outfalls.



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## 3.0 PRELIMINARY INVESTIGATIONS

Except for SWMU 4, the areas included in this investigation previously have not been studied. SWMU 4 was included in two previous investigations (SOUTHDIV, 1988 and 1993) which are summarized below.

### 3.1 Sampling Report — Southern Division Naval Facilities Engineering Command (1988)

In 1988, SOUTHNAVFACENGCOM initiated an investigation of the culverted storm sewer part of SWMU 4. The sewer was photographed internally to determine if leaks had occurred at the pipe joints. Twenty-six joints were identified as suspect. The locations of these joints were determined at land surface and soil samples were collected adjacent to the sewer from different depth intervals ranging from 5 to 8 feet below land surface for metals and cyanide analyses. Analytical data did not identify any releases to surrounding soil. Appendix A contains a copy of the relevant portions of the 1988 Sampling Report.

### 3.2 Technical Memorandum — SWMUs 4 and 5 — Southern Division (1993)

Fieldwork for an IM investigation at the AFFTF (SWMU 5) was conducted by the U.S. Geological Survey (USGS) in October 1992 to determine if pending construction-project activities would threaten site workers. As part of the investigation, sediment samples were collected along a portion of SWMU 4 both upstream of and within the SWMU 5, and from areas in ditches draining SWMU 5 and emptying into SWMU 4. The samples were tested for full-scan analysis (FSA) to determine if there had been any impact from training activities at the AFFTF or the Carrier Deck Training Facility located northeast of the AFFTF. Analytical data indicated TPH concentrations ranging from 32.1 mg/kg to 660 mg/kg in sediment in SWMU 4 at a location just upgradient from the eastern boundary of the AFFTA. In addition to petroleum constituents, some sediment samples also tested positive for 1,2-dichloroethene (0.10 mg/kg), cyanide (3.6 mg/kg), and metals. Appendix A contains a copy of the 1993 Technical Memorandum.



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## 4.0 FIELD INVESTIGATIONS AND METHODOLOGY

The objectives of the Assembly B RFI sampling program were to confirm whether contaminants are present in the drainage ditch sediment and their association with previous activities at SWMUs 4, 6, 10, 31, 38, or any other SWMU on the NSA Memphis Northside. This section summarizes the field sampling protocols employed during the RFI, which were based on the U.S. Environmental Protection Agency (USEPA)- and Tennessee Department of Environment and Conservation (TDEC)-approved *Comprehensive RFI Work Plan* (E/A&H, 1994) and *Assembly B Site Investigation Plans* (E/A&H, 1995a).

The analytical methods used for sediment-sample analyses are presented in Section 4.1 of this report. General sampling rationale and methods for the sediment investigation are organized and presented in Sections 4.2 and 4.3. Specific sampling protocols (sample handling, field Quality Assurance/Quality Control [QA/QC], and decontamination) are presented in Section 4.4.

### 4.1 Analytical Methods

In accordance with the *Assembly B Site Investigation Plans*, sediment samples were submitted to the National Environmental Testing (NET) laboratory in Bedford, Massachusetts, for the following analyses:

| *Analysis* | *Method* |
|---|---|
| Volatile Organic Compounds | USEPA 8240 |
| Semivolatile Organic Compounds | USEPA 8270 |
| Total Petroleum Hydrocarbons | USEPA 418.1 |
| Total Petroleum Hydrocarbons — Gasoline and Diesel-Range Organics | TN Modified 8015-GRO.BTEX/DRO |
| Chlorinated Pesticides/Polychlorinated Biphenyls | USEPA 8080 |
| Organophosphorus Pesticides | USEPA 8140 |



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| *Analysis* | *Method* |
|---|---|
| Chlorinated Herbicides | USEPA 8150 |
| 40 CFR Pt. 264 Appendix IX Metals | USEPA Method 6010/7000 Series |
| Cyanide | USEPA Method 9012 |

Reporting requirements were based on the Contract Laboratory Program (CLP). Sediment samples were analyzed using Level III-equivalent Data Quality Objectives (DQOs) for 95% of the samples and Level IV-equivalent DQOs for the remaining 5%.

## 4.2 Sediment Sampling Rationale

The E/A&H sampling team comprised a field scientist and a technician, who were responsible for selecting, collecting, and processing the samples for submittal to the analytical laboratory. On May 1, 1995, E/A&H performed a site reconnaissance and selected seventeen sampling locations to provide adequate coverage throughout the drainage ditches. From May 3 through May 5, 1995, E/A&H collected 24 sediment samples from the following intervals at the selected locations:

- 0 to 6 inches below the beds of the ditches from all 17 sampling locations
- 18 to 24 inches below the beds of the ditches from seven of the 17 sampling locations

The shallower 0 to 6-inch sampling locations were selected to ensure that at least two sediment samples would be collected from each outfall or confluence area, one upstream and one downstream, to determine if contaminants were present. The deeper 18 to 24-inch sediment/soil samples were collected from seven of the 17 locations to determine whether contaminants have migrated downward through the sediment. In addition to providing assessment of the upstream and downstream conditions, the two samples (locations 4-1 and 4-2) collected from the drainage ditch (SWMU 4) adjacent to SWMU 5 provided data for comparison to 1993 investigation



900020

results, which indicated TPH concentrations up to 660 mg/kg. Based on the recommendations of the E/A&H March 19, 1996 Technical Memorandum, two additional sediment samples were collected from one location between sample location 38-8 and a mobile home park, approximately 1,000 feet downgradient from sample 38-8. The samples were collected on May 2, 1996. Figure 1-1 shows the sample locations and corresponding sample intervals.

## 4.3 Sediment Sampling Methods

Samples from the 0- to 6-inch interval were collected with plastic scoops using procedures outlined in Sections 4.4.3 and 4.7.2 of the *Comprehensive RFI Work Plan*. The first 18- to 24-inch sediment sample (location 6-1) was collected using a hollow stainless-steel tube, with the sample pushed out from the tube with a stainless-steel rod. Because of the density of the clayey sediment at this interval, the E/A&H scientist determined that the stainless-steel tube would not be adequate for collecting sediment samples. Therefore, a stainless-steel hand auger was used to collect the remaining 18- to 24-inch interval sediment samples using the methods outlined in Sections 4.4.3 and 4.7.2 of the *Comprehensive RFI Work Plan*.

In some areas, it was difficult to collect a discrete sediment sample from the 18- to 24-inch interval. At some sampling locations, standing water deeper than 1 to 2 inches was present and caused the auger hole to fill with loose sediment. Where water was too deep or sediment filling hindered proper sediment sample collection from the 18- to 24-inch interval, the samples were collected directly from the channel or bank at the water line. These samples are not expected to drastically differ in characteristics from the bed sediment, as they appear to have been underwater with the same frequency and therefore, would be similar to adjacent bed sediment in respect to contamination.



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All sediment samples were classified in the field by an E/A&H scientist in accordance with the Unified Soil Classification System (USCS) and documented with other pertinent information in a field log.

## 4.4 Sediment Sampling Protocol

All sampling activities adhered to the approved *Comprehensive RFI Work Plan* and the *Assembly B Site Investigation Plans*. Sample handling was minimized. When transferring material from the sampling device to containers, the operation was conducted expediently, in as clean an environment as possible. New gloves were donned before collecting each sample. Empty containers were kept packaged until filled, after which they were immediately chilled and isolated in coolers. Samples for analysis of volatile organic compounds (VOCs) were containerized first from unhomogenized sediment to minimize loss of volatile constituents. The remaining sample was homogenized in a stainless-steel mixing bowl and placed in an appropriate container.

Samples requiring chemical preservation were preserved in the field according to the USEPA Region IV *Standard Operating Procedures and Quality Assurance Manual* (USEPA, 1991). Immediately following sample collection, each sample container was labeled, a custody seal was placed over the lid with the sample ID, date, and sampler's name designated, then the sample was placed in a cooler.

### Sample Processing and Chain-of-Custody Procedures

The sediment samples, typically submitted to the laboratory the day of collection, were individually bubble-wrapped, bagged in resealable plastic bags, and packed on sealed ice inside sturdy coolers with sufficient volume to maintain uniform and appropriate preservation temperatures during shipment. Cooler lids were secured with packing tape and sealed with signed custody seals. Packaged samples were shipped via overnight service for next morning



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delivery. The laboratory was notified the day of shipment of the number of samples to be submitted. E/A&H personnel were contacted the following day, acknowledging receipt and the condition of submitted samples. All sample shipments were reported to have arrived at the laboratory in good condition and at appropriate temperatures.

To ensure the integrity of the sample transfer process, a strict chain-of-custody procedure was implemented for all samples collected. This procedure was initiated in the field for each sampling event and conducted through custody transfer to the contract laboratory. A chain-of-custody form was completed for each batch of samples, itemizing sample numbers, containerization, preservatives, analyses requested, date and time of sampling, and shipment number. Custody transfers were recorded by signature, date, and time of relinquishment, and receipt of custody by the parties involved.

**Sample Labeling**

All samples collected in the field were labeled with a 10-digit alphanumeric code identifying the site, sample type, sample location, sample depth, and QA sample type (as appropriate). The first three digits identify the site location (SWMU 4 = 004). The fourth digit identifies the sample type (sediment = M, sediment duplicate = N). The fifth through eighth digits represent the station location (sample location 4 = 0004). The final two digits represent the deepest point of the sample interval to the nearest foot (18 to 24 inches = 02). Matrix codes and QA/QC designations are provided in Attachment 1 (Data Validation Report), along with the analytical results, and in Attachment 2, the data validation report for supplemental samples.



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Examples:

- 004M000201 SWMU 4/sediment/sample location 2/0 to 6 inch depth
- 038N000502 SWMU 38/sediment duplicate/sample location 5/18 to 24 inch depth

## 4.5 QA/QC Samples

QA/QC samples were collected to test the level of reproducibility attainable in the sampling and analytical process, quality of equipment decontamination, quality of source waters and materials, sample exposure to ambient contamination during handling, and the level of laboratory precision and accuracy. QA/QC samples were analyzed for the same contaminant assessment parameters as the associated environmental samples. All field QA/QC samples were collected in accordance with the work plans and consisted of the following:

**Type and Frequency**

- *Duplicate* samples were collected at a frequency of 10% of soil and groundwater samples.
- Equipment *rinsate* samples were collected at a frequency of one per week during sampling activities.
- *Field blanks* were collected once per sampling event (week) per source of water.
- *Matrix spikes/matrix spike duplicates* were designated at a frequency of 5% of the samples collected.



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- *Trip blanks* were submitted with each cooler containing VOC samples.

- *Temperature blanks* were submitted with each cooler.

## 4.6 Data Validation

NSA Memphis Assembly B data were validated either by E/A&H or E/A&H's subcontractor, Validata Chemical Services of Norcross, Georgia. Data validation adhered to the *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (USEPA, February 1994). The data validation findings for all Assembly B SWMUs are presented in the *Data Validation Report — NSA Memphis Assembly B* (E/A&H, 1995), provided as Attachment 1, or in the *Data Validation Report for Supplemental Samples* (E/A&H, 1996), provided as Attachment 2.

## 4.7 Decontamination

Field equipment was decontaminated following guidelines set forth in the work plan. All sampling equipment was decontaminated at the central decontamination pad at the N-7 aircraft wash rack, before and after use. Decontamination procedures consisted of the following steps:

- Hand scrub with soap and potable water.
- Rinse with potable water.
- Rinse with deionized, organic-free water.
- Rinse twice with pesticide-grade isopropyl alcohol.
- Rinse with deionized, organic-free water.
- Wrap with aluminum foil.



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A new pair of disposable latex gloves was donned before handling decontaminated sampling equipment. Rinse water from decontamination activities was stored in a 1,200-gallon holding tank at the decontamination pad and emptied after a VOC scan and approval from the City of Millington's wastewater consultant, Fisher & Arnold, Inc. Sediment samples were collected directly from the sampling device; therefore, no investigation-derived waste was generated.



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# 5.0 GEOLOGY AND HYDROGEOLOGY

## 5.1 Regional Geology and Hydrogeology

The general hydrogeology of the Memphis area is discussed in detail in Section 2.11 and a conceptual model of the hydrogeology at the NSA is presented in Section 2.12 of the *Comprehensive RFI Work Plan*. Updated information is available in the *Hydrogeology of Post-Wilcox Group Stratigraphic Units in the Area of the Naval Air Station Memphis, Near Millington, Tennessee* (Kingsbury and Carmichael, 1995). On the basis of this updated information, the hydrogeology of NSA Memphis is summarized below.

The two stratigraphic units investigated during the RFIs at NSA Memphis are the loess/alluvial deposits of Pleistocene and Holocene age and the underlying fluvial deposits of Pleistocene to Pliocene age. The loess — eolian deposits consisting of silt, silty clay, clay, and minor amounts of sand — is the principal unit occurring at land surface throughout the NSA Memphis Northside. Alluvium, which is restricted to stream valleys, includes alluviated or reworked loess. The loess is typically 0 to 65 feet in the Memphis area; at NSA Memphis it ranges from 15 to 45 feet in thickness. Water-bearing zones are present in the loess, primarily in the upper part of this unit; however, yields are low and water quality analyses performed during the water-use survey portion of previous UST investigations indicate that loess groundwater does not meet many primary and secondary drinking water standards. Previous investigations at NSA Memphis have found depth to water in the loess varying between 5 and 15 feet below land surface and vertical hydraulic conductivities to range from $10^{-6}$ to $10^{-8}$ centimeter per second (cm/sec). Thus, the loess may be considered an aquitard on the basis of the relatively low hydraulic conductivities. Nevertheless, groundwater movement in the loess is primarily downward to recharge the underlying fluvial deposits, although locally some groundwater in the loess may discharge to nearby streams, drainage ditches, and other surface-water bodies.



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The fluvial deposits underlie the loess in upland areas and consist of sand, gravel, and some clay, with thin layers of ferruginous sandstone and conglomerate generally at the base. This unit ranges in thickness from 0 to 100 feet in the Memphis area; on the Northside of NSA Memphis it ranges from approximately 10 to 53 feet thick and represents the most significant component of the surficial aquifer. Many shallow domestic wells in the Memphis rural areas are completed in the fluvial deposits. Relative groundwater elevations between wells completed in the loess/alluvium and fluvial deposits indicate semiconfined to confined conditions in the fluvial deposits. Typically a downward vertical gradient exists between water in the loess and the fluvial deposits. Sediments in the fluvial deposits generally coarsen with depth, and typically, the upper portion consists of a mixture of very fine sand with varying degrees of silt and clay and becomes increasingly less silty with depth, grading into a fine to medium sand near the middle of the unit. Grain sizes typically coarsen below this interval, grading into a gravelly sand near the fluvial deposits basal section.

The fluvial deposits are underlain by the Cockfield Formation, a part of the Jackson-upper Claiborne confining unit, which is a heterogeneous formation consisting of very fine silty sand interbedded with clay and silt lenses or clay with interbedded fine sand lenses. The more-permeable characteristics of the fluvial deposits, compared to the relatively impermeable properties of the overlying loess/alluvium and the underlying Jackson-upper Claiborne confining unit, result in the fluvial deposits being the preferential zone of groundwater flow and the route for contaminant transport in NSA Memphis's subsurface.

## 5.2 Site-Specific Geology and Hydrogeology

Sediment conditions were only analyzed from the surface to 24 inches deep during this RFI. In less eroded portions of the drainage ditches, the sediment was a coarse sandy clay with a hard clay layer at 6 to 8 inches below the sediment surface. The hard clay layer was present from the bed surface to 24 inches in depth in more eroded portions of the drainage ditches.



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# 6.0 NATURE AND EXTENT OF CONTAMINATION

## 6.1 Background

One ditch background sample and a duplicate were collected at sample location 6-6 (Figure 6-1) for the upgradient, on-base only samples. This location was selected because it drains an undeveloped area, upstream of the other sample locations, and is not likely to be impacted by industrial operations. However, sediment sample 6-6 was collected adjacent to an agricultural field, and analytical results indicate the sample has been impacted by agricultural operations. Elevated concentrations of the herbicides MCPA (common name for [4-chloro-2-methylphenoxy] acetic acid), MCPP (common name for potassium-2-[2-methyl-4-chlorophenoxy]propionate), and 2,4,5-TP (common name for Silvex or 2-[2,4,5-trichlorophenoxy] propionic acid) were identified in sample 6-6 and its duplicate. Sample 38-7 was collected as a background sample for the North Fork Creek area sample locations. This sample location was chosen as a background because it is upgradient of the confluence of the drainage ditch and North Fork Creek and it was on the opposite bank from the base. This sample did not contain elevated levels of any contaminants of concern related to ecological risk.

### Organic Compounds

As a reference for organic compounds detected in sediment, contaminant concentrations have been compared with the January - June 1995 Risk-Based Concentrations (RBCs) (USEPA, March 1995) for residential and industrial scenarios to address human-health concerns. Health risks associated with exceedances are discussed in Section 7, Baseline Risk Assessment (BRA). An exception is noted for onsite pesticide and herbicide occurrences, which are discussed with respect to background concentrations. To address ecological concerns, organic contaminant concentrations were compared to the Draft USEPA Region IV Sediment Screening Values (SSVs), where they exist. Organic contaminants exceeding the SSVs are discussed in Section 8, Ecological Risk Assessment (ERA).



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**Metals**

The background reference concentration (RC) for the on-base samples was established by doubling the highest concentration of each metal detected in either sediment sample 6-6, or its duplicate (whichever concentration was greater). The background reference concentration (RC) for the North Fork Creek area samples was established by doubling the highest concentration of each metal detected in sediment sample 38-7. Each metal identified in site sediment was evaluated by comparing its concentration to the RC and to the RBC for residential and industrial soil. Health risks associated with exceedances are discussed in Section 7, BRA. To address ecological concerns, metals also were compared to RCs and SSVs. SSVs exist for only a few metals, but were used where applicable. Exceedances of SSVs and their relevance to ecological risk are discussed in Section 8, ERA.

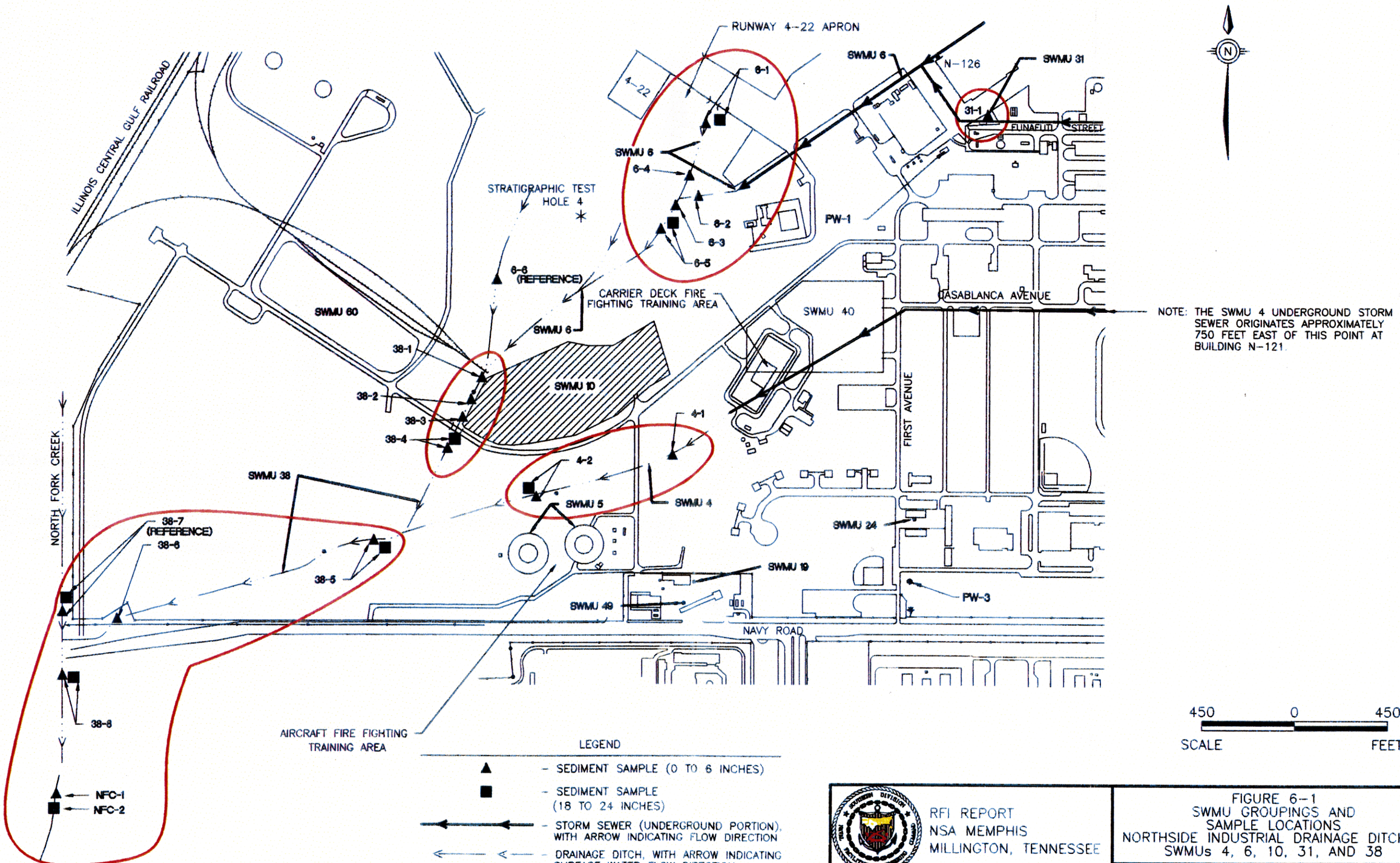
## 6.2 Sediment Analytical Results

Twenty-six sediment samples were submitted to the laboratory to characterize the nature and extent of drainage-ditch contamination. Analytical results indicate the presence of VOCs, semivolatile organic compounds (SVOCs), TPH, herbicides, pesticides, and metals in drainage-ditch sediment. Each contaminant group and those exceeding the background standard and/or the established RBCs and SSVs are discussed below with supporting figures and/or tables. Attachment 1 contains the analytical reports.

Sampling locations along the SWMUs were grouped into five areas based in proximity to each other or to a particular SWMU (in the case of SWMUs 10 and 31). SWMU 4 samples 4-1 and 4-2 were collected from a drainage ditch near SWMU 5. SWMU 6 samples 6-1 through 6-5 were collected from the upper reaches of the drainage ditches comprising SWMU 6. SWMU 31 includes sample 31-1 only, because it was collected in a separate area away from the drainage ditches. SWMU 38 samples 38-1 through 38-4 were collected near SWMU 10. The North Fork Creek area includes sample locations 38-5 through 38-8. These samples were collected near



000030




RFI REPORT
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 6-1
SWMU GROUPINGS AND SAMPLE LOCATIONS
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 08/15/96 | DWG NAME: 94IDDSL

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where SWMU 38 drains into North Fork Creek and in North Fork Creek itself. Two additional sediment samples (NFC-1 and NFC-2) were collected downgradient in North Fork Creek, about 600 feet downstream of sample 38-8, and the sample results for these two samples are included in Attachment 2 to this report. Sample locations and SWMU groupings are shown on Figure 6-1.

### Volatile Organic Compounds

VOCs were identified in sediment samples at total (summed) concentrations ranging from 4 micrograms per kilogram ($\mu$g/kg) to 7,600 $\mu$g/kg and were limited to only five different compounds (2-butanone, acetone, carbon disulfide, bromomethane, and toluene). The highest VOC concentrations were detected in sediment collected from North Fork Creek, where acetone (a common laboratory contaminant and breakdown product of isopropanol) was detected in the 18- to 24-inch samples at locations 38-7 (1,200 $\mu$g/kg) and 38-8 (7,600 $\mu$g/kg). It is unclear whether the acetone in both of these samples is representative of site conditions, is a laboratory contaminant, or is a result of an inadequate final deionized organic-free water rinse during equipment decontamination. Acetone was not detected in the 0- to 6-inch interval in either sample location. Table 6-1 summarizes the VOC results for all sample locations and compares them to RBCs for residential and industrial soil. None of the detected VOC concentrations exceed their RBCs for residential soil. No SSVs are listed for the five VOCs detected in the sediment samples. Figure 6-2 provides a plot of the total VOC concentrations for each sediment sample collected during the RFI.

### Semivolatile Organic Compounds

Twenty-two SVOCs were detected in the sediment samples. Samples containing the highest concentrations of SVOCs were collected at SWMU 31, directly below outfalls at SWMUs 6



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**Table 6-1**
**Comparison of Volatile Organic Compounds in Sediment With RBCs**
**Northside Industrial Drainage Ditches — SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 004-M-0002-02 | 6-1 (18-24") 006-M-0001-02 | 6-4 (0-6") 006-M-0004-01 | 6-6 (0-6") 006-M-0006-01 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|
| 2-Butanone (MEK) | 4 J | ND | ND | ND | ND | 4,700,000 | 1,000,000,000 |
| Acetone | ND | 59 | 180 J | 4 J | ND | 7,800,000 | 200,000,000 |
| Carbon Disulfide | ND | ND | 5 J | ND | ND | 7,800,000 | 200,000,000 |
| Bromomethane | ND | ND | ND | ND | 2 J | 110,000 | 2,900,000 |
| Toluene | ND | ND | ND | ND | ND | 16,000,000 | 410,000,000 |

| Analyte | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | 38-4 (18-24") 038-M-0004-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|
| 2-Butanone (MEK) | ND | ND | ND | ND | 7 J | 4,700,000 | 1,000,000,000 |
| Acetone | ND | 8 J | ND | 49 | 93 | 7,800,000 | 200,000,000 |
| Carbon Disulfide | ND | ND | ND | ND | ND | 7,800,000 | 200,000,000 |
| Bromomethane | ND | ND | 2 J | ND | 2 J | 110,000 | 2,900,000 |
| Toluene | 2 J | ND | ND | ND | 1 J | 16,000,000 | 410,000,000 |

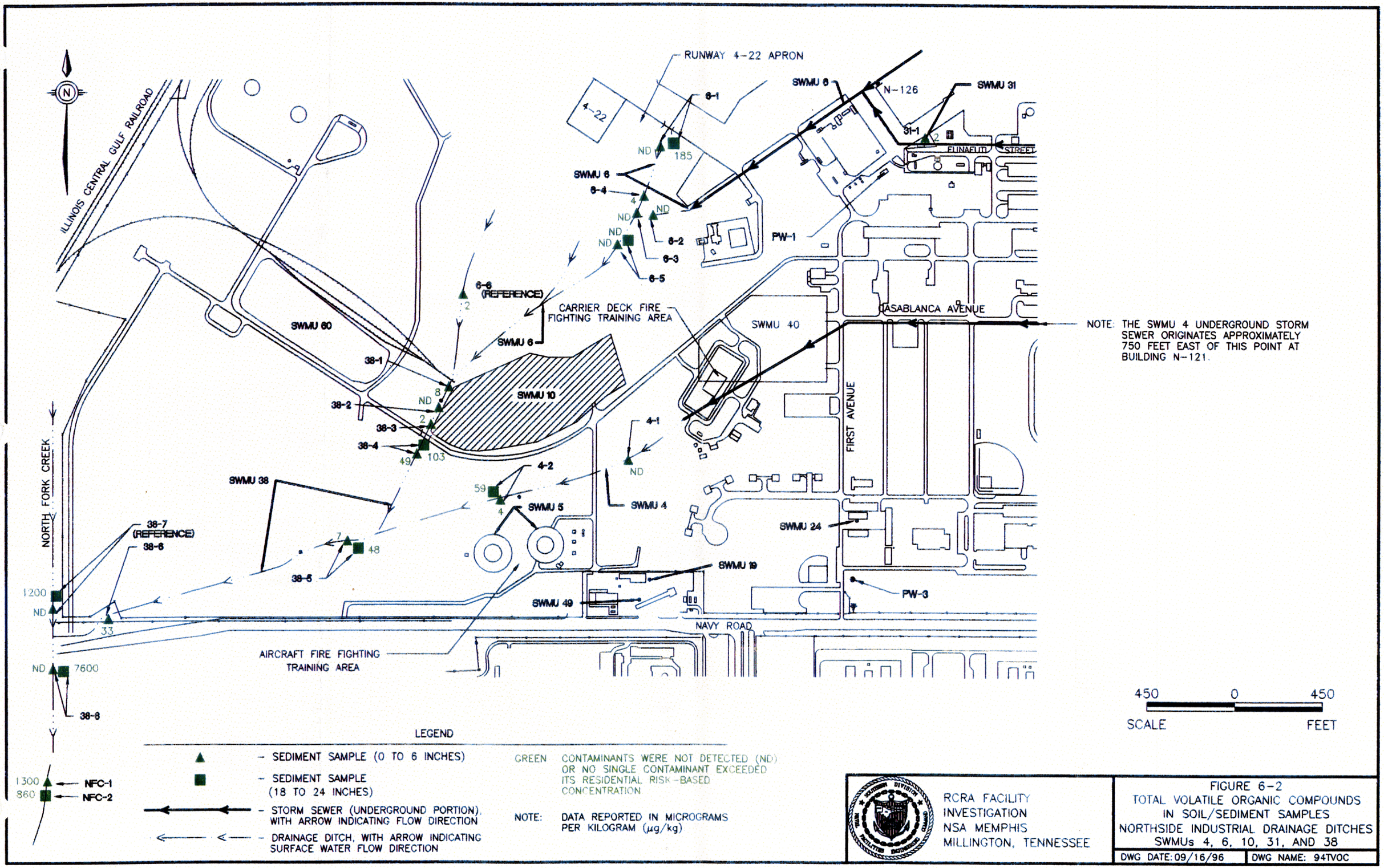
| Analyte | 38-5 (0-6") 038-M-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (18-24") 038-M-0008-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|
| 2-Butanone (MEK) | ND | ND | ND | ND | ND | 4,700,000 | 1,000,000,000 |
| Acetone | 5 J | 48 | 33 | 1,200 | 7,600 | 7,800,000 | 200,000,000 |
| Carbon Disulfide | ND | ND | ND | ND | ND | 7,800,000 | 200,000,000 |
| Bromomethane | 2 J | ND | ND | ND | ND | 110,000 | 2,900,000 |
| Toluene | ND | ND | ND | ND | ND | 16,000,000 | 410,000,000 |

| Analyte | NFC-1 (0-6") NFC-M-0001-01 | NFC-2 (18-24") NFC-M-0001-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|
| Acetone | 1300 | 860 | 7,800,000 | 200,000,000 |

*Notes:*
RBC = Risk-Based Concentration (USEPA Region III, January to June 1995)
ND = Analyte not detected
J = Reported concentration represents an estimated value.



000033

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and 38, and downstream from SWMU 38 in North Fork Creek. Table 6-2 summarizes the SVOC sample results and compares them to residential and industrial RBCs. Table 6-3 compares SVOC sample results to listed SSVs. Figure 6-3 lists the total (summed) SVOC concentration in each sample and indicates which samples contain SVOCs in excess of residential and industrial RBCs. Figure 6-4 shows the number of SVOCs exceeding their corresponding SSV. SVOCs identified at each SWMU are discussed below.

*SWMU 4 (Sampling Locations 4-1 and 4-2)*

Three SVOCs were detected in sediment samples collected from SWMU 4. The highest total SVOC concentration was 292 $\mu$g/kg in the 0- to 6-inch sample at location 4-2; however, the total SVOC concentration was lower (47 $\mu$g/kg) in the 18- to 24-inch interval sample. No RBCs or SSVs were exceeded at SWMU 4.

*SWMU 6 (Samples 6-1 through 6-5)*

Sixteen SVOCs were detected in the samples collected from SWMU 6, with total detected concentrations ranging from 41 $\mu$g/kg (location 6-1, 18- to 24-inch interval) to over 20,000 $\mu$g/kg (location 6-3, 0- to 6-inch interval). At location 6-3, three SVOCs exceeded their respective residential RBCs, one exceeded both the residential and industrial RBC, and five exceeded their SSVs. Sample 6-3 was collected at a concrete outfall leading into the main channel, and, therefore, would be expected to show the highest contaminant concentrations. Total SVOC concentrations were lower in downstream duplicate sample 6-5 (4,789 $\mu$g/kg, 0- to 6-inch interval). However, even at this downstream location, one SVOC exceeded its residential RBC and five SVOCs exceeded their SSVs (Table 6-3). SVOCs were not detected in the 18- to 24-inch interval of sample location 6-5.

***SWMU 31 (Sampling Location 31-1)***

Eighteen SVOCs were detected in sample 31-1, with the total concentration exceeding 197,000 μg/kg (Table 6-3). One SVOC exceeded its residential RBC, five SVOCs exceeded their residential and industrial RBCs, and nine SVOCs exceeded their SSVs. This sample was collected from a soil deposit over an asphalted parking lot near the Runway 4-22 apron. The asphalt may be the source of elevated SVOC concentrations.

***SWMU 38 (Samples 38-1 through 38-4)***

Twenty SVOCs were detected in SWMU 38 upstream sediment samples collected from locations 38-1 through 38-4, with total SVOC concentrations ranging from 590 μg/kg at location 38-2 (0- to 6-inch interval) to greater than 35,000 μg/kg at location 38-1 (0- to 6-inch interval) (Table 6-3). The sediment samples exhibiting the highest SVOC concentrations were in the 0- to 6-inch interval at locations 38-1 and 38-3, in the drainage gullies leading from SWMU 10 into the SWMU 38 drainage ditch. At location 38-1, four SVOCs exceeded their RBCs, one SVOC exceeded both the residential and industrial RBC, and eight SVOCs exceeded their SSVs. At location 38-3, one SVOC exceeded its residential RBC, another exceeded both the residential and industrial RBC, and eight SVOCs exceeded their SSVs. No SVOCs were detected at sample location 38-4 (downstream of SWMU 10).

***North Fork Creek Area (Samples 38-5 through 38-8)***

Sixteen SVOCs were identified in sediment samples collected from the North Fork Creek area, with total SVOC concentrations ranging from 45 μg/kg in the duplicate sample collected from location 38-5 (0- to 6-inch interval) to 8,730 μg/kg at location 38-8 (0- to 6-inch interval) (Table 6-3). Nine SVOCs were detected in the 0- to 6-inch interval sample at location 38-5, but none exceeded residential RBCs or SSVs. No SVOCs were identified in the 18- to 24-inch sample at location 38-5. Seven SVOCs were identified in the 0- to 6-inch sample at location 38-6, but none exceeded either the SSV or the residential RBC. Two SVOCs were



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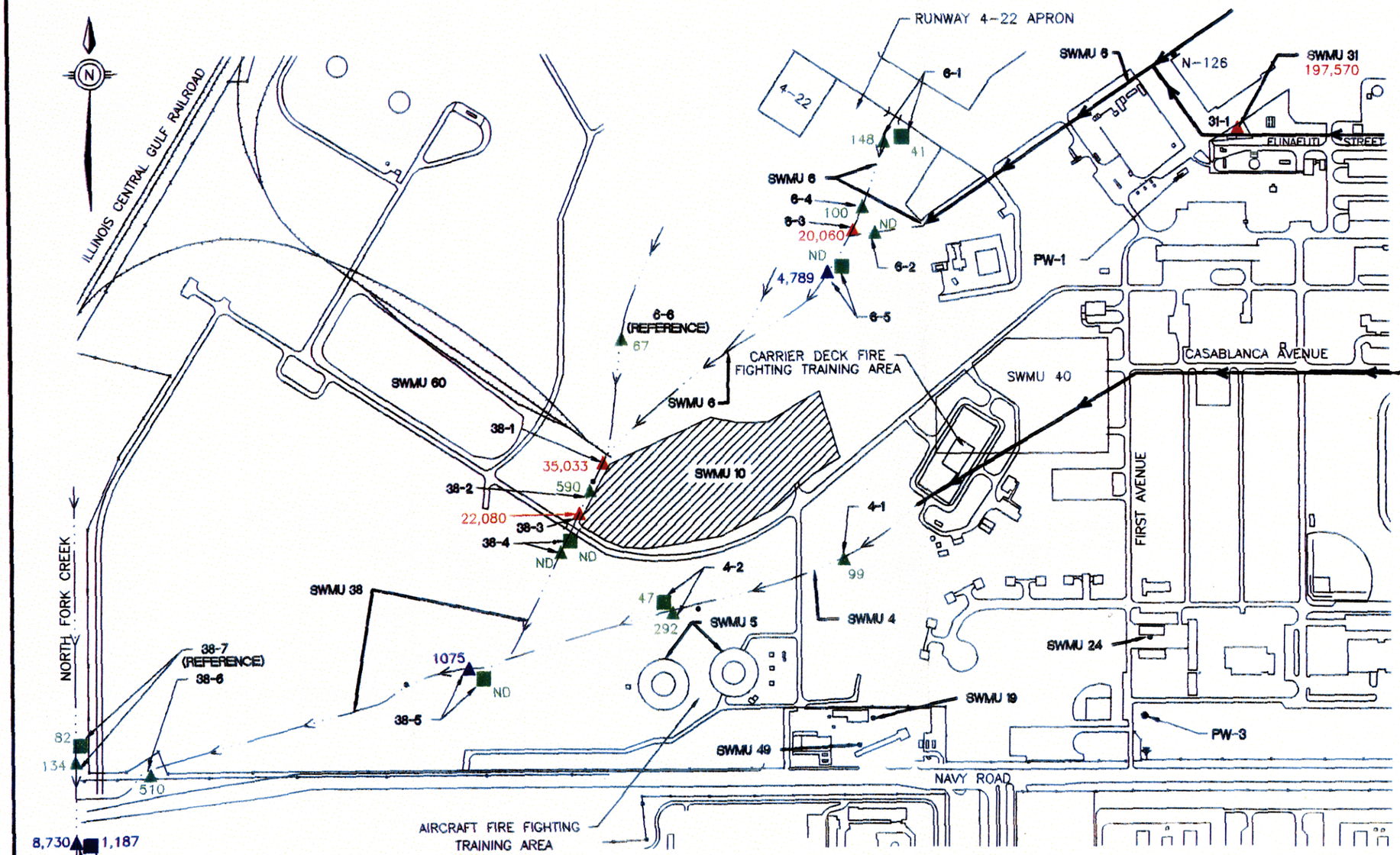


NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

450 0 450
SCALE FEET

LEGEND

- ▲ – SEDIMENT SAMPLE (0 TO 6 INCHES)
- ■ – SEDIMENT SAMPLE (18 TO 24 INCHES)
- ND ▲ ← NFC-1
- ND ■ ← NFC-2
- ← – STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- ← – DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

NOTE: DATA REPORTED IN MICROGRAMS PER KILOGRAM (μg/kg)

GREEN CONTAMINANTS WERE NOT DETECTED OR NO SINGLE CONTAMINANT EXCEEDED ITS RESIDENTIAL RISK-BASED CONCENTRATION

BLUE ONE OR MORE CONTAMINANTS WERE DETECTED THAT EXCEEDED RESIDENTIAL RISK-BASED CONCENTRATIONS, BUT DID NOT EXCEEED INDUSTRIAL RISK-BASED CONCENTRATIONS.

RED ONE OR MORE CONTAMINANTS WERE DETECTED THAT EXCEEDED RESIDENTIAL AND INDUSTRIAL RISK-BASED CONCENTRATIONS

RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 6-3
TOTAL SEMIVOLATILE ORGANIC COMPOUNDS
IN SOIL/SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 09/16/96 | DWG NAME: 94TSOC

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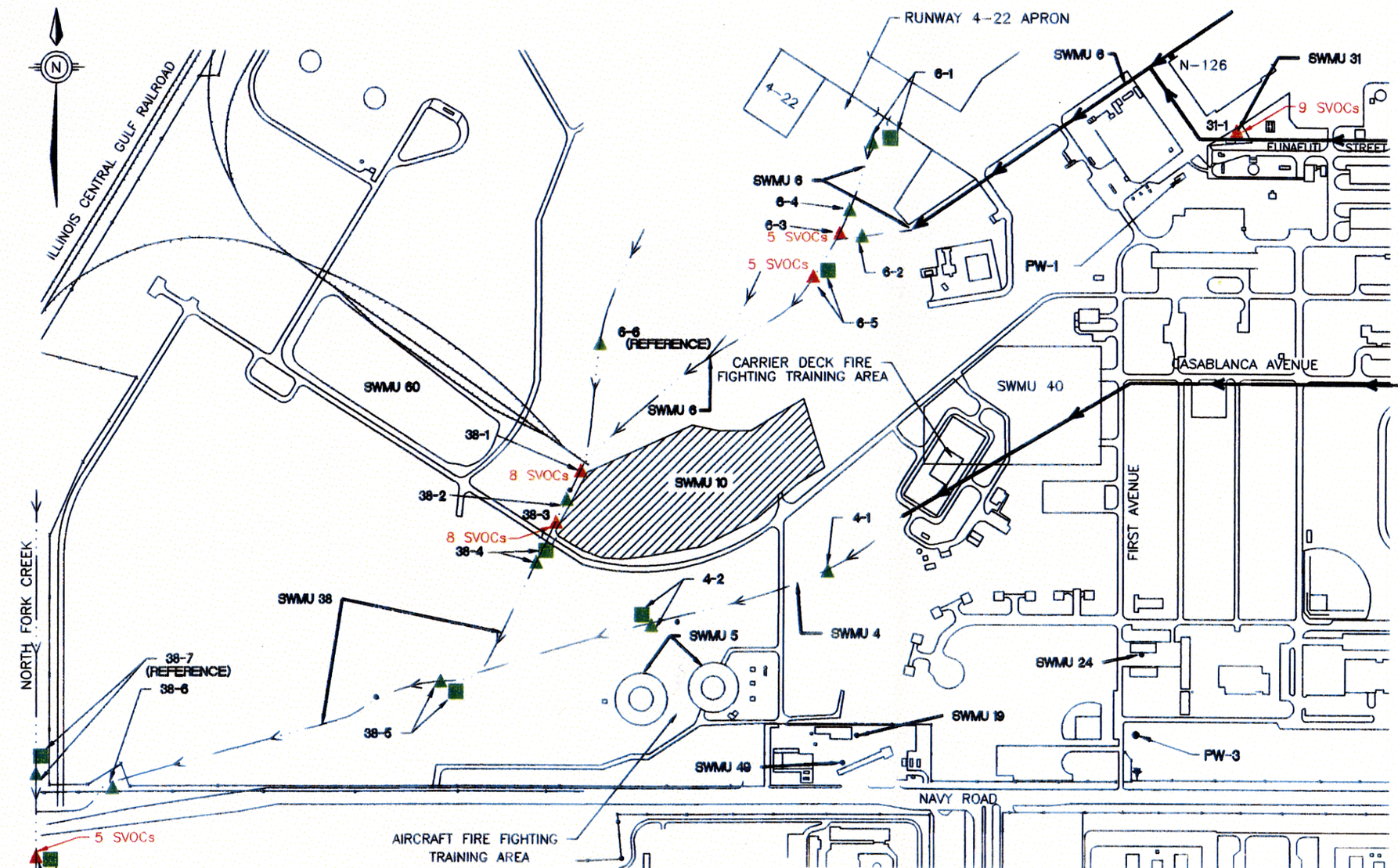


NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

450 0 450
SCALE FEET

LEGEND

- SEDIMENT SAMPLE (0 TO 6 INCHES)
- SEDIMENT SAMPLE (18 TO 24 INCHES)
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

NFC-1
NFC-2

GREEN — CONTAMINANT NOT DETECTED (ND) OR NO SINGLE CONTAMINANT EXCEEDED ITS SEDIMENT SCREENING VALUE, WHERE APPLICABLE

RED — ONE OR MORE CONTAMIMANTS WERE DETECTED THAT EXCEEDED THEIR SEDIMENT SCREENING VALUES, WHERE APPLICABLE

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 6-4
NUMBER OF SEMIVOLATILE ORGANIC COMPOUNDS EXCEEDING SSVs IN SOIL/SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 08/15/96 | DWG NAME: 94NSOCE

**Table 6-2**
**Comparison of Semivolatile Organic Compounds in Sediment With RBCs**
**Industrial Drainage Ditches — SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| bis(2-ethylhexyl)phthalate | 99 J | 140 J | 47 J | 60 J | ND | ND | 1,800 J | 62 J | ND | 46,000 | 410,000 |
| Fluoranthene | ND | 79 J | ND | ND | 41 J | ND | 2,900 J | ND | 350 J | 3,100,000 | 82,000,000 |
| Pyrene | ND | 73 J | ND | ND | ND | ND | 2,400 J | 38 J | 310 J | 2,300,000 | 61,000,000 |
| Benzo(a)pyrene | ND | ND | ND | 46 J | ND | ND | 2,000 J | ND | ND | 88 | 780 |
| Benzo(g,h,i)perylene | ND | ND | ND | 42 J | ND | ND | 1,300 J | ND | ND | 2,300,000* | 61,000,000* |
| Phenanthrene | ND | ND | ND | ND | ND | ND | 460 J | ND | ND | 2,300,000* | 61,000,000* |
| Benzo(a)anthracene | ND | ND | ND | ND | ND | ND | 1,800 J | ND | ND | 880 | 7,800 |
| Chrysene | ND | ND | ND | ND | ND | ND | 2,300 J | ND | ND | 88,000 | 780,000 |
| Benzo(b)fluoranthene | ND | ND | ND | ND | ND | ND | 2,200 J | ND | ND | 880 | 7,800 |
| Benzo(k)fluoranthene | ND | ND | ND | ND | ND | ND | 1,700 J | ND | ND | 8,800 | 78,000 |
| Indeno(1,2,3-cd)pyrene | ND | ND | ND | ND | ND | ND | 1,200 J | ND | ND | 880 | 7,800 |
| Total SVOCs | 99 | 292 | 47 | 148 | 41 | ND | 20,060 | 100 | 660 | N/A | N/A |

**Table 6-2 (continued)**
**Comparison of Semivolatile Organic Compounds in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 6-6 (0-6") 006-M-0006-01 | 6-6 DUP (0-6") 006-N-0006-01 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| bis(2-ethylhexyl)phthalate | 180 J | ND | ND | 67 J | 2,300 J | 410 J | ND | 630 J | ND | 46,000 | 410,000 |
| Fluoranthene | 860 | ND | ND | ND | 20,000 | 4,700 | 330 J | 3,800 | ND | 3,100,000 | 82,000,000 |
| Pyrene | 650 | ND | ND | ND | 19,000 | 4,700 | 260 J | 3,300 J | ND | 2,300,000 | 61,000,000 |
| Benzo(a)pyrene | 340 | ND | ND | ND | 26,000 | 3,900 | ND | 1,700 J | ND | 88 | 780 |
| Benzo(g,h,i)perylene | 210 J | ND | ND | ND | 14,000 | 1,400 | ND | 630 | ND | 2,300,000* | 61,000,000* |
| Phenanthrene | 520 | ND | ND | ND | 1,800 J | 1,900 | ND | 1,800 J | ND | 2,300,000* | 61,000,000* |
| Benzo(a)anthracene | 370 J | ND | ND | ND | 16,000 | 3,200 | ND | 1,900 J | ND | 880 | 7,800 |
| Chrysene | 420 J | ND | ND | ND | 21,000 | 3,600 | ND | 2,100 J | ND | 88,000 | 780,000 |
| Benzo(b)fluoranthene | 330 J | ND | ND | ND | 30,000 | 5,000 | ND | 1,900 J | ND | 880 | 7,800 |
| Benzo(k)fluoranthene | 310 J | ND | ND | ND | 24,000 | 2,100 | ND | 1,600 J | ND | 8,800 | 78,000 |
| Indeno(1,2,3-cd)pyrene | 190 J | ND | ND | ND | 14,000 | 1,500 | ND | 750 J | ND | 880 | 7,800 |
| Dibenzo(a,h)anthracene | 82 J | ND | ND | ND | 5,300 | 630 | ND | 350 J | ND | 88 | 780 |
| Acenaphthene | 52 J | ND | ND | ND | 750 J | 310 J | ND | 640 J | ND | 4,700,000 | 120,000,000 |
| Fluorene | 70 J | ND | ND | ND | 420 J | 260 J | ND | 510 J | ND | 3,100,000 | 82,000,000 |
| Anthracene | 120 J | ND | ND | ND | 620 J | 400 J | ND | 470 J | ND | 23,000,000 | 610,000,000 |
| Carbazole | 85 J | ND | ND | ND | 430 J | 340 J | ND | ND | ND | 32,000 | 290,000 |
| Acenaphthalene | ND | ND | ND | ND | 1,100 J | 93 J | ND | ND | ND | None | None |
| Butylbenzylphthalate | ND | ND | ND | ND | 850 J | 380 J | ND | ND | ND | 16,000,000 | 410,000,000 |
| Naphthalene | ND | ND | ND | ND | ND | 60 J | ND | ND | ND | 3,100,000 | 82,000,000 |
| Dibenzofuran | ND | ND | ND | ND | ND | 150 J | ND | ND | ND | 310,000 | 8,200,000 |
| Total SVOCs | 4,789 | ND | ND | 67 | 197,570 | 35,033 | 590 | 22,080 | ND | N/A | N/A |

**Table 6-2 (continued)**
**Comparison of Semivolatile Organic Compounds in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in parts per billion)**

| Analyte | 38-4 (18-24") 038-M-0004-02 | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (0-6") 038-M-0007-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| bis(2-ethylhexyl)phthalate | ND | ND | ND | ND | 46 J | 92 J | 82 J | 130 J | 52 J | 46,000 | 410,000 |
| Fluoranthene | ND | 89 J | ND | ND | 130 J | 42 J | ND | 1,800 | 220 J | 3,100,000 | 82,000,000 |
| Pyrene | ND | 78 J | ND | ND | 91 J | ND | ND | 1,200 | 160 J | 2,300,000 | 61,000,000 |
| Benzo(a)pyrene | ND | 170 J | 45 J | ND | 52 J | ND | ND | 610 | 110 J | 88 | 780 |
| Benzo(g,h,i)perylene | ND | 140 J | ND | ND | ND | ND | ND | 410 J | 73 J | 2,300,000[a] | 61,000,000[a] |
| Phenanthrene | ND | ND | ND | ND | 83 J | ND | ND | 1,200 | 82 J | 2,300,000[a] | 61,000,000[a] |
| Benzo(a)anthracene | ND | 100 J | ND | ND | 52 J | ND | ND | 690 | 110 J | 880 | 7,800 |
| Chrysene | ND | 130 J | ND | ND | 56 J | ND | ND | 660 | 110 J | 88,000 | 780,000 |
| Benzo(b)fluoranthene | ND | 170 J | ND | ND | ND | ND | ND | 600 | 120 J | 880 | 7,800 |
| Benzo(k)fluoranthene | ND | 88 J | ND | ND | ND | ND | ND | 400 J | 80 J | 8,800 | 78,000 |
| Indeno(1,2,3-cd)pyrene | ND | 110 J | ND | ND | ND | ND | ND | 380 J | 70 J | 880 | 7,800 |
| Dibenzo(a,h)anthracene | ND | ND | ND | ND | ND | ND | ND | 130 J | ND | 88 | 780 |
| Fluorene | ND | ND | ND | ND | ND | ND | ND | 76 J | ND | 3,100,000 | 82,000,000 |
| Anthracene | ND | ND | ND | ND | ND | ND | ND | 250 J | ND | 23,000,000 | 610,000,000 |
| Acenaphthylene | ND | ND | ND | ND | ND | ND | ND | 84 J | ND | None | None |
| Butylbenzylphthalate | ND | ND | ND | ND | ND | ND | ND | 110 J | ND | 16,000,000 | 410,000,000 |
| Total SVOCs | ND | 1,075 | 45 | ND | 510 | 134 | 82 | 8,730 | 1,187 | N/A | N/A |

**Table 6-2 (continued)**
**Comparison of Semivolatile Organic Compounds in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in parts per billion)**

| Analyte | NFC-1 (0-6") NFC-M-0004-01 | NFC-2 (18-24") NFC-M-0001-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|
| **Butylbenzylphthalate** | 510 | ND | 16,000,000 | 410,000,000 |
| **Total SVOCs** | 510 | ND | N/A | N/A |

*Notes:*

RBC = Risk-based Concentration (EPA Region III, January - June 1995).
* = RBC values for phenanthrene and benzo(g,h,i)perylene do not exist. Surrogate values reported are pyrene RBCs.
ND = Not detected
J = Reported concentration represents an estimated value.
N/A = Not applicable
SVOC concentrations in **BOLD** exceed the residential RBC.

**Table 6-3**
**Comparison of Semivolatile Organic Compounds in Sediment With SSVs**
**Industrial Drainage Ditches — SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Pyrene | ND | 73 J | ND | ND | ND | ND | 2400 J | 38 J | 310 J | 330 |
| Benzo(a)pyrene | ND | ND | ND | 46 J | ND | ND | 2000 J | ND | ND | 330 |
| Phenanthrene | ND | ND | ND | ND | ND | ND | 460 J | ND | ND | 330 |
| Benzo(a)anthracene | ND | ND | ND | ND | ND | ND | 1800 J | ND | ND | 330 |
| Chrysene | ND | ND | ND | ND | ND | ND | 2300 J | ND | ND | 330 |

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 6-6 (0-6") 006-M-0006-01 | 6-6 DUP (0-6") 006-N-0006-01 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 650 | ND | ND | ND | 19000 | 4700 | 260 J | 3,300 J | ND | 330 |
| Benzo(a)pyrene | 340 | ND | ND | ND | 26000 | 3900 | ND | 1,700 J | ND | 330 |
| Phenanthrene | 520 | ND | ND | ND | 1800 J | 1900 | ND | 1,800 J | ND | 330 |
| Benzo(a)anthracene | 370 J | ND | ND | ND | 16000 | 3200 | ND | 1,900 J | ND | 330 |
| Chrysene | 420 J | ND | ND | ND | 21000 | 3600 | ND | 2,100 J | ND | 330 |
| Dibenzo(a,h)anthracene | 82 J | ND | ND | ND | 5300 | 630 | ND | ND | ND | 330 |
| Acenaphthene | 52 J | ND | ND | ND | 750 J | 310 J | ND | 640 J | ND | 330 |
| Fluorene | 70 J | ND | ND | ND | 420 J | 260 J | ND | 510 J | ND | 330 |
| Anthracene | 120 J | ND | ND | ND | 620 J | 400 J | ND | 470 J | ND | 330 |

**Table 6-3 (continued)**
**Comparison of Semivolatile Organic Compounds in Sediment With SSVs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 38-4 (18-24") 038-M-0004-02 | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (0-6") 038-M-0007-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Pyrene | ND | 78 J | ND | ND | 91 J | ND | ND | **1,200** | 160 J | 330 |
| Benzo(a)pyrene | ND | 170 J | 45 J | ND | 52 J | ND | ND | **610** | 110 J | 330 |
| Phenanthrene | ND | ND | ND | ND | 83 J | ND | ND | **1,200** | 82 J | 330 |
| Benzo(a)anthracene | ND | 100 J | ND | ND | 52 J | ND | ND | **690** | 110 J | 330 |
| Chrysene | ND | 130 J | ND | ND | 56 J | ND | ND | **660** | 110 J | 330 |
| Dibenzo(a,h)anthracene | ND | ND | ND | ND | ND | ND | ND | 130 J | ND | 330 |
| Fluorene | ND | ND | ND | ND | ND | ND | ND | 76 J | ND | 330 |
| Anthracene | ND | ND | ND | ND | ND | ND | ND | 250 J | ND | 330 |
| Acenaphthylene | ND | ND | ND | ND | ND | ND | ND | 84 J | ND | 330 |

*Notes:*
ND = Analyte not detected.
J = Reported concentration represents an estimated value.
SVOC concentrations in **BOLD** exceed the Sediment Screening Value.

identified in the 0- to 6-inch sample at location 38-7, with none exceeding either the SSV or the residential RBC. In the 18- to 24-inch interval at location 38-7, the only SVOC detected was below its residential RBC and does not have an SSV. Sixteen SVOCs were identified in the 0- to 6-inch interval sample at location 38-8, with two exceeding the residential RBCs and five exceeding SSVs. In the 18- to 24-inch interval at location 38-8, 11 SVOCs were identified, with one exceeding the residential RBC and five exceeding SSVs.

***Downgradient North Fork Creek Samples (Samples NFC-1 and NFC-2)***

Two SVOCs were identified in sample NFC-1, collected from the 0-6 inch interval, about 600 feet downgradient from sample 38-8. Di-n-butlyphthalate was detected at 48 $\mu$g/kg and butylbenzylphthalate was detected at 510 $\mu$g/kg. Neither of these exceeded either the residential RBC or the SSV.

**Total Petroleum Hydrocarbons**

TPH were detected in sediment throughout most portions of the drainage ditches and in both depth intervals sampled. Table 6-4 summarizes TPH concentrations in sediment samples, and Figure 6-5 shows the total TPH concentrations detected by USEPA Method 418.1. RBC values do not exist for TPH in soil or sediment, however, the TDEC Solid Waste Management Division has established relevant soil cleanup levels of 100 milligrams per kilogram (mg/kg). Groundwater in the uppermost part of the loess, the material in which most of the drainage ditches are developed, is not used for drinking water at NSA Memphis.

TPH concentrations found in sediment in the drainage ditches exceed the 100 mg/kg cleanup levels at sample locations 6-1, 6-3, 6-4, 6-5, 38-1, 38-3, 38-5, 38-6, and 38-8. Sample locations 4-1 and 4-2, which were selected to provide an assessment of current upstream and downstream conditions and to followup on the TPH concentrations found in the 1993 investigation, exhibited low concentrations (11 to 41 mg/kg) of TPH-DRO and nondetectable concentrations for



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TPH-GRO and TPH using Method 418.1. Changes in the TPH concentrations detected during the 1993 investigation and this RFI could be attributed to frequent flushing of the drainage ditch. Little information is available regarding the impacts of TPH on human health or ecological risk. Quantification of impacts is difficult since TPH represents a broad range of compounds with differing properties.

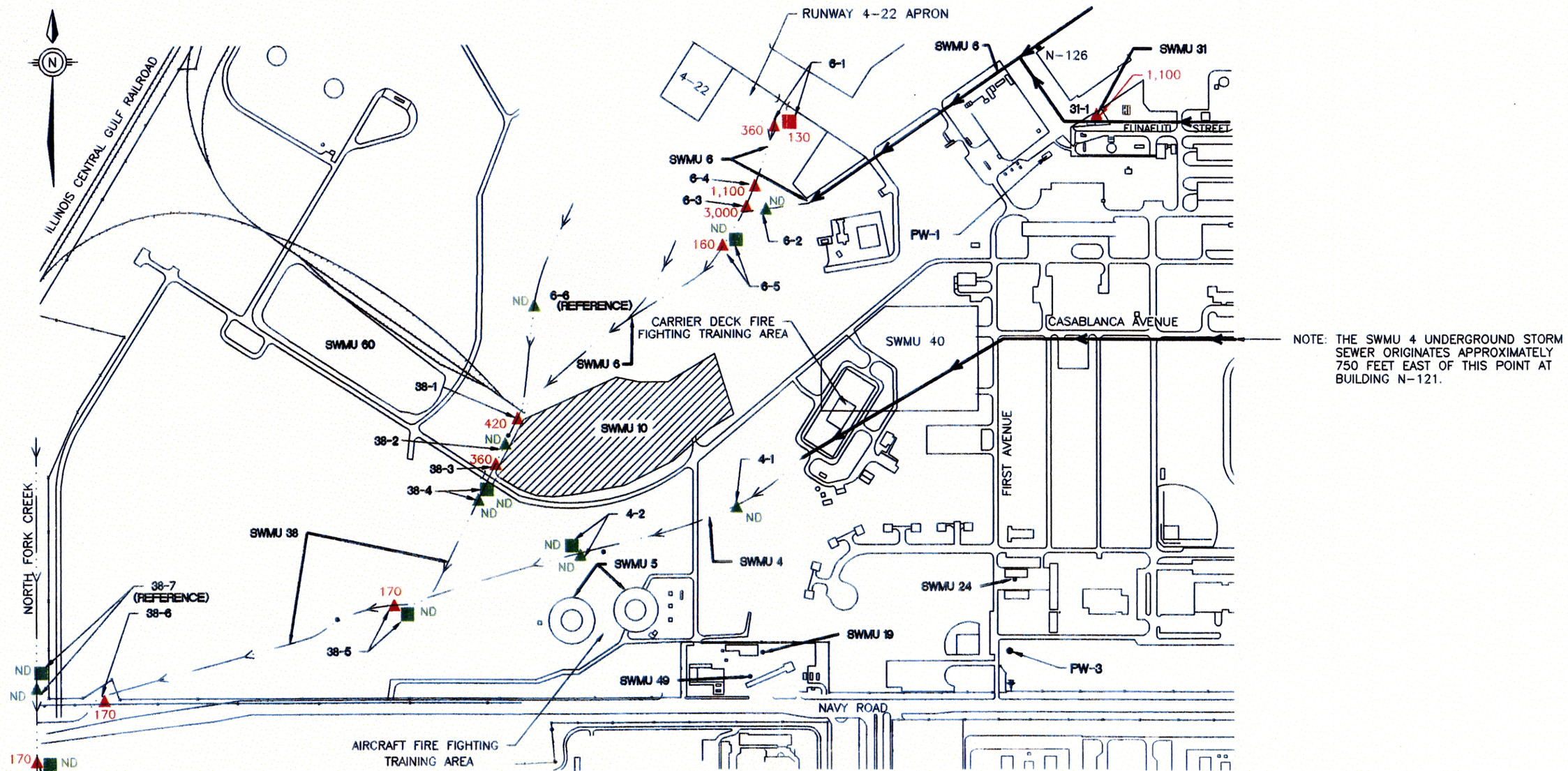
**Pesticides (Chlorinated and Organophosphorus)**

Pesticides were detected in some sediment samples collected from each SWMU area in both depth intervals (Table 6-5). Dieldrin was the pesticide detected most frequently throughout the drainage ditches, with concentrations ranging from 9.5 $\mu$g/kg in the 18- to 24-inch interval sample from location 6-1 to 220 $\mu$g/kg in the 0- to 6-inch interval sample at location 38-1. The SSV for dieldrin (3.3 $\mu$g/kg) was exceeded in 20 samples (3 of which are duplicates) from 15 sampling locations. The residential RBC for dieldrin (40 $\mu$g/kg) was exceeded in the 0- to 6-inch interval sample at eight locations (4-2, 6-3, 6-4, 6-8, 38-1, 38-2, 38-3, and 38-6); however, the residential RBC also was exceeded at background location 6-6 (220 $\mu$g/kg). Dieldrin concentrations decreased with depth; the RBC for dieldrin was not exceeded in any 18- to 24-inch interval samples. Dieldrin's presence at NSA Memphis has been attributed to its basewide aerial application during the 1950s and 1960s by the U.S. Department of Agriculture to control the spread of white-fringed beetles. The basewide presence of dieldrin is discussed further in the June 2, 1995 Technical Memorandum *Discussion of Dieldrin Risk Management Issues*, provided in Appendix B.

Other detected pesticides include aldrin, DDT and its breakdown products DDD and DDE, heptachlor epoxide, and stirophos. These compounds are probably present as a result of basewide applications for contol of mosquitos and other insects. DDT exceeded its SSV of 3.3 $\mu$g/kg at every sample location where it was detected, but did not exceed its RBC at any sample location. DDD exceeded its RBC at sample location 6-3. None of the other pesticides detected have an associated SSV.



000046




NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

LEGEND

- ▲ – SEDIMENT SAMPLE (0 TO 6 INCHES)
- ■ – SEDIMENT SAMPLE (18 TO 24 INCHES)
- ⟵⟶ – STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- ⟵ < – DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

NOTE: DATA REPORTED IN MILLIGRAMS PER KILOGRAM (mg/kg)

GREEN – CONTAMINANT NOT DETECTED (ND) OR LESS THAN TPH SOIL CLEANUP LEVEL (100 mg/kg) ESTABLISHED BY TDEC SOLID WASTE MANAGEMENT DIVISION STATE REMEDIATION SECTION.

BLUE – CONTAMINANT CONCENTRATION GREATER THAN TPH SOIL CLEANUP LEVEL FOR A DRINKING WATER AQUIFER (100 mg/kg) BUT LESS THAN THAN CLEANUP LEVEL FOR NON-DRINKING WATER AQUIFER (1000 mg/kg) ESTABLISHED BY TDEC UST DIVISION.

RED – CONTAMINANT CONCENTRATION GREATER THAN TPH SOIL CLEANUP LEVEL (100 mg/kg) ESTABLISHED BY THE SOLID WASTE MANAGEMENT DIVISION STATE REMEDIATION SECTION.

RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 6-5
TOTAL PETROLEUM HYDROCARBONS
IN SOIL/SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 08/15/96 | DWG NAME: 94TPHS

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**Table 6-4**
**Total Petroleum Hydrocarbons in Sediment**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Sample Location, Interval, and Identification | TPH-GRO (8010) | TPH-DRO (8015) | TPH (418.1) |
|---|---|---|---|
| 4-1 (0-6")<br>004-M-0001-01 | ND | 11 | ND |
| 4-2 (0-6")<br>004-M-0002-01 | ND | 41 | ND |
| 4-2 (18-24")<br>004-M-0002-02 | ND | 29 | ND |
| 6-1 (0-6")<br>006-M-0001-01 | ND | 11 | 360 |
| 6-1 (18-24")<br>006-M-0001-02 | ND | ND | 130 |
| 6-2 (0-6")<br>006-M-0002-01 | ND | ND | ND |
| 6-3 (0-6")<br>006-M-0003-01 | ND | 77 | **3,000** |
| 6-4 (0-6")<br>006-M-0004-01 | 0.13 | 360 | **1,100** |
| 6-5 (0-6")<br>006-M-0005-01 | ND | 10 | ND |
| 6-5 DUP (0-6")<br>006-N-0005-01 | ND | 10 | 160 |
| 6-5 (18-24")<br>006-M-0005-02 | ND | ND | ND |
| 6-6 (0-6")<br>006-M-0006-01 | ND | ND | ND |
| 6-6 DUP (0-6")<br>006-N-0006-01 | ND | ND | ND |
| 31-1 (2-3" over asphalt slab)<br>031-M-0001-01 | ND | 360 | **1,100** |
| 38-1 (0-6")<br>038-M-0001-01 | ND | 82 | **420** |
| 38-2 (0-6")<br>038-M-0002-01 | ND | 11 | ND |



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**Table 6-4**
**Total Petroleum Hydrocarbons in Sediment**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Sample Location, Interval, and Identification | TPH-GRO (8010) | TPH-DRO (8015) | TPH (418.1) |
|---|---|---|---|
| 38-3 (0-6")<br>038-M-0003-01 | ND | 23 | **360** |
| 38-4 (0-6")<br>038-M-0004-01 | 0.067 J | ND | ND |
| 38-4 (18-24")<br>038-M-0004-02 | ND | 15 | ND |
| 38-5 (0-6")<br>038-M-0005-01 | ND | ND | **170** |
| 38-5 (0-6") DUP<br>038-N-0005-01 | ND | ND | ND |
| 38-6 (0-6")<br>038-M-0006-01 | ND | ND | **170** |
| 38-7 (0-6")<br>038-M-0007-01 | 0.073 J | 8 | ND |
| 38-7 (18-24")<br>038-M-0007-02 | ND | ND | ND |
| 38-8 (0-6")<br>038-M-0008-01 | ND | 21 | **190** |
| 38-8 (18-24")<br>038-M-0008-02 | ND | 27 | ND |
| NFC-1 (0-6")<br>NFC-M-0001-01 | NA | 22 | NA |
| NFC-2 (18-24")<br>NFC-M-0001-02 | NA | 16 | NA |

*Notes:*
"J" denotes reported concentration represents an estimated value.
Concentrations shown in **BOLD** exceed the 100 mg/kg cleanup standard for nondrinking water aquifers established by TDEC's UST Division
NA = NOT ANALYZED



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**Table 6-5**
**Comparison of Pesticides/PCBs/Herbicides in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 0004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | 13 | 76 | 11 | 34 | 9.5 | ND | 73 DJ | 170 DJ | 30 | 40 | 360 |
| 4,4'-DDD | 9.2 | 20 | 4.8 | ND | ND | ND | 6,000 DJ | 720 DJ | 12 | 2,700 | 24,000 |
| 4,4'-DDE | ND | 24 | 5.7 | ND | ND | ND | 35 DJ | 50 DJ | 6.4 J | 1,900 | 17,000 |
| 4,4'-DDT | 7.3 | 6 | ND | 9.3 | ND | ND | 22 DJ | 86 DJ | 12 | 1,900 | 17,000 |
| Aldrin | ND | 10 | ND | ND | ND | ND | ND | ND | ND | 38 | 340 |
| Heptachlor Epoxide | ND | 4 | ND | ND | ND | ND | ND | ND | ND | 70 | 630 |
| Aroclor-1260 | ND | 180 | 77 | ND | ND | ND | ND | ND | ND | 320 | 2850 |
| MCPA | ND | 5,300 | 1,100 | ND | ND | ND | ND | ND | ND | 39,000 | 1,000,000 |
| 2,4-D | ND | ND | 36J | ND | ND | ND | ND | ND | 22 J | 780,000 | 20,000,000 |
| 2,4-DB | ND | ND | ND | ND | ND | ND | ND | ND | 33 J | 630,000 | 16,000,000 |
| 2,4,5-TP (silvex) | 5.8 | ND | ND | ND | ND | ND | ND | ND | 2.5 J | 650,000 | 16,000,000 |
| Dichloroprop | ND | ND | 23 | ND | ND | ND | ND | ND | ND | NA | NA |
| Total Pesticides/ PCBs/Herbicides | 35.3 | 5,620 | 1,257.5 | 43.3 | 9.5 | ND | 6,130 | 1,026 | 117.9 | N/A | N/A |

**Table 6-5 (continued)**
**Comparison of Pesticides/PCBs/Herbicides in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 6-6 (0-6") 006-M-0006-01 | 6-6 DUP (0-6") 006-N-0006-01 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | 30 J | ND | 14 J | 120 DJ | 32 DJ | 220 DJ | 44 DJ | 150 DJ | 12 J | 40 | 360 |
| 4,4'-DDD | 12 J | ND | ND | ND | 12 DJ | 460 DJ | 37 DJ | 130 DJ | 11 J | 2,700 | 24,000 |
| 4,4'-DDE | 6.4 J | ND | ND | ND | 20 DJ | 95 DJ | 72 DJ | 70 DJ | ND | 1,900 | 17,000 |
| 4,4'-DDT | 12 J | ND | ND | ND | ND | 180 DJ | 47 DJ | 87 DJ | ND | 1,900 | 17,000 |
| Endrin Ketone | ND | ND | ND | ND | 76 DJ | ND | ND | ND | ND | NA | NA |
| Heptachlor Epoxide | ND | ND | ND | ND | 31 DJ | ND | ND | ND | ND | 70 | 630 |
| Stirphos | ND | ND | ND | ND | 270 J | ND | ND | ND | ND | NA | NA |
| MCPA | ND | ND | 11,000 J | 18,000 J | ND | ND | 5100 J | ND | ND | 39,000 | 1,000,000 |
| 2,4-D | 49 J | 130 J | ND | ND | 22 | ND | ND | ND | ND | 780,000 | 20,000,000 |
| 2,4-DB | 28 J | ND | ND | ND | ND | ND | ND | ND | ND | 630,000 | 16,000,000 |
| 2,4,5-TP (Silvex) | ND | ND | 12 J | ND | ND | ND | ND | ND | ND | 650,000 | 16,000,000 |
| Dicamba | ND | ND | ND | ND | 7.2 | ND | ND | ND | ND | 2,300,000 | 61,000,000 |
| Dinoseb | 15 J | ND | ND | ND | 24 | ND | ND | ND | ND | 78,000 | 2,000,000 |
| Total Pesticides/ PCBs/Herbicides | 152.4 | 130 | 11,026 | 18,120 | 494.2 | 955 | 5,300 | 437 | 23 | N/A | N/A |

**Table 6-5 (continued)**
**Comparison of Pesticides/PCBs/Herbicides in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 38-4 (18-24") 038-M-0004-02 | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (0-6") 038-M-0007-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | ND | 26 J | 16 J | ND | 42 J | ND | ND | 24 J | ND | 40 | 360 |
| 4,4'-DDD | ND | 11 J | 6.7 J | ND | 66 J | ND | ND | 9.3 J | ND | 2,700 | 24,000 |
| 4,4'-DDE | ND | 6.8 J | ND | ND | 10 J | ND | ND | ND | 9.1 J | 1,900 | 17,000 |
| 4,4'-DDT | ND | 8.4 J | 8.6 J | ND | 13 J | ND | ND | ND | ND | 1,900 | 17,000 |
| Aldrin | ND | ND | ND | ND | 3.4 J | ND | ND | ND | ND | 38 | 340 |
| Aroclor-1260 | ND | 110 J | ND | ND | ND | ND | ND | ND | ND | 320 | 2850 |
| MCPP | ND | ND | 5,200 | 3,600 J | ND | ND | ND | ND | ND | 78,000 | 2,000,000 |
| 2,4,5-TP (Silvex) | ND | ND | ND | ND | ND | ND | ND | 6.0 J | ND | 650,000 | 16,000,000 |
| Dicamba | ND | ND | ND | ND | ND | ND | ND | 7.2 | ND | 2,300,000 | 61,000,000 |
| Total Pesticides/ PCBs/Herbicides | ND | 162.2 | 5,231.3 | 3,600 | 134.4 | ND | ND | 46.5 | 9.1 | N/A | N/A |

**Table 6-5 (continued)**
**Comparison of Pesticides/PCBs/Herbicides in Sediment With RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | NFC-1(0-6") NFC-M-0001-01 | NFC-2 (18-24") NFC-M-0001-02 | RBC Residential | RBC Industrial |
|---|---|---|---|---|
| **Dieldrin** | 2.5 J | ND | 40 | 360 |
| **4,4'-DDE** | 5.2 J | 3.5 J | 1,900 | 17,000 |
| **Aldrin** | 2.0 J | ND | 38 | 340 |
| **Total Pesticides/ PCBs/Herbicides** | 9.7 | 3.5 | N/A | N/A |

*Notes:*

| | | |
|---|---|---|
| RBC | = | Risk-Based Concentration (USEPA Region III, January to June, 1996) |
| ND | = | Analyte not detected |
| J | = | Reported concentration represents an estimated value |
| D | = | Compound identified in analysis as dilution. |

Compounds shown in **BOLD** exceed residential RBCs.

Table 6-5 summarizes the sediment sample results for pesticides, herbicides, and polychlorinated biphenyls (PCBs) and compares them to residential and industrial RBCs. Table 6-6 compares sample results to the SSVs. Total (summed) pesticides, PCBs, and herbicides in the sediment samples are shown in Figure 6-6. The concentrations shown on Figure 6-6 have been color-coded to designate their status with respect to residential and industrial RBCs. Figure 6-7 shows the number of pesticides, PCBs, and herbicides which exceed published SSVs.

**Polychlorinated Biphenyls (PCBs)**

The PCB Aroclor-1260 was detected at two sample locations: 4-2 (180 μg/kg in the 0- to 6-inch interval and 77 μg/kg in the 18- to 24-inch interval) and 38-5 (110 μg/kg in the 0- to 6-inch interval). Its SSV (33 μg/kg) was exceeded at both locations, but neither the residential RBC (320 μg/kg) nor the industrial RBC (2,850 μg/kg) was exceeded.

**Herbicides**

The herbicides MCPA, MCPP, dicamba, 2,4,5-TP (silvex), 2,4-D (2,4-dichlorophenoxyacetic acid), 2,4-DB (4-2,4-dichlorophenoxy) butyric acid), dinoseb, and dichloroprop were detected in the sediment samples at relatively low concentrations (130 μg/kg or less), except for MCPA and MCPP. MCPA was detected at location 4-2 at concentrations of 5,300 μg/kg (0- to 6-inch interval) and 1,100 μg/kg (18- to 24-inch interval; background location 6-6 at concentrations of 11,000 μg/kg (0- to 6-inch interval) and 18,000 μg/kg (duplicate sample, 0- to 6-inch interval); and location 38-2 at a concentration of 5,100 μg/kg (0- to 6-inch interval). The only detection of MCPP was at location 38-5, with concentrations of 5,200 μg/kg (0- to 6-inch interval) and 3,600 μg/kg (18- to 24-inch interval). MCPA, MCPP, and 2,4-D were detected in both intervals; 2,4-DB, 2,4,5-TP, dicamba, and dinoseb were detected only in the 0- to 6-inch interval; and dichloroprop was only detected in the 18- to 24-inch interval. None of the herbicides exceeded their residential RBC, and none of the herbicides are listed as having an SSV.

## Metals

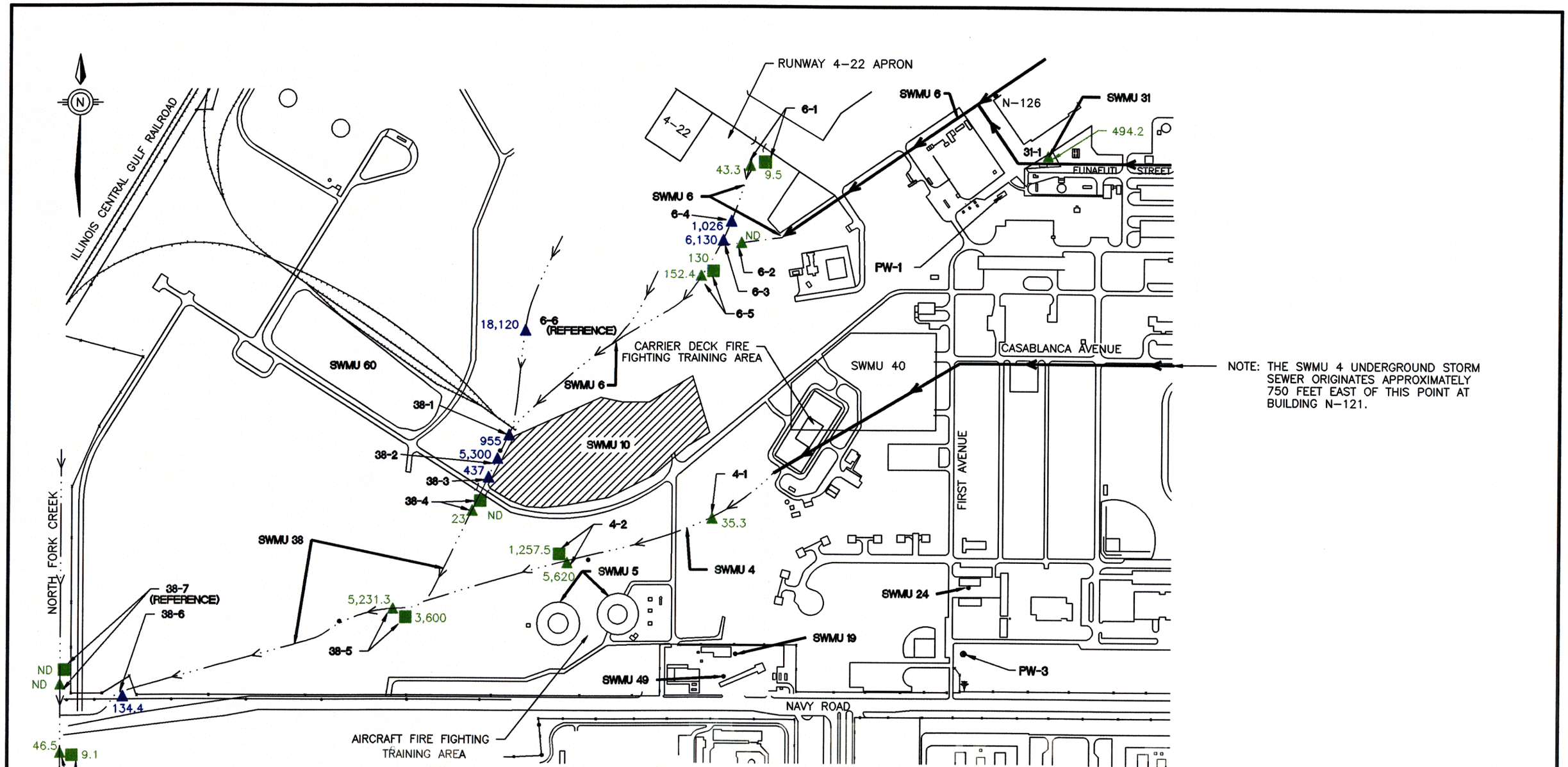
Concentrations of metals in the ditch sediment samples have been compared to RCs (two times the background concentration for the drainage ditches), residential and industrial RBCs, and SSVs. Several metals were detected in sediment above the RC in both depth intervals, including antimony, cadmium, chromium, lead, mercury, thallium, zinc, and cyanide. The residential RBC was exceeded for arsenic at three locations (one of which was background location 6-6). The SSV for at least one analyte was exceeded at nearly every sampling location in both depth intervals. No metals concentrations in background sample 6-6 exceeded either their RCs or the residential RBCs; however, SSVs were exceeded for nearly every listed metal. Sample 38-7 served as the background sample for the samples collected in the North Fork Creek area (samples 38-5 through 38-8 and NFC-1 and NFC-2). No metal concentrations in background sample 38-7 exceeded either their RCs, residential RBCs, or SSVs. Table 6-7 summarizes the metals concentrations in sediment and compares the results to RCs and RBCs. Table 6-8 compares the analytical results to their SSVs. Figure 6-8 plots the metals concentrations which exceed either the RC or the residential RBC. Figure 6-9 lists the number of metals exceeding their respective SSVs at each sample location. The following sections discuss the results of the metals analyses at each SWMU group.

### *SWMU 4 (Samples 4-1 and 4-2)*

One metal exceeded its RC, no metals exceeded their RBCs, and five metals exceeded their SSVs. Arsenic exceeded the SSV (5.4 mg/kg) in the 0- to 6-inch interval at locations 4-1 (9.3 mg/kg) and 4-2 (9.9 mg/kg). Lead exceeded its SSV (21 mg/kg) only at location 4-2, where it was detected at 43.8 mg/kg in the 0- to 6-inch interval. The mercury concentration in the 18- to 24-inch sample at location 4-2 (0.15 mg/kg) exceeded its RC (non-detect) and SSV (0.1 mg/kg). The SSV for nickel (20.9 mg/kg) was exceeded only at location 4-1 (27.6 mg/kg, 0- to 6-inch interval). The zinc concentration in the 0- to 6-inch interval at locations 4-1 (69 mg/kg) and 4-2 (78.4 mg/kg) exceeded the SSV (68 mg/kg).



000055




NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N–121.

LEGEND

- ▲ – SEDIMENT SAMPLE (0 TO 6 INCHES)
- ■ – SEDIMENT SAMPLE (18 TO 24 INCHES)
- ⟵ – STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- ⟵ – DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

NOTE: DATA REPORTED IN MICROGRAMS PER KILOGRAM (μg/kg)

GREEN — CONTAMINANTS WERE NOT DETECTED (ND) OR NO SINGLE CONTAMINANT EXCEEDED ITS RESIDENTIAL RISK–BASED CONCENTRATION.

BLUE — ONE OR MORE CONTAMINANTS WERE DETECTED THAT EXCEEDED RESIDENTIAL RISK–BASED CONCENTRATIONS, BUT DID NOT EXCEED INDUSTRIAL RISK–BASED CONCENTRATIONS.

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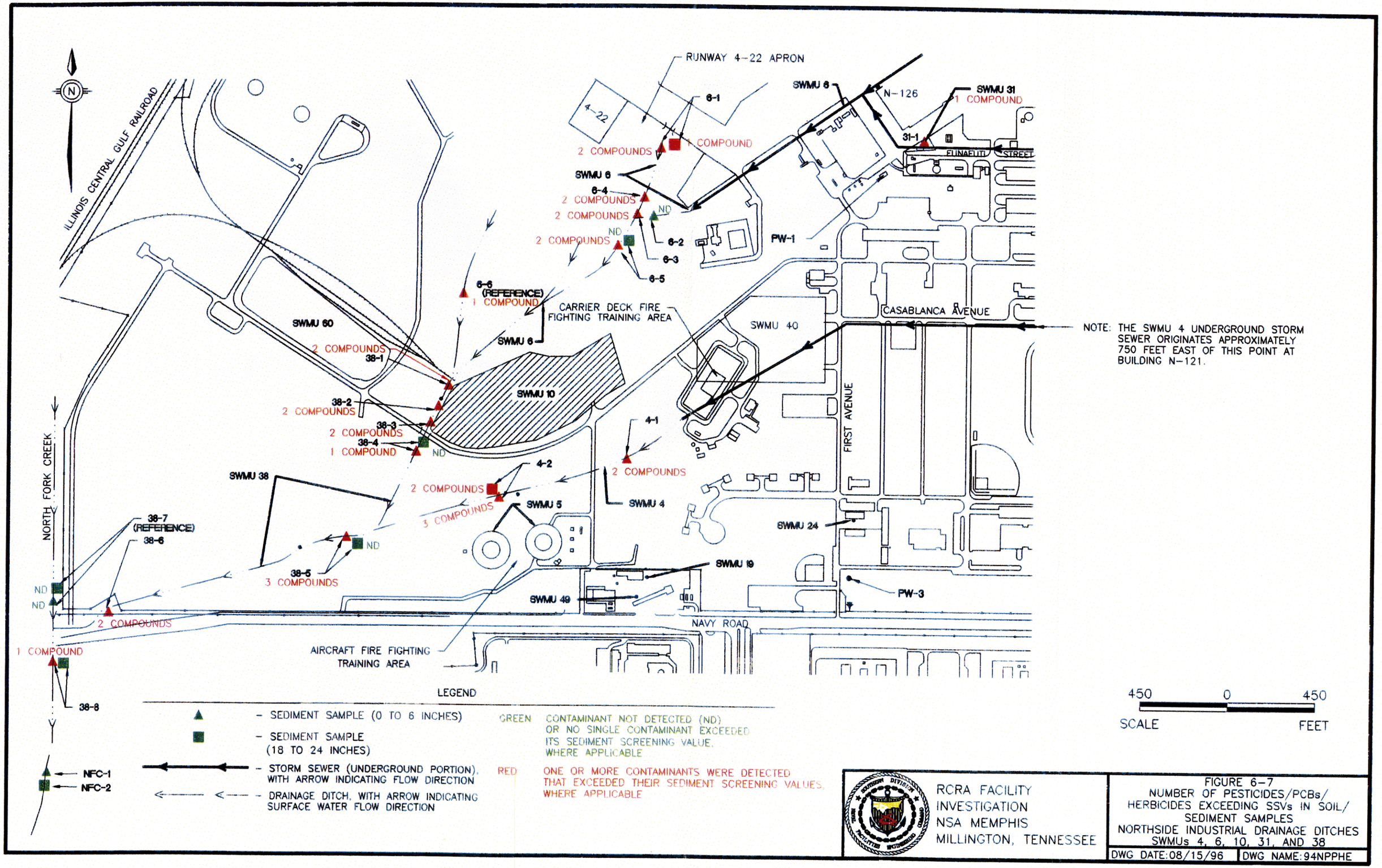
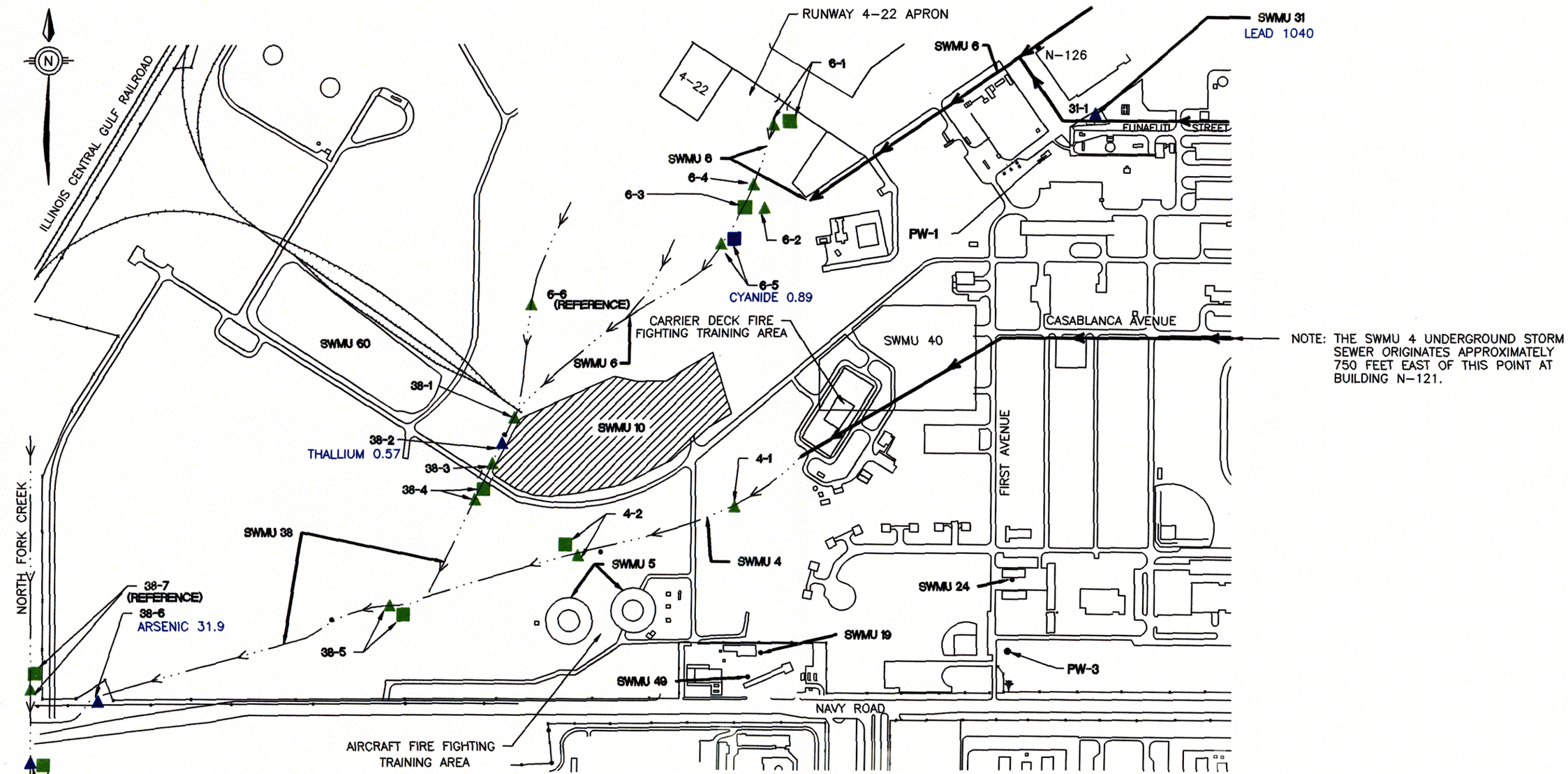
FIGURE 6–6
TOTAL PESTICIDES/PCBS/HERBICIDES IN SOIL/SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 01/02/96 | DWG NAME: 94TPPHS

00608FB2Y


N
ILLINOIS CENTRAL GULF RAILROAD
NORTH FORK CREEK
RUNWAY 4-22 APRON
4-22
6-1
2 COMPOUNDS
1 COMPOUND
SWMU 6
6-4
2 COMPOUNDS
2 COMPOUNDS
ND
2 COMPOUNDS
ND
6-2
6-3
6-5
SWMU 8
N-126
SWMU 31
1 COMPOUND
31-1
FUNAFUTI STREET
PW-1
6-6
(REFERENCE)
1 COMPOUND
CARRIER DECK FIRE
FIGHTING TRAINING AREA
SWMU 6
SWMU 60
2 COMPOUNDS
38-1
SWMU 10
38-2
2 COMPOUNDS
38-3
2 COMPOUNDS
38-4
1 COMPOUND
ND
SWMU 40
CASABLANCA AVENUE
FIRST AVENUE
4-1
2 COMPOUNDS
4-2
2 COMPOUNDS
3 COMPOUNDS
SWMU 38
SWMU 5
SWMU 4
38-7
(REFERENCE)
38-6
ND
38-5
3 COMPOUNDS
SWMU 24
SWMU 19
SWMU 49
PW-3
ND
ND
2 COMPOUNDS
NAVY ROAD
1 COMPOUND
AIRCRAFT FIRE FIGHTING
TRAINING AREA
38-8
NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.
LEGEND
- SEDIMENT SAMPLE (0 TO 6 INCHES)
- SEDIMENT SAMPLE (18 TO 24 INCHES)
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION
NFC-1
NFC-2
GREEN CONTAMINANT NOT DETECTED (ND) OR NO SINGLE CONTAMINANT EXCEEDED ITS SEDIMENT SCREENING VALUE, WHERE APPLICABLE
RED ONE OR MORE CONTAMINANTS WERE DETECTED THAT EXCEEDED THEIR SEDIMENT SCREENING VALUES, WHERE APPLICABLE
450 0 450
SCALE FEET
RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 6-7
NUMBER OF PESTICIDES/PCBs/
HERBICIDES EXCEEDING SSVs IN SOIL/
SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38
DWG DATE:08/15/96
DWG NAME:94NPPHE




LEGEND

- SEDIMENT SAMPLE (0 TO 6 INCHES)
- SEDIMENT SAMPLE (18 TO 24 INCHES)
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

NOTE: DATA REPORTED IN MILLIGRAMS PER KILOGRAM (mg/kg)

GREEN CONTAMINANTS WERE NOT DETECTED OR NO SINGLE INORGANIC WAS DETECTED EXCEEDING BOTH THE RC AND THE RESIDENTIAL RBC.

BLUE ONE OR MORE INORGANICS WERE DETECTED EXCEEDING BOTH THE RC AND THE RESIDENTIAL RBC, BUT NOT THE INDUSTRIAL RBC.

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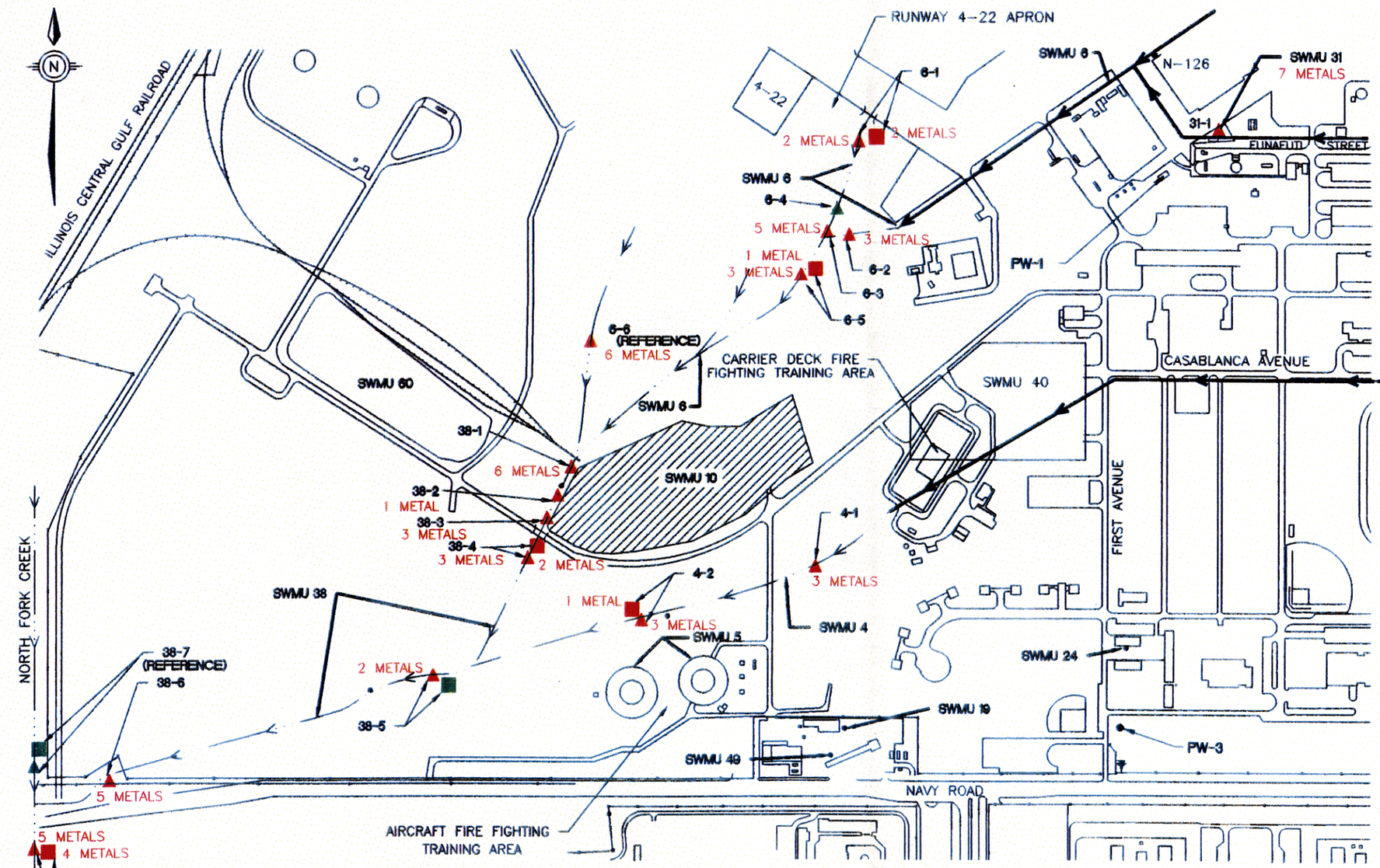
FIGURE 6-8
INORGANICS IN SOIL/SEDIMENT SAMPLES
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 01/02/96 | DWG NAME: 94MCSS




NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

450 0 450
SCALE FEET

LEGEND

- ▲ – SEDIMENT SAMPLE (0 TO 6 INCHES)
- ■ – SEDIMENT SAMPLE (18 TO 24 INCHES)
- NFC-1 ▲ 1 METAL
- NFC-2 ■ 1 METAL
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

GREEN CONTAMINANT NOT DETECTED OR NO SINGLE INORGANIC WAS DETECTED EXCEEDING THE SSV, WHERE APPLICABLE

RED ONE OR MORE INORGANICS WERE DETECTED EXCEEDING THE SSV, WHERE APPLICABLE.

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FIGURE 6-9
NUMBER OF INORGANICS IN SOIL/
SEDIMENT SAMPLES EXCEEDING
SEDIMENT SCREENING VALUE
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE:09/16/96 | DWG NAME:94NMSS

**Table 6-6**
**Comparison of Pesticides/PCBs/Herbicides in Sediment With SSVs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in µg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 0004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | **13** | **76** | **11** | **34** | **9.5** | ND | **73 DJ** | **170DJ** | **30** | 3.3 |
| 4,4'-DDT | 7.3 | **6** | ND | 9.3 | ND | ND | **22 DJ** | **86 DJ** | **12** | 3.3 |
| Aroclor-1260 | ND | **180** | **77** | ND | ND | ND | ND | ND | ND | 33 |

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 6-6 (0-6") 006-M-0006-01 | 6-6 DUP (0-6") 006-N-0006-01 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | **30 J** | ND | **14 J** | **120 DJ** | **32 DJ** | **220 DJ** | **44 DJ** | **150 DJ** | **12 J** | 3.3 |
| 4,4'-DDT | **12 J** | ND | ND | ND | ND | **180 DJ** | **47 DJ** | **87 DJ** | ND | 3.3 |
| Arochlor-1260 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 33 |

| Analyte | 38-4 (18-24") 038-M-0004-02 | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (0-6") 038-M-0007-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrin | ND | **26 J** | **16 J** | ND | **42 J** | ND | ND | **24 J** | ND | 3.3 |
| 4,4'-DDT | ND | **8.4 J** | **8.6 J** | ND | **13 J** | ND | ND | ND | ND | 3.3 |
| Aroclor-1260 | ND | **110 J** | ND | ND | ND | ND | ND | ND | ND | 33 |

| Analyte | NFC-1 (0-6") NFC-M-0001-01 | NFC-2 (18-24") NFC-M-0001-02 | Sediment Screening Values |
|---|---|---|---|
| Dieldrin | 2.5 | ND | 3.3 |

*Notes:*
ND = Analyte not detected
J = Reported concentration represents an estimated value.
D = Compound identified in analysis at a dilution.
Concentrations shown in **BOLD** exceed Sediment Screening Values.

**Table 6-7**
**Comparison of Metals in Sediment With RCs and RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | RC (2 x Background) | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 9.3 | 9.9 | 2.9 | 7 J | 8.2 | 16.6 | 11 | 5.4 | 5.4 J | 83.6 | 23 | 610 |
| Barium | 294 | 221 | 178 | 159 | 137 | 361 | 176 | 233 | 215 | 1276 | 5,500 | 140,000 |
| Beryllium | ND | ND | 0.6 | ND | ND | ND | ND | ND | ND | 638 | 0.15 | 1.3 |
| Cadmium | ND | ND | ND | ND | ND | 0.97 J | 10.3 | ND | ND | 3.8 | 39 | 1,000 |
| Chromium | 14.4 | 26 | 14.1 | 39.2 | 10.7 | 12.7 | 57.8 | 13.9 | 13.4 | 45 | 390 | 10,000 |
| Cobalt | 14.9 | 9.3 J | 4.9 J | 8 J | 10.2 J | 32.4 | 9.8 J | 11.9 J | 17.9 | 93 | 4,700 | 120,000 |
| Copper | 17.4 | 25.8 | 15.3 | 8.1 | 13.8 | 19.8 | 24.9 | 12.3 | 18.2 | 67.4 | 2,900 | 76,000 |
| Lead | 18.2 J | 43.8 J | 16.3 J | 346 J | 41.8 J | 29.4 J | 122 J | 13 J | 21.5 J | 188 | None | None |
| Mercury | ND | ND | 0.15 | ND | ND | ND | ND | ND | ND | ND | 23 | 610 |
| Nickel | 27.6 | 18.9 | 15.8 | 8.8 J | 16.9 | 31.4 | 14.1 | 15.6 | 26.9 | 116.4 | 1,600 | 41,000 |
| Vanadium | 33.8 | 20.8 | 13.4 J | 14.1 | 19.1 | 40 | 18.4 | 20.6 | 30 | 166.4 | 550 | 14,000 |
| Zinc | 69 | 78.4 | 56 | 20.2 J | 44.4 | 49.1 | 184 | 32.6 | 47.5 | 155.8 | 23,000 | 610,000 |

**Table 6-7 (continued)**
**Comparison of Metals in Sediment With RCs and RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | 38-4 (18-24") 038-M-0004-02 | RC (2 x Background) | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 9.5 | 8 | 4.8 | 8.9 | 6.8 | 10.1 | 18.3 J | 16.2 J | 83.6 | 23 | 610 |
| Barium | 192 | 137 | 96.4 | 109 | 102 | 116 | 233 | 196 | 1276 | 5,500 | 140,000 |
| Beryllium | ND | ND | ND | ND | ND | ND | ND | ND | 638 | 0.15 | 1.3 |
| Cadmium | ND | ND | 13.8 | 1.1 J | ND | 0.83 J | 1.3 J | 1.1 J | 3.8 | 39 | 1,000 |
| Chromium | 12.1 | 9.3 | 75.7 | 19.9 | 11.9 | 14.9 | 10.3 J | 10.9 | 45 | 390 | 10,000 |
| Cobalt | 13.6 J | 7.4 J | 7.7 J | 9.4 J | 6J | 10.1 J | 18.3 | 9.2 J | 93 | 4,700 | 120,000 |
| Copper | 18 | 17.5 | 52.1 | 22.4 | 14.5 | 16.6 | 18.7 | 19 | 67.4 | 2,900 | 76,000 |
| Lead | 23.7 J | 11 J | 1040 J• | 73 J | 22.2 J | 43 J | 18.7 J | 16.7 J | 188 | None | None |
| Mercury | ND | ND | 0.18 | 0.2 | ND | 0.16 | ND | ND | ND | 23 | 610 |
| Nickel | 23 | 19.8 | 22.9 | 22.9 | 14.1 | 16.3 | 21 | 13.2 | 116.4 | 1,600 | 41,000 |
| Selenium | ND | ND | ND | ND | ND | ND | ND | ND | 1.42 | 390 | 10,000 |
| Thallium | ND | ND | ND | ND | 0.57 J | ND | ND | ND | ND | NA | NA |
| Vanadium | 26.2 | 18.3 | 13.8 J | 25.8 | 19.2 | 21.2 | 33.8 J | 21.7 J | 166.4 | 550 | 14,000 |
| Zinc | 53.7 | 43.6 | 856 | 85.4 | 47.8 | 58.9 | 57 J | 50.9 J | 155.8 | 23,000 | 610,000 |
| Cyanide | ND | 0.89 | ND | ND | ND | ND | ND | | ND | NA | NA |

**Table 6-7 (continued)**
**Comparison of Metals in Sediment With RCs and RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | RC (2 x Background) | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | ND | ND | ND | ND | 14 J | ND | ND | 31 | 820 |
| Arsenic | 11.7 J | 10.3 | ND | 31.9 J | 24.7 J | 22 J | 9.6 | 23 | 610 |
| Barium | 94.6 J | 209 | 38.4 J | 550 | 549 | 223 | 222 | 5,500 | 140,000 |
| Cadmium | 1.9 | 1.8 | ND | 1.9 | 3.4 | 1.1 J | ND | 39 | 1,000 |
| Chromium | 18 J | 9.1 J | 5.8 J | 6J | 21.2 J | 17.7 J | 11 | 390 | 10,000 |
| Cobalt | 8.5 J | 16.4 J | 4.3 J | 25.1 | 33.4 | 22.7 | 14.8 | 4,700 | 120,000 |
| Copper | 15.8 | 19.4 | 15.4 | 18.2 | 20.4 | 18.3 | 21.2 | 2,900 | 76,000 |
| Lead | 19.3 J | 28.5 J | 10.7 J | 53.3 J | 54.6 J | 67.4 J | 25.2 | None | None |
| Mercury | ND | ND | ND | 0.24 J | ND | ND | ND | 23 | 610 |
| Nickel | 12.9 | 20.4 | ND | 22.7 | 28.2 | 22 | 16.2 | 1,600 | 41,000 |
| Vanadium | 23J | 25.3 | 10.3 J | 36.8 J | 51.6 J | 43 J | 26.4 | 550 | 14,000 |
| Zinc | 46.4 J | 49 J | 29.5 J | 46 J | 59.8 J | 57.0 J | 43.0 | 23,000 | 610,000 |

**Table 6-7 (continued)**
**Comparison of Metals in Sediment With RCs and RBCs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | NFC-1 (0-6") NFC-M-0001-01 | NFC-2 (18-24") NFC-M-0001-02 | RC (2 x Background) | RBC Residential | RBC Industrial |
|---|---|---|---|---|---|
| **Arsenic** | 5.4 J | 6.4 J | 9.6 | 23 | 610 |
| **Barium** | 115 J | 108 J | 222 | 5,500 | 140,000 |
| **Beryllium** | **0.38 J** | **0.35 J** | ND | 0.15 | 1.3 |
| **Cadmium** | **14.2** | **12.2** | ND | 39 | 1,000 |
| **Chromium** | 8.8 | 7.4 | 11.0 | 390 | 10,000 |
| **Cobalt** | 9.1 J | 7.8 J | 14.8 | 4,700 | 120,000 |
| **Copper** | 11.9 | 11.4 | 21.2 | 2,900 | 76,000 |
| **Lead** | 14.8 | 12.7 | 25.2 | None | None |
| **Nickel** | 14.3 | 13.1 | 16.2 | 1,600 | 41,000 |
| **Vanadium** | 17.6 | 15.3 | 26.4 | 550 | 14,000 |
| **Zinc** | 35.4 | 32.1 | 43.0 | 23,000 | 610,000 |
| **Tin** | **20.1 J** | **24.6 J** | ND | **1,000,000** | **47,000** |

*Notes:*
• Detected concentration exceeds the recommended soil screening concentration for lead (400 ppm) for residential land use (USEPA Office of Solid Waste Emergency Response Directive 9355.4-12).
RBC = Risk-based Concentration(EPA Region III, January - June, 1995)
ND = Analyte not detected
J = Reported concentration represents an estimated value.

Concentrations shown in **BOLD** exceed 2X the background concentration (RC), or the residential RBC.

**Table 6-8**
**Comparison of Metals in Sediment With SSVs**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | 4-1 (0-6") 004-M-0001-01 | 4-2 (0-6") 004-M-0002-01 | 4-2 (18-24") 004-M-0002-02 | 6-1 (0-6") 006-M-0001-01 | 6-1 (18-24") 006-M-0001-02 | 6-2 (0-6") 006-M-0002-01 | 6-3 (0-6") 006-M-0003-01 | 6-4 (0-6") 006-M-0004-01 | 6-5 (0-6") 006-M-0005-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 9.3 | 9.9 | 2.9 | 7 J | 8.2 | 16.6 | 11 | 5.4 | 5.4 J | 8 |
| Cadmium | ND | ND | ND | ND | ND | 0.97 J | 10.3 | ND | ND | 1 |
| Chromium | 14.4 | 26 | 14.1 | 39.2 | 10.7 | 12.7 | 57.8 | 13.9 | 13.4 | 33 |
| Copper | 17.4 | 25.8 | 15.3 | 8.1 | 13.8 | 19.8 | 24.9 | 12.3 | 18.2 | 28 |
| Lead | 18.2 J | 43.8 J | 16.3 J | 346 J | 41.8 J | 29.4 J | 122 J | 13 J | 21.5 J | 21 |
| Mercury | ND | ND | 0.15 | ND | ND | ND | ND | ND | ND | 0.1 |
| Nickel | 27.6 | 18.9 | 15.8 | 8.8 J | 16.9 | 31.4 | 14.1 | 15.6 | 26.9 | 20.9 |
| Zinc | 69 | 78.4 | 56 | 20.2 J | 44.4 | 49.1 | 184 | 32.6 | 47.5 | 68 |

| Analyte | 6-5 DUP (0-6") 006-N-0005-01 | 6-5 (18-24") 006-M-0005-02 | 6-6 (0-6") 006-M-0006-01 | 6-6 DUP (0-6") 006-N-0006-01 | 31-1 (2-3") over asphalt slab 031-M-0001-01 | 38-1 (0-6") 038-M-0001-01 | 38-2 (0-6") 038-M-0002-01 | 38-3 (0-6") 038-M-0003-01 | 38-4 (0-6") 038-M-0004-01 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 9.5 | 8 | 41.8 J | 22.1 J | 4.8 | 8.9 | 6.8 | 10.1 | 18.3 J | 8 |
| Cadmium | ND | ND | 1.9 J | 0.93 J | 13.8 | 1.1 J | ND | 0.83 J | 1.3 J | 1 |
| Chromium | 12.1 | 9.3 | 22.5 | 19.3 | 75.7 | 19.9 | 11.9 | 14.9 | 10.3 J | 33 |
| Copper | 18 | 17.5 | 33.7 | 23 | 52.1 | 22.4 | 14.5 | 16.6 | 18.7 | 28 |
| Lead | 23.7 J | 11 J | 94 J | 39.1 J | 1040 J | 73 J | 22.2 J | 43 J | 18.7 J | 21 |
| Mercury | ND | ND | ND | ND | 0.18 | 0.2 | ND | 0.16 | ND | 0.1 |
| Nickel | 23 | 19.8 | 58.2 | 39.3 | 22.9 | 22.9 | 14.1 | 16.3 | 21 | 20.9 |
| Zinc | 53.7 | 43.6 | 77.9 | 65.8 | 856 | 85.4 | 47.8 | 58.9 | 57 J | 68 |

**Table 6-8 (continued)**
**Comparison of Metals in Sediment With Sediment Screening Values**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | 38-4 (18-24") 038-M-0004-02 | 38-5 (0-6") 038-M-0005-01 | 38-5 DUP (0-6") 038-N-0005-01 | 38-5 (18-24") 038-M-0005-02 | 38-6 (0-6") 038-M-0006-01 | 38-7 (0-6") 038-M-0007-01 | 38-7 (18-24") 038-M-0007-02 | 38-8 (0-6") 038-M-0008-01 | 38-8 (18-24") 038-M-0008-02 | Sediment Screening Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | ND | ND | ND | ND | ND | ND | ND | 14 J | ND | 12 |
| Arsenic | 16.2 J | 11.7 J | 10.3 | ND | 31.9 J | 4.8 J | 4.1 J | 24.7 J | 22 J | 8 |
| Cadmium | 1.1 J | 1.9 | 1.8 | ND | 1.9 | ND | ND | 3.4 | 1.1 J | 1 |
| Chromium | 10.9 J | 18 J | 9.1 J | 5.8 J | 6 J | 5.5 J | 3.7 J | 21.2 J | 17.7 J | 33 |
| Copper | 19 | 15.8 | 19.4 | 15.4 | 18.2 | 10.6 | 7 | 20.4 | 18.3 | 28 |
| Lead | 16.7 J | 19.3 J | 28.5 J | 10.7 J | 53.3 J | 12.6 J | 8.1 J | 54.6 J | 67.4 J | 21 |
| Mercury | ND | ND | ND | ND | 0.24 J | ND | ND | ND | ND | 0.1 |
| Nickel | 13.2 | 12.9 | 20.4 | ND | 22.7 | 8.1 J | ND | 28.2 | 22 | 20.9 |
| Zinc | 50.9 J | 46.4 J | 49 J | 29.5 J | 46 J | 21.5 J | 19.1 J | 59.8 J | 57 J | 68 |

**Table 6-8 (continued)**
**Comparison of Metals in Sediment With Sediment Screening Values**
**Industrial Drainage Ditches - SWMUs 4, 6, 10, 31, and 38**
**(data in mg/kg)**

| Analyte | NFC-1 (0-6") NFC-M-0001-01 | NFC-2 (18-24") NFC-M-0001-02 | Sediment Screening Values |
|---|---|---|---|
| **Arsenic** | 5.4 J | 6.4 J | 8 |
| **Cadmium** | **14.2** | **12.2** | 1 |
| **Chromium** | 8.8 | 7.4 | 33 |
| **Copper** | 11.9 | 11.4 | 28 |
| **Lead** | 14.8 | 12.7 | 21 |
| **Nickel** | 14.3 | 13.1 | 20.9 |
| **Zinc** | 35.4 J | 32.1 J | 68 |

*Notes:*
ND = Analyte not detected
J = Reported concentration represents an estimated value.

Concentrations shown in **BOLD** exceed the Sediment Screening Value.

***6 (Samples 6-1 through 6-5)***

The highest concentrations of metals at SWMU 6 were in samples from locations 6-1 and 6-3, which were collected directly below outfalls. Five metals exceeded their RCs, no metals exceeded the residential RBCs, and six metals exceeded their SSVs. Arsenic did not exceed its RC (83.6 mg/kg), but exceeded its SSV (8 mg/kg) in the 0- to 6-inch interval at locations 6-2, 6-3, and 6-5, where concentrations ranged from 9.5 mg/kg to 16.6 mg/kg. In the 18- to 24-inch interval, arsenic exceeded its RC at location 6-1 (8.2 mg/kg) and 6-5 (8 mg/kg) and equalled or exceeded its SSV.

At location 6-3, concentrations of cadmium (10.3 mg/kg), chromium (57.8 mg/kg), and zinc (184 mg/kg) exceeded their RCs (3.8 mg/kg, 45 mg/kg, and 155.8 mg/kg, respectively) and SSVs (1 mg/kg, 33 mg/kg, and 68 mg/kg, respectively) in the 0- to 6-inch interval. The chromium SSV also was exceeded in the 0- to 6-inch interval sample at location 6-1 (39.2 mg/kg).

The lead concentration at location 6-1 (346 mg/kg, 0- to 6-inch interval) exceeded its RC (188 mg/kg) and its SSV (21 mg/kg). Lead SSVs also were exceeded in 0- to 6-inch interval samples from locations 6-2, 6-3, and 6-5, at concentrations ranging from 29.4 mg/kg to 122 mg/kg. In the 18- to 24-inch interval, lead exceeded its SSV at location 6-1 (41.8 mg/kg).

Nickel did not exceed its RC, but exceeded its SSV of 20.9 mg/kg in the 0- to 6-inch interval at locations 6-2 and 6-5, where it was detected at 31.4 mg/kg and 26.9 mg/kg, respectively. The cyanide RC (non-detect) was exceeded in the 0- to 6-inch interval sample from location 6-5 (0.89 mg/kg); however, no SSV exists for this compound.



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### *SWMU 31*

Five metals exceeded their RCs and seven exceeded their SSVs at one sample location (31-1); however, none of the compounds exceeded their RBCs. This sediment sample was collected from a depth of 2 to 3 inches above an asphalt slab in a parking lot.

### *SWMU 38 (Samples 38-1 through 38-4)*

Two metals exceeded their RCs, none exceeded their residential RBCs, and six exceeded their SSVs. The highest concentrations were detected in samples 38-1, 38-3, and 38-4.

Arsenic exceeded its SSV (8 mg/kg) in the 0- to 6-inch interval at locations 38-1 (8.9 mg/kg), 38-3 (10.1 mg/kg), and 38-4 (18.3 mg/kg), and in the 18- to 24-inch interval at location 38-4 (16.2 mg/kg). No arsenic concentration detected in this SWMU group exceeded the RC. Cadmium exceeded its SSV (1 mg/kg) at location 38-1 (1.1 mg/kg, 0- to 6-inch interval) and location 38-4 (1.3 mg/kg and 1.1 mg/kg in the 0- to 6-inch and 18- to 24-inch intervals, respectively). Lead exceeded its SSV (21 mg/kg) in the 0- to 6-inch interval at locations 38-1, 38-2, and 38-3, where concentrations ranged from 22.2 mg/kg to 73 mg/kg. Nickel exceeded its SSV (20.9 mg/kg) in the 0- to 6-inch interval sample collected at locations 38-1 (22.9 mg/kg) and 38-4 (21.0 mg/kg). Mercury exceeded both its RC (non-detect) and its SSV (0.1 mg/kg) in the 0- to 6-inch interval at locations 38-1 (0.2 mg/kg) and 38-3 (0.16 mg/kg). Thallium, detected only in the 0- to 6-inch interval sample from location 38-2, was detected at 0.57 mg/kg, exceeding its RC of non-detect. Zinc exceeded its SSV (68 mg/kg) at location 38-1 only, where it was detected at 85.4 mg/kg in the 0- to 6-inch interval.

### *North Fork Creek Area (Samples 38-5 through 38-8)*

Eleven metals exceeded their RCs, one exceeded its residential RBC, and six exceeded their SSVs. The highest metals concentrations were detected in samples 38-6 and 38-8, collected in



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the drainage ditch and North Fork Creek, respectively. No RCs, RBCs or SSVs were exceeded at sediment sampling location 38-7.

Antimony exceeded its RC (non-detect) and SSV (12 mg/kg) in the 0- to 6-inch sample collected at location 38-8 (14 mg/kg). Arsenic was the only metal which exceeded its residential RBC (23 mg/kg), with exceedances in the 0- to 6-inch interval at locations 38-6 (31.9 mg/kg) and 38-8 (24.7 mg/kg). However, arsenic is present throughout the base and either is an element ocurring naturally in elevated concentrations or is a result of arsenical pesticide application to cotton crops in the area. Although occurring in soil and sediment throughout the base, the observed concentrations are less than half of the RC (83.6 mg/kg). The SSV for arsenic (8 mg/kg) was exceeded in the 0- to 6-inch interval sample at locations 38-5, 38-6, and 38-8, with concentrations ranging from 11.7 mg/kg to 31.9 mg/kg. The 18- to 24-inch interval sample from location 38-8 also exceeded the SSV for arsenic, exhibiting a concentration of 22 mg/kg.

Cadmium exceeded its RC and SSV at locations 38-5 (0-to 6-inch interval), 38-6 (0- to 6-inch interval), and 38-8 (both intervals), with concentrations ranging from 1.9 mg/kg to 3.4 mg/kg. Chromium exceeded its RC at the 0- to 6-inch interval of location 38-5 and in both intervals of sample location 38-8. Chromium concentrations ranged from 17.7 mg/kg to 21.2 mg/kg. Lead exceeded its RC and SSV at locations 38-5 (0- to 6-inch interval), 38-6 (0- to 6-inch interval), and 38-8 (both intervals), with concentration ranging from 28.5 mg/kg to 67.4 mg/kg. Mercury exceeded both its RC (non-detect) and SSV (0.1 mg/kg) at location 38-6 only, where it was detected at 0.24 mg/kg in the 0- to 6-inch interval. Nickel exceeded its RC and SSV at locations 38-6 (22.7 mg/kg) and 38-8 (28.2 mg/kg in the 0- to 6-inch interval and 22 mg/kg in the 18- to 24-inch interval). Zinc exceeded its RC at the 0- to 6-inch interval of location 38-5 (49mg/kg), the 0- to 6-inch interval of location 38-6 (46 mg/kg), and both intervals of location 38-8 (59.8 mg/kg and 57.0 mg/kg, respectively).



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***Downgradient North Fork Creek Sample (Samples NFC-1 and NFC-2)***

The only exceedance of an RBC was for beryllium, which was detected at 0.38 mg/kg and 0.35 mg/kg in samples NFC-1 and NFC-2, respectively. The only exceedance of the SSV was for cadmium, which was detected at 14.2 mg/kg and 12.2 mg/kg in samples NFC-1 and NFC-2, respectively. NFC-1 was collected from the 0-6 inch interval and NFC-2 was collected from the 18-24 inch interval.

## 6.3 Summary of Nature and Extent

Analytical results indicate that sediment in certain reaches of the ditches contain elevated concentrations of SVOCs, TPH, pesticides, PCBs, herbicides, and metals. Horizontally, most of the contaminated sediment is in the SWMU 38 drainage ditch just below the drainage gullies leading from SWMU 10 and directly below outfalls. Vertically, most of the contamination is limited to the upper six inches of the sediment, except for those locations where contaminant concentrations in the shallowest intervals were relatively elevated. Figure 6-10 presents each sampling location where at least one contaminant concentration exceeds its RBC or RC. Figure 6-11 identifies all sampling locations where at least one contaminant concentration exceeds it SSV. The following sections provide an overall analytical summary of sediment samples collected from each SWMU group.

**SWMU 4 (Samples 4-1 and 4-2)**

SVOCs, metals, and pesticides are present at concentrations lower than samples collected from other portions of the drainage ditches. The highest total (summed) SVOC concentration was 292 $\mu$g/kg in the 0- to 6-inch sample at location 4-2. Metals were present at relatively low concentrations. However, pesticides and herbicides were present in samples collected from both locations at concentrations exceeding the RCs and SSVs.



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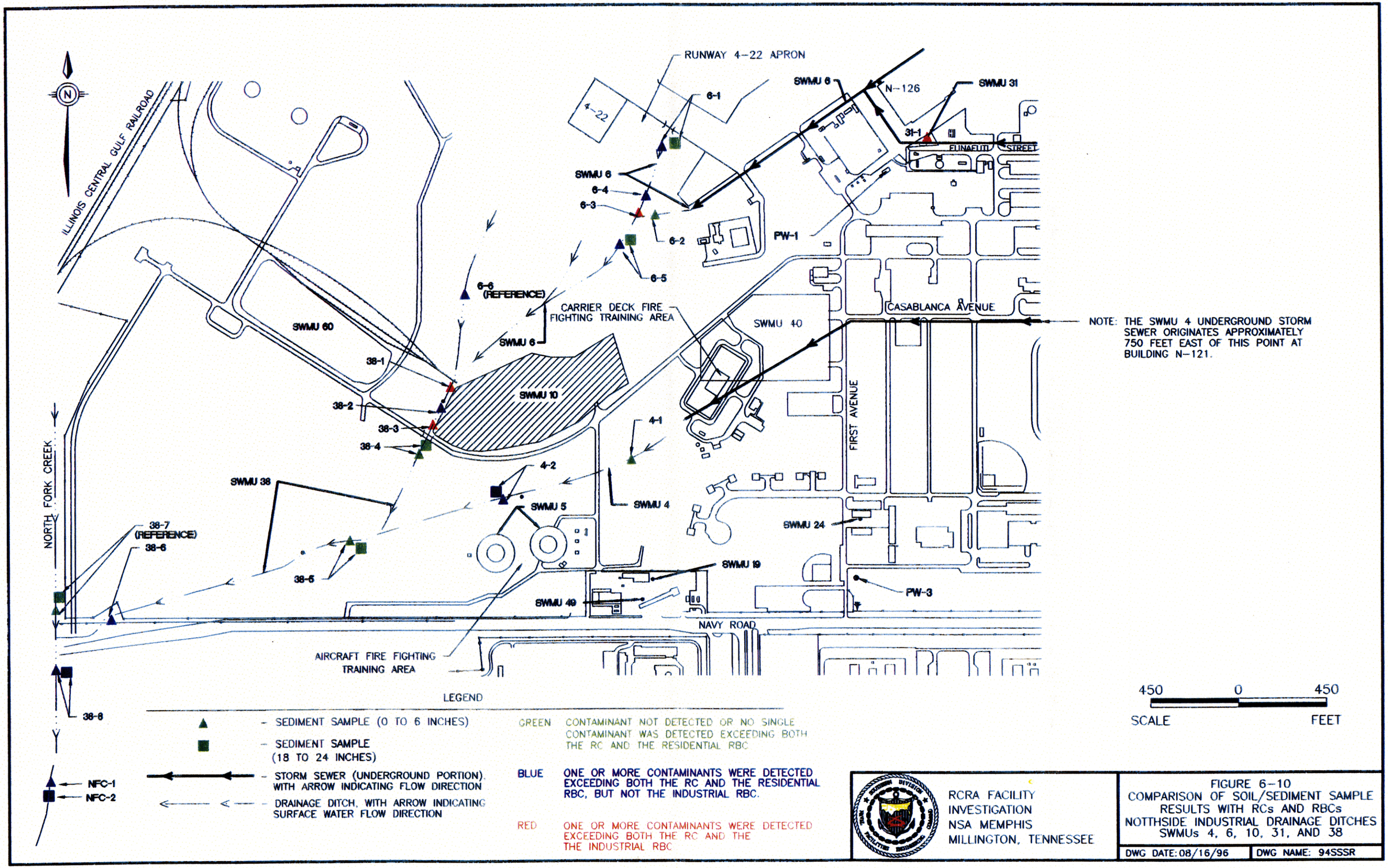
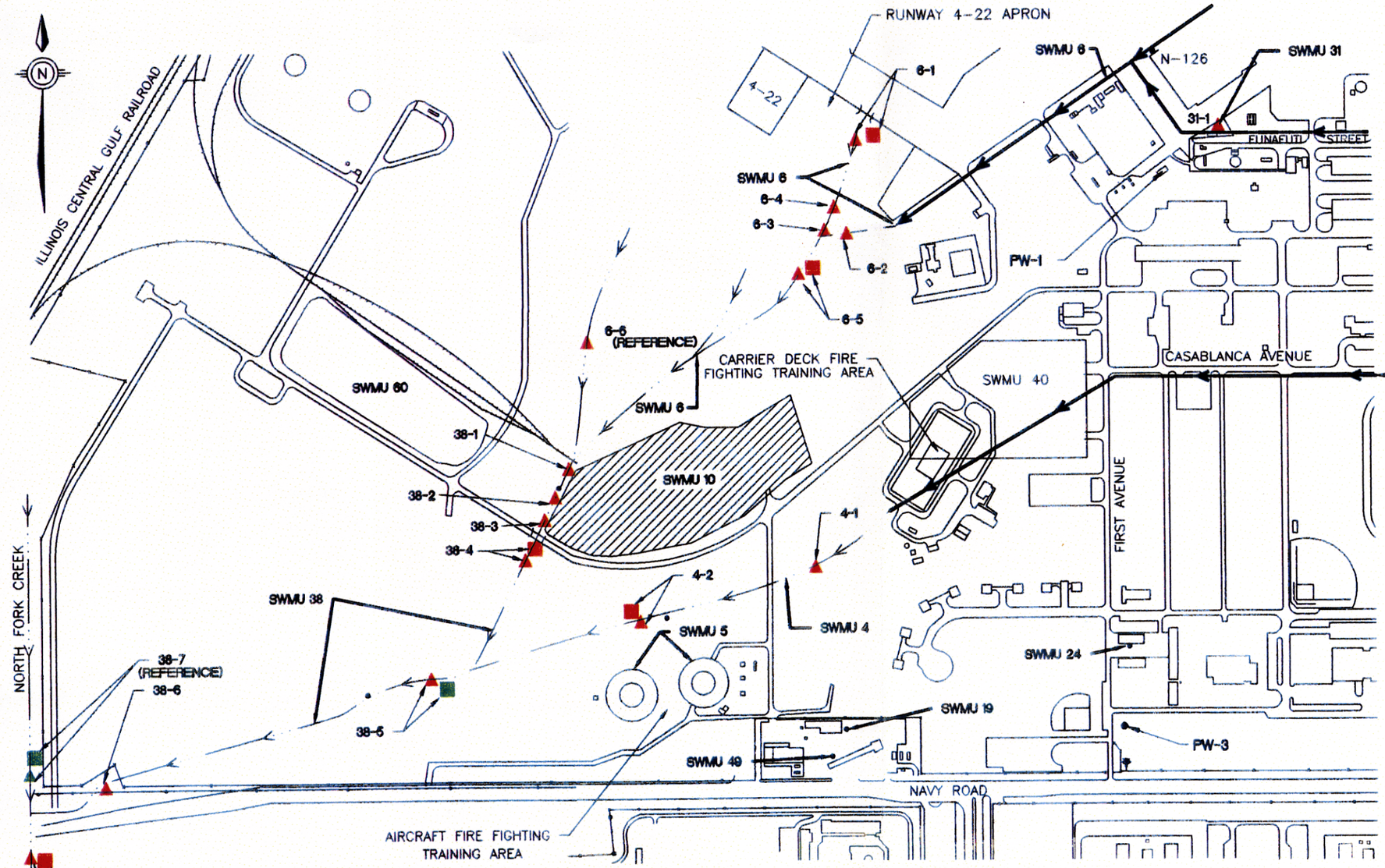



NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

00608FB3Y 00007




NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

450 0 450
SCALE FEET

LEGEND

- SEDIMENT SAMPLE (0 TO 6 INCHES)
- SEDIMENT SAMPLE (18 TO 24 INCHES)
- STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

GREEN CONTAMINANT NOT DETECTED OR NO SINGLE CONTAMINANT WAS DETECTED WHICH EXCEEDED THE SSV WHERE APPLICABLE

RED ONE OR MORE CONTAMINANTS WERE DETECTED WHICH EXCEEDED THE SSV WHERE APPLICALBLE

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 6-11
COMPARISON OF SEDIMENT/SOIL SAMPLE RESULTS WITH SSVs
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 08/16/96 | DWG NAME: 94SSR4A

**SWMU 6 (Samples 6-1 through 6-5)**

The greatest concentrations of contaminants were identified in samples collected directly below outfalls that flow into the ditches, particularly sample location 6-3, which had a total (summed) SVOC concentration of more than 20,000 $\mu$g/kg. Metals, pesticides, TPH, and TPH-diesel range organics (DRO) also were detected at elevated concentrations. The extent of contamination appears to diminish downstream from the primary outfalls near locations 6-1 and 6-3. At sample location 6-5, the most downstream sample from this SWMU, total SVOCs reduced to 4,789 $\mu$g/kg. The same trend was noted for metals, with sample locations 6-1 and 6-3 exhibiting higher lead concentrations than at location 6-5.

It is difficult to show any pattern with the pesticides/herbicides or TPH distribution. Pesticides/herbicides appear most elevated at locations 6-3 and 6-4. The ubiquitous basewide application of pesticides probably has contributed to their distribution in the ditches. Except for sample location 6-2, TPH was detected at every 0 to 6-inch sample location. The presence of TPH and TPH-DRO is not unexpected, because fuels have been used extensively at the base.

**SWMU 31 (Sample 31-1)**

Toluene was the only VOC detected at sample location 31-1. However, a variety of SVOCs were detected exceeding RBCs and SSVs. Pesticides, herbicides, and metals exceeding their SSV also were detected. This sample was collected directly upstream from a storm drain and above an asphalted portion of a parking lot. It is possible that the SVOCs and other constituents present result from the asphalt and/or apron activities. Contaminants from this area likely will migrate into the nearby drain and discharge into the drainage ditches.

**SWMU 38 (Samples 38-1 through 38-4)**

The greatest concentrations of contaminants were collected near the drainage gullies that transport surface water from SWMU 10 to the SWMU 38 drainage ditch, particularly at sample



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locations 38-1 and 38-3. Samples collected from locations 38-1 and 38-3 had total SVOC concentrations of more than 35,000 μg/kg and 22,000 μg/kg, respectively. Metals were not detected in high concentrations relative to RBCs or SSVs. However, pesticides were elevated at the three upstream sampling locations (38-1, 38-2, and 38-3). TPH and TPH-DRO also were detected. The extent of contamination appears to diminish farther from the outfalls. At sample location 38-4, the most downstream sample location at this SWMU, SVOCs were not detected.

**North Fork Creek Area (Samples 38-5 through 38-8 and samples NFC-1 & NFC-2)**

The greatest concentrations of contaminants were collected in sample 38-8, downstream from where the Navy Road bridge crosses over North Fork Creek. Although other constituents were detected in North Fork Creek, it appears that impacts from Navy Road may be contributing to the identified contamination. Sample 38-8 had a total SVOC concentration of more than 9,900 μg/kg from both the 0- to 6-inch and 18- to 24-inch interval. SSVs were exceeded for six metals at this sample location. Pesticides also were detected in sample 38-8. It is uncertain whether pesticides are due to application at the base or in the general area.

Two additional sediment samples (NFC-1 and NFC-2) were collected from one location approximately 600 feet downgradient from sample 38-8 (Figure 6-1). The only exceedances for either RBCs or SSVs was for metals, where beryllium exceeded the RBC in both samples and cadmium exceeded the SSV in both samples. Because cadmium and beryllium were not prevalent in the drainage ditches on base, particularly in the area of SWMU 38 and North Fork Creek, the contamination is assumed to have originated from another source. The technical memorandum, included as Appendix C, identifies other sources which may be contributing to contamination in North Fork Creek.



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# 7.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

## 7.1 Introduction

A Baseline Risk Assessment (BRA) analyzes the potential adverse effects arising from actual or hypothetical exposures to hazardous substances released from a site if no remedial actions are taken to reduce the present contamination. This BRA assesses human health risk at the industrial drainage ditch areas (i.e., SWMUs 4, 6, 10, 31, and 38) on the Northside of NSA Memphis. Data management and analysis algorithms used to reach the conclusions of this human health risk assessment are discussed below. The following sections describe the methods, procedures, considerations, toxicological information, and related uncertainties affecting the industrial drainage ditch areas at NSA Memphis. The following BRA was prepared generally in accordance with the guidelines set forth in:

- *Provisional Guidance for Quantitative Risk Assessment of PAHs* (USEPA, 1993).
- *Risk Assessment Guidance for Superfund (RAGS), Volume I — Human Health Evaluation Manual, Part A* (USEPA, December 1989).
- *RAGS, Volume I — Human Health Evaluation Manual, (Part B, Development of Risk-Based Preliminary Remediation Goals)* (USEPA, December 1991).
- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance — Standard Default Exposure Factors — Interim Final* (USEPA, March 1991).
- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance — Dermal Risk Assessment — Interim Guidance* (USEPA, August 1992).



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- Supplemental Guidance to RAGS: Region IV Bulletin, *Development of Health-Based Preliminary Remediation Goals, Remedial Goal Options (RGO) and Remediation Levels* (USEPA, October 1994).

- Supplemental Guidance to RAGS: Region IV Bulletin, *Calculating the Concentration Term* (USEPA, May 1992).

- *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Table* (USEPA, March 1994).

- *Risk-Based Concentration Table* (USEPA, March 1995).

## 7.2 Objectives

The objectives of the BRA are to:

- Characterize the source media and determine the chemicals of potential concern (COPCs) for affected environmental media.

- Identify potential receptors and quantify their potential exposures under current and future conditions for all affected environmental media.

- Qualitatively and quantitatively evaluate the adverse effects associated with the site-specific COPCs in each medium.

- Characterize the baseline carcinogenic and noncarcinogenic risks associated with exposure to impacted environmental media at the NSA Memphis drainage ditch areas under current and future conditions.



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- Evaluate the uncertainties related to exposure predictions, toxicological data, and resultant carcinogenic risk and noncarcinogenic hazard predictions.

- Establish Remedial Goal Options (RGOs) for chemicals of concern (COC) in each environmental medium based on risk/hazard to facilitate risk management decision-making.

The risk assessment's value, as a basis for making remedial decisions and determining whether detected site concentrations have the potential for toxic effects or increased cancer incidences, depends on adequately characterizing chemical contamination. Variables considered in characterizing the study area and its associated risk are the amount, type, and location of sources; the pathways of exposure (media type and migration routes); and the type, sensitivities, exposure duration, and dynamics of the exposed populations (receptors).

Sampling activities consisted of collecting surface (0- to 6-inch interval) and subsurface (18- to 24-inch interval) sediment samples from the industrial drainage ditch areas and submitting them for laboratory analyses. Only the analytical data for the surface-sediment samples were used to predict potential human exposure to environmental contaminant. Subsurface-sediment samples are not expected to result in contaminant exposure, and therefore, were not considered. Figure 7-1 shows the sediment-sampling locations.

As shown on Figure 7-1, SWMU 6 is the outfall and drainage ditch which drain the Runway 4 apron. During a storm, drainage flows southwest from the Runway 4 apron outfall (SWMU 6), past the western end of SWMU 10 (Northside Landfill, Eastern Portion), and through SWMU 38 (Industrial Drainage Ditch), where the drainage ditch is joined from the east by the SWMU 4 ditch. SWMU 60, the Northside landfill (containing asphalt and other construction debris), is west of the ditch across from SWMU 10. Drainage flow from SWMU 38 passes into



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North Fork Creek and beneath Navy Road bridge approximately 2,000 feet past the landfills (SMWUs 60 and 10). Runoff from Navy Road bridge and the surrounding roadway drain directly into North Fork Creek.

Ditch sediment samples were collected at SWMUs 4, 6, 31, and 38, and from the western end of the landfill (SWMU 10) to address potential leaching from the landfill into the drainage ditch. The four sediment samples collected near the landfill were assigned ID's corresponding to SWMU 38, which is the drainage ditch directly downstream from SWMU 10. Three sediment samples were collected in the North Fork Creek Area (downstream of all SWMUs addressed in this BRA), and one sample was collected within the SWMU 38 area downgradient of the confluence of two ditches (designated 38-5 in Figure 7-1). Four North Fork Creek Area and four SWMU 38 sediment samples were collected. No samples were designated as SWMU 10 samples. Five sediment samples were collected at SWMU 6, and two were collected at SWMU 4.

The storm sewer at SWMU 31, the Aircraft Wash Rack, was inaccessible. A sample of sediment accumulating at the storm-sewer grating was collected. The accumulated sediment was approximately three inches deep and underlain by the asphalt surface of the parking lot. Previous studies have demonstrated that asphaltic surfaces (particularly roadways and parking lots) can contribute significant levels of polycyclic aromatic hydrocarbon (PAH) and metal contamination to freshwater streams, and highway runoff can elevate PAH and metals concentrations in sediment and surface water (Maltby et al., 1995). The representativeness of sediment sample 38-8 data (collected downstream of the Navy Road bridge) to reflect site impacts is questionable, so it and SWMU 31 sediment data were not used in this BRA because they have been impacted by the road and parking lot, respectively.



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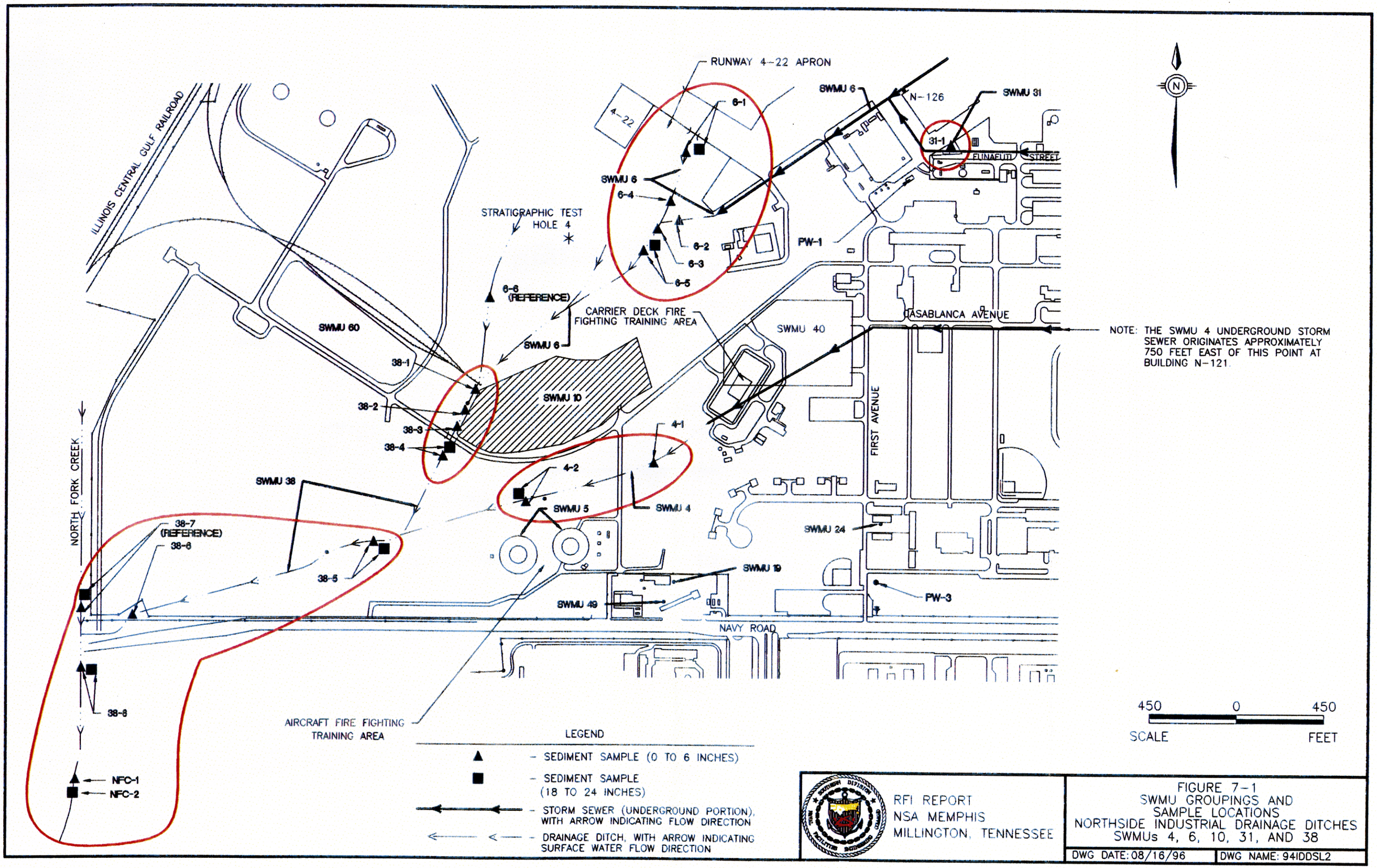


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No more than five sediment samples were collected from each drainage ditch for characterization. These samples were analyzed for VOCs, SVOCs, chlorinated pesticides/PCBs, organophosphorus pesticides, chlorinated herbicides, Appendix IX metals, cyanide, and TPH using Level IV-equivalent DQOs for all compounds except for TPH, which was analyzed using a Level III-equivalent DQO. Samples were analyzed using SW-846 methods with CLP deliverables and reporting requirements.

**Organization**

A human health risk assessment, as defined by RAGS Part A, includes the following steps:

- Site characterization: evaluation of data regarding site geography, geology, hydrogeology, climate, and demographics.

- Data collection: analysis of environmental media samples, including background/ reference samples.

- Data evaluation: statistical analysis of analytical data to identify the nature and extent of contamination and to establish a preliminary list of COPCs based on risk-based and background screening. This list will be refined to identify COCs.

- Exposure assessment: identification of potential receptors under current and predicted conditions and potential exposure pathways, and calculation/quantitation of exposure point concentrations (EPC) and chemical intakes.

- Toxicity assessment: qualitative evaluation of the adverse effects of the COPCs, and quantitative estimate of the relationship between exposure and severity or probability of effect.



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- Risk characterization: combination of the output of the exposure assessment and the toxicity assessment to quantify the total noncancer and cancer risk to the hypothetical receptors.

- Uncertainty: discussion and evaluation of the areas of recognized uncertainty in human health risk assessments in addition to medium- and exposure pathway-specific influences.

- Risk/hazard summary: presentation and discussion of the results of the quantification of exposure (risk and hazard) for the potential receptors and their exposure pathways identified under the current and future conditions.

- RGOs: computation of exposure concentrations corresponding to risk projections within the USEPA target risk range of 1E-6 to 1E-4 for carcinogenic COCs and hazard quotient goals of 0.1, 1, and 10 for noncarcinogenic COCs.

## 7.3 Site Characterization

When performing a BRA, environmental media data are compiled to determine potential site-related chemicals and exposures as outlined in RAGS Part A. The steps identifying COPCs are discussed in the following subsections.

### 7.3.1 Data Sources

Sediment samples were collected and analyzed to delineate the sources, nature, magnitude, and general extent of any contamination associated with current or past site operations. The data used in the BRA for the combined drainage ditch areas were obtained from the results of the RFI and associated sampling activities. Tables 7-1 and 7-2 summarize sample analyses performed



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and sediment-sample identifications, respectively. Samples were submitted to NET laboratory for analysis. Analytical results are provided within Attachment 1 of this document.

**Table 7-1**
**Analytical Parameters**
**Chemical Characterization**
**Assembly B — Drainage Ditch Area Sediment**

| Media | Parameters | SW-846 Method |
|---|---|---|
| Sediment | TCL Volatile Organic Compounds | 8240 |
| | TCL Semivolatile Organic Compounds | 8270 |
| | TCL Chlorinated Pesticides/PCBs | 8080 |
| | Organophosphorus Pesticides | 8140 |
| | Chlorinated Herbicides | 8150 |
| | Appendix IX Metals and Cyanide | 6010, 7060, 7421, 7740, 7841, 9012 |
| | Total Petroleum Hydrocarbons | EPA 418.1 |
| | Total Petroleum Hydrocarbons — GRO/DRO | TN Mod. 8015 — GRO.BTEX/DRO |

*Note:*
TCL = Target Compound List

**Table 7-2**
**Sample Identification Numbers**
**Assembly B — Drainage Ditch Area Sediment**

| Associated SWMU(s) | Sample Location | Sample Identification Number/Interval |
|---|---|---|
| SWMU 4 | 4-1 | 004-M-0001-01 |
| | 4-2 | 004-M-0002-01 |
| SWMU 6 | 6-1 | 006-M-0001-01 |
| | 6-2 | 006-M-0002-01 |
| | 6-3 | 006-M-0003-01 |
| | 6-4 | 006-M-0004-01 |
| | 6-5 | 006-M-0005-01 |
| SWMU 31 (accumulated soil) | 31-1 | 031-M-0001-01 |
| SWMUs 38 (between SWMUs 10 and 60) | 38-1 | 038-M-0001-01 |
| | 38-2 | 038-M-0002-01 |
| | 38-3 | 038-M-0003-01 |
| | 38-4 | 038-M-0004-01 |
| | 38-5 | 038-M-0005-01 |
| North Fork Creek Area (downstream from the confluence of SWMUs 4, 6, and 38) | 38-6 | 038-M-0006-01 |
| | 38-7 | 038-M-0007-01 |
| | 38-8 | 038-M-0008-01 |



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### 7.3.2 Data Validation

Data validation is an after-the-fact, independent, systematic process of evaluating data and comparing them to preestablished criteria to confirm they are of the technical quality necessary to support the decisions made in the RFI process. Parameters specific to the data are reviewed to determine whether they meet the stipulated DQO equivalencies. The quality objectives address five principal parameters: precision, accuracy, completeness, comparability, and representativeness. To verify that these objectives are met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and nonconformances and discrepancies in the data are examined to determine compliance with appropriate and applicable procedures. Data for NSA Memphis were validated in accordance with the methods outlined in the October 1994 *Comprehensive RFI Work Plan* for NSA Memphis. In its validated form, the data set was deemed usable for risk-assessment purposes. Attachment 1 of this document contains the Assembly B Data Validation Report, while Attachment 2 contains the Assembly B Data Validation Report for the two additional samples collected offsite in North Fork Creek.

### 7.3.3 Management of Site-Related Data

All environmental sampling data were evaluated for suitability for use in the quantitative BRA. Data obtained via the following methods were considered inappropriate:

- Analytical methods that are not specific for a particular chemical, such as total organic carbon, total organic halogen, or TPH.

- Field screening instruments including total organic vapor monitoring units and organic vapor analyzers.



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### 7.3.4 Selection of COPCs

The objective of this section of the BRA was to screen the available information on the substances detected at the industrial drainage ditches (chemicals present in site samples or CPSSs) in order to develop a list or group of COPCs. COPCs are, therefore, chemicals selected by comparison with screening concentrations (risk-based and reference), intrinsic toxicological properties, persistence, fate and transport characteristics, and cross-media transport potential. Any COPC that is carried through the risk assessment process and found to contribute to a scenario with an incremental lifetime excess cancer risk (ILCR) in excess of 1E-4 or a hazard index (HI) greater than 1 for any of the exposure scenarios evaluated, and has an individual exposure pathway risk greater than 1E-6 or exposure pathway hazard quotient (HQ) greater than 0.1, is referred to as a COC. ILCR, HQ, and HI are detailed in Toxicity Assessment (Section 7.5) and Risk Characterization (Sections 7.6).

Before evaluating the potential risks/hazards associated with site media, it was first necessary to delineate the contamination onsite by noting the chemicals detected in environmental media. These chemicals represent the CPSSs for combined drainage-ditch area sediment. The nature and general extent of CPSSs were discussed in detail in Section 6 of this RFI report. The following two comparisons were made to reduce the CPSS list and focus the assessment on COPCs.

**Comparison of Site-Related Data to Risk-Based Screening Concentrations**

The maximum concentrations of CPSSs detected during sampling were compared to risk-based screening values. These values were obtained from *Determination of COCs by Risk-Based Screening*, USEPA Region III, March 18, 1994, and subsequent versions. As a conservative screening measure, reported sediment concentrations were compared to residential soil-screening values. As stated in the USEPA Region III document, a target hazard quotient of 0.1 and a risk goal of 1E-6 were used to calculate screening concentrations for noncarcinogens and



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carcinogens, respectively. In instances where a more recent version of USEPA Region III's RBC tables was necessary, noncarcinogenic chemical values were adjusted to equate with a hazard quotient of 0.1. CPSSs with maximum detected concentrations exceeding their RBCs will be retained for further evaluation and reference screening. In addition, surrogate screening values based on toxicological similarities were used if no screening value was available in USEPA's table.

The maximum benzo(a)pyrene (BaP) equivalent concentration reported for carcinogenic PAHs was compared to its corresponding screening value. At any one SWMU, if the BaP-equivalent concentration exceeded its corresponding screening value, all carcinogenic PAH concentrations reported at that SWMU were formally addressed in this BRA. PAH conversions were performed using current Toxicity Equivalency Factors (TEFs) for PAHs in accordance with *Provisional Guidance for Quantitative Risk Assessment of PAHs* (USEPA, July 1993). Therefore, the theoretical maximum equivalent concentration of BaP equivalents was calculated for any SWMU where PAHs were identified as COPCs. The maximum concentration of each carcinogenic PAH reported in any sample collected on a SWMU-specific basis was used to calculate this value. This approach is highly conservative, because the maximum concentration of each PAH could be reported at different sample locations, and simultaneous exposure to multiple locations is unlikely. Table 7-3 calculates BaP equivalents for the industrial drainage ditches.

**Comparison of Site-Related Data to Background Concentrations**

Background data for NSA Memphis consist of sediment results discussed in Section 6.1; background analytical data are summarized in the Technical Memorandum *Assemblies A through D Background Reference Concentrations* (E/A&H, 1996). Two-times the concentrations reported in the background sample were compared to the maximum concentration reported in corresponding site media. Following comparison to risk- and hazard-based screening values,



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Table 7-3
Calculation of Benzo(a)pyrene Equivalents
NSA - Memphis
Millington, Tennessee

**Calculated for Each SWMU Where PAHs Were Identified as COPCs**

| PAH | TEF | Maximum Reported Concentrations at Each SWMU (mg/kg) NFCA | 38 | 6 | Maximum TEQ at Each SWMU (mg/kg) NFCA | 38 | 6 |
|---|---|---|---|---|---|---|---|
| Benzo(a)anthracene | 0.1 | 0.69 | 3.2 | 1.8 | 0.069 | 0.32 | 0.18 |
| Benzo(b)fluoranthene | 0.1 | 0.6 | 5 | 2.2 | 0.06 | 0.5 | 0.22 |
| Dibenz(a,h)anthracene | 1 | 0.13 | 0.63 | 0.082 | 0.13 | 0.63 | 0.082 |
| Benzo(k)fluoranthene | 0.01 | 0.4 | 2.1 | 1.7 | 0.004 | 0.021 | 0.017 |
| Benzo(a)pyrene | 1 | 0.61 | 3.9 | 2 | 0.61 | 3.9 | 2 |
| Indeno(1,2,3-cd)pyrene | 0.1 | 0.38 | 1.5 | 1.2 | 0.038 | 0.15 | 0.12 |
| Chrysene | 0.001 | 0.66 | 3.6 | 2.3 | 0.00066 | 0.004 | 0.0023 |
| Benzo(a)pyrene equivalents* | | | | | 0.91 | 5.52 | 2.62 |

NOTES:

* concentrations equivalent to benzo(a)pyrene were calculated to assess the sum potential excess cancer risk posed by PAHs

NFCA North Fork Creek Area (near SWMU 38)

TEF Toxicity Equivalency Factor

TEQ Toxic Equivalents, relative to benzo(a)pyrene

COPC Chemical of potential concern

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COPCs whose maximum detected concentrations exceeded corresponding background (reference) concentrations were retained for further consideration as COCs. This comparison helps account for naturally occurring elements that are common in nature, such as aluminum, manganese, and arsenic. Thus, risk and/or hazard associated with naturally occurring elements are not addressed where their concentrations are similar to corresponding background.

Commonly used pesticides also were considered when comparing detected compounds to background. MCPA, MCPP, and dieldrin background concentrations were determined as discussed in Section 6.1. In addition, dieldrin at NSA Memphis was discussed in the June 2, 1995, Technical Memorandum *Discussion of Dieldrin Risk Management Issues*, which has been included in this RFI report as Appendix B. Dieldrin was used extensively at NSA Memphis during a white-fringed beetle quarantine in the 1950s and 1960s. Dieldrin also was used in the pest control trade with chlordane for general subterranean termite control. The maximum and average concentrations reported for dieldrin at background soil locations were 0.311 mg/kg and 0.131 mg/kg, respectively. The average background concentration reported in soil is greater than the maximum dieldrin concentration reported in sediment from the ditches. Furthermore, the reference concentration reported for dieldrin in sediment is 0.24 mg/kg. The range of reported dieldrin concentrations for sediment samples from the industrial drainage ditches is 0.003 to 0.220 mg/kg. Therefore, dieldrin was not considered to be a COPC at any industrial drainage ditch.

For other chemicals detected in drainage-ditch sediment, if the maximum concentration of a CPSS was determined to be less than either two-times background or less than the risk-based screening values, the CPSS was not considered further unless deemed appropriate based on chemical-specific characteristics (e.g., degradation product with greater toxicity).



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**Elimination of Essential Elements: Calcium, Iron, Magnesium, Potassium, and Sodium**

In accordance with RAGS Part A, essential elements that are potentially toxic only at extremely high concentrations may be eliminated as COPCs. Specifically, an essential nutrient may be screened out if it is present at concentrations not associated with adverse health effects. Based on RAGS, the lack of risk-related data, and the relatively low toxicity of these essential elements, the following essential elements were eliminated from this human health risk assessment: calcium, iron, magnesium, potassium, and sodium.

**Summary of COPCs**

In summary, the risk information usually obtained from the Integrated Risk Information Service (IRIS) or Health Effects Assessment Summary Tables (HEAST) is necessary to estimate risk and hazard (and risk-based screening values). This information is based on toxicological and epidemiological data which are critiqued and approved by the scientific and regulatory community (i.e., listed in IRIS and/or HEAST). Risk information was not available for some CPSSs, so their risk and/or hazard could not be calculated. Data for drainage-ditch media sampled were screened using risk-based and background values. The results of the screening process are tabulated in this BRA. Chemicals determined to be COPCs through the screening process are designated as such using **bold type**. No risk-based screening values are available for TPH, so exposure was not quantified for this group of compounds.

The results of the sediment screening evaluations are presented in Tables 7-4, 7-5, 7-6, and 7-7 for SWMUs 4, 6, 38, and North Fork Creek Area sediment, respectively. COPCs identified in sediment are: antimony, chromium, 4,4'-DDD, PCB Aroclor-1260, and the PAHs chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene. Table 7-8 summarizes the COPCs for each associated SWMU.



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### 7.3.5 Calculation of Risk and Hazard

As previously discussed, CPSSs exceeding their respective screening values are considered COPCs. Subsequently identifying COCs is a two-phase process. First, COPCs are identified, and exposure is estimated for this group of chemicals. Risk/hazard is subsequently calculated based on exposure estimates, then exposure scenarios exceeding USEPA acceptable limits are identified. In the next step, COPCs that exceed 1E-6 ILCR or a HQ greater than 0.1 in a scenario of concern (i.e., the sum of all exposure pathways in one scenario having ILCR greater than 1E-4 or HI greater than 1) are retained as COCs. Section 7.5, Toxicity Assessment, discusses cancer risk and noncancer toxicity thresholds in detail.

**Table 7-4**
**Chemicals Detected in Sediment at SWMU 4**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| 2-Butanone | ½ | 4 | ND | 4,700,000 | No |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Fluoranthene | 1/2 | 79 | ND | 310,000 | No |
| Pyrene | 1/2 | 73 | ND | 230,000 | No |
| Bis(2-ethylhexyl)phthalate | 2/2 | 99-140 | ND | 46,000 | No |
| **Inorganic Chemicals (mg/kg)** | | | | | |
| Arsenic | 2/2 | 9.3-9.9 | 83.6 | 0.37 | No |
| Barium | 2/2 | 221-294 | 1276 | 550 | No |
| Chromium | 2/2 | 14.4-26 | 45 | 39 | No |
| Cobalt | 2/2 | 9.3-14.9 | 93 | 470 | No |
| Copper | 2/2 | 17.4-25.8 | 67.4 | 290 | No |
| Lead | 2/2 | 18.2-43.8 | 188 | 400 | No |
| Nickel | 2/2 | 18.9-27.6 | 116.4 | 160 | No |
| Vanadium | 2/2 | 20.8-33.8 | 166.4 | 55 | No |
| Zinc | 2/2 | 69-78.4 | 155.8 | 2,300 | No |



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**Table 7-4**
**Chemicals Detected in Sediment at SWMU 4**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Aldrin | 1/2 | 10 | ND | 38 | No |
| Heptachlor Epoxide | 1/2 | 4 | ND | 70 | No |
| Dieldrin | 2/2 | 13-76 | 240 | 40 | No |
| 4-4'-DDE | 1/2 | 24 | ND | 1,900 | No |
| 4-4'-DDD | 2/2 | 9.2-20 | ND | 2,700 | No |
| 4-4'-DDT | 2/2 | 6-7.3 | ND | 1,900 | No |
| MCPA | 1/2 | 5,300 | ND | 3,900 | No |
| 2,4,5-TP | 1/2 | 5.8 | ND | 63,000 | No |
| **PCB Aroclor-1260** | 1/2 | 180 | ND | 83 | **Yes** |
| **TPH Compounds (mg/kg)** | | | | | |
| TPH-GRO | 0/2 | ND | ND | NA | No |
| TPH-DRO | 2/2 | 11-41 | ND | NA | No |
| TPH (418.1) | 0/2 | ND | ND | NA | No |

**Table 7-5**
**Chemicals Detected in Sediment at SWMU 6**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 1/5 | 4 | ND | 780,000 | No |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Acenaphthene | 1/5 | 52 | ND | 470,000 | No |
| Fluorene | 1/5 | 70 | ND | 310,000 | No |
| Anthracene | 1/5 | 120 | ND | 2,300,000 | No |
| Carbazole | 1/5 | 85 | ND | 32,000 | No |
| Phenanthrene | 2/5 | 460-520 | ND | 230,000 | No |
| Fluoranthene | 2/5 | 860-2,900 | ND | 310,000 | No |
| Pyrene | 3/5 | 38-2,400 | ND | 230,000 | No |
| **Benzo(a)anthracene** | 2/5 | 370-1,800 | ND | 880 | **Yes** |
| **Chrysene** | 2/5 | 420-2,300 | ND | 88,000 | **Yes** |
| Bis(2-ethylhexyl)phthalate | 4/5 | 60-1,800 | ND | 46,000 | No |



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**Table 7-5**
**Chemicals Detected in Sediment at SWMU 6**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| **Benzo(b)fluoranthene** | 2/5 | 330-2,200 | ND | 880 | **Yes** |
| **Benzo(k)fluoranthene** | 2/5 | 310-1,700 | ND | 8,800 | **Yes** |
| **Benzo(a)pyrene** | 3/5 | 46-2,000 | ND | 88 | **Yes** |
| **Dibenz(a,h)anthracene** | 1/5 | 82 | ND | 88 | **Yes** |
| **Indeno(1,2,3-cd)pyrene** | 2/5 | 190-1,200 | ND | 880 | **Yes** |
| Benzo(g,h,i)perylene | 3/5 | 42-1,300 | ND | 230,000 | No |
| **Inorganic Chemicals (mg/kg)** | | | | | |
| Arsenic | 5/5 | 5.4-16.6 | 83.6 | 0.37 | No |
| Barium | 5/5 | 159-361 | 1276 | 550 | No |
| Cadmium | 2/5 | 0.97-10.3 | 3.8 | 3,900 | No |
| **Chromium** | 5/5 | 12.7-57.8 | 45 | 39 | **Yes** |
| Cobalt | 5/5 | 8.1-32.4 | 93 | 470 | No |
| Copper | 5/5 | 8.1-24.9 | 67.4 | 7,600 | No |
| Lead | 5/5 | 13-346 | 188 | 400 | No |
| Nickel | 5/5 | 8.8-31.4 | 116.4 | 1,600 | No |
| Vanadium | 5/5 | 14.1-40 | 166.4 | 55 | No |
| Zinc | 5/5 | 20.2-184 | 155.8 | 2,300 | No |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Dieldrin | 4/5 | 3.0-170 | 240 | 40 | No |
| 4-4'-DDE | 3/5 | 6.4-50 | ND | 1,900 | No |
| **4-4'-DDD** | 3/5 | 12-6,000 | ND | 2,700 | **Yes** |
| 4-4'-DDT | 4/5 | 9.3-86 | ND | 1,900 | No |
| 2,4-D | 1/5 | 49 | ND | 78,000 | No |
| 2,4-DB | 1/5 | 33 | ND | 63,000 | No |
| 2,4,5-TP | 1/5 | 2.5 | ND | 63,000 | No |
| Dinoseb | 1/5 | 15 | ND | 7,800 | No |
| **TPH Compounds (mg/kg)** | | | | | |
| TPH-GRO | 1/5 | 0.13 | ND | NA | No |
| TPH-DRO | 4/5 | 10-360 | ND | NA | No |
| TPH (418.1) | 3/5 | 360-3,000 | ND | NA | No |



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**Table 7-6**
**Chemicals Detected in Sediment at SWMU 38**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 2/4 | 8-49 | ND | 7,800 | No |
| Bromomethane | 1/4 | 2 | ND | 11,000 | No |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Naphthalene | 1/4 | 60 | ND | 310,000 | No |
| Acenaphthylene | 1/4 | 93 | ND | 470,000 | No |
| Acenaphthene | 2/4 | 310-640 | ND | 470,000 | No |
| Dibenzofuran | 2/4 | 150-270 | ND | 31,000 | No |
| Fluorene | 2/4 | 260-510 | ND | 310,000 | No |
| Phenanthrene | 2/4 | 1,800-1,900 | ND | 230,000 | No |
| Anthracene | 2/4 | 400-470 | ND | 230,000 | No |
| Carbazole | 1/4 | 340 | ND | 32,000 | No |
| Fluoranthene | 3/4 | 330-4,700 | ND | 230,000 | No |
| Pyrene | 3/4 | 260-4,700 | ND | 230,000 | No |
| Butylbenzylphthalate | 1/4 | 380 | ND | 1,600,000 | No |
| **Benzo(a)anthracene** | 2/4 | 1,900-3,200 | ND | 880 | **Yes** |
| **Chrysene** | 2/4 | 2,100-3,600 | ND | 88,000 | **Yes** |
| Bis(2-ethylhexyl)phthalate | 2/4 | 410-630 | ND | 46,000 | No |
| **Benzo(b)fluoranthene** | 2/4 | 1,900-5,000 | ND | 880 | **Yes** |
| **Benzo(k)fluoranthene** | 2/4 | 1,600-2,100 | ND | 8,800 | **Yes** |
| **Benzo(a)pyrene** | 2/4 | 1,700-3,900 | ND | 88 | **Yes** |
| **Indeno(1,2,3-cd)pyrene** | 2/4 | 730-1,500 | ND | 880 | **Yes** |
| Benzo(g,h,i)perylene | 2/4 | 630-1,400 | ND | 230,000 | No |
| **Dibenz(a,h)anthracene** | 2/4 | 350-630 | ND | 88 | **Yes** |



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**Table 7-6**
**Chemicals Detected in Sediment at SWMU 38**

| Compound Name | Number of Detections/Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Inorganic Chemicals (mg/kg)** | | | | | |
| Arsenic | 4/4 | 6.8-18.3 | 83.6 | 0.37 | No |
| Barium | 4/4 | 102-233 | 638 | 550 | No |
| Cadmium | 3/4 | 0.83-1.3 | 3.8 | 3.9 | No |
| Chromium | 4/4 | 10.3-19.9 | 45 | 39 | No |
| Cobalt | 4/4 | 6-18.3 | 93 | 470 | No |
| Copper | 4/4 | 14.5-22.4 | 67.4 | 290 | No |
| Lead | 4/4 | 18.7-73 | 188 | 400 | No |
| Mercury | 2/4 | 0.16-0.2 | ND | 2.3 | No |
| Nickel | 4/4 | 14.1-22.9 | 116.4 | 160 | No |
| Vanadium | 4/4 | 19.2-33.8 | 166.4 | 55 | No |
| Thallium (as carbonate) | 1/4 | 0.57 | ND | 6,300 | No |
| Zinc | 4/4 | 47.8-85.4 | 155.8 | 2,300 | No |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Dieldrin | 4/4 | 12-220 | 240 | 40 | No |
| 4-4'-DDE | 3/4 | 70-95 | ND | 1,900 | No |
| 4-4'-DDD | 4/4 | 11-460 | ND | 2,700 | No |
| 4-4'-DDT | 3/4 | 47-180 | ND | 1,900 | No |
| MCPA | 1/4 | 5,100 | ND | 3,900 | No |
| **TPH Compounds (mg/kg)** | | | | | |
| TPH-GRO | 1/4 | 0.067 | ND | NA | No |
| TPH-DRO | 3/4 | 11-82 | ND | NA | No |
| TPH (418.1) | 2/4 | 360-420 | ND | NA | No |

**Table 7-7**
**Chemicals Detected in Sediment at the North Fork Creek Area**

| Compound Name | Number of Detections/ Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 2/4 | 5-33 | ND | 780,000 | No |
| Bromomethane | 1/4 | 2 | ND | 11,000 | No |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Acenaphthylene | 1/4 | 84 | ND | 470,000 | No |
| Fluorene | 1/4 | 76 | ND | 310,000 | No |
| Phenanthrene | 2/4 | 83-1,200 | ND | 230,000 | No |
| Anthracene | 1/4 | 250 | ND | 2,300,000 | No |
| Fluoranthene | 4/4 | 42-1,800 | ND | 310,000 | No |
| Pyrene | 3/4 | 78-1,200 | ND | 230,000 | No |
| Butylbenzylphthalate | 1/4 | 110 | ND | 1,600,000 | No |
| **Benzo(a)anthracene** | 3/4 | 52-690 | ND | 880 | **Yes** |
| **Chrysene** | 3/4 | 56-660 | ND | 88,000 | **Yes** |
| Bis(2-ethylhexyl)phthalate | 3/4 | 46-130 | ND | 46,000 | No |
| **Benzo(b)fluoranthene** | 2/4 | 170-600 | ND | 880 | **Yes** |
| **Benzo(k)fluoranthene** | 2/4 | 88-400 | ND | 8,800 | **Yes** |
| **Benzo(a)pyrene** | 3/4 | 52-610 | ND | 88 | **Yes** |
| **Indeno(1,2,3-cd)pyrene** | 2/4 | 110-380 | ND | 880 | **Yes** |
| **Dibenz(a,h)anthracene** | 1/4 | 130 | ND | 88 | **Yes** |
| Benzo(g,h,i)perylene | 2/4 | 140-410 | ND | 230,000 | No |
| **Inorganic Chemicals (mg/kg)** | | | | | |
| **Antimony** | 1/4 | 14 | ND | 3.1 | **Yes** |
| Arsenic | 4/4 | 4.8-31.9 | 83.6 | 0.37 | No |
| Barium | 4/4 | 111-550 | 1276 | 550 | No |
| Cadmium | 3/4 | 1.9-3.4 | 3.8 | 3.9 | No |
| Chromium | 4/4 | 5.5-21.2 | 45 | 39 | No |
| Cobalt | 4/4 | 7.4-33.4 | 93 | 470 | No |
| Copper | 4/4 | 10.6-20.4 | 67.4 | 290 | No |



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**Table 7-7**
**Chemicals Detected in Sediment at the North Fork Creek Area**

| Compound Name | Number of Detections/ Number of Samples | Range | Reference Concentration (RC) | Human Health-Based Sediment Screening Value | Chemical of Potential Concern? |
|---|---|---|---|---|---|
| **Inorganic Chemicals (mg/kg)** | | | | | |
| Lead | 4/4 | 12.6-54.6 | 188 | 400 | No |
| Mercury | 1/4 | 0.24 | ND | 2.3 | No |
| Nickel | 4/4 | 8.1-28.2 | 116.4 | 160 | No |
| Vanadium | 4/4 | 13.2-51.6 | 166.4 | 55 | No |
| Zinc | 4/4 | 21.5-59.8 | 155.8 | 2,300 | No |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Aldrin | 1/4 | 3.4 | ND | 38 | No |
| Dieldrin | 3/4 | 24-42 | 240 | 40 | No |
| 4-4'-DDE | 2/4 | 6.8-10 | ND | 1,900 | No |
| 4-4'-DDD | 3/4 | 9.3-66 | ND | 2,700 | No |
| 4-4'-DDT | 2/4 | 8.6-13 | ND | 1,900 | No |
| MCPP | 1/4 | 5,200 | ND | 7,800 | No |
| 2,4,5-T | 1/4 | 6.0 | ND | 78,000 | No |
| Dicamba | 1/4 | 7.2 | ND | 230,000 | No |
| **PCB Aroclor-1260** | 1/4 | 110 | ND | 83 | **Yes** |
| **TPH Compounds (mg/kg)** | | | | | |
| TPH-GRO | 1/4 | 0.073 | ND | NA | No |
| TPH-DRO | 2/4 | 8-21 | ND | NA | No |
| TPH (418.1) | 3/4 | 170-190 | ND | NA | No |



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**Table 7-8**
**Summary of Chemicals of Potential Concern Identified in Drainage Ditch Sediment at NSA Memphis — Millington, Tennessee**

| SWMU | PAHs | PCBs | Antimony | Chromium | 4,4'-DDD |
|---|---|---|---|---|---|
| 4 | | ✓ | | | |
| 6 | ✓ | | | ✓ | ✓ |
| 38 | ✓ | | | | |
| North Fork Creek Area | ✓ | ✓ | ✓ | | |

## 7.4 Exposure Assessment

This section of the BRA will determine the magnitude of contact that a potential receptor may have with site-related COPCs. Exposure assessment involves four stages:

- Characterizing the physical setting and land use of the site.
- Identifying COPC release and migration pathway(s).
- Identifying the potential receptors, under various land-use or site-condition scenarios, and the pathways through which they might be exposed.
- Quantifying the intake rates, or contact rates, of COPCs.

### 7.4.1 Exposure Setting and Land Use

This section describes the basic layout of each SWMU as well as the suspected contamination source(s). Based on the BRAC reuse plan, the land is expected to be commercial/industrial. Currently, the ditches are not within the operational area, and site workers do not maintain them (i.e., lawn care, etc.), thus no chronic exposure pathway is complete. After the land is transferred to the City of Millington, security likely will not be as strictly enforced, and



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trespassing may become more common. In addition, site workers might be tasked with ditch upkeep. Therefore, adolescent trespassers and site workers were assessed as potential receptors at SWMUs 4, 6, 38, and the North Fork Creek Area. The following text describes the industrial drainage ditches. Figure 7-1 provides a site map of the industrial drainage ditch area and shows the sediment-sampling locations, which were grouped based on their SWMU designation or proximity to a particular SWMU.

**SWMU 4**

SWMU 4 originates as a storm sewer at Building N-121 and runs westward along Casablanca Road to First Avenue, then southwesterly to a section of open drainage ditch which discharges into SWMU 38. Building N-121 housed a plating shop where cadmium, chromium, copper, nickel, and cyanide-based solutions were used. The Building N-121 Plating Shop Dry Well (SWMU 3) was reportedly used for disposal of small quantities of concentrated plating solutions and plating-tank overflow. Previous reports also state that up to 17,000 gallons per day of dilute wastewater was discharged into the storm sewer and drainage ditch from Building N-121 operations (Harmon, 1983).

Samples for SWMU 4 (4-1 and 4-2) were collected from the 0- to 6-inch interval of depositional areas in the drainage ditch (i.e., areas that contain stagnant water except during storms). Sample 4-1 was collected upgradient from SWMU 5 in organic-rich sediment where contaminants could have concentrated. Sample 4-2 was collected farther downstream in a channelized area near SWMU 5. Sample 4-2 reportedly had a strong diesel odor.

Both samples collected from SWMU 4 contained four SVOCs. DROs were detected at concentrations ranging from 11 mg/kg to 41 mg/kg.



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**SWMU 6**

SWMU 6 originates as an underground storm sewer at Building N-126 and as an open drainage ditch just south of the Runway 4-22 apron. The underground portion of SWMU 6 at Building 126 flows southwesterly to the apron along Runway 4-22, where it turns due west and becomes an open drainage ditch, intersecting the open drainage ditch south of the Runway 4-22 apron. The open drainage ditch portion of SWMU 6 continues southwest to a point between SWMU 60 (Northside Landfill, Western Portion) and SWMU 10 (Northside Landfill, Eastern Portion), where it empties into the SWMU 38 drainage ditch. Building N-126 is located in the flight operations area. A battery shop in the northeast corner of the building operated from 1955 until 1981 and reportedly discharged liquid battery wastes through drains into SWMU 6. SWMU 6 is part of the storm sewer system which currently drains the N-126 area. When the battery shop in Building N-126 was operating, approximately 100 gallons per day of a diluted and neutralized acid mixture reportedly was discharged into the storm sewer. Electrolyte spills and drippings also were discharged into Building N-126 floor drains. These floor drains were connected to 3- and 4-inch acid-resistant pipes which emptied into the storm sewer. The sewer reportedly has been damaged by the acid releases. Substantial erosion also has been identified where the storm sewer discharges into the ditch west of Building N-126.

All five samples for SWMU 6 (6-1 through 6-5) were collected from the upper reaches of the drainage ditches; contaminants appear most prevalent at sampling locations 6-1 through 6-4. Sample 6-6 was not included in this group because it is considered a background sample. Sample 6-1 was collected from an area of extensive sediment deposition in the drainage ditch about 35 feet downstream from the outfall that marks the most upstream point of the drainage ditches. The sediment in the upper 3 to 4 inches was coarse brown sand, underlain by a tight clay, with little petroleum odor. Samples 6-2, 6-3, and 6-4 all were collected near a concrete outfall leading into the main channel of the SWMU 6 drainage ditch. Sediment characteristics generally were similar to those of sample location 6-1. However, a diesel odor was noted at



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locations 6-3 and 6-4. Sample 6-2 may not have had the diesel odor because it was collected from recently deposited sediments in a gully that appeared to drain a localized area. Sample 6-5 was collected about 30 feet downstream from where samples 6-3 and 6-4 were collected. Sample 6-5 had sediment characteristics similar to sample location 6-1 and reportedly had a slight diesel odor.

Sample location 6-3 had the highest concentrations of SVOCs and metals in comparison to the other sample locations. This sample, collected directly below the concrete outfall, would be expected to show the highest concentrations of contaminants, if the outfall is a suspected source.

**SWMU 38**

All four samples for SWMU 38 (38-1 through 38-4) were collected near SWMU 10 where leachate impacts would be most likely. SWMU 10 is north of the existing Aircraft Fire Fighting Training Facility (AFFTF) (SWMU 5) and south of the Runway 4-22. Although the exact boundaries of the landfill are unknown, it is suspected to cover 13 to 20 acres. SWMU 10 was a ravine reportedly used for construction debris disposal. The only documented description of waste disposal at the site is found in several 1980 contract documents which required contractors to use the area for disposal of rubbish and construction debris (i.e., construction materials, paper, metal scrap, leaves, and ash associated with paper incineration). SWMU 10 was originally designated as a "No Further Action" site because of the presumed nature of the landfill's contents. Erosion and debris were visible on the banks of SWMU 6, where it flows past SWMU 10. Because of this and the planned transfer of this property to the City of Millington, SWMU 10 was partially assessed by sampling the bank sediments of SMWUs 6 and 38 to determine whether contaminants are leaching from the landfill.

Although many SVOCs were detected in the sediment, they appear localized to the portion of the drainage ditch that borders SWMU 10. This may indicate that SWMU 10 is responsible for



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the contaminants present in this portion of the drainage ditches. Sample 38-1, a brown, silty clay, was collected approximately 50 feet downstream of where another drainage ditch flows into the main drainage ditch. Sample 38-1 was collected from a dry, shallow drainage gully that appeared to drain a portion of SWMU 10. A diesel odor was noted in this sample. Sample 38-2 was collected from a dry, steep gully that also appeared to drain a portion of SWMU 10. The sediment was a brown silty clay, but no petroleum odors were noted. Sample 38-3 was collected from a shallow gully leading from an area of exposed concrete at SWMU 10, and no petroleum odors were noted. Sample 38-4 was collected about 100 feet downstream from SWMU 10 in an area of extensive sediment deposition. Clay was encountered at less than 1 inch below the surface, and the sample did not have a petroleum odor.

The samples with the highest concentration of contaminants were collected at the water line directly below the dry gullies leading from SWMU 10 into the SWMU 38 drainage ditch. Sixteen SVOCs were detected at sample locations 38-1 and 38-3, which both were collected below the drainage gullies. Like the samples near SWMU 6, it appears that contamination in the upper portion of the drainage ditches at SWMU 10 is localized and not likely to impact North Fork Creek.

### North Fork Creek Area

Sample locations 38-5 through 38-8 were grouped because that area receives runoff from all the SWMUs previously mentioned and it is close to North Fork Creek. SWMU 38 consists of miscellaneous ditches draining the industrial areas in the northern portion of NSA Memphis and a small part of the southern portion of the base. The open drainage ditches comprising SWMU 38 within the NSA Memphis Northside flow to the southwest, where they eventually discharge into North Fork Creek. SWMU 38 is intersected by SWMU 6 south of Runway 4-22, and SWMU 4 northwest of the AFFTF (SWMU 5). Surface-water runoff and other outfalls

from the north side of the base also discharge into SWMU 38. Most wastes entering the drainage ditch would be transported downstream with flow.

Samples 38-5 through 38-8 were collected within and upstream of North Fork Creek, which borders the base to the west. North Fork Creek flows south, and samples were collected upstream and downstream of the confluence with SWMU 38. The bank of North Fork Creek at sample location 38-7 was very steep, and it was difficult to collect a sediment sample; therefore, the sediment samples were collected from the water's edge to obtain a more discrete sample interval.

Sample 38-5 was collected within the drainage ditch in an area characterized by stiff clay that appeared heavily eroded. Sample 38-6 was collected in the ditch about 100 feet upstream of its confluence with North Fork Creek. The sediment collected was very sandy and appeared to have been deposited recently. This sample location was also adjacent to a steep bank downstream from Navy Road. Sample 38-7, the reference sample for conditions in North Fork Creek, was collected about 75 feet upstream of the confluence with SWMU 38. Sample 38-8 also was collected in North Fork Creek, but downstream of the SWMU 38 ditch and downstream of the Navy Road overpass.

Nine SVOCs were reported in sample 38-5. As previously mentioned, the high concentrations of SVOCs in sample 38-8 are suspected to be related to runoff from the heavily traveled Navy Road bridge which crosses North Fork Creek. A comparison of sample 38-7 data (upstream of the Navy Road bridge) and sample 38-8 data corroborates this hypothesis. Recent studies have quantified the impacts of roadways on freshwater streams. A summary of this research is discussed in Section 6 (Nature and Extent of Contamination).



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**SWMU 31**

SWMU 31, Aircraft Wash Rack, is connected to the underground storm sewer portion of SWMU 6. The wash rack was first used in 1956 to rinse treatment chemicals from aircraft, but has not been used since at least 1985. Aluminum parts on aircraft were reportedly treated with chromic acid ("alodine") before arriving at the wash rack. The aircraft then were washed with a high-pressure detergent to remove the acid.

Because the storm sewer was inaccessible at SWMU 31, sample 31-1 was collected from surface sediment adjacent to the storm sewer. The sediment was about 3 inches thick and underlain by the asphalt surface of a parking lot. The soil was a dark, organic mixture of silt and clay with no noticeable odor. Because this sample was collected from a parking lot surface and sediment in the sewer is not accessible (the grating will not open), it was deemed inappropriate to estimate risk based on data for a sample collected from accumulating asphalt and runoff detritus.

### 7.4.2 Potentially Exposed Populations

This section describes who may be exposed to contaminants in environmental media. The drainage ditches are not currently used or maintained by the Navy, and there would be no complete current-use exposure pathway. The potentially exposed populations addressed were a hypothetical adolescent trespasser, with the typical future site worker scenario included for comparison. The hypothetical future scenario assumes continuous exposure to current surface-sediment conditions.

### 7.4.3 Exposure Pathways

This section of the BRA summarizes how potential receptors (hypothetical trespassers and site workers) may be exposed to site media. In general, sediment matrix-related pathways include incidental ingestion and dermal contact. Wading in and around the ditches was assumed for hypothetical trespassers, and approximately 65% of their body surface was assumed to directly



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contact sediment (including head, hands, arms, legs, and feet). Approximately 20% of hypothetical future site workers' body surface area was assumed to directly contact sediment, in accordance with typical dermal exposure assumptions. Because of the limited number of sediment samples used to characterize each SWMU, uniform exposure to the maximum reported COPC concentrations was assumed for all sample locations.

### 7.4.4 Exposure Point Concentrations

The Exposure Point Concentration (EPC) is the concentration of a contaminant in an exposure medium that will be contacted by a real or hypothetical receptor. Determining the EPC depends on factors such as:

- Availability of data
- Amount of data available to perform statistical analysis
- Reference concentrations not attributed to site impacts
- Location of the potential receptor

USEPA Region IV guidance calls for assuming lognormal distributions for environmental data and the calculation of 95% upper confidence limit (UCL) on the mean for use in exposure quantification. Applying the UCL is generally inappropriate when there are less than 10 samples. For media where less than 10 samples were collected, the maximum positive detection of each COPC identified, referred to as the EPC, was used to compute exposure. Because of the limited area to be characterized, fewer than 10 sediment samples were collected at each SWMU. Therefore, the maximum reported concentrations were used to estimate exposure for each SWMU.



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### 7.4.5 Quantification of Exposure

This section describes the models, equations, and input parameter values used to quantify doses or intakes of the COPCs for the sediment exposure pathways. The models are designed to estimate route- and medium-specific factors, which are multiplied by the EPC to estimate chronic daily doses. The intake model variables generally reflect 50th or 95th percentile values which, when applied to the EPC, ensure that the estimated intakes represent the reasonable maximum exposure (RME). Formulae were derived from RAGS, Part A unless otherwise indicated.

The dermal contact area was calculated assuming the head, arms, hands, legs, and feet would be directly exposed to sediment. The mean dermal contact area for each body part was calculated to reflect growth and changes in body proportions during adolescence. From the *Exposure Factors Handbook* (USEPA, 1990), the mean total body surface area (90th percentile) of a child between the ages of 7 and 16 was calculated to be 15,550 square centimeters ($cm^2$). The percent of the total body surface accounted for by hands, legs, arms, feet, and head averages 65% between 7 and 16. From this information, the exposed adolescent skin surface per contact event was estimated to be 10,200 $cm^2$. Table 7-9 lists input parameters used to compute chronic daily intake (CDI) for potential receptors exposed to sediment contaminants. These exposure pathway assumptions were applied for SWMUs 4, 6, 10, and 38.

Because NSA Memphis is part of BRAC, future site use cannot be determined with absolute certainty. Therefore, the conservative assumptions were used to account for any reasonable future use. Current reuse plans propose that the drainage ditches will be in an area zoned for commercial/industrial use, with possible continued use of the nearby airfield.



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**Table 7-9**
**Parameters Used to Estimate CDI**
**NSA Memphis — Assembly B Drainage Ditches**

| Pathway Parameters | Trespassing Child (age 7-16) | Adult Site Worker | Units |
|---|---|---|---|
| **Surface Soil Ingestion and Dermal Contact** | | | |
| Ingestion Rate (soil) | 100[a,b] | 100[a,b] | mg/day |
| Exposure Frequency | 52[f] | 250[a,b] | days/year |
| Exposure Duration | 10[g] | 25[a,b] | years |
| Dermal Contact Area | 10,200[a] | 4,100[a,b] | $cm^2$ |
| Skin Adherence Factor | 1 | 1 | $mg/cm^2$ |
| Absorbance Factor | 0.01 (organics)<br>0.001 (inorganics) | 0.01 (organics)<br>0.001 (inorganics) | unitless |
| Dermal Adjustment Factor | 0.8 (VOCs)<br>0.5 (other organic compounds)<br>0.2 (inorganics) | 0.8 (VOCs)<br>0.5 (other organic compounds)<br>0.2 (inorganics) | unitless |
| Conversion Factor | 1E-6 | 1E-6 | kg/mg |
| Body Weight | 45[a,b] | 70[a,b] | kg |
| Averaging Time, Non-cancer | 3,650[d] | 9125[b] | days |
| Averaging Time, Cancer | 25,550[e] | 25,550[e] | days |

*Notes*:
a = USEPA (1989) "Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual Part A)" and USEPA (1990) "Exposure Factors Handbook."
b = USEPA (March 1991) "Risk Assessment Guidance for Superfund Vol. I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, "Interim Final, OSWER Directive: 9285.6-03.EPA/600/8-89/043.
c = USEPA (December 1991), Risk Assessment Guidance for Superfund: Vol. I — Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)," OSWER Directive 9285.7-01B.
d = Calculated as the product of Exposure Duration (years) x 365 days/year.
e = Calculated as the product of 70 years (assumed lifetime) x 365 days per year.
f = Assuming one day per week exposure
g = Assuming trespassing occurs during the 10-year adolescent/teenage period
NA = Not applicable.

## Sediment Pathway Exposure

### *Ingestion of COPCs in Sediment*

The following equation is used to estimate the ingestion of COPCs in sediment:

$$CDI_s = (C_s)(IR)(EF)(ED)(F)(FI)/(BW)(AT)$$



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where:

$CDI_s$ = ingested dose (mg/kg-day)

$C_s$ = concentration of contaminant in sediment (mg/kg)

IR = ingestion rate (milligrams per day [mg/day])

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FI = fraction ingested from contaminated source (unitless)

BW = body weight (kg)

AT = averaging time (days)

***Dermal Contact with COPCs in Sediment***

The following equation is used to estimate intake due to dermal contact with COPCs in sediment:

$$CDI_{sd}=(C_s)(CF)(EF)(ED)(F)(FC)(ABS)(AF)/(BW)(AT)$$

where:

$CDI_{sd}$ = dermal dose (mg/kg-day)

$C_s$ = concentration of contaminant in sediment (mg/kg)

CF = contact factor ($cm^2$)

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FC = fraction contacted from contaminated source (unitless)

ABS = absorption factor (unitless value, specific to organic versus inorganic chemicals)

AF = adherence factor (milligrams per square centimeter [$mg/cm^2$])

BW = body weight (kg)

AT = averaging time (days)



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As discussed in Section 7.4.4, the maximum concentrations detected for sediment COPCs were used as the EPCs. CDIs for incidental ingestion of sediment are shown in Tables 7-10, 7-11, 7-12, and 7-13 for SWMUs 4, 6, 38, and the North Fork Creek Area, respectively. CDIs for dermal contact with sediment are shown in Tables 7-14, 7-15, 7-16, and 7-17 for SWMUs 4, 6, 38, and the North Fork Creek Area, respectively. Figure 7-2 provides the formulae for calculating the CDI for sediment.

## 7.5 Toxicity Assessment

### 7.5.1 Carcinogenicity and Noncancer Effects

USEPA has established a classification system for rating the potential carcinogenicity of environmental contaminants based on the weight of scientific evidence. The cancer classes are described below. Cancer weight-of-evidence class "A" (human carcinogens) means that human toxicological data have shown a proven correlation between exposure and the onset of cancer (in varying forms). The "B1" classification indicates some human exposure studies have implicated the compound as a probable carcinogen. Weight-of-evidence class "B2" indicates a possible human carcinogen, a description based on positive laboratory animal data (for carcinogenicity) in the absence of human data. Weight-of-evidence class "C" identifies possible human carcinogens, and class "D" indicates a compound not classifiable with respect to its carcinogenic potential. USEPA has established slope factors (SF) for carcinogenic chemicals. The SF is defined as a "plausible upper-bound estimate of the probability of a response (cancer) per unit intake of a chemical over a lifetime" (RAGS, Part A).

In addition to potential carcinogenic effects, most substances also can produce other toxic responses at doses greater than experimentally derived threshold concentrations. USEPA has derived Reference Dose (RfD) values for these substances. A chronic RfD is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure concentration for the human population, including sensitive subpopulations, that is



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**Figure 7-2**

**Formulae for Calculating CDI for Sediment Trespass and Site Worker Scenario**

**SEDIMENT INGESTION PATHWAY**

*Noncarcinogens:*

$$CDI_{NC} = \frac{C_s \times IR \times EF \times F \times FI \times ED}{AT_{NC} \times BW}$$

*Carcinogens:*

$$CDI_{C} = \frac{C_s \times IR \times EF \times F \times FI \times ED}{AT_{C} \times BW}$$

**SEDIMENT DERMAL CONTACT PATHWAY**

*NonCarcinogens:*

$$CDI_{NC} = \frac{C_s \times CF \times EF \times F \times FC \times AF \times ABS \times ED}{AT_{NC} \times BW}$$

*Carcinogens:*

$$CDI_{C} = \frac{C_s \times CF \times EF \times F \times FC \times AF \times ABS \times ED}{AT_{C} \times BW}$$



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**Figure 7-2 (continued)**

**Formulae for Calculating CDI for Sediment**

| Variable | Description |
|---|---|
| $BW_{trespasser}$ | average trespasser body weight (ages 7-16) (kg) |
| $BW_{worker}$ | average worker body weight (kg) |
| ABS | absorbance factor (unitless value specific to organic versus inorganic chemicals) |
| AF | adherence factor (1 mg/cm$^2$) |
| $ED_{trespasser}$ | trespasser exposure duration during (ages 7-16) (yr) |
| $ED_{worker}$ | worker exposure duration during (yr) |
| $EF_{trespasser}$ | trespasser exposure frequency (days/year) |
| $EF_{worker}$ | worker exposure frequency (days/year) |
| $IR_{trespasser}$ | trespasser sediment intake rate (mg/day) |
| $IR_{worker}$ | worker sediment intake rate (mg/day) |
| FC | fraction contacted from contaminated source (unitless = 1) |
| $CF_{trespasser}$ | trespasser sediment dermal contact factor (cm$^2$/day) |
| $CF_{worker}$ | worker sediment dermal contact factor (cm$^2$/day) |
| $AT_C$ | averaging time (carcinogen) |
| $AT_{NC\text{-}W}$ | averaging time (noncarcinogen worker) |
| $AT_{NC\text{-}T}$ | averaging time (noncarcinogen trespasser) |
| $C_s$ | chemical concentration in sediment (mg/kg) |
| FI | fraction ingested from contaminated source (unitless = 1) |
| F | conversion factor (1E-6 kg/mg) |

*Notes:*
CDI indicates Chronic Daily Intake
CF units were derived assuming (1 event/day) X (cm$^2$/event) = cm$^2$/day



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Table 7-10
Chronic Daily Intakes (CDI)
Incidental Ingestion of SWMU 4 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Exposure Point Concentration (mg/kg) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|
| PCB Aroclor-1260 | 0.18 | 1 | 5.70E-08 | 8.14E-09 | 8.81E-08 | 3.15E-08 |

NOTES:

| | |
|---|---|
| CDI | Chronic Daily Intake in mg/kg-day |
| H-CDI | CDI for hazard quotient |
| C-CDI | CDI for excess cancer risk |
| NA | No information available |

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Table 7-11
Chronic Daily Intakes (CDI)
Incidental Ingestion of SWMU 6 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 2.62 | 1 | 1 | 8.29E-07 | 1.18E-07 | 1.28E-06 | 4.58E-07 |
| Chromium (hexavalent) | 57.8 | NA | 1 | 1.83E-05 | 2.61E-06 | 2.83E-05 | 1.01E-05 |
| 4,4'-DDD | 6 | NA | 1 | 1.90E-06 | 2.71E-07 | 2.94E-06 | 1.05E-06 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
TEF Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene.

Table 7-12
Chronic Daily Intakes (CDI)
Incidental Ingestion of SWMU 38 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 5.52 | 1 | 1 | 1.75E-06 | 2.50E-07 | 2.70E-06 | 9.64E-07 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
TEF Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene.

Table 7-13
Chronic Daily Intakes (CDI)
Incidental Ingestion of North Fork Creek Area Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|
| Antimony | 14 | NA | 1 | 4.43E-06 | 6.33E-07 | 6.85E-06 | 2.45E-06 |
| Benzo(a)pyrene equivalents | 0.91 | 1 | 1 | 2.88E-07 | 4.12E-08 | 4.45E-07 | 1.59E-07 |
| PCB Aroclor-1260 | 0.11 | NA | 1 | 3.48E-08 | 4.97E-09 | 5.38E-08 | 1.92E-08 |

NOTES:

| | |
|---|---|
| CDI | Chronic Daily Intake in mg/kg-day |
| H-CDI | CDI for hazard quotient |
| C-CDI | CDI for excess cancer risk |
| NA | No information available |
| TEF | Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene. |

Table 7-14
Chronic Daily Intakes (CDI)
Dermal Contact with SWMU 4 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Dermal Absorption Factor (unitless) | Exposure Point Concentration (mg/kg) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|
| PCB Aroclor-1260 | 0.01 | 0.18 | 1 | 5.81E-08 | 8.30E-09 | 7.22E-08 | 2.58E-08 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
- The dermal absorption factor was applied to the exposure point concentration to reflect the different trans-dermal migration of inorganic versus organic chemicals

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Table 7-15
Chronic Daily Intakes (CDI)
Dermal Contact with SWMU 6 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Dermal Absorption Factor (unitless) | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 0.01 | 2.62 | 1 | 1 | 8.46E-07 | 1.21E-07 | 1.05E-06 | 3.75E-07 |
| Chromium (hexavalent) | 0.001 | 57.8 | NA | 1 | 1.87E-06 | 2.67E-07 | 2.32E-06 | 8.28E-07 |
| 4,4'-DDD | 0.01 | 6 | NA | 1 | 1.94E-06 | 2.77E-07 | 2.41E-06 | 8.60E-07 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
TEF Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene.
- The dermal absorption factor was applied to the exposure point concentration to reflect the different trans-dermal migration of inorganic versus organic chemicals

Table 7-16
Chronic Daily Intakes (CDI)
Dermal Contact with SWMU 38 Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Dermal Absorption Factor (unitless) | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 0.01 | 5.52 | 1 | 1 | 1.78E-06 | 2.55E-07 | 2.21E-06 | 7.91E-07 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
TEF Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene.
- The dermal absorption factor was applied to the exposure point concentration to reflect the different trans-dermal migration of inorganic versus organic chemicals

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Table 7-17
Chronic Daily Intakes (CDI)
Dermal Contact with North Fork Creek Area Sediment (0-1')
NSA - Memphis
Millington, Tennessee

| Chemical | Dermal Absorption Factor (unitless) | Exposure Point Concentration (mg/kg) | TEF (unitless) | Fraction from Contaminated Source | Trespassing child (age 7-16) H-CDI (mg/kg-day) | Trespassing child (age 7-16) C-CDI (mg/kg-day) | Site Worker H-CDI (mg/kg-day) | Site Worker C-CDI (mg/kg-day) |
|---|---|---|---|---|---|---|---|---|
| Antimony | 0.001 | 14 | NA | 1 | 4.52E-07 | 6.46E-08 | 5.62E-07 | 2.01E-07 |
| Benzo(a)pyrene equivalents | 0.01 | 0.91 | 1 | 1 | 2.94E-07 | 4.20E-08 | 3.65E-07 | 1.30E-07 |
| PCB Aroclor-1260 | 0.01 | 0.11 | NA | 1 | 3.55E-08 | 5.07E-09 | 4.41E-08 | 1.58E-08 |

NOTES:

CDI Chronic Daily Intake in mg/kg-day
H-CDI CDI for hazard quotient
C-CDI CDI for excess cancer risk
NA No information available
TEF Toxicity equivalency factor used to modify the concentration of polynuclear aromatic hydrocarbons relative to benzo(a)pyrene.
- The dermal absorption factor was applied to the exposure point concentration to reflect the different trans-dermal migration of inorganic versus organic chemicals

likely to be without an appreciable risk of deleterious effects during a lifetime." These toxicological values are used in risk formulae to assess the upper-bound level of cancer risk and noncancer hazard associated with exposure to a given concentration of contamination.

For carcinogens, the potential risk posed by a chemical is computed by multiplying the CDI (as mg/kg-day) by the SF (in reciprocal mg/kg-day). The hazard quotient (for noncarcinogens) is computed by dividing the CDI by the RfD. USEPA has set standard limits (or points of departure) for carcinogens and noncarcinogens to evaluate whether significant risk is posed by a chemical (or combination of chemicals). For carcinogens, the point-of-departure range is 1E-6, with a generally accepted range of 1E-6 to 1E-4. These risk values correlate with one in 10,000 and one in 1 million excess cancer incidence resulting from exposure to xenobiotics (all pathways).

For noncarcinogens, other toxic effects are generally considered possible if the HQ (or sum of HQs for a pathway-hazard index) exceeds the threshold value of 1. Although both cancer risk and noncancer hazard are generally additive (within each group) only if the target organ is common to multiple chemicals, a most conservative estimate of each may be obtained by summing the individual risks or hazards, regardless of target organ. This BRA has taken the universal summation approach for each class of toxicant. Details regarding the risk formulae applied to site data are provided in Section 7.6, Risk Characterization.

Critical studies used in establishing toxicity classifications by USEPA are shown in the IRIS database (primary source) and/or HEAST, Fiscal Year 1995 (secondary source). In addition, the USEPA Region III, RBC Tables, First Quarter 1995, contain toxicological values not listed in primary or secondary sources. Where applicable, these values also were included in the database for this BRA. Table 7-18 summarizes toxicological data in the form of RfDs and SFs obtained for COPCs identified in site media, as well uncertainty/modifying factors, target organs, and cancer classes (where available).



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Table 7-18
Toxicological Reference Information
for Chemicals of Potential Concern
NSA Memphis RFI
Millington, Tennessee

| | Non-Carcinogenic Toxicity Data | | | | | | | | Carcinogenic Toxicity Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Oral Reference Dose (mg/kg/day) | | Confidence Level | Critical Effect | Uncertainty Factor Oral | Inhalation Reference Dose (mg/kg/day) | Confidence Level | Critical Effect | Uncertainty Factor Inhalation | Oral Slope Factor [(mg/kg/day)]-1 | | Inhalation Slope Factor [(mg/kg/day)]-1 | | Weight of Evidence | Tumor Type |
| Antimony | 0.0004 | a | L | whole body/blood increased mortality | 1000 | NA | | | NA | NA | | NA | | D | |
| Benzo(a)pyrene Equivalents | NA | | | | NA | NA | | | NA | 7.3 | a | NA | | B2 | mutagen |
| Cadmium (food) | 0.001 | a | H | proteinuria | 10 | NA | | | NA | NA | | 6.3 | a | B1 | lung |
| Chromium (as chromium +6) | 0.005 | a | L | NA | 500/10 | NA | | | NA | NA | | 42 | a | A | lung |
| PCB Aroclor-1260 | NA | | | | NA | NA | | | NA | 7.7 | | NA | | B2 | hepatocellular carcinoma |
| 4,4'-DDD | NA | | | | NA | NA | | | NA | 0.024 | a | NA | | B2 | liver |

***Notes:***

a = Integrated Risk Information System (IRIS)
b = Health Effects Assessment Summary Tables (HEAST)
L = Low confidence level
H = High confidence level
NA = Not applicable or not available
A = Human carcinogen: human toxicological data have shown a proven correlation between exposure and the onset of cancer
B1 = Probably human carcinogen: some human exposure studies have implicated the compound as a probable human carcinogen
B2 = Possible human carcinogen: based on positve laboratory animal carcinogenicity data in the absence of human data.
D = Noncarcinogen: indicates a compound not classifiable with respect to its carcinogenic potential

### 7.5.2 Evaluating Dermal Exposure and the Resulting Toxicity

Dermal RfD values and Sfs are derived from the corresponding oral values. In the derivation of a dermal RfD, the oral RfD is multiplied by an oral absorption factor (ABF), expressed as a decimal. The resulting dermal RfD is based on the absorbed dose. The RfD based on absorbed dose is the appropriate value with which to compare a dermal dose, because dermal doses are expressed as absorbed rather than administered (intake) doses. For the same reasons, a dermal SF is derived by dividing the oral SF by the ABF. The oral SF is divided rather than multiplied because Sfs are expressed as reciprocal doses.

Appendix A of RAGS, Part A states that in the absence of specific data, an assumption of 5% oral absorption would be relatively conservative. *Supplemental Guidance to RAGS: Region IV Bulletin* indicates that in the absence of specific data, USEPA Region IV suggests an oral absorption factor of 80% for VOCs, 50% for SVOCs, and 20% for inorganic chemicals. These percentages (or associated fractions) were used in this BRA.

### 7.5.3 Toxicity Profiles for COPCs

In accordance with RAGS, brief toxicological profiles were included for all COPCs. Most information for the brief profiles below was gleaned from IRIS as a primary source, and HEAST as a secondary source. Oral- and inhalation-based RfDs and SFs are noted with an "o" or an "i," respectively (i.e., $RfD_o$ refers to an oral RfD). Any additional references are noted specifically in the profiles below (in parentheses). The profiles summarize adverse effects of COPCs and the amount associated with such effects.

***Antimony*** belongs to the same periodic group as arsenic. This element is absorbed slowly through the targeted gastrointestinal tract. Another target is blood, where antimony concentrates. Due to frequent industrial use, the primary exposure route for antimony to the general population is food. Antimony is also a common industrial air pollutant (Klaassen,



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et al., 1986). The critical effect of antimony is a reduction of longevity. USEPA has not classified antimony as a carcinogen, and the $RfD_o$ is 0.0004 mg/kg-day.

***Chromium*** exists in two stable, natural forms: trivalent (CrIII), and hexavalent (CrVI). Acute exposure to chromium can result in kidney damage following oral exposure, or damage to the nasal mucosa and septum following inhalation exposure (Klaassen, et al., 1986). Chronic inhalation exposure to hexavalent chromium has resulted in kidney and respiratory tract damage, as well as excess lung cancer in both animals and humans following occupational exposure. Only hexavalent chromium is believed to be carcinogenic by inhalation. Oral RfD values for both forms of chromium are 1.0 and 5E-3 (mg/kg-day), respectively. For trivalent chromium, the RfD is based on liver toxicity in the rat. For the hexavalent form, the RfD is based on unspecified pathological changes observed in rat studies. In addition, hexavalent chromium is considered as a group A carcinogen for inhalation exposures, and a $SF_o$ of 42 $(mg/kg\text{-}day)^{-1}$ has been established for the hexavalent form. Vitamin supplements contain approximately 0.025 mg of chromium (NRC, 1989).

***PCB Aroclors*** are a group of chlorinated hydrocarbons (such as ***Aroclors 1248, 1254, and 1260***) that accumulate in fat tissue. Occupational exposure (both inhalation and dermal) to PCBs causes eye and lung irritation, loss of appetite, liver enlargement, increased serum liver enzyme levels, rashes and chloracne, and decreased birth weight of infants in heavily exposed working mothers (Klaassen, et al., 1986 and Dreisbach, et al., 1987). The liver is the primary target organ. USEPA classified PCB Aroclors as group B2 carcinogens, primarily based on animal data. Oral ingestion of PCBs causes liver and stomach tumors in rat studies. USEPA set 7.7 $(mg/kg\text{-}day)^{-1}$ as the $SF_o$ for PCB Aroclors, and the RfD was set to 0.00007 mg/kg-day.

***4,4'-DDD***, a by-product of the pesticide DDT, is a compound typical of halobenzene derivatives. It is soluble in fat, but not in water, and its target organ is the brain. This analog of DDT is



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the least toxic of the three primary DDT analogs (i.e., the least likely to cause cancer). Other DDD effects could include cell death in the liver, changes in heart muscles, and kidney damage. In a study mentioned in Dreisbach, et al., workers historically exposed to DDT had up to 648 ppm DDT in their body fat, and no adverse health effects were observed. If an individual loses body fat, DDD concentrations are not stored at sufficient concentrations to induce toxic effects (Dreisbach, et al., 1987). This compound is listed as a B2 carcinogen, and USEPA determined the $SF^{o}$ for DDD to be 0.24 $(mg/kg\text{-}day)^{-1}$.

***PAHs*** include the following list of COPCs:

| Parameter | TEF |
|---|---|
| Benzo(a)anthracene | 0.1 |
| Benzo(b)fluoranthene | 0.1 |
| Dibenz(a,h)anthracene | 1.0 |
| Benzo(k)fluoranthene | 0.01 |
| Benzo(a)pyrene | 1.0 |
| Indeno(1,2,3-cd)pyrene | 0.1 |
| Chrysene | 0.001 |

Some PAHs are toxic to the liver, kidney, and blood. However, the toxic effects of the PAHs above have not been well established. There are no RfDs for the PAHs above due to a lack of data. USEPA classifies the above-listed PAHs as B2 carcinogens, and their carcinogenicity is addressed relative to that of benzo(a)pyrene, having a SF 7.3 $(mg/kg\text{-}day)^{-1}$. TEFs, also set by USEPA, are multipliers that are applied to the detected concentrations, which are subsequently used to calculate excess cancer risk as discussed earlier. Most carcinogenic PAHs have been classified as such due to animal studies using large doses of purified PAHs. There is some doubt as to the validity of these listings, and the SFs listed in USEPA's RBC Table are



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provisional. However, these PAHs are carcinogens when the exposure involves a mixture of other carcinogenic substances (i.e., coal tar, soots, cigarette smoke, etc.), (Klaassen, et al., 1986).

Other PAHs — those not classified by USEPA as carcinogens — are toxic to the liver, kidney, and blood. This group of PAHs includes compounds such as pyrene, acenaphthene, acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. USEPA determined RfDs for only two of these compounds: pyrene's $RfD_o$ is 0.03 mg/kg-day, and this RfD is also used as a surrogate $RfD_o$ for phenanthrene. The $RfD_o$ for acenaphthene was determined to be 0.06 mg/kg-day.

## 7.6 Risk Characterization

Risk characterization combines the exposure assessment and toxicity assessment results to yield qualitative and quantitative expressions of risk and/or hazard for the exposed receptors. The quantitative component expresses the probability of developing cancer, or a nonprobabilistic comparison of the estimated dose with a reference dose for noncancer effects. These quantitative estimates are developed for individual chemicals, exposure pathways, transfer media, and source media, and for each receptor for all media to which one may be exposed. The qualitative component usually involves comparing COC concentrations in media with established criteria or standards for chemicals for which there are no corresponding toxicity values. The risk characterization is used to guide risk-management decisions.

Generally, the risk characterization follows the methods prescribed by RAGS Part A, as modified by more recent information and supplemental guidance cited in the earlier sections of this document. The USEPA methods are, appropriately, designed to be health-protective, and tend to overestimate, rather than underestimate, risk. The risk results, therefore, are generally overly conservative, because risk characterization involves summing the overestimated risk results.



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### 7.6.1 Risk Characterization Methodology

Risks to humans following exposure to COPCs are estimated using USEPA-established methods, when available. As discussed above, these methods are health-protective and are likely to overestimate risk. Risks from hazardous chemicals are calculated for either carcinogenic or noncarcinogenic effects. Some carcinogenic chemicals may also pose a noncarcinogenic hazard. The potential human health effects associated with chemicals that produce systemic toxic and carcinogenic influences are characterized for both types of health effects.

**Carcinogenic Effects of Chemicals**

The risk attributed to exposure to carcinogens is estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. In the low-dose range, which would be expected for most environmental exposures, cancer risk is estimated from the following linear equation (USEPA, December 1989):

$$ILCR = (CDI)(SF)$$

where:

| | | |
|---|---|---|
| ILCR | = | incremental lifetime excess cancer risk, a unitless expression of the probability of developing cancer, adjusted for reference incidence |
| CDI | = | chronic daily intake, averaged over 70 years (mg/kg-day) |
| SF | = | cancer slope factor $(mg/kg\text{-}day)^{-1}$ |

For a given pathway with simultaneous exposure of a receptor to several carcinogens, the following equation is used to sum cancer risks:

$$Risk_p = ILCR(chem_1) + ILCR(chem_2) + \ldots ILCR(chem_i)$$



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where:

| | | |
|---|---|---|
| $Risk_p$ | = | total pathway risk of cancer incidence |
| $ILCR(chem_i)$ | = | incremental lifetime excess cancer risk for a specific chemical |

Cancer risk for a given receptor across pathways and across media is summed in the same manner.

**Noncarcinogenic Effects of Chemicals**

The risks associated with the noncarcinogenic effects of chemicals are evaluated by comparing an exposure level or intake with a reference dose. The HQ, defined as the ratio of intake to RfD, is defined as (RAGS, Part A):

$$HQ = CDI/RfD$$

where:

| | | |
|---|---|---|
| HQ | = | hazard quotient (unitless) |
| CDI | = | intake of chemical (mg/kg-day) |
| RfD | = | reference dose (mg/kg-day) |

Chemical noncarcinogenic effects are evaluated on a chronic basis, using chronic RFD values. An HQ of 1 indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be a concern for potential adverse health effects.

In the case of simultaneous exposure of a receptor to several chemicals, an HI will be calculated as the sum of the Hqs by:

$$HI = HQ_1 + HQ_2 + \ldots HQ_i$$



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where:

| | | |
|---|---|---|
| HI | = | Hazard Index (unitless) |
| HQ | = | Hazard Quotient (unitless) |

Risk and hazard projections are tabulated on a medium-specific basis following the general discussions of risk and hazard quantification methods.

### 7.6.2 Sediment Pathways

Exposure to sediment onsite was evaluated under the hypothetical trespass scenario for adolescent age trespassers. For this scenario, the incidental ingestion and dermal contact exposure pathways were evaluated. Tables 7-19, 7-20, 7-21, and 7-22 present the computed carcinogenic risks and/or HQs associated with the incidental ingestion of site sediment for SWMUs 4, 6, 38, and the North Fork Creek Area, respectively. Tables 7-23, 7-24, 7-25, and 7-26 present the computed carcinogenic risks and/or HQs estimated for the dermal contact with sediment pathway for SWMUs 4, 6, 38, and the North Fork Creek Area, respectively.

**SWMU 4**

***Hypothetical Future Site Trespasser***

Site trespasser ILCRs are 6E-8 and 1E-7 for the ingestion and dermal contact pathways, respectively. PCB Aroclor-1260 was the only COPC identified at this SWMU; it contributed less than 1E-6 to the sum ILCR for both exposure pathways. Hazard was not estimated for PCB Aroclor-1260 because no reference dose is currently available through IRIS or HEAST.



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Table 7-19
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Sediment Ingestion at SWMU 4
NSA - Memphis
Millington, Tennessee

| Chemical | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|
| PCB Aroclor-1260 | ND | 7.7 | NA | 6.3E-08 | NA | 2.4E-07 |
| Hazard Indices | | | NA | | NA | |
| Total Risk | | | | 6E-08 | | 2E-07 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
NA Not applicable due to the lack of appropriate toxicological values.
RfD Reference dose
SF Slope factor

Table 7-20
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Sediment Ingestion at SWMU 6
NSA - Memphis
Millington, Tennessee

| Chemical | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | ND | 7.3 | NA | 8.7E-07 | NA | 3.3E-06 |
| Chromium (hexavalent) | 0.005 | ND | 0.0037 | NA | 0.0057 | NA |
| 4,4'-DDD | ND | 0.24 | NA | 6.5E-08 | NA | 2.5E-07 |
| Hazard Indices | | | 0.004 | | 0.006 | |
| Total Risk | | | | 9E-07 | | 4E-06 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.

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Table 7-21
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Sediment Ingestion at SWMU 38
NSA - Memphis
Millington, Tennessee

| Chemical | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | ND | 7.3 | NA | 1.8E-06 | NA | 7.0E-06 |
| Hazard Indices | | | NA | | NA | |
| Total Risk | | | | 2E-06 | | 7E-06 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.

Table 7-22
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Sediment Ingestion at the North Fork Creek Area
NSA - Memphis
Millington, Tennessee

| Chemical | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|
| Antimony | 0.0004 | ND | 0.0111 | NA | 0.0171 | NA |
| Benzo(a)pyrene equivalents | ND | 7.3 | NA | 3.0E-07 | NA | 1.2E-06 |
| PCB Aroclor-1260 | ND | 7.7 | NA | 3.8E-08 | NA | 1.5E-07 |
| Hazard Indices | | | 0.01 | | 0.02 | |
| Total Risk | | | | 3E-07 | | 1E-06 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.

Table 7-23
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact with Sediment at SWMU 4
NSA - Memphis
Millington, Tennessee

| Chemical | Oral to Dermal Adjustment | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|---|
| PCB Aroclor-1260 | 0.5 | ND | 7.7 | NA | 1.3E-07 | NA | 4.0E-07 |
| Hazard Indices | | | | NA | | NA | |
| Total Risks | | | | | 1E-07 | | 4E-07 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.
\- Dermal to absorbed dose adjustment factor is applied to adjust for Oral RfD; the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI

Table 7-24
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact with Sediment at SWMU 6
NSA - Memphis
Millington, Tennessee

| Chemical | Oral to Dermal Adjustment | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 0.5 | ND | 7.3 | NA | 1.8E-06 | NA | 5.5E-06 |
| Chromium (hexavalent) | 0.2 | 0.005 | ND | 0.0019 | NA | 0.002 | NA |
| 4,4'-DDD | 0.5 | ND | 0.24 | NA | 1.3E-07 | NA | 4.1E-07 |
| Hazard Indices | | | | 0.002 | | 0.002 | |
| Total Risks | | | | | 2E-06 | | 6E-06 |

**NOTES:**

ND Not Determined due to lack of available information
lwa lifetime weighted average; used to calculate excess carcinogenic risk, RAGS Parts A and B
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.
\- Dermal to absorbed dose adjustment factor is applied to adjust for Oral RfD; the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI

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Table 7-25
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact with Sediment at SWMU 38
NSA - Memphis
Millington, Tennessee

| Chemical | Oral to Dermal Adjustment | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene equivalents | 0.5 | ND | 7.3 | NA | 3.7E-06 | NA | 1.2E-05 |
| Hazard Indices | | | | NA | | NA | |
| Total Risks | | | | | 4E-06 | | 1E-05 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.
\- Dermal to absorbed dose adjustment factor is applied to adjust for Oral RfD; the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI

Table 7-26
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact with Sediment at the North Fork Creek Area
NSA - Memphis
Millington, Tennessee

| Chemical | Oral to Dermal Adjustment | Oral RfD Used (mg/kg-day) | Oral SF Used (mg/kg-day)-1 | Trespassing child (age 7-16) Hazard Quotient | Trespassing child (age 7-16) ILCR | Site Worker Hazard Quotient | Site Worker ILCR |
|---|---|---|---|---|---|---|---|
| Antimony | 0.2 | 0.0004 | ND | 0.0057 | NA | 0.007 | NA |
| Benzo(a)pyrene equivalents | 0.5 | ND | 7.3 | NA | 6.1E-07 | NA | 1.9E-06 |
| PCB Aroclor-1260 | 0.5 | ND | 7.7 | NA | 7.8E-08 | NA | 2.4E-07 |
| Hazard Indices | | | | 0.006 | | 0.007 | |
| Total Risks | | | | | 7E-07 | | 2E-06 |

**NOTES:**

ND Not Determined due to lack of available information
ILCR Incremental Lifetime excess Cancer Risk
RfD Reference dose
SF Slope factor
NA Not applicable due to the lack of appropriate toxicological values.
\- Dermal to absorbed dose adjustment factor is applied to adjust for Oral RfD; the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI

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***Hypothetical Future Site Workers***

Site worker ILCRs are 2E-7 and 4E-7 for the ingestion and dermal contact pathways, respectively. PCB Aroclor-1260 was the only COPC identified at this SWMU: it contributed less than 1E-6 to the sum ILCR for both exposure pathways. Hazard was not estimated for PCB Aroclor-1260 because no reference dose is currently available through IRIS or HEAST.

**SWMU 6**

***Hypothetical Future Site Trespasser***

Site trespasser ILCRs are 9E-7 and 2E-6 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the primary contributor to ILCR, and 4,4'-DDD is a secondary contributor to ILCR (i.e., contributing less than 1E-6 to ILCR). Hazard indices for the ingestion and dermal hypothetical pathways were projected to be 0.004 and 0.002, respectively. The only contributor to the estimated hazard index was chromium.

***Hypothetical Future Site Workers***

Site worker ILCRs are 4E-6 and 6E-6 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the primary contributor to ILCR. Hazard indices for the ingestion and dermal hypothetical pathways were projected to be 0.006 and 0.002, respectively. The only contributor to the estimated hazard index was chromium.

**SWMU 38**

***Hypothetical Future Site Trespasser***

Site trespasser ILCRs are 2E-6 and 4E-6 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the only contributor to ILCR. Hazard was not estimated for BaP equivalents because no reference dose is currently available through IRIS or HEAST.



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*Hypothetical Future Site Workers*

Site worker ILCRs are 7E-6 and 1E-5 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the primary contributor to ILCR. Hazard was not estimated for BaP equivalents because no reference dose is currently available through IRIS or HEAST.

**North Fork Creek Area**

*Hypothetical Future Site Trespasser*

Site trespasser ILCRs are 3E-7 and 7E-7 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the primary contributor to ILCR. Hazard indices for the ingestion and dermal hypothetical pathways were projected to be 0.01 and 0.006, respectively. The only contributor to the estimated hazard index was antimony.

*Hypothetical Future Site Workers*

Site worker ILCRs are 1E-6 and 2E-6 for the ingestion and dermal contact pathways, respectively. BaP equivalents are the primary contributor to ILCR. Hazard indices for the ingestion and dermal hypothetical pathways were projected to be 0.02 and 0.007, respectively. The only contributor to the estimated hazard index was antimony.

### 7.6.3 COCs Identified

COCs were identified based on the sum of ingestion and dermal risk and hazard projected for each SWMU. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and a HI threshold of 1.0. Any COPC that is carried through the risk assessment process and found to contribute to a scenario with a cumulative ILCR in excess of 1E-4 or HI greater than 1 for any of the exposure scenarios evaluated in this risk assessment, and has an individual exposure pathway risk greater than 1E-6 or exposure pathway HQ greater than 0.1, is referred to as a COC. The cumulative ILCR estimated for each SWMU does not exceed 1E-4, and therefore, no COCs were identified in this BRA based on the sediment exposure pathways' contribution



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to ILCR. The HI estimated for each SWMU does not exceed 1.0, and therefore, no COCs were identified in this BRA based on their contribution to HI. No COCs were identified in this BRA.

## 7.7 Risk Uncertainty

This section discusses the uncertainty inherent in the risk assessment process in addition to medium-specific and exposure pathway-specific influences. Risk assessment sections are discussed separately below, and specific examples of uncertainty sources are included where appropriate.

### 7.7.1 General

Uncertainty is a factor in each step of the exposure and toxicity assessments presented in the preceding sections. Overall, uncertainties associated with the initial stages of the risk assessment process become magnified when they are combined with others. It is not possible to eliminate all uncertainties; however, recognizing the uncertainties is fundamental to understanding and subsequently using risk assessment results.

This section presents the uncertainty of site-specific and medium- and pathway-specific factors introduced as part of the risk assessment process, in addition to other factors influencing the uncertainty of the calculated incremental excess cancer risks and hazard quotients/indices. The exposure pathways considered in the Exposure Assessment Section of this BRA are extremely conservative.

Assumptions are made in the risk assessment process based on population studies and USEPA guidance, which divides the assumptions into two basic categories: the upper bound (90th to 95th percentile) and the mean or 50th percentile central tendency (CT) exposure assumptions. RME exposure is based on the upper-bound assumptions, and CT exposure is based on mean assumptions. Consequently, risks/hazards calculated using RME exposure assumptions are



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generally overestimates rather than underestimates. CT analysis is performed when COCs are identified based on RME calculations; however, no COCs were identified based on RME. Therefore, CT analysis was not performed. The following paragraphs discuss sources of uncertainty pertinent to each exposure pathway evaluated.

### 7.7.2 Quality of Data

Data collected during the investigation of NSA Memphis are summarized in Section 6 of this RFI. Data are evaluated to verify that the QC requirements of the data set have been met and to characterize the weakness of questionable data.

Environmental samples collected from NSA Memphis drainage ditch locations were analyzed using Level IV-equivalent DQOs for all analyses except TPH, which adhered to Level III — equivalent DQOs. The analytical methods and DQO-equivalent laboratory deliverables are summarized in the *Data Validation Report — NSA Memphis Assembly B* (E/A&H, November 1995) provided in Attachment 1 of this document and in the Data Validation Report for the two additional offsite samples in Attachment 2.

Most analytical data for environmental samples have inherent uncertainty, which is a function of the matrix characteristics and heterogeneity, and the precision and accuracy of sampling, preparation, and analysis methods employed. Although data are typically considered to be exact values, they are actually the laboratory's best estimate within a range defined by method control limits. As a result, reported concentrations for any chemical can underestimate or overestimate actual concentrations.

### 7.7.3 Identification of COPCs

Before addressing risk/hazard for all chemicals detected, screening values were used to focus the BRA on exposure scenarios of concern and COPCs which individually exceed 1E-6 risk or a hazard quotient of 0.1.

**Exposure Pathways and Contaminants**

As discussed previously in this BRA, a comparison was made using the most conservative soil screening values (residential land use) provided by USEPA applied to the sediment-exposure pathway. Although some uncertainty exists regarding potential cumulative effects, the fact that maximum concentrations detected were used in the screening comparison in concert with residential-based soil risk/hazard screening values reduces the potential for underestimating the risk/hazard posed by drainage-ditch sediment. The maximum concentration of each chemical detected at each SWMU was used in the screening comparison, and the comparisons were not location-specific. If the maximum reported concentration at any sample location at one SWMU exceeded the residential risk-based soil screening value, that chemical was carried through the screening process. The maximum concentration reported at each SWMU generally was not reported at only one sample location, and therefore, a theoretical hot spot was derived to represent maximal exposure at each SWMU (i.e., the maximum reported concentrations of all sample data corresponding to any one specific SWMU). The use of the theoretical hot spot is highly conservative, and continuous, chronic exposure to multiple sample locations is unlikely.

More than 10 constituents would have to be present at near-RBC concentrations to elicit a concern for cumulative effects, and exposure conditions would have to approach typical residential assumptions. Although the screening method is highly conservative, inhalation and dermal exposure are not incorporated into the soil screening values calculated by USEPA Region III. If these pathways were the primary concern (as opposed to ingestion), the screening method could eliminate contaminants that should be considered COPCs. An evaluation



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of NSA Memphis sediment data determined that VOCs were not prominent, and dermal exposure was addressed for all COPCs identified by risk-based screening.

**Comparison to Reference Concentrations (Background)**

Because the intent of the BRA is to estimate the excess cancer risk or health hazard posed by COPCs, site data were compared to reference concentrations in the RFI for NSA Memphis after comparing them to risk-based screening values. Additional uncertainty is introduced by comparing site data to nonspecific screening reference data. Although the background concentrations are specific to NSA Memphis, they are not SWMU-specific. The limited number of background samples and sample locations at NSA Memphis increases the potential to over or underestimate exposure because a larger data set more adequately accounts for natural variability in media composition.

The June 2, 1995, Technical Memorandum *Discussion of Dieldrin Risk Management Issues*, has been included in this RFI as Appendix B. In summary, the memorandum stated that dieldrin was detected at NSA Memphis at relatively insignificant concentrations. Dieldrin was applied as a pesticide at NSA Memphis in the 1950s and 1960s. Dieldrin was also used in the pest control trade with chlordane for general subterranean termite control. The maximum soil dieldrin concentration reported in the RFI was 50 to 100 times less than residual soil dieldrin concentrations resulting from termite control applications. As stated in the memorandum, "this finding indicates that dieldrin levels found at each SWMU do not necessitate remedial action in the absence of other significant carcinogenic risk contributors." The maximum dieldrin concentrations reported for drainage ditch sediment is 0.220 mg/kg, and the maximum dieldrin soil concentration at background locations is 0.311 mg/kg, as reported in the memorandum. The reference concentration for dieldrin in sediment is 0.24 mg/kg, as reported in the Section 6.1. Therefore, dieldrin was not considered to be a COPC in any drainage ditch.



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**Elimination of Essential Nutrients**

In accordance with RAGS, the following nutrients were eliminated from the drainage ditch area BRA: calcium, sodium, potassium, magnesium, and iron. Toxicity from overexposure to these nutrients is possible only if human receptors are exposed to extremely high doses. USEPA recommends eliminating these chemicals from formal risk assessment. Because no screening comparison was performed, the hazard indices calculated in this BRA could be positively influenced by the nutrient concentrations detected onsite. Therefore, the hazard indices are possibly underestimates with respect to nutrient contributions to the hazard indices.

### 7.7.4 Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions recommended by USEPA Region IV when assessing potential and current exposure. The exposure assumptions made in the site worker scenario are highly conservative and would tend to overestimate exposure. Current site workers are not exposed to site sediment, and future activities (if any) at the drainage-ditch areas would be expected to be related to their maintenance. Hypothetical future site workers would not be expected to work onsite in contact with sediment for eight hours per day, 250 days per year as assumed in the exposure assessment. Working in sediment 52 days per year, four hours per day would result in one-tenth the projected CDI for site workers. In addition, trespassers would not be expected to frequent the site consistent with assumed conditions. If trespassing did occur at the assumed frequency of 52 days per year, it is unlikely that a trespasser would spend 16 waking hours per day exposed to ditch sediment.

Construction workers would be exposed to sediment, and the future site worker scenario is a generally conservative estimate of their exposure and resulting risk/hazard. Although construction workers' exposure to subsurface soil would result in different exposure conditions, acute or subchronic exposure would be expected (as opposed to the chronic exposure conditions



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assumed in the future site worker scenario in this BRA). The nature of the contaminants suggest subsurface soil and sediment may not be significantly impacted. The conservative scenarios and exposure assumptions employed in this BRA generally overestimate risk and hazard posed to the hypothetical future trespasser and hypothetical future site worker for the sediment-exposure pathway.

**Determination of EPCs**

Based on the USEPA guidance, EPCs are concentrations used to estimate the CDI. The uncertainty associated with EPCs primarily stems from imposing maximum concentrations. USEPA does not recommend using maximum concentrations to estimate exposure because exposure to the maximum concentration of every chemical detected across the site overestimates exposure (i.e., a theoretical hot spot having the maximum concentrations detected in all samples collected). Because fewer than 10 sediment samples were collected to assess the drainage ditches, the 95 percentile UCL Mean was not calculated for NSA Memphis sediment data, and the maximum reported concentration was used to estimate exposure for the COPCs identified in this BRA.

***Frequency of Detection and Spatial Distribution***

Sediment generally was sampled from stagnant pools within the drainage ditches, which likely would be a sink for contaminants. Targeting areas which could be a sink for contaminants upwardly biases sediment-exposure estimates. In addition to the biased sampling strategy used to assess the drainage ditches, the maximum concentration reported at all locations within a SWMU was used to estimate exposure. Therefore, estimates of sediment exposure (and resulting risk and hazard) are overestimates.

This BRA did not employ the hot-spot adjustment. In addition to using the maximum concentration reported at each SWMU to estimate exposure, exposure to carcinogenic PAHs



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(cPAHs) was calculated based on BaP equivalents. BaP equivalents were calculated using the maximum cPAH concentrations reported at each SWMU, rather than on a location-specific basis. This approach further overestimates risk calculated for BaP equivalents because the maximum reported concentration of one cPAH could be reported at a different sample location than another. This approach overestimates exposure to cPAHs in drainage ditch sediment because a theoretical maximum TEF hot spot is derived for BaP equivalents. Location-specific analysis would generally reduce the exposure estimated for most COPCs in this BRA.

### 7.7.5 Toxicity Assessment Information

There is a generally recognized uncertainty in human risk values developed from experimental data primarily due to the uncertainty of data extrapolation in the areas of: (1) high- to low-dose exposure and (2) animal data to human experience. The site-specific uncertainty is mainly in the degree of accuracy of the exposure assumptions. Most of the assumptions used in this and any risk assessment have not been verified. For example, the degree of chemical absorption from the gut or through the skin or the amount of sediment contact is not known with certainty.

USEPA default dermal absorption factors are based on soil exposure. Dermal contact with sediment would change the adsorption and absorption properties of human skin due to the different properties of wet versus dry skin. Sediment also would be disturbed by activity within a drainage ditch, and surface water could serve as a transport for sediment to directly contact the skin. In addition, chemicals' adsorption and absorption could be influenced by physico-chemical properties of the surface water, such as pH, hardness, chemical oxygen demand, photo-ionization effects, and the solubility of contaminants bound to disturbed sediment. These variables could lead to over- or underestimates of the risk and hazard posed by COPCs identified in sediment. To reduce the potential for underestimating risk and hazard for the trespasser scenario, the skin surface area exposure assumption for the adolescent trespasser was 10,200 $cm^2$. This is more conservative than typical dermal exposure assumptions, and would



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generally overestimate exposure when estimating soil exposure. However, the skin surface area was increased to account for potential underestimates made by assuming sediment exposure calculations would be similar to soil.

The uncertainty of toxicological values from the IRIS and HEAST databases (provided by USEPA) are summarized (where available) in Table 7-18 (previously presented). The uncertainty factors assigned to these values account for acute to chronic dose extrapolation, study inadequacies, and sensitive subpopulations, among other factors. Although uncertainty factors for a specific compound may be 1,000 or higher, these safety factors are applied by USEPA to help guarantee the overall assessment of risk/hazard is conservative toward human health concerns. In the presence of such uncertainty, the USEPA and the risk assessor are obligated to make conservative assumptions so the chance is very small for the actual health risk to be greater than what is determined through the risk assessment process. On the other hand, the process is not to yield overly conservative risk values that have no basis in reality. This balance was kept in mind in developing exposure assumptions and pathways and in interpreting data and guidance for this BRA.

**Evaluation of Chemicals for Which No Toxicity Values Are Available**

In addition to the typical uncertainties inherent in toxicity values, parameters which do not have corresponding RBCs due to the lack of approved toxicological values were not included in the CDI calculation data. This does not indicate that chemicals lacking approved toxicological values pose no hazard, such as BaP. Essential nutrients (calcium, sodium, potassium, magnesium, and iron) were eliminated based on their low potential for toxicity. Therefore, these chemicals were not assessed further in this BRA.



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### 7.7.6 Quantification of Risk/Hazard

This section discusses uncertainty sources identified in the quantification of risk and hazard that are not covered in preceding discussions.

**SWMU 4 Sediment**

Of the CPSSs screened from formal assessment, none eliminated was reported at concentrations close to the corresponding RBCs (i.e., a 10% difference with respect to the RBC). This minimizes the likelihood of potentially significant cumulative risk/hazard with respect to the eliminated CPSSs. Arsenic, dieldrin, and MCPA exceeded their corresponding RBCs, but these chemicals did not exceed the corresponding RCs. Therefore, they were eliminated from formal assessment based on comparisons to corresponding RCs.

**SWMU 6 Sediment**

Of the CPSSs screened from formal assessment, none eliminated was reported at concentrations close to the corresponding RBCs (i.e., a 10% difference with respect to the RBC). This minimizes the likelihood of potentially significant cumulative risk/hazard with respect to the eliminated CPSSs. Arsenic and dieldrin exceeded their corresponding RBCs, but these chemicals did not exceed the corresponding RCs. Therefore, they were eliminated from formal assessment based on comparisons to corresponding RCs.

**SWMU 38 Sediment**

Of the CPSSs screened from formal assessment, none eliminated was reported at concentrations close to the corresponding RBCs (i.e., a 10% difference with respect to the RBC). This minimizes the likelihood of potentially significant cumulative risk/hazard with respect to the eliminated CPSSs. Arsenic, dieldrin, and MCPA exceeded their corresponding RBCs, but these chemicals did not exceed the corresponding RCs. Therefore, they were eliminated from formal assessment based on comparisons to corresponding RCs.



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**North Fork Creek Area Sediment**

Of the CPSSs screened from formal assessment, barium was reported at a concentrations equal to the corresponding RBCs (i.e., a 10% difference with respect to the RBC). However, the RBC for barium in residential soil is based not only on residential exposure assumptions, but also on a hazard quotient of 0.1. The scenarios used to estimate risk and hazard in this BRA would result in less CDI than a residential scenario, and barium would contribute less than 0.1 to the hazard indices. No chemicals of concern were identified in this BRA based on hazard indices, and including barium in the list of COPCs would not affect that conclusion. Arsenic and dieldrin exceeded their corresponding RBCs, but these chemicals did not exceed the corresponding RCs. Therefore, they were eliminated from formal assessment based on comparisons to corresponding RCs.

Although the future land use at these sites is unknown, worker and trespasser exposure scenarios were assessed in this BRA. As previously discussed, these scenarios would likely lead to overestimates of risk and/or hazard.

## 7.8 Risk Summary

This section summarizes risk and hazard projected for each receptor group, exposure medium, exposure pathway, and identifies COCs (when applicable). The risk and hazard posed by contaminants at NSA Memphis drainage ditch areas were assessed using two exposure scenarios: the hypothetical reasonable maximum exposure of site workers and the hypothetical reasonable maximum exposure child (adolescent) trespasser scenario. Incidental ingestion and dermal contact exposure pathways were used to address potential future sediment exposure.

As discussed in Section 7.7, the use of maximum theoretical hot spot and other conservative assumptions made in this BRA would generally overestimate exposure; therefore, risk and hazard calculated for the drainage ditch area sediment are overestimates. COCs are identified for



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exposure scenarios exceeding either excess cancer risk 1E-4 or a hazard index of 1. Table 7-27 summarizes the risk and hazard calculated for the drainage ditches. No chemicals of concern exceeded these thresholds, and therefore, no COCs were identified in this BRA.

## 7.9 Remedial Goal Options

RGOs are chemical concentrations computed to equate with specific risk and/or hazard goals that may be established for a particular site. As previously discussed, COCs are identified as any COPC that significantly contributes to a scenario of concern. A scenario having a combined ILCR greater than 1E-4 or HI greater than 1 is defined as a scenario of concern, and an individual chemical which contributes either 1E-6 ILCR or 0.1 HI to one exposure pathway is considered to significantly contribute to the scenario ILCR or HI (i.e., a COC). Based on this algorithm, no COCs were identified which required calculation of RGOs. Therefore, RGOs do not apply to this BRA.

**Table 7-27**
**Summary of Risk and Hazard for the Drainage Ditch Areas**
**NSA Memphis, Assembly B**

| Medium | Exposure Pathway | HI (tresp) | ILCR (tresp) | HI (worker) | ILCR (worker) |
|---|---|---|---|---|---|
| *SWMU 4* | Incidental Ingestion | ND | 6E-8 | ND | 2E-7 |
| | Dermal Contact | ND | 1E-7 | ND | 4E-7 |
| *SWMU 6* | Incidental Ingestion | 0.004 | 9E-7 | 0.006 | 4E-6 |
| | Dermal Contact | 0.002 | 2E-6 | 0.002 | 6E-6 |
| *SWMU 38* | Incidental Ingestion | ND | 2E-6 | ND | 7E-6 |
| | Dermal Contact | ND | 4E-6 | ND | 1E-5 |
| *North Fork Creek Area* | Incidental Ingestion | 0.01 | 3E-7 | 0.02 | 1E-6 |
| | Dermal Contact | 0.006 | 7E-7 | 0.007 | 2E-6 |

*Notes:*
ND = not determined due to the lack of available risk information
ILCR = incremental lifetime cancer risk
HI = hazard index
tresp = the trespasser scenario



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# 8.0 ECOLOGICAL RISK ASSESSMENT

## 8.1 Introduction

The Ecological Risk Assessment (ERA) assesses the actual or potential effects to ecological receptors due to contamination at NSA Memphis. This ERA focuses specifically on the aquatic ecosystem associated with SWMUs 4, 6, 10, 31, and 38. This assessment considers sediment contaminant concentrations and distributions, media- specific physicochemical conditions, and exposure pathways which could result in unacceptable levels of exposure to ecological receptors now or in the future. The approach to this assessment is based on USEPA's *Risk Assessment Guidance for Superfund Volume II-Environmental Evaluation Manual* (1989), USEPA's *Framework for Ecological Risk Assessment* (USEPA/630/R-92/001), USEPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (Draft, 1994), and USEPA's *Supplemental Guidance to RAGS: Region 4 Bulletins--Ecological Risk Assessment, Draft* (November 1995).

### 8.1.1 Site Description

SWMUs 4, 6, 10, 31, and 38 (Northside portion) comprise the drainage ditch system within the northwest quadrant of NSA Memphis. The ditch system and associated SWMUs receive water from surface runoff, storm sewers, and previous wastewater discharges from various buildings in the central and southwestern portions of the NSA Memphis Northside. To better organize the areas of concern, the drainage ditches have been divided into five sections, as shown on Figure 8-1. Sections were chosen based on sample proximity and relationship to particular SWMUs. By grouping portions of the drainage ditch system, a relative risk from SWMUs may be established.

While sampling the drainage ditches, habitat and biota were qualitatively evaluated to determine whether ecological receptors were present and how they may be impacted by contamination. Surveys determined that intermittent flow in the drainage ditches occurred for only short periods



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after storms events and thus no aquatic ecosystem was established. Although standing water may be present in the ditches throughout the year, this is mostly in the form of shallow, stagnant, ponds.

In addition to the limited amount of water typically present, most of the ditches are significantly eroded. A hard clay layer, comprising the sediment surface, most likely limits establishment of a benthic community and would not provide an adequate cover or food source for nekton species. The ditches may be used by terrestrial species, such as raccoons or opossums, for drinking water. However, no evidence of their presence was noted during the habitat and biota survey. A qualitative review of habitat conditions noted during the sampling event is included as Appendix D. Local bird species also may use riparian areas for cover and may use the ditches as a water source. There was no evidence that NSA Memphis provides habitat to any threatened or endangered species. A review of the database provided by the Tennessee Department of Environment and Conservation (Appendix E), showed no evidence of threatened or endangered species within the boundaries of NSA Memphis or the downgradient areas sampled in North Fork Creek.

Most of NSA Memphis is developed with limited habitat available for species in the area. Roads, buildings, and aircraft runways are common across the base. As a result of these features, high levels of human activity limit the attractiveness and accessibility of the base as suitable habitat for plant or animal species.

### 8.1.2 Reference Values and Sediment Screening Values

To determine if compounds detected in sediment were a potential risk to ecological receptors, concentrations were compared to twice the mean reference concentration (RC) and to available USEPA Region IV draft sediment screening values (SSV). RCs, for portions of the drainage



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RUNWAY 4-22 APRON
4-22
6-1
SWMU 6
N-126
SWMU 31
31-1
FUNAFUTI STREET
ILLINOIS CENTRAL GULF RAILROAD
SWMU 6
6-4
STRATIGRAPHIC TEST HOLE 4
6-2
6-3
6-5
PW-1
6-6 (REFERENCE)
CARRIER DECK FIRE FIGHTING TRAINING AREA
SWMU 60
SWMU 6
SWMU 40
CASABLANCA AVENUE
38-1
38-2
38-3
38-4
SWMU 10
4-1
4-2
FIRST AVENUE
NORTH FORK CREEK
SWMU 38
SWMU 5
SWMU 4
38-7 (REFERENCE)
38-6
38-5
SWMU 24
SWMU 19
SWMU 49
PW-3
NAVY ROAD
38-8
AIRCRAFT FIRE FIGHTING TRAINING AREA
NFC-1
NFC-2

NOTE: THE SWMU 4 UNDERGROUND STORM SEWER ORIGINATES APPROXIMATELY 750 FEET EAST OF THIS POINT AT BUILDING N-121.

N

450 0 450
SCALE FEET

LEGEND

- ▲ – SEDIMENT SAMPLE (0 TO 6 INCHES)
- ■ – SEDIMENT SAMPLE (18 TO 24 INCHES)
- ←— – STORM SEWER (UNDERGROUND PORTION), WITH ARROW INDICATING FLOW DIRECTION
- ←— – DRAINAGE DITCH, WITH ARROW INDICATING SURFACE WATER FLOW DIRECTION

RFI REPORT
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 8-1
SWMU GROUPINGS AND SAMPLE LOCATIONS
NORTHSIDE INDUSTRIAL DRAINAGE DITCHES
SWMUs 4, 6, 10, 31, AND 38

DWG DATE: 08/16/96 | DWG NAME: 94SGSL81

ditch above the confluence with North Fork Creek, were derived using the maximum value from either the original sediment sample or its duplicate collected from the 0- to 6-inch sampling interval at location 6-6. This location was selected as a reference due to an obvious lack of contamination source nearby. RCs for sediment samples from North Fork Creek were established from a sample (38-7) collected upstream of the drainage ditch-North Fork Creek confluence. It was assumed that off-site transport of contaminants into North Fork Creek would only be found downstream of the confluence. The SSVs represent effects levels derived from either three studies which were focused in coastal areas throughout the United States or the contract required quantitation limit (CRQL) for that particular contaminant. Their application in freshwater environments, as at NSA Memphis, may not be truly applicable. Also, SSVs do not consider the influences of total organic carbon, grain size, or other site-specific factors that may influence contaminant bioavailability in sediment.

For this assessment, if contaminant concentrations exceed the RC they may be considered site-related. If a contaminant concentration was greater than its RC, it was then compared to its SSV.

## 8.2 Contaminant Characteristics

The toxic effects of the major constituents detected within the sediment of the drainage ditches are discussed below. Limited information exists for many of the contaminants detected, but is discussed where appropriate. It should also be recognized that site-specific conditions play a large role in determining contaminant toxicity, bioavailability, fate, and transport.



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### 8.2.1 Organics

**SVOCs**

PAHs vary by molecular weight and comprise most of the SVOCs detected in the drainage ditch system and North Fork Creek. With increasing molecular weight, aqueous solubility generally decreases; the octanol-water partitioning coefficient ($K_{ow}$) generally increases thus increasing solubility in fats; resistance to oxidation and reduction generally decreases; and vapor pressure generally decreases (Eisler, 1987). Accordingly, PAHs of different molecular weight vary substantially in their behavior and distribution in the environment and in their biological effects. In water, PAHs either evaporate, disperse into the water column, become incorporated into sediments, or undergo degradative processes such as photooxidation, chemical oxidation, and biological transformation by bacteria and animals (Neff, 1979).

Most environmental concern has focused on PAHs that range in molecular weight from 128.16 (naphthalene) to 300.36 (coronene). Generally, lower molecular weight PAH compounds, containing two or three aromatic rings, exhibit significant acute toxicity but are not carcinogenic. High molecular weight PAH compounds, four to seven rings, are significantly less toxic, but are demonstrably carcinogenic, mutagenic, or teratogenic to aquatic species. PAHs show little tendency to biomagnify in the food chain because most are rapidly metabolized (Eisler, 1987). Very little information is available on food chain adverse effects as a result of soil PAH contamination and relatively few field studies have addressed PAH toxicity in sediment.

**Organochlorine Pesticides**

Organochlorine pesticides have been used extensively in the U.S. since the 1940s. They appear to be ubiquitous in the environment, being found in surface water, sediment, and biological tissues. They are readily absorbed by warm-blooded species and degradatory products are frequently more toxic than the parent form. Food chain biomagnification is usually low, except



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in some marine mammals. In soil invertebrates, organochlorine pesticides can accumulate to concentrations higher than those in the surrounding soil, and residues may, in turn, be ingested by birds and other animals feeding on earthworms (Beyer and Gish, 1980). Most environmental studies have been directed at mammals and birds.

### 8.2.2 Metals

In general, heavy metals adversely affect survival, growth, reproduction, development, and metabolism of both terrestrial and aquatic invertebrate species, but effects are substantially modified by physical, chemical, and biological variables. Most heavy metals do not biomagnify. In contact tests with terrestrial earthworms, the order of toxicity for selected heavy metals, from most toxic to least toxic, was copper > zinc > nickel = cadmium > lead.

#### Arsenic

Arsenic naturally occurs and, with respect to cycling in the environment, is constantly changing. Many inorganic arsenicals are known teratogens and are more toxic than organic arsenicals (Eisler, 1988). Soil biota appear to be capable of tolerating and metabolizing relatively high concentrations (microbiota to 1,600 mg/kg) of arsenic (Wang et al., 1984), but adverse effects to aquatic organisms have been reported at concentrations of 19 to 48 micrograms per liter ($\mu$g/L) in water. Arsenic does not appear to magnify along the aquatic food chain.

#### Cadmium

Cadmium is a relatively rare heavy metal. It is a known teratogen, carcinogen, and probably a mutagen, and has been implicated as the cause of severe deleterious effects on fish and wildlife (Eisler, 1985). Birds and mammals are comparatively resistant to the biocidal properties of cadmium. Freshwater organisms appear to be most susceptible to cadmium toxicity and this is modified significantly by water hardness. Adsorption and desorption processes are likely to be major factors in controlling cadmium concentrations in natural waters. Adsorption and



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desorption rates of cadmium are rapid on mud solids and particles of clay, silica, humic material, and other naturally occurring solids.

**Chromium**

Hexavalent chromium (Cr VI) produces more adverse effects to biota than does the trivalent phase. In clayey sediments, trivalent chromium dominates and benthic invertebrate bio-accumulation is limited (Neff et al., 1978). The solubility and potential bioavailability of waste chromium added to soil through sewage sludge are modified by soil pH and organic complexing substances (James and Bartlett, 1983).

**Copper**

Copper is an essential micronutrient, and therefore, it is readily accumulated by aquatic organisms. It is a broad-spectrum biocide, which may be associated with both acute and chronic toxicity.

**Lead**

In soils, lead concentrates in organic-rich surface horizons (NRCC, 1973). Estimated residence time of lead in soils is about 20 years (Nriagu, 1978). In sediments, lead is primarily found in association with iron and manganese hydroxides and may also form associations with clays and organic matter. Under oxidizing conditions, lead tends to remain tightly bound to sediments, but may be released into the water column under reducing conditions (Jaagumagi, 1990). Lead is most toxic in water and may accumulate to relatively high concentrations in aquatic biota.

**Zinc**

In natural waters, zinc speciates into the toxic aquo ion, other dissolved chemical species, and various inorganic and organic complexes; it also is readily transported. Most zinc introduced



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into aquatic environments is eventually partitioned into the sediments. Reduced conditions enhance zinc's bioavailability.

**Other Metals**

No information was available on the toxicological effects associated with antimony, barium, beryllium, cobalt, nickel selenium, silver, or vanadium contamination in soil or sediment.

## 8.3 Contaminant Distributions

Contaminants identified from the sediment sampling data generated during the RFI are presented in detail in Section 6.

Twenty-six sediment samples collected from the drainage ditches were analyzed for FSA (Figure 8-1). Only those sample results from the upper 6 inches of the sediment were considered in the ERA. Sample results from each SWMU grouping are summarized in this section.

In general, SVOCs, pesticides, and some heavy metals were predominant within sediment in shallow portions of the drainage ditches and appear to be most prevalent in areas immediately below outfalls, drainage gullies, and other areas where contaminants may be concentrated. Within North Fork Creek, the most contaminated sample location was collected downstream of the confluence of SWMU 38 and the creek and downstream of heavily traveled Navy Road, where it crosses the creek. Pesticides were detected throughout the drainage-ditch system. Pesticides, which are considered ubiquitous and usually persist in the environment for decades, often result from routine-spraying operations.



000156

### 8.3.1 SWMU 4 — N-121 Plating Shop Storm Sewer and Ditch

*Site History*

SWMU 4 originates as a storm sewer at Building N-121 and runs westerly along Casablanca Street to First Avenue, then southwesterly to a section of open drainage ditch which discharges into the lower portion of the drainage ditch system (SWMU 38). Building N-121, at the northwest corner of the intersection of Eighth and Casablanca Avenues, housed a plating shop where cadmium, chromium, copper, nickel, and cyanide-based solutions were used. The Building N-121 Plating Shop Dry Well (SWMU 3) was reportedly used for disposal of small quantities of concentrated plating solutions and plating-tank overflow. Previous reports state that up to 17,000 gallons per day of dilute wastewater was discharged into the storm sewer and drainage ditch from operations at Building N-121 (Harmon, 1983).

*Sample Results*

Samples for SWMU 4 (4-1 and 4-2) were collected from depositional areas in the drainage ditch. Sample 4-1 was collected upstream from SWMU 5 (Aircraft Fire Fighting Training Facility) in highly organic sediment where contaminants would have likely been deposited. Sample 4-2 was collected farther downstream in a channelized area near SWMU 5. Sample 4-2 had a strong diesel odor. Sample results are summarized in Table 8-1. From both locations, only three SVOCs were detected, with no SSVs exceeded. Two of the SVOCs were PAH compounds. Few of the detected metal concentrations exceeded RCs or SSVs. Diesel-range organics (DROs) were detected at concentrations ranging from 11 to 41 mg/kg. Pesticides and PCBs were also detected; DDT exceeded its SSV at both sample locations.

*Exposure Characterization*

As discussed previously, a lack of annual flow at SWMU 4 prevents establishment of an aquatic community. In addition, little habitat is available for terrestrial wildlife in the immediate area. Low concentrations observed suggests that risk from off-site transport of contaminants will not be a concern. A very low risk potential exists for receptors at this site from the contamination observed.



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**Table 8-1**
**Chemicals Detected in Sediment at SWMU 4**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| 2-Butanone | 1/2 | 4 | ND | NA | 1/NA |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Fluoranthene | 1/2 | 79 | ND | 330 | 1/0 |
| Pyrene | 1/2 | 73 | ND | 330 | 1/0 |
| Bis(2-ethylhexyl)phthalate | 2/2 | 99 - 140 | 134 | 182 | 1/0 |
| **Metals (mg/kg)** | | | | | |
| Arsenic | 2/2 | 9.3 - 9.9 | 83.6 | 7.24 | 0/2 |
| Barium | 2/2 | 221 - 294 | 1276 | NA | 0/NA |
| Chromium | 2/2 | 14.4 - 26 | 45 | 52.3 | 0/0 |
| Cobalt | 2/2 | 9.3 - 14.9 | 93 | NA | 0/NA |
| Copper | 2/2 | 17.4 -25.8 | 67.4 | 18.7 | 0/1 |
| Lead | 2/2 | 18.2 - 43.8 | 188 | 30.2 | 0/1 |
| Nickel | 2/2 | 18.9 - 27.6 | 116.4 | 15.9 | 0/2 |
| Vanadium | 2/2 | 20.8 - 33.8 | 166.4 | NA | 0/NA |
| Zinc | 2/2 | 69 - 78.4 | 155.8 | 124 | 0/0 |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Aldrin | 1/2 | 10 | ND | NA | 1/NA |
| Heptachlor Epoxide | 1/2 | 4 | ND | NA | 1/NA |
| Dieldrin | 2/2 | 13 - 76 | 240 | 3.3 | 0/2 |
| 4-4'-DDE | 1/2 | 24 | ND | 3.3 | 1/1 |
| 4-4'-DDD | 2/2 | 9.2 - 20 | ND | 3.3 | 2/2 |
| 4-4'-DDT | 2/2 | 6 - 7.3 | ND | 3.3 | 2/2 |
| MCPA (4-chloro-2-methyl phenoxy acetic acid) | 1/2 | 5,300 | 22,000 | NA | 0/NA |
| 2,4,5-TP | 1/2 | 5.8 | 24 | NA | 1/NA |
| MCPA | 1/2 | 5,300 | ND | NA | 1/NA |
| Aroclor 1260 | 1/2 | 180 | ND | 33 | 1/1 |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-DRO | 2/2 | 11 - 41 | ND | NA | 2/NA |



000153

### 8.3.2 SWMU 6 — N-126 Plating Shop Storm Sewer and Ditch

*Site History*

SWMU 6 originates as an underground storm sewer at Building N-126 and as an open drainage ditch just south of the Runway 4-22 apron. The underground portion of SWMU 6 at Building N-126 flows southwesterly to the end of the apron along Runway 4-22, where it turns due west and becomes an open drainage ditch, intersecting the open drainage ditch south of the Runway 4-22 apron. The open drainage ditch portion of SWMU 6 continues southwest to a point between SWMU 60 (Northside Landfill, Western Portion) and SWMU 10 (Northside Landfill, Eastern Portion), where it empties into the SWMU 38 portion of the drainage ditch system.

Building N-126 is located in the flight operations area. A battery shop in the northeast corner of the building operated from 1955 until 1981. When the battery shop was operating, approximately 100 gallons per day of a diluted and neutralized acid mixture was reportedly discharged into the storm sewer. Electrolyte spills and drippings were also discharged into Building N-126 floor drains. These floor drains were connected to 3- and 4-inch acid-resistant pipes which emptied into the storm sewer. The sewer reportedly has been damaged by the acid releases. Substantial erosion also has been identified where the storm sewer discharges into the ditch west of Building N-126.

*Sample Results*

Five samples for SWMU 6 (6-1 through 6-5) were collected from the upper reaches of the drainage ditches. A majority of the contaminants found were from locations 6-1 through 6-4. Sample 6-1 was collected from an area of high sediment deposition in the drainage ditch itself, about 35 feet downgradient from the outfall that marks the most upgradient point of the drainage ditches. The sediment in the upper 3 to 4 inches was coarse brown sand, underlain by a tight clay. Samples 6-2, 6-3, and 6-4 were collected below two outfalls. Sediment characteristics



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were similar to those at location 6-1. However, a diesel odor was noted at locations 6-3 and 6-4. Sample 6-5 was collected about 30 feet downgradient from sample 6-4 and had sediment characteristics similar to location 6-1; also with a slight diesel odor. Sample results from SWMU 6 are summarized in Table 8-2.

Except for lead at location 6-1, only PAHs appear to be significantly elevated in the SWMU 6 portion of the drainage ditch system. Location 6-3 had individual PAH concentrations well above their SSVs. The location is directly below an outfall and this could explain the elevated levels. At location 6-5 the contaminant concentrations were again lower. Only the metal cadmium exceeded its RC. At one location or more arsenic, cadmium, chromium, copper, lead, nickel, and zinc exceeded their SSVs. Pesticides were detected at sample location 6-5, but at concentrations lower than the upstream samples. Although the highest concentrations of contamination are at the confluence of the outfalls, the result from sample 6-5 indicates that contaminants may have migrated to this area. In SWMU 6, it appears that most contamination is confined to the upper or mid-reaches of the drainage system.

*Exposure Characterization*

In SWMU 6, as with SWMU 4, a viable aquatic community cannot exist due to an intermittent and seasonal flow regime. Also, terrestrial vertebrate use of the area should be limited based on the surrounding habitat features. Downstream transport of inorganic and organic compounds did not appear to be occurring and thus a low risk potential is predicted to receptors from the contamination observed within this portion of the drainage system.

**Table 8-2**
**Chemicals Detected in Sediment at SWMU 6**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 1/5 | 4 | ND | NA | 1/NA |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Acenaphthene | 1/5 | 52 | ND | 330 | 1/0 |
| Fluorene | 1/5 | 70 | ND | 330 | 1/0 |
| Anthracene | 1/5 | 120 | ND | 330 | 1/0 |
| Carbazole | 1/5 | 85 | ND | NA | 1/NA |
| Phenanthrene | 2/5 | 460 - 520 | ND | 330 | 2/2 |
| Fluoranthene | 2/5 | 860 - 2,900 | ND | 330 | 2/1 |
| Pyrene | 3/5 | 38 - 2,400 | ND | 330 | 3/1 |
| Benzo(a)anthracene | 2/5 | 370 - 1,800 | ND | 330 | 2/2 |
| Chrysene | 2/5 | 420 - 2,300 | ND | 330 | 2/2 |
| Bis(2-ethylhexyl)phthalate | 4/5 | 60 - 1,800 | 134 | 182 | 4/1 |
| Benzo(b)fluoranthene | 2/5 | 330 - 2,200 | ND | NA | 2/NA |
| Benzo(k)fluoranthene | 2/5 | 310 - 1,700 | ND | NA | 2/NA |
| Benzo(a)pyrene | 3/5 | 46 - 2,000 | ND | 330 | 3/1 |
| Dibenz(a,h)anthracene | 1/5 | 82 | ND | 330 | 1/0 |
| Indeno(1,2,3-cd)pyrene | 2/5 | 190 - 1,200 | ND | NA | 2/NA |
| Benzo(g,h,i)perylene | 3/5 | 42 - 1,300 | ND | NA | 3/NA |
| **Metals (mg/kg)** | | | | | |
| Arsenic | 5/5 | 5.4 - 16.6 | 83.6 | 7.24 | 0/4 |
| Barium | 5/5 | 159 - 361 | 1276 | NA | 0/NA |
| Cadmium | 2/5 | 0.97 - 10.3 | 3.8 | 1 | 2/2 |
| Chromium | 5/5 | 12.7 - 57.8 | 45 | 52.3 | 1/2 |
| Cobalt | 5/5 | 8.1 - 32.4 | 93 | NA | 0/NA |
| Copper | 5/5 | 8.1 - 24.9 | 67.4 | 18.7 | 0/2 |
| Lead | 5/5 | 13 - 346 | 188 | 30.2 | 1/3 |
| Nickel | 5/5 | 8.8 - 31.4 | 116.4 | 15.9 | 0/3 |
| Vanadium | 5/5 | 14.1 - 40 | 166.4 | NA | 0/NA |
| Zinc | 5/5 | 20.2 - 184 | 155.8 | 124 | 1/1 |



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**Table 8-2**
**Chemicals Detected in Sediment at SWMU 6**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Dieldrin | 4/5 | 3.0 - 170 | 240 | 3.3 | 4/4 |
| 4-4'-DDE | 3/5 | 6.4 - 50 | ND | 3.3 | 3/3 |
| 4-4'-DDD | 3/5 | 12 - 6,000 | ND | 3.3 | 3/3 |
| 4-4'-DDT | 4/5 | 9.3 - 86 | ND | 3.3 | 4/4 |
| 2,4-D | 1/5 | 49 | ND | NA | 1/NA |
| 2,4-DB | 1/5 | 33 | ND | NA | 1/NA |
| 2,4,5-TP | 1/5 | 2.5 | 24 | NA | 0/NA |
| Dinoseb | 1/5 | 15 | ND | NA | 1/NA |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-GRO | 1/5 | 0.13 | ND | NA | 1/NA |
| TPH-DRO | 4/5 | 10 - 360 | ND | NA | 4/NA |
| TPH (418.1) | 3/5 | 360 - 3000 | ND | NA | 3/NA |

### 8.3.3 SWMU 31 — Aircraft Wash Rack at 4th Street

*Site History*

SWMU 31 includes the aircraft wash rack and underground storm sewer line which connects to SWMU 6. It originates at the aircraft wash rack at Funafuti Street and Fourth Avenue, just southeast of Building N-126. The aircraft wash rack, a paved area that slopes to a catch basin in the parking lot, was first used in 1956 to rinse treatment chemicals from aircraft. The wash rack has not been used in approximately 10 years. Reportedly, aluminum parts on aircraft were treated with chromic acid ("alodine") before arriving at the wash rack. The aircraft were then washed with a high-pressure detergent to remove the acid. Wastewater on the concrete slab collected in the catch basin connected to the storm sewer leading to SWMU 6.



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### *Sample Results*

Because the storm sewer was inaccessible at SWMU 31, sample 31-1 was collected from an area of surface soil adjacent to the storm sewer inlet. The soil, about 3 inches deep was underlain by an asphalt parking lot. The soil was a dark, organic mixture of silt and clay. The sample results from SWMU 31 are shown in Table 8-3.

RCs were exceeded for all SVOCs, most metals, and all pesticides and herbicides analyzed. Likewise, the SSVs were exceeded for all SVOCs, and for seven metals. PAHs, lead, and zinc, along with general petroleum compounds, were the most significantly elevated contaminants found. However, this sample was collected from a deposit of soil over an asphalt parking lot and thus these elevated levels were not surprising.

### *Exposure Characterization*

Receptor exposure to contamination associated with SWMU 31 is virtually non-existent near the site. As stated, the portion of the drainage system near SWMU 31 is mostly underground and thus no aquatic or terrestrial species will be affected. The potential for off-site transport of contaminants associated with the site appears to be the most significant exposure scenario. Elevated lead, zinc, and PAH concentrations at downgradient SWMU 6 (sample location 6-3) may be a result of sediment movement from SWMU 31. As with other portions of the drainage system direct exposure to receptors is very limited and the risk potential is low.



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**Table 8-3**
**Chemicals Detected in Sediment at SWMU 31**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Toluene | 1/1 | 2 | ND | NA | 1/NA |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Acenaphthylene | 1/1 | 1100 | ND | 330 | 1/1 |
| Acenaphthene | 1/1 | 750 | ND | 330 | 1/1 |
| Fluorene | 1/1 | 420 | ND | 330 | 1/NA |
| Phenanthrene | 1/1 | 1800 | ND | 330 | 1/1 |
| Anthracene | 1/1 | 620 | ND | 330 | 1/1 |
| Carbazole | 1/1 | 430 | ND | NA | 1/NA |
| Fluoranthene | 1/1 | 20000 | ND | 330 | 1/1 |
| Pyrene | 1/1 | 19000 | ND | 330 | 1/1 |
| Butylbenzylphthalate | 1/1 | 850 | ND | NA | 1/NA |
| Benzo(a)anthracene | 1/1 | 16000 | ND | 330 | 1/1 |
| Chrysene | 1/1 | 21000 | ND | 330 | 1/1 |
| Bis(2-ethylhexyl)phthalate | 1/1 | 2300 | 134 | 182 | 1/1 |
| Benzo(b)fluoranthene | 1/1 | 30000 | ND | NA | 1/NA |
| Benzo(k)fluoranthene | 1/1 | 24000 | ND | NA | 1/NA |
| Benzo(a)pyrene | 1/1 | 26000 | ND | 330 | 1/1 |
| Indeno(1,2,3-cd)pyrene | 1/1 | 14000 | ND | NA | 1/NA |
| Dibenzo(a,h)anthracene | 1/1 | 5300 | ND | 330 | 1/1 |
| Benzo(g,h,i)perylene | 1/1 | 14000 | ND | NA | 1/NA |
| **Metals (mg/kg)** | | | | | |
| Arsenic | 1/1 | 4.8 | 83.6 | 7.24 | 0/0 |
| Barium | 1/1 | 96.4 | 1276 | NA | 0/NA |
| Cadmium | 1/1 | 13.8 | 3.8 | 1 | 1/1 |
| Chromium | 1/1 | 75.7 | 45 | 52.3 | 1/1 |
| Cobalt | 1/1 | 7.7 | 93 | NA | 0/NA |
| Copper | 1/1 | 52.1 | 67.4 | 18.7 | 0/1 |



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**Table 8-3**
**Chemicals Detected in Sediment at SWMU 31**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | |
| Lead | 1/1 | 1040 | 188 | 30.2 | 1/1 |
| Mercury | 1/1 | 0.18 | ND | 0.1 | 1/1 |
| Nickel | 1/1 | 22.9 | 116.4 | 15.9 | 0/1 |
| Vanadium | 1/1 | 13.8 | 166.4 | NA | 0/NA |
| Zinc | 1/1 | 856 | 155.8 | 124 | 1/1 |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Heptachlor Epoxide | 1/1 | 31 | ND | NA | 1/NA |
| Dieldrin | 1/1 | 32 | 240 | 3.3 | 1/1 |
| 4-4'-DDE | 1/1 | 20 | ND | 3.3 | 1/1 |
| 4-4'-DDD | 1/1 | 12 | ND | 3.3 | 1/1 |
| Endrin Ketone | 1/1 | 76 | ND | NA | 1/NA |
| Stirophos | 1/1 | 270 | ND | NA | 1/NA |
| 2,4-D | 1/1 | 22 | ND | NA | 1/NA |
| Dinoseb | 1/1 | 24 | ND | NA | 1/NA |
| Dicamba | 1/1 | 7.2 | ND | NA | 1/NA |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-DRO | 1/1 | 360 | ND | NA | 1/NA |
| TPH (418.1) | 1/1 | 1100 | ND | NA | 1/NA |

### 8.3.4 SWMU 38 — upper reach- (Near SWMU 10 Landfill)

*Site History*

The SWMU 38 - upper reach portion of the drainage ditch system is associated with SWMU 10 landfill. SWMU 10 is north of SWMU 5, the Aircraft Fire Fighting Training Facility (AFFTF, see Figure 1-1) and south of the main runway (Runway 4-22). Although the spatial extent of



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the landfill is not exactly known, it is estimated to be 13 to 20 acres. The landfill area was originally a ravine reportedly used for construction debris disposal. The only documented description of waste disposal at the site was found in several 1980 contract documents which required contractors to use the area for disposal of rubbish and construction debris (i.e., construction materials, paper, metal scrap, leaves, and ash associated with paper incineration). SWMU 10 originally was designated as a "No Further Action" site because of the presumed nature of its contents. Visual inspections along the banks of the SWMU 38 - upper reach portion of the drainage ditch, where it passes SWMU 10, have identified erosion and debris in the banks of the ditch on the landfill side. Because of this and the planned transfer of this property to the City of Millington, SWMU 10 was partially assessed by sampling the bank sediments to determine whether contaminants are leaching from the landfill.

*Sample Results*

For this discussion samples 38-1 through 38-4 will be referred to as SWMU 38 - upper reach. All four samples were collected in an area from which SWMU 10 could potentially influence contamination within that portion of the drainage ditch. Sample 38-1, a brown, silty clay, was collected in the main drainage channel, about 50 feet downgradient of a confluence of the SWMU 6 ditch and a smaller channel. It was collected at the water's edge just downgradient of a dry, shallow erosion channel leading from SWMU 10. Sample 38-2 was collected just below another dry, steep channel that also appeared to be a discharge from SWMU 10. The sediment was a brown, silty clay. Sample 38-3 was collected from a shallow gully leading from an area of exposed concrete within SWMU 10. Sample 38-4 was collected approximately 100 feet downgradient from SWMU 10 in an area of high sediment deposition. At this location, clay was found at less than 1 inch below the surface and the sample had a strong petroleum odor. SVOCs detected in the sediment appear to be localized to the portion of the drainage ditch that borders SWMU 10. This suggests that SWMU 10 may possibly be the source for

contaminants present in this portion of the drainage ditch. Sample results from SWMU 38 are summarized in Table 8-4.

Samples with the highest contaminant concentrations were associated with the discharge channels leading from SWMU 10. At least 16 SVOCs (mostly PAHs) were detected at sample locations 38-1 and 38-3. Most of these exceeded their RCs and SSVs. Lead, arsenic, and nickel concentrations were moderately elevated at these sample locations. However, at location 38-4, collected downgradient of SWMU 10, all concentrations were reduced.

*Exposure Characterization*

At SWMU 38-upper reach, as noted at SWMU 6, it appears that contaminants from upper portions of the drainage ditch system are isolated and are not being transported downgradient. Elevated concentrations were observed at individual locations and no spatial trend was obvious. Down-gradient transport of contamination does not appear to be a concern within this portion of the drainage ditch.

Again, the ditch at SWMU 38-upper reach does not appear to be capable of supporting aquatic life and does not provide habitat to support terrestrial species. Although more woody habitat surrounds this portion of the ditch system, compared to SWMU 6, it appears to have been established recently and also has been highly disturbed. Outside of the wooded area are maintained fields and roads common to the base. The habitat and biota survey did not reveal significant used of the area by terrestrial species other than songbirds.



000167

**Table 8-4**
**Chemicals Detected in Sediment at SWMU 38 — Upper Reach**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 2/4 | 8 - 49 | ND | NA | 2/NA |
| Bromomethane | 1/4 | 2 | ND | NA | 1/NA |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Naphthalene | 1/4 | 60 | ND | 330 | 1/0 |
| Acenaphthylene | 1/4 | 93 | ND | 330 | 1/0 |
| Acenaphthene | 2/4 | 310 - 640 | ND | 330 | 2/1 |
| Dibenzofuran | 2/4 | 150 - 270 | ND | NA | 2/NA |
| Fluorene | 2/4 | 260 - 510 | ND | 330 | 2/1 |
| Phenanthrene | 2/4 | 1,800 - 1,900 | ND | 330 | 2/2 |
| Anthracene | 2/4 | 400 - 470 | ND | 330 | 2/2 |
| Carbazole | 1/4 | 340 | ND | NA | 1/NA |
| Fluoranthene | 3/4 | 330 - 4,700 | ND | 330 | 3/3 |
| Pyrene | 3/4 | 260 - 4,700 | ND | 330 | 3/2 |
| Butylbenzylphthalate | 1/4 | 380 | ND | NA | 1/NA |
| Benzo(a)anthracene | 2/4 | 1,900 - 3,200 | ND | 330 | 2/2 |
| Chrysene | 2/4 | 2,100 - 3,600 | ND | 330 | 2/2 |
| Bis(2-ethylhexyl)phthalate | 2/4 | 410 - 630 | 134 | 182 | 2/2 |
| Benzo(b)fluoranthene | 2/4 | 1,900 - 5,000 | ND | NA | 2/NA |
| Benzo(k)fluoranthene | 2/4 | 1,600 - 2,100 | ND | NA | 2/NA |
| Benzo(a)pyrene | 2/4 | 1,700 - 3,900 | ND | 330 | 2/2 |
| Indeno(1,2,3-cd)pyrene | 2/4 | 730 - 1,500 | ND | NA | 2/NA |
| Benzo(g,h,i)perylene | 2/4 | 630 - 1,400 | ND | NA | 2/NA |
| Dibenz(a,h)anthracene | 2/4 | 350 - 630 | ND | 330 | 2/2 |



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**Table 8-4**
**Chemicals Detected in Sediment at SWMU 38 — Upper Reach**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | |
| Arsenic | 4/4 | 6.8-18.3 | 83.6 | 7.24 | 0/3 |
| Barium | 4/4 | 102-233 | 638 | NA | 0/NA |
| Cadmium | 3/4 | 0.83-1.3 | 3.8 | 1 | 0/2 |
| Chromium | 4/4 | 10.3-19.9 | 45 | 52.3 | 0/0 |
| Cobalt | 4/4 | 6-18.3 | 93 | NA | 0/NA |
| Copper | 4/4 | 14.5-22.4 | 67.4 | 18.7 | 0/1 |
| Lead | 4/4 | 18.7-73 | 188 | 30.2 | 0/2 |
| Mercury | 2/4 | 0.16-0.2 | ND | 0.13 | 2/2 |
| Nickel | 4/4 | 14.1-22.9 | 116.4 | 15.9 | 0/3 |
| Vanadium | 4/4 | 19.2-33.8 | 166.4 | NA | 0/NA |
| Thallium | 1/4 | 0.57 | ND | NA | 1/NA |
| Zinc | 4/4 | 47.8-85.4 | 155.8 | 124 | 0/0 |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Dieldrin | 4/4 | 12-220 | 240 | 3.3 | 0/4 |
| 4-4'-DDE | 3/4 | 70-95 | ND | 3.3 | 3/3 |
| 4-4'-DDD | 4/4 | 11-460 | ND | 3.3 | 4/4 |
| 4-4'-DDT | 3/4 | 47-180 | ND | 3.3 | 4/4 |
| MCPA | 1/4 | 5,100 | 22,000 | NA | 0/NA |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-GRO | 1/4 | 0.067 | ND | NA | 1/NA |
| TPH-DRO | 3/4 | 11-82 | ND | NA | 3/NA |
| TPH (418.1) | 2/4 | 360-420 | ND | NA | 2/NA |



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### 8.3.5 SWMU 38-lower reach (North Fork Creek Area)

*Site History*

SWMU 38-lower reach consists of miscellaneous ditches which drain the industrial areas in the northern portion, and a small part of the southern portion, of the base. The open drainage ditch constituting SWMU 38-lower reach, flows to the southwest where it discharges into North Fork Creek. SWMU 38-lower reach accepts drainage from up-gradient SWMUs 38-upper reach, 6, 4, and 31. Also, surface-water runoff and numerous other outfalls from the north side of the base ultimately discharge into SWMU 38-lower reach.

*Sample Results*

Sample locations 38-5, 38-6, and 38-8 were grouped together as SWMU 38-lower reach, because they received runoff from all upstream sections of the drainage system and are proximal to North Fork Creek. Samples were collected either within the drainage ditch just upstream of North Fork Creek, or within the creek proper. North Fork Creek flows southerly. The sample location in North Fork Creek (38-8) was downstream of the confluence with the drainage system.

Sample 38-5 was collected in an area of hard clay that appeared heavily eroded. Sample 38-6 was collected in the ditch about 100 feet upstream of the confluence with North Fork Creek. The sediment matrix was sandy and appeared to have been recently deposited. Sample 38-8 was also collected in North Fork Creek, below the confluence and below the Navy Road crossing. Construction debris (concrete, rebar, and asphalt) was present in this sampling location. Sample results for SWMU 38-lower reach are shown in Table 8-5.

Within the drainage ditch system at SWMU 38-lower reach SVOC and metal concentrations were similar to those observed throughout other portions of the system. Most contaminants detected in samples 38-5 and 38-6 were below RCs, and, of the metals detected, concentrations



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above SSVs were not significantly high. Fifteen SVOCs, all above their RCs, and some above SSVs, were detected in sample 38-8. Antimony exceeded its RC and SSV, and six other metals exceeded their SSVs.

### *Exposure Characterization*

Sample results do not indicate movement of contaminants within the lower reach of the SWMU 38 drainage ditch. No spatial trend was observed and it is suspected that elevated PAH levels within North Fork Creek sediments are a result of surface runoff from proximal Navy Road.

The portion of SWMU 38-lower reach near sample 38-5, prior to the confluence with North Fork Creek, does not appear to be readily accessible to terrestrial vertebrate species and does not appear to provide cover for animals that may live in the area. North of the drainage ditch, near sample location 38-6, is an extensive wooded area. This area appears capable of supporting terrestrial species which could potentially use the drainage ditch and North Fork Creek as a food and water source. North Fork Creek, is bordered to the west by commercial development along Navy Road. To the east of North Fork Creek is an extensive wooded area. North Fork Creek and the lower reaches of the drainage ditch may support aquatic life and benthic species.

**Table 8-5**
**Chemicals Detected in Sediment at the SWMU 38-Lower Reach**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 2/3 | 5-33 | 26 | NA | 1/NA |
| Bromomethane | 1/3 | 2 | ND | NA | 0/NA |



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**Table 8-5**
**Chemicals Detected in Sediment at the SWMU 38-Lower Reach**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Acenaphthylene | 1/3 | 84 | ND | 330 | 1/0 |
| Fluorene | 1/3 | 76 | ND | 330 | 1/0 |
| Phenanthrene | 2/3 | 83-1,200 | ND | 330 | 2/1 |
| Anthracene | 1/3 | 250 | ND | 330 | 1/0 |
| Fluoranthene | 3/3 | 89-1,800 | 84 | NA | 3/NA |
| Pyrene | 3/3 | 78-1,200 | ND | 330 | 3/1 |
| Butylbenzylphthalate | 1/3 | 110 | ND | NA | 1/NA |
| Benzo(a)anthracene | 3/3 | 52-690 | ND | 330 | 1/1 |
| Chrysene | 3/3 | 56-660 | ND | 330 | 3/1 |
| Bis(2-ethylhexyl)phthalate | 2/3 | 46-130 | 184 | NA | 0/NA |
| Benzo(b)fluoranthene | 2/3 | 170-600 | ND | NA | 2/NA |
| Benzo(k)fluoranthene | 2/3 | 88-400 | ND | NA | 2/NA |
| Benzo(a)pyrene | 3/3 | 52-610 | ND | 330 | 3/1 |
| Indeno(1,2,3-cd)pyrene | 2/3 | 110-380 | ND | NA | 2/NA |
| Dibenz(a,h)anthracene | 1/3 | 130 | ND | 330 | 1/0 |
| Benzo(g,h,i)perylene | 2/3 | 140-410 | ND | NA | 1/NA |
| **Metals (mg/kg)** | | | | | |
| Antimony | 1/3 | 14 | ND | 12 | 1/1 |
| Arsenic | 3/3 | 11.7-31.9 | 9.6 | 7.24 | 0/3 |
| Barium | 3/3 | 209-550 | 222 | NA | 2/NA |
| Cadmium | 3/3 | 1.9-3.4 | ND | 1 | 3/3 |
| Chromium | 3/3 | 17.7-21.2 | 11 | 52.3 | 3/0 |
| Cobalt | 3/3 | 16.4-33.4 | 14.8 | NA | 3/NA |
| Copper | 3/3 | 18.2-20.4 | 21.2 | 18.7 | 0/2 |
| Lead | 3/3 | 28.5-54.6 | 25.2 | 30.2 | 3/2 |



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**Table 8-5**
**Chemicals Detected in Sediment at the SWMU 38-Lower Reach**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | |
| Mercury | 1/3 | 0.24 | ND | 0.13 | 1/1 |
| Nickel | 3/3 | 20.4-28.2 | 16.2 | 15.9 | 3/3 |
| Vanadium | 3/3 | 25.3-51.6 | 26.4 | NA | 2/NA |
| Zinc | 3/3 | 46.0-59.8 | 43.0 | 124 | 3/0 |
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Aldrin | 1/3 | 3.4 | ND | NA | 1/NA |
| Dieldrin | 3/3 | 24-42 | ND | 3.3 | 0/3 |
| 4-4'-DDE | 2/3 | 6.8-10 | ND | 3.3 | 2/2 |
| 4-4'-DDD | 3/3 | 9.3-66 | ND | 3.3 | 3/3 |
| 4-4'-DDT | 2/3 | 8.6-13 | ND | 3.3 | 2/2 |
| MCPP | 1/3 | 5,200 | ND | NA | 1/NA |
| 2,4,5-T | 1/3 | 6.0 | ND | NA | 0/NA |
| Dicamba | 1/3 | 7.2 | ND | NA | 1/NA |
| Aroclor-1260 | 1/3 | 110 | ND | 33 | 1/1 |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-GRO | 0/3 | ND | 0.146 | NA | 0/NA |
| TPH-DRO | 1/3 | 21 | 16 | NA | 1/NA |
| TPH (418.1) | 3/3 | 170-190 | ND | NA | 3/NA |

### 8.3.6 Downgradient Sample in North Fork Creek

An additional sediment sample (NFC-1) was collected from North Fork Creek on May 2, 1996. The sample was collected about 600 feet downgradient from sample 38-8. Only the upper interval (0-6 inch) portion of the sample is considered for risk. This area of North Fork Creek may be impacted by numerous off-base sources which were noted during the field reconnaissance



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prior to the sampling event (Appendix C). The disturbed nature of the area will likely preclude the establishment of viable aquatic habitat in this area.

Two SVOCs were detected at NFC-1, neither had applicable SSVs for comparison purposes (Table 8-6). Three pesticides were also detected, and only 4,4'DDE exceeded its SSV. Except for cadmium, all metal concentrations were below their respective RCs and SSVs. The cadmium concentration (14.2 mg/kg) was significantly elevated above the SSV. Cadmium was not detected in the upstream station (38-7) which is being considered as a reference for the creek, and concentrations observed at 38-8 were not nearly as elevated as those detected at this station.

**Table 8-6**
**Chemicals Detected in Sediment in Downgradient North Fork Creek**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Volatile Organic Compounds (μg/kg)** | | | | | |
| Acetone | 1/1 | 26 | ND | NA | 1/NA |
| **Semivolatile Organic Compounds (μg/kg)** | | | | | |
| Di-N-Butylphthalate | 1/1 | 48 J | ND | NA | 1/NA |
| Butylbenzylphthalate | 1/1 | 510 | ND | NA | 1/NA |
| **Metals (mg/kg)** | | | | | |
| Arsenic | 1/1 | 5.4 | 9.6 | 7.24 | 0/0 |
| Barium | 1/1 | 115 | 222 | NA | 0/NA |
| Cadmium | 1/1 | 14.2 | ND | 1 | 1/1 |
| Chromium | 1/1 | 8.8 | 11.0 | 52.3 | 0/0 |
| Cobalt | 1/1 | 9.1 | 14.8 | NA | 0/NA |
| Copper | 1/1 | 11.9 | 21.2 | 18.7 | 0/0 |
| Lead | 1/1 | 14.8 | 25.2 | 30.2 | 0/0 |
| Nickel | 1/1 | 14.3 | 16.2 | 15.9 | 0/0 |
| Vanadium | 1/1 | 17.6 | 26.4 | NA | 0/NA |
| Zinc | 1/1 | 35.4 | 43.0 | 124 | 0/0 |



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**Table 8-6**
**Chemicals Detected in Sediment in Downgradient North Fork Creek**

| Chemical Name | Number of Detections/ Samples | Range | Reference Concentration (RC) | Sediment Screening Value | Number of RC/SSV Exceedances |
|---|---|---|---|---|---|
| **Pesticides/Herbicides/PCBs (μg/kg)** | | | | | |
| Aldrin | 1/1 | 2 | ND | NA | 1/NA |
| Dieldrin | 1/1 | 2.5 | ND | 3.3 | 1/0 |
| 4-4'-DDE | 1/1 | 5.2 | ND | 3.3 | 1/1 |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-DRO | 1/1 | 22 | 16 | NA | 1/NA |

## 8.4 Contaminant Sources

Sources of contamination throughout the drainage system appear to be a combination of proximal SWMUs, such as those described in Section 8.3, along with surficial runoff from streets and parking areas. Metal concentrations observed within the system may be related to past SWMU activities but an obvious relationship was not apparent. Spatial distribution of pesticides detected did not provide information on sources and it is suspected that basewide spraying operations and local agricultural activities are responsible.

Previous studies have demonstrated that runoff from highways can contribute significant concentrations of PAH and metal contamination to freshwater streams. A recent study by Maltby et al. (1995) has shown that highway runoff can be responsible for elevated concentrations of PAHs and metal in sediment, surface water, and tissue. It is suspected that highway runoff from the Navy Road bridge, where it crosses North Fork Creek, may be responsible for the elevated PAH concentrations in sediment sample 38-8. However, it is possible that the NSA drainage ditch, during high flow conditions, may also be contributing to the elevated concentrations.



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## 8.5 Risk Characterization

SVOCs, metals, pesticides, and herbicides have been detected in the drainage-ditch sediment. However, sediment contamination appears to be limited to the upper reaches of the drainage ditches and is not likely a source to North Fork Creek. Although, at some locations, contaminant concentrations in the ditches are high in comparison to RC and SSV values, the lack of suitable habitat for sediment- or surface water-dwelling organisms severely limits the potential for exposure. The habitat and biota survey revealed that flow occurred only in immediate response to precipitation and therefore the ditches cannot support aquatic life.

In addition, the drainage system provides minimal life requisites to support terrestrial species. No evidence of mammalian species in the area of the drainage ditches was noted during the habitat and biota survey. A lack of suitable habitat in the general area of the base also may account for this. Much of the base has been cleared of vegetation. Significant human activity also discourages use of the area by terrestrial species.

In contrast to the drainage ditches, North Fork Creek is a perennial stream and appears capable of supporting aquatic life. Assessment of observed concentrations within North Fork Creek are compared to a published study on PAH toxicological impacts to aquatic organisms. Maltby et al. (1995) assessed sediment and surface-water toxicity from streams near a busy highway. Their study compared samples upstream of an impact zone to downstream locations, suspected of receiving the greatest impact. The study demonstrated only a "slight" (10%) reduction in survival of the amphipod *Gammarus pulex* in downstream sediments at PAH concentrations of 500,000 to 600,000 $\mu$g/kg. These concentrations are two orders of magnitude greater than total PAH concentrations of 8,730 $\mu$g/kg found downstream (sample 38-8) in North Fork Creek.



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Maltby et al., (1995) also found that survival of *G. pulex* exposed to upstream sediments (total PAH concentrations averaging 20,000 $\mu$g/kg) averaged 96%. This suggests that although concentrations may exceed SSVs for individual PAHs, they may not be toxic to organisms exposed to North Fork Creek sediment. Other samples from the drainage ditches, (6-3 and 38-1), had PAH concentrations in the 20,000 to 22,000 $\mu$g/kg range. However, it has been shown that these drainage ditches are incapable of supporting a viable aquatic community, therefore effects resulting from PAH contamination are inconsequential.

Maltby et al., (1995) also concluded that body burdens concentrations were not associated with elevated PAH sediment concentrations. This suggests that food-chain transfer of PAHs may not be of concern. The study also showed that ambient water, both upstream and downstream in the stream, were not acutely toxic. Thus, partitioning of PAHs from sediment to surface water should not be a concern when evaluating impacts to aquatic biota.

The lack of toxic effects by PAHs as presented in Maltby et al., (1995), suggests that applicability of SSVs for PAHs may be inappropriate. If only "slight" toxic effects were observed in sediments at concentrations of 500,000 to 600,000 $\mu$g/kg, then SSVs near 330 $\mu$g/kg for individual PAHs may be overly conservative.

## 8.6 Uncertainty

- Sediment samples collected are representative of a small area of the drainage ditches.

- Differences were noted between some of the samples and their duplicates, suggesting that errors may have resulted from field collection methods or during sample analysis, or may be a product of field variability.



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- Synergistic and/or antagonistic relationships among contaminants were not accounted for.
- A lack of criteria or screening values for many chemicals compounds the uncertainty for screening-level assessments.
- Toxicological effects studies may be different at individual versus community levels.
- Extrapolation of literature-generated effects levels to onsite species and communities does not account for site-specific conditions.
- Exceedance of SSVs indicates that a potential ecological impact to sensitive aquatic life species may be present.
- SSVs exist for only a limited number of contaminants, but were used whenever possible.

## 8.7 Recommendation

Based on the above information, it is recommended that no further study be conducted on the drainage ditches and North Fork Creek from an ecological perspective. Concentrations do not appear to represent a single source and runoff characteristics across the area most likely will remain the same. The best remedial action would be no action and let the contamination present in the sediment naturally attenuate.

Additional sediment/soil samples were collected from the surface of the landfill and within the gullies leading from the landfill during a confirmatory sampling investigation (CSI) conducted at SWMU 10 in May 1996. The results for these samples will be reported in the SWMU 10 CSI Report which is currently being prepared.



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## 9.0 CONTAMINANT FATE AND TRANSPORT

Previous sections of this report have documented sediment contamination in the drainage ditches. The evaluation of contaminant fate and transport assesses the potential for contaminant migration in a medium and the potential for concentration reductions and/or chemical transformations during movement.

### 9.1 Source Definition

The principal sediment contaminants identified at the sites are SVOCs, pesticides, herbicides, TPH, and metals. Some compound classes identified at the sites are at relatively high concentrations with respect to RC values, RBCs, and SSVs.

The most contaminated areas are immediately downstream of outfalls and primarily contain elevated concentrations of SVOCs, pesticides, TPH, and metals. The vertical extent of contamination in most sample locations is limited to the sediment in upper 6 inches of the ditch beds. SVOCs and metals concentrations are reduced significantly in the 18- to 24-inch depth interval. However, pesticides and herbicides were detected in relatively high concentrations at some sample locations at depths of 18 to 24 inches.

Several metals were detected at concentrations greater than their respective RBCs in sediment from the 0- to 6-inch depth interval. However, most concentrations were less than their RBCs, but exceeded SSVs. Sediment from depths of 18 to 24 inches was found to contain metals in concentrations greater than the background RC, but still below RBCs and in most cases below SSVs.

Dieldrin was the only pesticide compound detected as exceeding its RBC and SSV. However, all dieldrin concentrations are within the RC established in background sample 6-6 and its duplicate. The only other pesticide detected in concentrations in excess of its RBC was DDD,



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which exceeded its RBC at sample location 6-3. Although not detected in excess of its RBC, DDT was detected at concentrations greater than its SSV in every location where it was detected. Of the remaining pesticides, none has an associated SSV.

## 9.2 Soil/Sediment Contaminant Fate and Transport

Although direct soil or sediment-exposure pathways (incidental ingestion and/or dermal contact, biotranslocation, bioaccumulation) often present the most imminent threat to human health and the environment, other related concerns exist. If soil or sediment contains sufficient quantities of contaminants, the potential exists for cross-media transfer to surface water through equilibrium partitioning. This phenomenon depends on the mass of soil/sediment contaminants present and soil/sediment physical and chemical characteristics.

The simplest and most common method for expressing the distribution of a chemical between soil/sediment surfaces is the adsorption or distribution coefficient ($K_d$). The $K_d$ is defined as:

$$K_d = K_{oc} \times f_{oc}$$

where $K_{oc}$ = Soil adsorption coefficient normalized for the soil organic-carbon content.

$f_{oc}$ = The soil organic carbon content (mg organic carbon/mg soil).

$K_d$ values indicate the mobility of a compound in soil or sediment. The higher the $K_d$ value, the lower the compound's mobility. For example, $K_d$ values for benzene have been reported to range from 0.1 to 1.0 (depending on $f_{oc}$), and $K_d$ values for pesticides (particularly DDT) have



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been reported as high as 7,700. Also, the octanol-water partition coefficient ($K_{ow}$), represents the distribution of a chemical between octanol and water in contact at equilibrium conditions.

Measured values of $K_{ow}$ are readily available in literature for most chemicals. $K_{ow}$ is related to $K_{oc}$ by the following equation:

$$K_{oc} = 0.63 \ x \ K_{ow}$$

$K_{ow}$ has been found to be related to water solubility and soil-sediment adsorption coefficients. In general, $K_{ow}$ measures the hydrophobicity of an organic compound. The more hydrophobic the contaminant is, the more likely it is to partition onto soil/sediment and to have low solubility in water.

The human health risk and hazard posed by soil/sediment contaminants in the drainage ditches were assessed using ingestion and dermal-contact pathways. The results of this assessment concluded there are no COCs related to human health risk for ditch sediments. Ecological risk and hazard were evaluated using a more subjective determination of exposure potential based on a habitat evaluation and comparison of sample results to SSVs. The following subsections evaluate the potential for impacts to surface water and sediment from organic and inorganic contaminants identified as a potential human health and ecological threat in soil or sediment.

### 9.2.1 Sediment Contaminant Fate and Transport — Organic Compounds

Fate and transport for SVOCs, pesticides, and herbicides are discussed below.

#### Semivolatile Organic Compounds

Most SVOCs analyzed for in sediment samples from the drainage ditches are a subset of PAHs, which consist of hydrogen and carbon arranged as two or more fused benzene rings. Concern about SVOCs in the environment is due to their persistence and to the fact that some are known



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to be potent mammalian carcinogens, although environmental effects of most noncarcinogenic PAHs are poorly understood. Many of the SVOCs present in sediments may experience photooxidation or biodegradation. SVOCs in the water column degrade rapidly through photooxidation. They degrade most rapidly at higher concentrations, elevated temperatures, elevated dissolved oxygen concentrations, and during higher incidences of solar radiation. The ultimate fate of SVOCs that accumulate in sediments is believed to be biotransformation and biodegradation by benthic organisms. SVOCs in aquatic sediments degrade very slowly in the absence of penetrating radiation or oxygen and may persist indefinitely in oxygen-poor basins or in anoxic sediments. PAHs in the aquatic environment degrade at a slower rate than in the atmosphere, and the cycling of SVOCs in aquatic environments, as is true for other ecological systems, is poorly understood (Eisler, 1987).

**Pesticides and Herbicides**

Hydrophobicity is a characteristic of uncharged, organic chemicals such as pesticides and herbicides. Water will tend to repel these chemicals to a less energetic phase such as mineral surfaces, sediment, or suspended particles. Hydrophobicity also generally increases as molecular weight increases. Most pesticides and herbicides are complex, heavy molecules which are more likely to bind to sediment than dissolve in water. Dieldrin and DDT, two commonly encountered contaminants in the drainage ditches, are chlorinated. Chlorine is a bulky, highly electronegative atom that tends to protect the nucleus of an organic molecule from chemical attack. By increasing stability, the breakdown rate of chlorinated compounds is reduced (Clarke and McFarland, 1991).

Other variables controlling the mobility of pesticides and herbicides in soil/sediment are their adsorbent properties. The presence of an electrical charge in the soil matrix, the soil pH, and the organic-matter content affect the adsorbent efficiency. The adsorptive coefficient $K_d$ may be used as a relative measure of soil/sediment adsorptive capacity for a particular pesticide.



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Based on a range of literature values for $K_{oc}$ and $f_{oc}$ in site sediment, the $K_d$ range for pesticides and herbicides is high enough to indicate that adsorption will be a major factor in limiting pesticide movement.

In general, pesticides and herbicides are highly hydrophobic and it is unlikely that they will persist long-term in the water column. In addition, most of these compounds are highly resistant to breakdown in the environment and so are likely to remain sediment-bound for decades. An example of this is the presence of DDT and its breakdown products detected in several locations throughout the drainage ditches. Although its use has been banned since the early 1970s, DDT remains in the sediment at concentrations above SSVs. Another example is the pesticide dieldrin, whose half life in soil has been reported to be as high as three years. Aqueous biodegradation rates tend to be dependent upon oxygen, i.e., the anaerobic half life is reported to be seven days and the aerobic half life is reported to be three years.

**PCBs**

PCBs share some of the same characteristics as chlorinated pesticides. They are extremely stable compounds that are slow to chemically degrade under environmental conditions. The greater the number of chlorine atoms and the position of the chlorine atoms on the biphenyl molecule generally increase the stability of that compound. The $K_{ow}$ for PCBs ranges from 10,000 to 20,000. PCBs are strongly adsorbed on soil, sediments, and particulates in the environment, with concentrations usually the highest in aquatic sediments containing microparticulates and high organic and clay content.

### 9.2.2 Sediment Contaminant Fate and Transport — Metals

Metals are present in all soil and sediment. Therefore, to evaluate the significance of reported concentrations in sediment, they were compared to two times background RCs (Section 6). Unlike organic compounds, metals tend not to degrade in the environment, but may change



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chemical form. They are generally considered to be indefinitely persistent. Metals may interact with soil/sediment or other solids by ion exchange, adsorption, precipitation, or complexation. These processes are affected by pH, composition, or leachate or groundwater oxidation-reduction processes, and the type and amount of organic matter, minerals, and clay present. Extreme pH and Eh (oxidation-reduction) conditions can significantly increase metal's solubility and mobility. Therefore, the availability of the metal in the medium, the composition of groundwater, and the adsorption capacity of the soil/sediment determine the fate and transport of the metal in the environment.

The derivation of $K_d$ values is much more complicated for metals than for organic compounds. Unlike organic compounds, for which $K_d$ values are largely controlled by a single parameter, $K_d$ values for metals are significantly affected by a variety of soil/sediment conditions. The number of significant influencing parameters, their variability in the field, and differences in experimental methods result in a wide range of $K_d$ values for individual metals reported in the literature (over five orders of magnitude).

Metals have limited mobility in soil/sediment because of cation exchange or sorption on the surface of mineral grains. They can also form precipitates of varying solubility under specific Eh-pH conditions. Conditions that promote mobility include an acidic, sandy soil with low organic and clay content. Surface and subsurface soil/sediment at the NSA Memphis is classified as a loess (silty clay), thus is not specifically sandy. Literature suggests that site soil is not acidic, and has a pH greater than 6. Information regarding soil type and Eh-pH relationships with metals mobility was derived from *The Soil Chemistry of Hazardous Materials*, Hazardous Materials Control Research Institute, Greenbelt, Maryland, 1988 (Dragun, 1988), unless otherwise noted. Properties of some metals of concern detected in the drainage ditches is described below.



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### *Arsenic*

Arsenic is a naturally occurring element often found in association with copper or lead. Its primary use is in pesticides and as a plant defoliant. Most arsenic compounds are white or colorless. In the environment, arsenic can exist in several oxidation states. Under oxidizing conditions, the arsenate form is the stable oxidation state, which leads to the arsenite form under transitional conditions and then arsenic (elemental arsenic) under reducing conditions. chemical and physical properties of arsenic are presented below.

| | |
|---|---|
| Molecular Weight | 74.92 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 372 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | 5.724 |

### *Barium*

Barium belongs to the alkaline earth group, resembling calcium chemically. It oxidizes very easily, and is decomposed by water or alcohol. When pure, barium is silvery white like lead. Chemical and physical properties of barium are presented below.

| | |
|---|---|
| Molecular Weight | 137.33 |
| Vapor Pressure (mm Hg @ T°C) | 10 @ 1049 |
| Solubility in $H_2O$ (mg/L) | hydrolyzes |
| Specific Gravity | 3.6 |



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### *Beryllium*

Beryllium is used as an alloying agent in producing beryllium copper, and is widely used as a structural material for aircraft. At ordinary temperatures beryllium resists oxidation in air. Most of the metal now is prepared by reducing beryllium fluoride with magnesium metal. Chemical and physical properties of beryllium are as follows:

| | |
|---|---|
| Molecular Weight | 9.01 |
| Vapor Pressure (mm Hg @ T°C) | 0 (estimated) |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | 1.85 |

### *Cadmium*

Almost all cadmium is obtained as a by-product in the treatment of zinc, copper, and lead ores and is similar in many respects to zinc. Cadmium is used extensively in electroplating. It is also used in many types of solder and for nickel-cadmium batteries. Cadmium exists in an aqueous phase in the +2 valence state, and exists in insoluble forms over a redox range of -0.5 to 0.75 at a pH greater than 8. Chemical and physical properties of cadmium are presented below.

| | |
|---|---|
| Molecular Weight | 112.41 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 393 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | 8.64 |



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### *Chromium*

Chromium also is used extensively in electroplating. Chromium exists in an aqueous phase in the +3 valence state, and exists in insoluble forms over a redox range of about -0.5 to 0.75 at a pH greater than 5. Chemical and physical properties of chromium are as follows:

| | |
|---|---|
| Molecular Weight | 52.00 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 1616 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | not listed |

### *Lead*

Commercial uses for lead include solder, vehicle batteries, gasoline additive (no longer used), and in alloys. In the environment, lead is adsorbed to soil particles and found as a sulfate ($PbSO_4$), carbonate ($PbCO_3$), or sulfide (PbS), with oxides becoming important when pH exceeds 11. In oxidizing to transitional environments containing carbonate, aqueous lead concentrations are controlled by the solubility of $PbCO_3$, which results in low mobility. Likewise, under reducing conditions in the presence of sulfur, PbS is nearly insoluble and lead mobility is very low. The mobility of lead will be kept quite low due to its high affinity for adsorption sites on organic and inorganic surfaces. Chemical and physical properties of lead are presented below.

| | |
|---|---|
| Molecular Weight | 207.20 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 970 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | 11.34 |



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### *Nickel*

Nickel is also used extensively in electroplating and is also used for nickel-cadmium batteries. Nickel exists in an aqueous phase in the +2 valence state, and exists in insoluble forms over a redox range of about -0.25 to 0.80 at a pH less than about 8. Chemical and physical properties of nickel are presented below.

| | |
|---|---|
| Molecular Weight | 58.69 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 1800 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | not listed |

### *Vanadium*

Vanadium is found in phosphate rock and certain iron ores, and is present in some crude oils as organic complexes. Vanadium is used in producing rust-resistant, spring, and high-speed tool steel. It is an important carbide stabilizer in making steel. The mobility of vanadium in the soil/water system is primarily governed by the pH and oxidation state. Vanadium remains mobile at a pH less than 7 as $V^{+2}$, $V^{+3}$, and $VO^{+2}$ over an Eh range of -1 to 1. Chemical and physical properties of vanadium are as follows:

| | |
|---|---|
| Molecular Weight | 50.94 |
| Vapor Pressure (mm Hg @ T°C) | 0 (estimated) |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | 6.11 |



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*Zinc*

Zinc is a naturally occurring metal that is generally present in carbonate, oxide, or sulfide minerals. Under oxidizing to transitional conditions at neutral to slightly alkaline pH, $ZnCO_3$ is the stable solid phase in the presence of carbonate, while above a pH of about 8 ZnO becomes increasingly stable. Reducing conditions stabilize ZnS over a pH range of about 3 to 14. Below a pH of about 7, zinc is mobilized under oxidizing conditions as $ZN^{2+}$ or, occasionally, as carbonate complexes. Chemical and physical properties of zinc are presented below.

| | |
|---|---|
| Molecular Weight | 65.38 |
| Vapor Pressure (mm Hg @ T°C) | 1 @ 487 |
| Solubility in $H_2O$ (mg/L) | insoluble |
| Specific Gravity | not listed |

## 9.3 Conclusions

SVOCs, pesticides, herbicides, PCBs, and metals detected in sediment samples from the ditches appear to be tightly bound to the clayey sediments and have a low migration potential. In addition to having a low migration potential, these constituents are not likely to be dissolved in the water column and transferred via surface water into North Fork Creek.

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## 10.0 CONCLUSIONS AND RECOMMENDATIONS

Based on information gathered during this RFI, the following conclusions and recommendations have been reached.

- Sediment contaminants consisting of VOCs, SVOCs, TPH, metals, pesticides, and herbicides have been identified throughout the drainage ditches and in North Fork Creek. The contamination appears related to the discharge of petroleum based on the elevated concentrations of SVOCs, metals, and TPH detected. Analytical data indicate the vertical extent of this contamination is mostly limited to the ditch bed sediments in the uppermost 6 inches, and the lateral extent is primarily limited to immediate points of discharge. It is unclear whether contamination detected at the water line in the SWMU 38 ditch immediately downstream of the dry gullies that drain SWMU 10 is a result of deposition from upstream sources or runoff or leachate from SWMU 10. Additional soil/sediment samples were collected both from the surface of the landfill and within the gullies leading from the landfill during a confirmatory sampling investigation (CSI) conducted at SWMU 10 in May 1996. The results of these samples will be reported in the SWMU 10 CSI Report which is currently being prepared. The pesticides dieldrin and DDT were ubiquitous in sediment in the drainage ditches. Concentrations of these pesticides were within the range detected in background samples and were likely associated with aerial applications during the 1950s and 1960s by the USDA to control the spread of the white-fringed beetle, along with other application programs.

- For human health risk, a BRA was prepared. The risk and hazard posed by sediment contaminants in the drainage ditches was assessed using two exposure scenarios: the hypothetical reasonable maximum exposure of site workers and the hypothetical reasonable maximum exposure child (adolescent) trespasser scenario. Incidental ingestion and dermal contact exposure pathways were used to address potential future sediment



000192

exposure. COCs were identified for various exposure scenarios to determine whether they exceed an excess cancer risk of 1E-4 or a hazard index of 1. As shown on Table 7-27 in Section 7, no COCs exceeded these thresholds, thus negating the necessity of calculating remedial goal options for the Northside Industrial Drainage Ditches. Based on the BRA, the property comprising the Northside Industrial Drainage Ditches is suitable for lease in either industrial or residential scenarios.

- Risks to ecological receptors resulting from contaminants identified within the drainage system is low. Although most inorganic compound concentrations were above USEPA Region IV SSVs, a higher percentage were below the RC. Total PAH concentrations across the site were relatively high compared to SSVs, but when referenced field-toxicity studies were reviewed, it appears that SSV levels for PAHs may be overly conservative. The lack of a viable benthic or aquatic community within the drainage system further reduces the risk potential. Based on the ERA, no further investigation is recommended for the drainage ditches or North Fork Creek from an ecological perspective. Contaminant concentrations do not appear to represent a single source and runoff characteristics across the area most likely will remain the same. The ERA concluded that the best remedial action would be no action and allow any sediment contamination to naturally attenuate.

- Contaminant fate and transport was evaluated to assess the potential for contaminant migration in sediment and the potential for concentration reductions and/or chemical transformations during movement. Fate and transport evaluation concluded that the SVOCs, pesticides, herbicides, PCBs, and metals detected in sediment have a low migration potential as they appear to tightly bind to clayey sediments, and are not likely to be dissolved in the water column and transferred to North Fork Creek.



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The following recommendation is presented based on the findings of this RFI:

- Based on the BRA, ERA, and an evaluation of contaminant fate and transport, no further action is recommended for the Northside Industrial Drainage Ditches.



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900195

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000291

# Appendix A

## Sampling Report — NSA Memphis

## Interim Measures Field and Analytical Summary for SWMUs 4 and 5

# SAMPLING REPORT - NAVAL AIR STATION MEMPHIS

MILLINGTON, TENNESSEE

Prepared by

Southern Division
Naval Facilities Engineering Command

11 August 1988

Prepared by:

Robert W. Moser, PE

Reviewed by:

James Malone, PE

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LIST OF FOOTNOTE REFERENCES


(1) 100% ADDITIONAL SAMPLING REPORT - NAS MEMPHIS (NORTHSIDE STORM DRAIN) Prepared by Environmental & Safety Designs, Inc. August 9, 1988

(2) INITIAL ASSESSMENT STUDY OF NAVAL AIR STATION MEMPHIS, MILLINGTON, TENNESSE, NEESA 13-038, NOVEMBER 1983




000234

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APPENDIX C BORING LOGS OF SALVAGE YARD

000295

Currently there is not a facility of this type for a Navy aircraft crash and salvage crew to train under live fire conditions. This project was developed from the findings of the investigation into the problems associated with extinguishing the catastrophic fire onboard the USS NIMITZ. Investigators discovered that the current level of training for aircraft crash crews was inadequate because no facility exist where an aircraft crash crew can receive live fire training. This project will enable a team to receive live firefighting training with the unique hazards associated with shipboard aircraft firefighting. This team training will develop confidence in the crew's ability to extinguish large, complex shipboard aircraft deck fires, thus potentially saving thousands of lives aboard our ships.

## 3.0 SAMPLING RATIONALE

"The sampling target for site 1 was to sample soils surrounding the storm sewer at all defective joints. An internal inspection of the sewer was performed by Industrial Clean-up Inc. (ICI) and all suspect joints were marked and recorded (Table 1). Photographs of the joints are located in Appendix A. All joint locations were then transposed to the ground surface measured from the outfall. Sampling was performed by drilling to depths of 0-1 feet, 1-3 feet, and 3-5 feet below the pipe's invert. Two additional borings were taken at the entrance and exit of the storm sewer at the same depth interval as the defective joints. One final sample was taken from the sediment that had collected within the system. All of the 0-1 foot samples were analyzed for EP Toxicity Metals (EPA METHOD SW-846) and Total Cyanide." 1

"Site 2, the salvage yard, was visually inspected and monitored using a hNu photoionization detector. The visual inspection of the property indicated widespread discoloration of surface soils on the site. Consequently, three composite samples were collected from areas that showed staining or discoloration on the surface. An organic vapor background concentration of 0.1 ppm was established using the hNu and at sampling location SY1 there was a slight deflection to 0.3ppm. Sample locations SY2 and SY3 were determined by staining only. Composite samples were collected at each of these locations from depths of 0-1 feet, 1-3 feet, and 3-5 feet below the surface. Samples collected from the 0-1, and 1-3 foot level were analyzed for Total Petroleum Hydrocarbons and Total Lead." 1 Samples collected from the 1-3 foot level were also analyzed for EP Toxicity Lead and BTX.

During the field investigation site 2 was found to be covered with a good growth of grass. The grass had to be cut so that the salvage yard could be visually inspected. Asphalt was detected at the surface of the salvage yard and appeared to be fine millings. The boring logs are provided in appendix C.

"The sampling target for site 3 was the joint nearest the storm sewer manhole as shown on the attached location map (Figure 1). A composite sample was taken from a boring at depths 0-1 foot, 1-3 feet, and 3-5 feet below the pipe's invert. The storm sewer samples (from the 0-1 feet below the invert) were also analyzed for EP Toxicity Metals and Total Cyanide." 1



000206

TABLE 1
SAMPLE DESIGNATION
AND JOINT LOCATIONS

| SUSPECT JOINT NUMBER | FEET FROM OUTFALL | SAMPLE DESIGNATION |
|---|---|---|
| 2 | 8 | A |
| 3 | 12 | B |
| 9 | 36 | C |
| 13 | 52 | D |
| 18 | 72 | E |
| 20 | 80 | F |
| 25 | 100 | G |
| 32 | 128 | H |
| 40 | 160 | I |
| 45 | 180 | J |
| 53 | 212 | K |
| 61 | 244 | L |
| 70 | 280 | M |
| 77 | 308 | N |
| 85 | 340 | O |
| 89 | 356 | P |
| 95 | 380 | Q |
| 110 | 440 | R |
| 125 | 500 | S |
| 132 | 528 | T |
| 140 | 560 | U |
| 145 | 580 | V |
| 148 | 592 | W |
| 158 | 632 | X |
| 164 | 656 | Y |

## 1.0 INTRODUCTION

"Environmental and Safety Designs (EnSafe) was contracted by Southern Division Naval Facilities Engineering Command to investigate certain uncontroled hazardous waste disposal sites located at Naval Air Station (NAS) Memphis. The investigation was designed to identify possible contamination at the following Navy locations:

Site 1.) Soils adjacent to a 60" RCP (4' sections) storm sewer from its outfall and continuing upstream a distance of 660 linear feet. The site received approximately 17,000 gallons/day of cyanide electroplating waste daily from the fifties to the seventies.

Site 2.) An outside storage yard which stored lead acid batteries and gasoline, and;

Site 3.) An area adjacent to an existing storm sewer manhole located immediately west of 7th Avenue and south Casablanca street, near the former electroplating shop. The location of these site is shown on Figure 1." 1

The investigation was conducted in order to determine the proper handling of any contaminated soils within the limits of the Navy's Military Construction (MILCON) Project No. 283, SHIPBOARD AIRCRAFT CRASH CREW LIVE FIRE TRAINING FACILITY. The location of this facility and the location of the sites investigated are shown on Figure 1.

Sites 1, 2, and 3 are solid waste management units (SWMU) that have been identified in the Hazardous Solid Waste Amendments Permit No. TN 002, dated 15 September 1986. Site 1 of this report is SWMU site 4 - N-121 Plating Shop Ditch. Site 2 of this report is SWMU site 40 -Salvage Yard No. 1. Site 3 of this report is associated with SWMU site 3 - N-121 Plating Shop Dry well. A RCRA Facility Investigation Work Plan was submitted to both the state of Tennessee and EPA region IV in April 1987. We have been waiting for EPA's comments on the work plan since then. In June of 1988 we could not wait any longer, so we proceeded to investigate the three sites. If we can not award the below MILCON project this September 1988, we could lose the project.

## 2.0 MILCON PROJECT NO. 283

This project's primary facility consists of a concrete simulated flight deck for aircraft crash and rescue crew firefighting training. The primary facility will be underlined with a 40 mil impervious material. Support facilities will include an asphalt road which will circle the primary facility.



000208

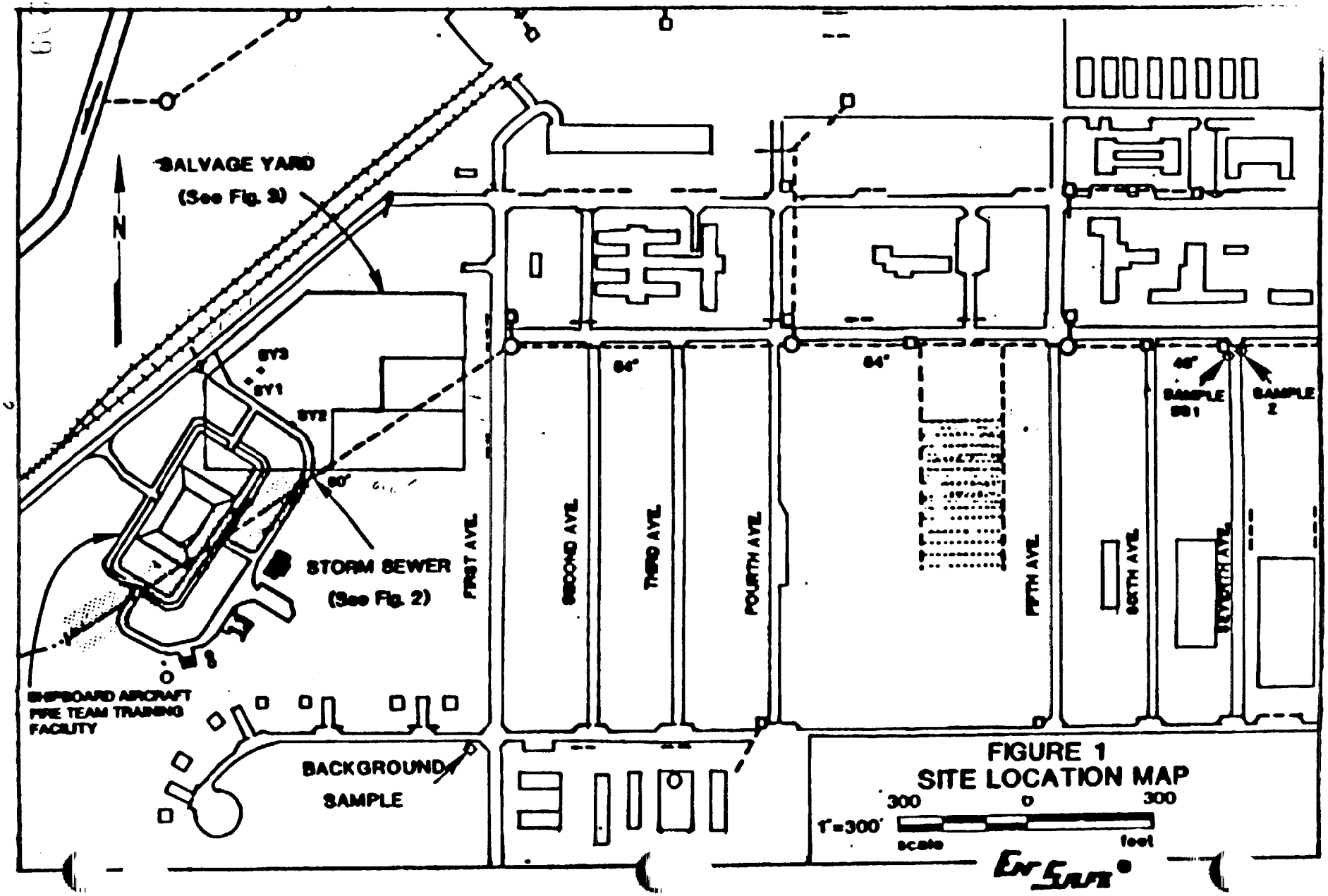



FIGURE 1
SITE LOCATION MAP

"Two additional samples were collected for "background" (BKG and BKGD2). The background samples were analyzed for EP Toxicity Metals, Total Cyanide, Total Petroleum Hydrocarbons and Total Lead for reference criteria for all samples. The samples collected for BKG were analyzed at the 7-8, 8-10, and 10-12 foot intervals. BKGD2 samples were collected at the 0-1, 1-3, and 3-5 foot intervals; however, only the 1-3 foot sample was analyzed for the aforementioned parameters." 1 In addition to the aforementioned parameters, the 1-3 foot sample was analyzed for BTX.

## 3.1 SAMPLING PROCEDURE

"The drilling operations for the sampling were conducted in an orderly and systematic manner in order to optimize the location of each boring. Soil samples were taken through the annulus of a hollow stem auger by driving a twenty-four inch split-spoon sampler. Upon withdrawal of the sampler, a composite sample was collected and placed in a labeled one quart wide mouth jar, covered with an aluminum foil seal, and capped." 1

"To prevent cross contamination the split spoon sampler was decontaminated between samples. Decontamination followed a three step process: 1) wash in a dilute HCL solution; 2) rinse in clean tap water; and, 3) rinse in distilled water. Also all personnel handling the sampler wore latex surgical gloves which were discarded between each sample. To prevent cross-contamination, all equipment: spatulas, sample jars, etc., as well as work gloves worn by workers were also decontaminated between samples." 1

## 3.2 CUSTODY PROCEDURES

"To assure the samples were maintained in a safe and reliable manner, a strict chain of custody procedure was followed. This was implemented in the field and carried throughout the analytical process. All parties handling the samples signed the chain-of-custody form which becomes a part of the permanent record." 1

## 4.0 ANALYTICAL PROCEDURES

"Soil samples were extracted by Method 1310, Extraction Procedure (EP) Toxicity Method. Samples were then analyzed by direct aspiration atomic absorption techniques, except arsenic and selenium which were analyzed by gaseous hydride methods, and mercury which was analyzed by cold vapor atomic absorption." 1

"Quality control included the analysis of one duplicate and "analytical spikes" at reporting concentrations. Triplicate spikes were performed to provide quality control data both on precision and accuracy of the analysis. Table 2 summarizes the quality control data obtained." 1

"Total Lead analyses were conducted by EPA Method 3050, Acid Digestion of Soils, and then analyzed by direct aspiration atomic absorption. Total Cyanide was analyzed by EPA Method 9010." 1 BTX was analyzed by EPA Method 8020. Total Petroleum Hydrocarbons was analyzed by Standard Method of Testing Water and Wastewater, standard 502-E.

Table 2
Quality Control Data

| Metal | Spike Conc. (mg/l) | Recovery 1 % | Recovery 2 % | Recovery 3 % |
|---|---|---|---|---|
| AS | 1.00 | 104 | 108 | 101 |
| SE | 1.00 | 104 | 108 | 94 |
| BA | 0.10 | 99 | 99 | 98 |
| CD | 0.40 | 95 | 95 | 90 |
| CR | 0.10 | 93 | 93 | 94 |
| PB | 1.00 | 109 | 94 | 94 |
| AG | 1.00 | 88 | 90 | 92 |
| HG | 0.20 | 95 | 85 | 100 |
| CN | 0.80 | 92 | 112 | - |

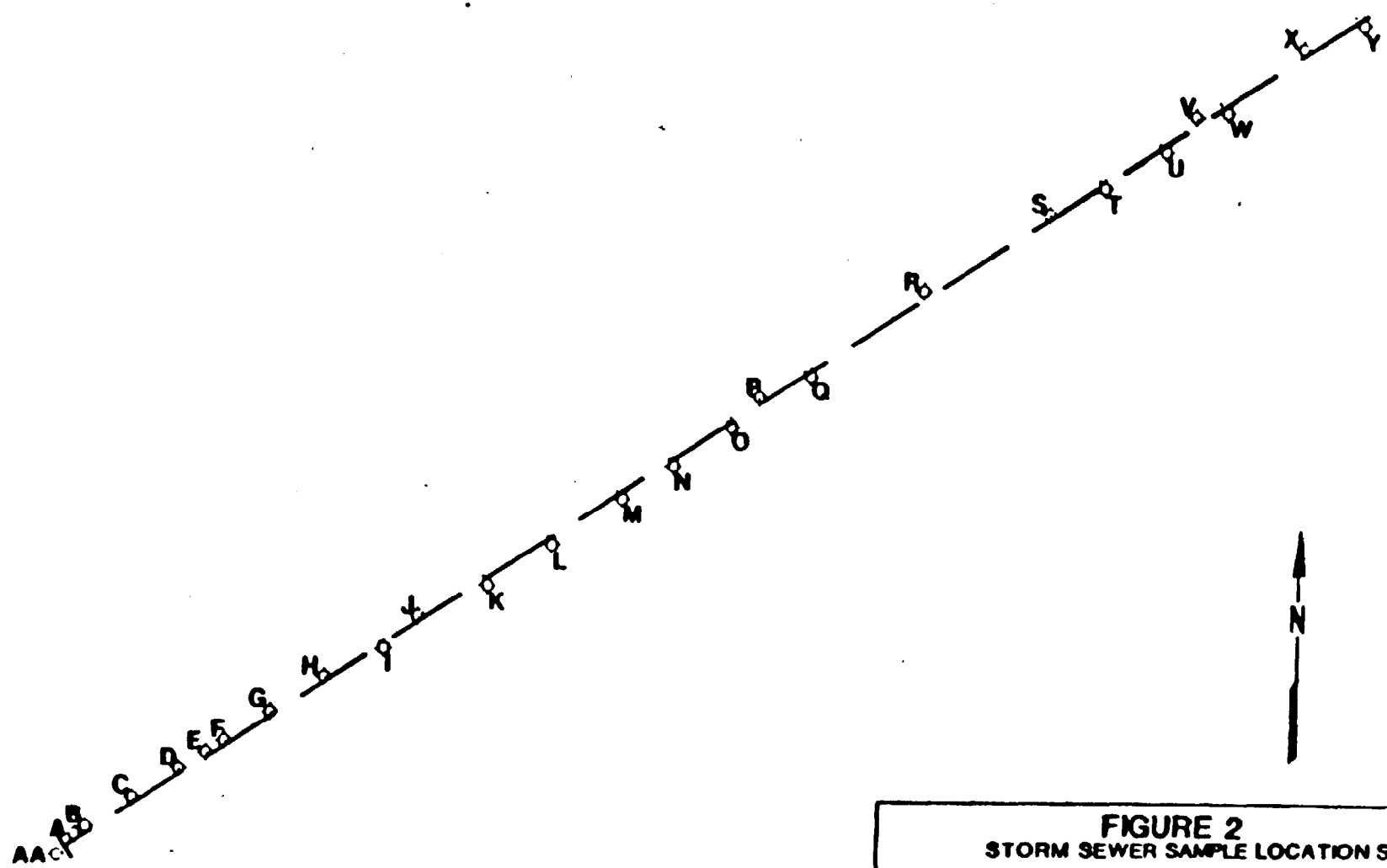



**FIGURE 2**
**STORM SEWER SAMPLE LOCATIONS**

1" = 66'

66' 0 66'
scale feet

EnSafe®

TABLE 3
ANALYTICAL RESULTS OF NAS MEMPHIS
STORM DRAIN INVESTIGATION

| SAMPLE NUMBER | EP TOXICITY AS | BA | CD | CR | PB | HG | SE | AG | TOTAL CYANIDE |
|---|---|---|---|---|---|---|---|---|---|
| | mg/l | | | | | | | | |
| A1 5-6' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| B1 5-6' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| C1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| C1 6-7'Dup | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| D1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| E1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| F1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| G1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| H1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| I1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| J1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| K1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| L1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| M1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| N1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| O1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| P1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Q1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| R1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| S1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| T1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| U1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| V1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| W1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| X1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Y1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Z1 0-1' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| AA 0-1' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Sediment | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| SS1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 8-10' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 10-12' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |

000213

## 5.0 RESULTS

### 5.1 Site 1

Twenty-eight soil samples were collected from the area corresponding with the storm sewer. Twenty-six samples collected along the course of the storm pipe are identified with an alphabetical designation from A to Y, one sample at the outfall was designated AA, and one composite sediment sample from within the drain pipe itself was labeled as "sediment". (Figure 2 shows each sample location) One additional sample was collected from the approximate entrance area to the storm sewer location and was designated as sample "Z" (Figure 1). As mentioned in section 2.0, each composite sample from 0-1 foot depth below the pipe's invert was analyzed for EP Toxicity Metals and Cyanide and results are found in Table 3. All the Site 1 samples showed no detectable levels of contamination above normal background for metals and/or cyanide. The complete laboratory results are included in Appendix B." 1

### 5.2 Site 2

"Three samples were collected from the salvage yard and were designated SY1, SY2, and SY3. Each composite sample at the 0-1 foot interval was analyzed for Total Petroleum Hydrocarbons and Total Lead. Laboratory results (Table 4) indicate the presence of high levels of hydrocarbons when referenced to the background sample. Laboratory results for composite samples collected at the 1-3 foot interval were below detectable limits. Complete laboratory results are included in Appendix B. Sample locations are shown in Figure 3." 1

Additionally, each composite sample at the 1-3 foot interval was analyzed for Total Petroleum Hydrocarbons, Total Lead, EP Toxicity Lead and BTX.

### 5.3 Site 3

"The final sample collected was adjacent to the storm sewer manhole located west of 7th Avenue and south of Casablanca. The sample, SS1, was collected by drilling to a depth of 0-1 feet, 1-3 feet, and 3-5 feet below the pipe's invert. Analytical results of the uppermost sample show no significant levels of contamination. Data for this sample is shown in Table 3 and complete laboratory results are indicated in Appendix B. Sample location is shown in Figure 1." 1

## 6.0 PHYSICAL FEATURES

### 6.1 General Ecology

The adjacent vegetation of the salvage yard is composed of hardwood/pine forest. The salvage yard ground is covered with grasses in the improved and semi-improved areas, and covered with native grasses and wild flowers in the undisturbed areas.



000214

Table 4
Data Summary for Salvage Yard
And Related Background Tests

| Sample Number | | Total Petroleum Hydrocarbons (ppm) | Total Lead |
|---|---|---|---|
| SY1 | 0-1' | 1100 | 70.3 |
| SY2 | 0-1' | 1850 | 15.7 |
| SY3 | 0-1' | 839 | 17.9 |
| SY1 | 1-3' | <1 | 7.49 |
| SY2 | 1-3' | <1 | 6.79 |
| SY3 | 1-3' | <1 | 10.0 |
| BKG2 | 1-3' | 389 | 12.3 |
| BKG | 7-8' | <1 | 4.65 |
| BKG | 8-10' | 9 | 5.20 |
| BKG | 10-12' | <1 | 4.80 |



900215

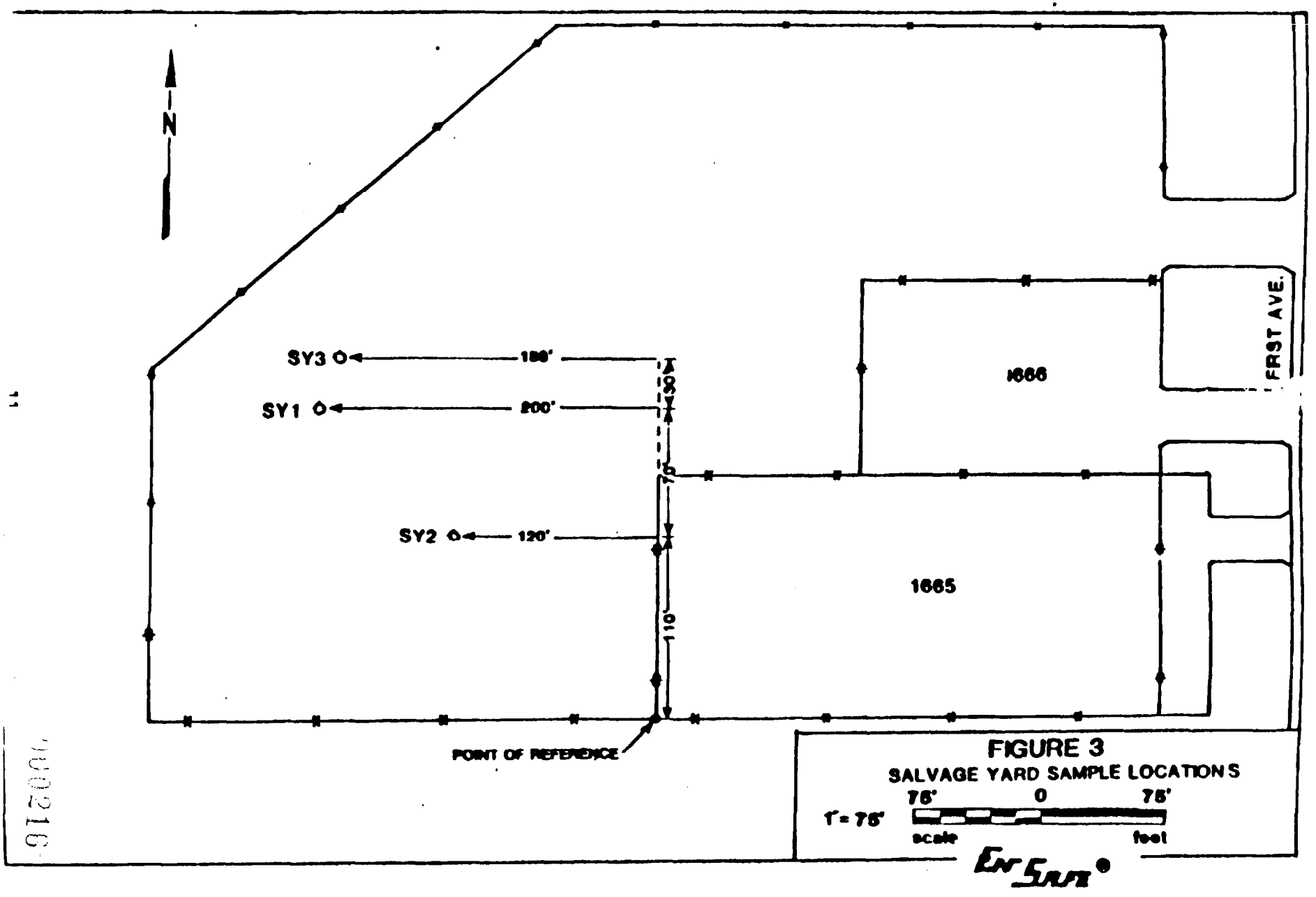



FIGURE 3
SALVAGE YARD SAMPLE LOCATIONS



100216

## 6.2 Climatology

"The climate of NAS Memphis is characterized by relative mild winters, with snow and ice occurring an average of ten times per year, and hot summers with temperatures above 90 degrees F. The average dates of the last freezing temperature, in spring and the first freezing temperature, in the fall, are 20 March and 10 November, respectively. The average annual precipitation is approximately 49 inches." 2

## 6.3 Topography

The salvage yard is relatively flat with it's elevation being approximately 273 feet above mean sea level. The salvage yard slopes from east to west at approximately 0.6 percent grade.

## 6.4 Geology

The geology of the site consists of fill materials at the surface of Pleistocene and Holocene alluvium and terrace deposits underlain by Eocene clastic sediments. Pleistocene deposits consist of alluvial sands and gravels while Holocene alluvium are composed of wind-blown silts of low permeability. The upper most units of Eocene clastic sediments, the Jackson formation, in the area of NAS consist of approximately 190 feet of gray, bluish-gray, greenish-gray, and tan clays. This is evident by the boring logs (see Appendix C) of the samples taken within the salvage yard.

## 6.5 Soils

The soils underneath the gravel and rock fragments are typical of Falaya soils. They are medium textured and appear to have locally-low infiltration rates.

## 6.6 Hydrology

The surface water flows slowly towards existing drainages along the north-west side of the site which drain into the tributary system of North Fork Creek. The salvage yard is located above the 100 year flood plain which is at elevation 257.8 feet mean sea level (MSL). The site is also above the standard project flood elevation of 260.6 feet MSL. 2

"The Memphis metropolitan area potable water sources are mostly obtained from the Memphis Sand ("500-foot sand") and the Fort Pillow sand ("1,400-foot sand"). There are small-capacity domestic wells in the Memphis area but are seldom considered due to hardness, high iron, and total dissolved solids contents." 2

## 6.7 Migration Potential

Surface water runoff has the most potential for migration since the site is underlain with clays which have been tested and found to contain no measurable Total Petroleum Hydrocarbons, BTX and EP Toxicity Lead and the hNu meter field results indicate that there is

000217

not a signif[illegible] air migration potential. However, runoff potential is lessened [illegible] the climate and topography.

The salvage yard is secured with a fence which is secured by the stations security fence. Access to the site is restricted to only base personnel.

Additional information about NAS's physical features may be obtained for the Initial Assessment Study of Naval Air Station Memphis Millington, Tennessee, NEESA 13-038 dated November 1983.

## 7.0 CONCLUSION

"The investigation at the three sites at NAS Memphis indicates that only the former salvage yard (site 2) shows positive contaminant levels in the superficial samples. Laboratory results substantiate the presence of hydrocarbons in only the 0-1 foot sampling interval. Visual inspection of the property indicates the contamination to be continuous throughout the area." 1 Although stains were found on the existing gravel, rock fragments and asphalt covered yard, the site is supporting a healthy growth of grass.

"The positive values obtained for Total Petroleum Hydrocarbons and Total Lead are probably indicative of oil and/or gasoline contamination.... Based on the levels of contamination encountered at the salvage yard and in accordance with the guidelines set forth by the Tennessee Department of Health and Environment Policy on Cleanup Levels for Gasoline and Other Petroleum Hydrocarbons, EnSafe recommends that all excavated soils from the 0-1 foot level within the salvage yard be handled in accordance with Tennessee Policy." 1

"The site location map (Figure 1) shows the aircraft training facility superimposed on the area of the storm sewer and the salvage yard. Excavation of soil ( maximum depth of 1 foot) from the project area would necessitate the removal of approximately 2000 cubic yards of soil." 1

"Due to the exorbitant cost of removal of the soils as hazardous waste, EnSafe recommends working with the Tennessee Department of Health and Environment for onsite remediation."1



000218

Based on the visual inspection of the salvage yard which found the presence of asphalt mixed in with the gravel covering and the levels of hydrocarbons encountered, the presence of vegetation, the climatology, topography, geology, soils, hydrology, migration potential, the lack of BTX constituents and EP Tox. Metals and the policy of Tennessee Department of Health and Environment on the clean up of other petroleum hydrocarbons, the Navy recommends no action for all soils 0-1 foot deep located within the salvage yard which are not to be disturbed by the MILCON project. This will allow the hydrocarbons to continue to decompose naturally. The Navy does propose to handle all excavated soils from the 0-1 foot interval of the salvage yard as either base or sub-base material for the MILCON project. By handling the soil in this manner, the material would be covered with an impervious cap and would become part of the asphalt road way. This will greatly lessen the potential for the hydrocarbon to migrate. We believe this is a viable alternative because the contaminant is similar to oils found in asphalt. One last note, the salvage yard has been a parking lot for the storage of scrap pieces of airplanes, anchor chains and cars.

To do any other remedial action, such as remove the soils as hazardous waste would only spread the Navy's liability and not remediate the Total Petroleum Hydrocarbon. Due to the known soil conditions and the presence of asphalt we ask the state of Tennessee to consider in our favor the Navy's proposed recommendations.

# APPENDIX B

# LABORATORY REPORTS

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

JUN 20 1988

CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/16/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ACLAY M. CRANE

cc/fc: ENSA/ENSA1

Page No.: 1

| Parameter | Sample ID : | F1 6-7' 06/03/88 | G1 6-7' 06/03/88 | H1 6-7' 06/02/88 | I1 6-7' 06/02/88 |
|---|---|---|---|---|---|
| | Lab ID : | 88060410 | 88060411 | 88060412 | 88060413 |
| | Sample Type : | 15 | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA | ENSA |
| CYANIDE, TOTAL | | <0.1 ppm | <0.1 ppm | <0.1 ppm | <0.1 ppm |
| ARSENIC | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES | YES | YES |

[illegible] Savage Road • Charleston, SC 29414 / P.O. Box [illegible] • Charleston, SC [illegible]
Phone: [illegible] • FAX [illegible]

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/16/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSA1

Page No.: 1

| Parameter | Sample ID : | J1 7-8' | K1 7-8' | L1 7-8' | M1 7-8' |
|---|---|---|---|---|---|
| | | 06/02/88 | 06/02/88 | 06/02/88 | 06/02/88 |
| | Lab ID : | 88060414 | 88060415 | 88060416 | 88060417 |
| | Sample Type : | 15 | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA | ENSA |
| CYANIDE, TOTAL | | <0.1 ppm | <0.1 ppm | <0.1 ppm | <0.1 ppm |
| ARSENIC | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES | YES | YES |

000222

[illegible] Road • Charleston SC 29411 / P.O. Box [illegible] • Charleston SC [illegible]

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184
Contact: MR. J. SPEAKMAN, PhD, PE

Date: 06/16/88

Released by: A.M. Crane
ALLAN M. CRANE

cc/fc: ENSA/ENSA1

Page No.: 1

| Parameter | Sample ID : | NI 7-8' 06/02/88 | OI 7-8' 06/02/88 | PI 7-8' 06/02/88 | UI 7-8' 06/02/88 |
|---|---|---|---|---|---|
| | Lab ID : | 88060418 | 88060419 | 88060420 | 88060421 |
| | Sample Type : | 15 | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA | ENSA |
| CYANIDE, TOTAL | | <0.1 ppm | <0.1 ppm | <0.1 ppm | <0.1 ppm |
| ARSENIC | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/16/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: A.M. Crane
ALLAN M. CRANE

cc/fc: ENSA/ENSA1



| Parameter | Sample ID : | V1 7-8' 06/01/88 | W1 7-8' 06/01/88 | X1 7-8' 06/01/88 | Y1 7-8' 06/01/88 |
|---|---|---|---|---|---|
| | Lab ID : | 88060426 | 88060427 | 88060428 | 88060429 |
| | Sample Type : | 15 | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA | ENSA |
| CYANIDE, TOTAL | | <0.1 ppm | <0.1 ppm | <0.1 ppm | <0.1 ppm |
| ARSENIC | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/17/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: A.M. Crane
ALLAN H. CRANE

cc/fc: ENSA/ENSA1

Page No.: 1

| Parameter | Sample ID : | STORM PIPE SEDIMENT 06/07/88 | SS1 7-8' 06/07//88 |
|---|---|---|---|
| | Lab ID : | 88060468 | 88060469 |
| | Sample Type : | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA |
| CYANIDE, TOTAL | | <0.1 ppm | <0.1 ppm |
| ARSENIC | | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

RECEIVED JUN 15 1988

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/13/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: A.M. Crane
ALLAN M. CRANE

cc/fc: ENSA/ENSA1

Page No.: 1

| Parameter | Sample ID : | NI 7-8' DUPLICATE | NI 7-8' TRIPLICATE |
|---|---|---|---|
| | Lab ID : | 88060514 | 88060515 |
| | Sample Type : | 15 | 15 |
| | Date Received: | 06/10/88 | 06/10/88 |
| | Collected by : | ENSA | ENSA |
| ARSENIC | | <1.00 ppm | <1.00 ppm |
| BARIUM | | <1.00 ppm | <1.00 ppm |
| CADMIUM | | <0.50 ppm | <0.50 ppm |
| CHROMIUM | | <1.00 ppm | <1.00 ppm |
| LEAD | | <1.00 ppm | <1.00 ppm |
| MERCURY | | <0.20 ppm | <0.20 ppm |
| SELENIUM | | <0.50 ppm | <0.50 ppm |
| SILVER | | <1.00 ppm | <1.00 ppm |
| DIGESTION FOR MERCURY ANALYSIS | | YES | YES |
| EP TOX EXTRACTION-SOLID | | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/17/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSA3

Page No.: 1

| Parameter | | | | |
|---|---|---|---|---|
| | Sample ID : | SY1 0-1' 06/07/88 | SY2 0-1' 06/07/88 | SY3 0-1' 06/07/88 |
| | Lab ID : | 88060470 | 88060471 | 88060472 |
| | Sample Type : | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA |
| TOTAL HYDROCARBONS | | 1100 ppm | 1850 ppm | 839 ppm |
| LEAD | | 70.3 ppm | 15.7 ppm | 17.9 ppm |
| ACID DIGESTION | | YES | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 07/29/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSAJ

Page No.: 1

RECEIVED
AUG - 2 1988

| | |
|---|---|
| Sample ID : | BKGD2 1-3' 07/21/88 NAS |
| Lab ID : | 88071073 |
| Sample Type : | 15 |
| Date Received: | 07/22/88 |
| Collected by : | ENSA |

| Parameter | |
|---|---|
| TOTAL HYDROCARBONS | 389 ppm |
| LEAD | 12.3 ppm |
| ACID DIGESTION | YES |
| LEAD | <1.00 ppm |
| EP TOX EXTRACTION-SOLID | YES |
| BENZENE | <5 ppb |
| ETHYLBENZENE | <10 ppb |
| TOLUENE | <10 ppb |
| XYLENE | <10 ppb |
| AROCLOR 1016 | <1 ppm |
| AROCLOR 1221 | <1 ppm |
| AROCLOR 1232 | <1 ppm |
| AROCLOR 1242 | <1 ppm |
| AROCLOR 1248 | <1 ppm |
| AROCLOR 1254 | <1 ppm |
| AROCLOR 1260 | <1 ppm |
| AROCLOR 1262 | <1 ppm |
| SAMPLE PREP - PCB'S | YES |

BORING LOGS

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

[redacted]

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | Nat Kempers | |

DRILLING METHOD: 4" Hollow Stem

BORING NO: AA

SHEET: 1 of 1

SAMPLING METHOD: split spoon

DRILLING

| | | | | | START | FINISH |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | | | TIME | TIME |
| TIME | | | | | | |
| DATE | | | | | DATE 7/6/88 | DATE 7/6/88 |
| CASING DEPTH | | | | | | |

DATUM

ELEVATION

SURFACE CONDITIONS: Center of pipe in grass (cutting) - 4' below surface store pipe

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH |
|---|---|---|---|---|---|---|---|
| SS | | | | | | 0 | |
| | | | | | | 1 | |
| SS | | | | | | 2 | |
| | | | | | | 3 | |
| SS | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | | | 6 | |
| | | | | | | 7 | |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 0 | |
| | | | | | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | | | 6 | |
| | | | | | | 7 | |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 0 | |

DRILLING CONTR

BY

DATE

CHK'D BY

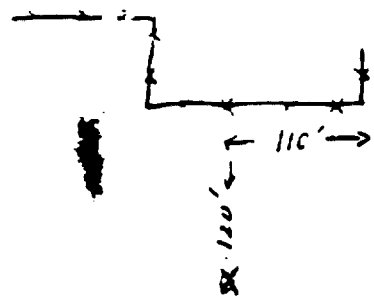
ES 1 (33) (REV 11 86)

T00230

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING




| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NAS Memphis | |

DRILLING METHOD: 4" Hollow Stem

SAMPLING METHOD: Split spoon

BORING NO: SV2

SHEET 1 OF 1

DRILLING

| | START | FINISH |
|---|---|---|
| TIME | | |
| DATE | 6/9/12 | 6/9/12 |

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATUM

ELEVATION

DRILLING CONTR: SVGE

BY: HS

CHK'D BY

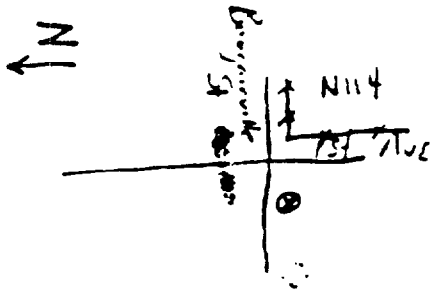
DATE

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: grassy/asphalt |
|---|---|---|---|---|---|---|---|---|
| SS | 18/12 | | 1/0 | 17 9 1 | | 0 | | light brown & gray silty sand, trace of clay |
| | | | | | | 1 | | |
| SS | 24/12 | | 2/1 | 6 10 14 14 | | 2 | | dark gray silty clay |
| | | | | | | 3 | | some, w/rust streaks |
| SS | 24/12 | | 3/3 | 12 40 [illegible] | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING




| | |
|---|---|
| JOB NO | |
| CLIENT | NAS Memphis |
| LOCATION | |
| DRILLING METHOD | 4" Hollow Stem |
| BORING NO | CKG |
| SHEET | 1 of 1 |
| SAMPLING METHOD | Split Spoon |
| DRILLING START TIME | |
| DRILLING FINISH TIME | |
| WATER LEVEL | |
| TIME | |
| DATE | |
| CASING DEPTH | |
| DRILLING START DATE | 6/7/02 |
| DRILLING FINISH DATE | 6/7/02 |

DATUM

ELEVATION

DRILLING CONTR CDS3

BY RS DATE CHKD BY

SURFACE CONDITIONS: grassy

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | CK 7 | 16 9.7 | | 7 | | light to med brown ~~stiff~~ silty clay some coal material |
| | | | 8 | | | 8 | | mottled brown & gray silty clay |
| SS | 24/20 | | CK 8 | 9 4.5 4 | | 9 | | |
| | | | | | | 10 | | |
| SS | 24 | | CK 10 | 12 4.5 6 6 | | 1 | | intermixed brown silty clay some areas of mottled gray and brown wet |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

SOB 1 (3) (REV 11-00)

100023

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO

CLIENT: Nassau HIS

LOCATION

DRILLING METHOD: 4" Hollow Stem

BORING NO: A

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING

| | | | | | START TIME | FINISH TIME |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | | | | |
| TIME | | | | | | |
| DATE | | | | | DATE 6/7/11 | DATE 6/7/11 |
| CASING DEPTH | | | | | | |

DATUM

ELEVATION

DRILLING CONTR

BY

CHK'D BY

DATE

SURFACE CONDITIONS: 3 ft rd of A facing SW

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6" SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| SS | 12/12 | | A1/5 | 2 | | 5 | | mottled brown & gray silty clay |
| | | | | | | 6 | | " " (WET) |
| SS | 24 | | A2/6 | 8 4 4 4 | | 7 | | |
| | | | | | | 8 | | gray mottled silty clay |
| SS | 24 | | A3/8 | 6 2 2 3 | | 9 | | wet |
| | | | | | | 10 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

000233

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NASA Memphis | |

DRILLING METHOD: 4" Hollow Stem

BORING NO: B

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING

| | START | FINISH |
|---|---|---|
| TIME | | |
| DATE | 4/6/88 | 4/6/88 |

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATUM

ELEVATION

SURFACE CONDITIONS: 3 ft Right of B facing SN

DRILLING CONTR: EDC

BY: PAS

DATE

CHK'D BY

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| SS | 12/12 | | B1/5 | 4 x 2 | | 5 | | mottled red brown & dark gray silty clay (moist) |
| | | | | | | 6 | | |
| SS | 24/20 | | B2/6 | 8 4 5 5 4 | | 7 | | " brown to red gray silty clay moist streaks |
| | | | | | | 8 | | " |
| SS | 24/20 | | B3/8 | 7 4 5 4 3 | | 9 | | |
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

SSB 1 (3) (REV 11 86)

EnSafe® Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO | CLIENT: NASMEMPHIS | LOCATION

DRILLING METHOD: 4" Hollow Stem

BORING NO: 1

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING: START TIME / FINISH TIME

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | | | | |
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

START DATE: 6/3/88 FINISH DATE: 6/3/88

DATUM | ELEVATION

DRILLING CONTR: EDGE

BY: PVS | CHK'D BY | DATE

SURFACE CONDITIONS: 3 ft right of D facing SW

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| SS | 12/10 | | D1/6 | 7 3.4 | | 6 | | dark gray to black silty clay shale |
| | | | | | | 7 | | |
| SS | 24/16 | | D2/7 | 19 7.9.10.9 | | 8 | | gradational to a light gray silty clay |
| | | | | | | 9 | | |
| SS | 24/16 | | D3/9 | 10 6.7.5.5 | | 10 | | mottled brown & gray silty clay |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

900235

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NAS Memphis | |

DRILLING METHOD: 4" Hollow Stem

BORING NO: F

SHEET: 1 OF 1

SAMPLING METHOD: Split Spoon

DRILLING

| | START | FINISH |
|---|---|---|
| TIME | | |
| DATE | 6/3/10 | 6/3/10 |

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATUM

ELEVATION

DRILLING CONTR.

BY

DATE

CHK'D BY

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6" SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: 3 ft right of "F" facing SW |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| SS | 12/12 | | F1/6 | 8 4 4 | | 6 | | Dark gray - stiff silty clay |
| | | | | | | 7 | | |
| SS | 24/12 | | F2/7 | 17 6 11 11 | | 8 | | light to med gray silty clay stiff |
| | | | | | | 9 | | |
| SS | 24/17 | | F3/1 | 10 5 5 5 | | 10 | | " various abundant organic debris |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

SSB 1 (3) (REV 11 80)

100236

EnSafe®

Environmental and Safety Designs, Inc.

| LOCATION OF BORING | JOB NO | CLIENT NAS Memphis | LOCATION |
|---|---|---|---|
| | DRILLING METHOD 4 1/4" H.S. Auger | | BORING NO G |
| | SAMPLING METHOD Split Spoon | | SHEET 1 of 1 |
| | | | DRILLING START TIME / FINISH TIME |
| | WATER LEVEL | | |
| | TIME | | |
| | DATE | | DATE 6/3/88 / DATE 6/3/88 |
| | CASING DEPTH | | |

DATUM ELEVATION

DRILLING CONTR. _____ BY _____ DATE _____ CHK'D BY _____

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6" SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: 4' right of "G" facing SW |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| SS | 12/8 | | G1/6 | 6 3.3 | | 6 | | mottled gray & light gray intermixed slightly silty clay |
| | | | | | | 7 | | clay appears to be almost black |
| SS | 24/14 | | G2/9 | 22 9.10.11.11 | | 8 | | |
| | | | | | | 9 | | dark to light gray mottled w/brown silty clay |
| SS | 24 | | G3/9 | 14 12.10.8.6 | | 10 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

SB-23 (REV 11-86)

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO

CLIENT: NAS Memphis

DRILLING METHOD: 4" Hollow Stem

SAMPLING METHOD: Split Spoon

BORING NO: H

SHEET: 1 of 1

DRILLING

| | START | FINISH |
|---|---|---|
| TIME | | |
| DATE | 6/2/88 | 6/2/88 |

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATUM

ELEVATION

DRILLING CONTR: SDC

BY: RS

CHK'D BY

DATE

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: 3 ft inside of "H" facing SW |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| SS | 12/12 | | 111/6 | 8 4 4 | | 6 | | medium to dark gray silty clay with sand stands |
| | | | | | | 7 | | |
| SS | 24/12 | | 112/4 | 11 4 6 7 4 | | 8 | | mud gray & lt gray mottled silty clay |
| | | | | | | 9 | | |
| SS | 24/10 | | 114/1 | 9 5 5 5 4 | | 10 | | SAME |
| | | | | | | 11 | | |
| | | | | | | 12 | | |
| | | | | | | 13 | | |
| | | | | | | 14 | | |
| | | | | | | 15 | | |
| | | | | | | 16 | | |
| | | | | | | 17 | | |
| | | | | | | 18 | | |
| | | | | | | 19 | | |
| | | | | | | 20 | | |

000236

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO | CLIENT | LOCATION

DRILLING METHOD: 4" Hollow Stem

BORING NO.

SHEET 1 OF 1

SAMPLING METHOD: Split Spoon

DRILLING

| | | | | | START | FINISH |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | - | | TIME | TIME |
| TIME | | | | | | |
| DATE | | | | | DATE | DATE |
| CASING DEPTH | | | | | 6/2/84 | 6/2/8 |

DATUM | ELEVATION

DRILLING CONTR

SURFACE CONDITIONS: 3 ft right of I southbound

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | J1/7 | 6 3 3 | | 7 | | mottled brown & gray silty clay |
| | | | | | | 8 | | |
| SS | 24/16 | | J2/8 | 9 2 2 4 5 | | 9 | | pulverulent gray silty clay some black specks |
| | | | | | | 0 | | |
| SS | 24 | | J3/10 | 11 3 3 6 5 | | 1 | | " |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

BY ____ DATE ____ CHK'D BY ____

00023

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO: NAS MEMPHIS

LOCATION

DRILLING METHOD: 4 Hole Stem

BORING NO: L

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING START TIME / FINISH TIME

| | | | | |
|---|---|---|---|---|
| WATER LEVEL | | | | |
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATE: 6/2/88 — DATE: 6/2/88

DATUM

ELEVATION

DRILLING CONTR: EDGE

SURFACE CONDITIONS: 3 ft left of L facing SW

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12 | | L1 / 7 | 7 / 3.4 | | 7 | | mottled brown w/ some gray slightly ~~gray slightly silty clay~~ silty clay |
| | | | | | | 8 | | |
| SS | 24 | | L2 / 8 | 10 / 4.7.5.5 | | 9 | | predominantly gray silty clay ~~some organics~~ |
| | | | | | | 10 | | |
| SS | 24 | | L3 / 10 | 6 / 3.3.3.3 | | 1 | | MOIST |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

BY: HS — CHK'D BY: — DATE:

000 1 (3) (REV 11-80)

ENSAFE®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NAS Memphis | |

| DRILLING METHOD | BORING NO |
|---|---|
| 4" Hollow Stem | M |
| | SHEET 1 OF 1 |
| SAMPLING METHOD: Split Spoon | DRILLING |

| | | | | | START TIME | FINISH TIME |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | | | | |
| TIME | | | | | | |
| DATE | | | | | DATE 6/2/11 | DATE 6/2/11 |
| CASING DEPTH | | | | | | |

DATUM ELEVATION

DRILLING CONTR EDC

| SAMPLER TYPE | HOMES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: 2 ft left of "M" facing SW |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | A1/7 | 5 2 3 | | 7 | | silty clay, gray mottled w/ brown and black |
| | | | | | | 8 | | |
| SS | 24/18 | | A2/8 | 9 2 3 4 5 | | 9 | | fills more silty than previous sample |
| | | | | | | 10 | | |
| SS | 24/20 | | A3/11 | 12 4 5 5 7 | | 11 | | |
| | | | | | | 12 | | |
| | | | | | | 13 | | |
| | | | | | | 14 | | |
| | | | | | | 15 | | |
| | | | | | | 16 | | |
| | | | | | | 17 | | |
| | | | | | | 18 | | |
| | | | | | | 19 | | |
| | | | | | | 20 | | |

BY RLS DATE CHK'D BY

GSB-4 (3) (REV 11-86)

00241

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NARMEMPHIS | |

DRILLING METHOD: 4" Hollow Stem

BORING NO.: N

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING

| | | | | | START | FINISH |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | | | TIME | TIME |
| TIME | | | | | | |
| DATE | | | | | DATE | DATE |
| CASING DEPTH | | | | | 6/2/88 | 6/2/88 |

DATUM

ELEVATION

DRILLING CONTR

BY

DATE

CHK'D BY

SURFACE CONDITIONS: 3 ft left of "N" facing SW

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | #1/7 | 11 7.4 | | 7 | | Mottled gray & brown, silty clay abundant wood materials some iron staining |
| | | | | | | 8 | | |
| SS | 24/14 | | #2/8 | 10 4 6 3 5 | | 9 | | |
| | | | | | | 10 | | 11 |
| SS | 24/20 | | #3/10 | | | 11 | | |
| | | | | | | 12 | | |
| | | | | | | 13 | | |
| | | | | | | 14 | | |
| | | | | | | 15 | | |
| | | | | | | 16 | | |
| | | | | | | 17 | | |
| | | | | | | 18 | | |
| | | | | | | 19 | | |
| | | | | | | 20 | | |

GB 1 (3) (REV 11-80)

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO

CLIENT: Nx Memphis

LOCATION

DRILLING METHOD: 4" Hollow Stem

BORING NO: P

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING

| | | | | | START TIME | FINISH TIME |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | - | | | |
| TIME | | | | | | |
| DATE | | | | | DATE | DATE |
| CASING DEPTH | | | | | 6/2/88 | 6/2/88 |

DATUM

ELEVATION

SURFACE CONDITIONS: 3 ft Asph Paving SW

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE ID / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/10 | | P1/7 | 3 | | 7 | | Medium brown silty clay with gravel Moist |
| | | | | | | 8 | | |
| SS | 24/18 | | P2/8 | 6 3 3 | | 9 | | |
| | | | | | | 10 | | " |
| SS | 24/18 | | P3/11 | 9 7 4 5 | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

DRILLING CONTR

BY

CHK'D BY

DATE

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NASMEMPHIS | |

DRILLING METHOD: 4" Hollow Stem

BORING NO: R

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

| | | | | | DRILLING | |
|---|---|---|---|---|---|---|
| | | | | | START | FINISH |
| WATER LEVEL | | | | | TIME | TIME |
| TIME | | | | | | |
| DATE | | | | | DATE | DATE |
| CASING DEPTH | | | | | | |

DATUM

ELEVATION

DRILLING CONTR.

BY

DATE

CHK'D BY

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6" SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS: 3' Right of R facing SW |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | R1/7 | 29 M 15 | | 7 | | red brown silty clay, some coal or shale chips |
| | | | | | | 8 | | |
| SS | 24/ | | R2/7 | [illegible] | | 9 | | [illegible] gray [illegible] from [illegible] |
| | | | | | | 0 | | |
| SS | 24/ | | R3/10 | [illegible] | | 1 | | " |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

ESB 1 (3) (REV 11 80)

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT NAS Memphis | LOCATION |
|---|---|---|
| DRILLING METHOD: 4" Hollow Stem | | BORING NO 5 |
| | | SHEET 1 of 1 |
| SAMPLING METHOD: Split Spoon | | DRILLING |
| | | START TIME / FINISH TIME |
| WATER LEVEL | | |
| TIME | | |
| DATE | | DATE / DATE |
| CASING DEPTH | | |

DATUM ELEVATION

DRILLING CONTR

BY

DATE CHK'D BY

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | SURFACE CONDITIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 12/12 | | S1/7 | 6 4 | | 7 | | dk gray & brown silty clay |
| | | | | | | 8 | | " |
| SS | 24/18 | | S2/8 | 8 [illegible] | | 9 | | |
| | | | | | | 0 | | " |
| SS | 24/18 | | S3/18 | 8 [illegible] | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

1024

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

[redacted]

DATUM

ELEVATION

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NAS Memphis | |

DRILLING METHOD: 4" Hollow Stem

SAMPLING METHOD:

BORING NO: 1

SHEET: 1 of 1

| | | | | | DRILLING | |
|---|---|---|---|---|---|---|
| | | | | | START | FINISH |
| WATER LEVEL | | | | | TIME | TIME |
| TIME | | | | | | |
| DATE | | | | | DATE | DATE |
| CASING DEPTH | | | | | | |

DRILLING CONTR

BY

DATE

CHK'D BY

SURFACE CONDITIONS: Right of T facing SW left

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT. SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | 1 | | | 6 | | |
| SS | 12/2 | | T1/7 | 12 5 7 | | 7 | | [illegible] |
| | | | | | | 8 | | [illegible] |
| SS | 24/18 | | T2/8 | 7 5 5 5 | 4 | 9 | | Moist |
| | | | | | | 10 | | |
| SS | 24/18 | | T3/10 | 7 [illegible] | [illegible] | 1 | | Moist |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| | | | | | | 7 | | |
| | | | | | | 8 | | |
| | | | | | | 9 | | |
| | | | | | | 0 | | |

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

JOB NO | CLIENT | LOCATION

DRILLING METHOD: 4" Hollow Stem

BORING NO: V

SHEET: 1 of 1

SAMPLING METHOD: Split Spoon

DRILLING: START TIME | FINISH TIME

| WATER LEVEL | | | | |
|---|---|---|---|---|
| TIME | | | | |
| DATE | | | | |
| CASING DEPTH | | | | |

DATUM | ELEVATION

DRILLING CONTR

BY | DATE | CHK'D BY

| SAMPLER TYPE | HOURS DRIVEN / HOURS RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/6" SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH |
|---|---|---|---|---|---|---|---|
| | | | | | | 0 | |
| | | | | | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | | | 6 | |
| SS | 12/12 | | V1/7 | 10 5.5 | | 7 | |
| | | | | | | 8 | |
| SS | 21/11 | | V2/8 | 7 4.4 | 3.4 | 9 | |
| | | | | | | 10 | |
| SS | 24/18 | | V3/10 | 6 4.4 | 3.3 | 11 | |
| | | | | | | 12 | |
| | | | | | | 13 | |
| | | | | | | 14 | |
| | | | | | | 15 | |
| | | | | | | 16 | |
| | | | | | | 17 | |
| | | | | | | 18 | |
| | | | | | | 19 | |
| | | | | | | 20 | |

SURFACE CONDITIONS: ≈ 2' Rt of stake V facing southwest

7 Mottled brown & gray silty clay

11 Moist

00024

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NASMEMPHIS | |

| DRILLING METHOD | BORING NO |
|---|---|
| 4" Hollow Stem | X |
| SAMPLING METHOD | SHEET |
| B & . 1 Split Spoon | 1 of 1 |
| | DRILLING |

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

DATUM ELEVATION

SURFACE CONDITIONS: Right side of X when facing Southwest

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0 | | |
| | | | | | | 1 | | |
| | | | | | | 2 | | |
| | | | | | | 3 | | |
| | | | | | | 4 | | |
| | | | | | | 5 | | |
| | | | | | | 6 | | |
| SS | 18/12 | | X1/7 | 2' 14.7 | | 7 | | Slightly silty mottled orange & brown clay. Wood, fiber, probably from fill around pipe |
| | | | | | | 8 | | |
| SS | 24/16 | | X2/8 | 10 (.7 7 7 | | 9 | | |
| | | | | | | 10 | | |
| SS | 24/17 | | X3/10 | 8 <9 3 5 | | 11 | | |
| | | | | | | 12 | | |
| | | | | | | 13 | | |
| | | | | | | 14 | | |
| | | | | | | 15 | | |
| | | | | | | 16 | | |
| | | | | | | 17 | | |
| | | | | | | 18 | | |
| | | | | | | 19 | | |
| | | | | | | 20 | | |

DRILLING CONTR _____ BY _____ DATE _____ CHK'D BY _____

ESI 1 (3) (REV 11-86)

EnSafe®

Environmental and Safety Designs, Inc.

LOCATION OF BORING

| JOB NO | CLIENT | LOCATION |
|---|---|---|
| | NAS Memphis | |

DRILLING METHOD: 4" Hollow Stem

BORING NO: Y

SHEET: 1 of 1

SAMPLING METHOD: 2" Split Spoon

DRILLING: START TIME / FINISH TIME

| | | | | | | |
|---|---|---|---|---|---|---|
| WATER LEVEL | | | | | | |
| TIME | | | | | | |
| DATE | | | | | | |
| CASING DEPTH | | | | | | |

DATE / DATE

DATUM

ELEVATION

DRILLING CONTR.

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | DEPTH OF CASING | SAMPLE NO / SAMPLE DEPTH | BLOWS/FT SAMPLER | NUMBER OF RINGS | DEPTH IN FEET | SOIL GRAPH |
|---|---|---|---|---|---|---|---|
| | | | | | | 0 | |
| | | | | | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | | | 6 | |
| SS | 12/12 | | Y1/7 | 9 / 2.4 X | | 7 | |
| | | | | | | 8 | |
| SS | 24/24 | | Y2/8 | 8 / 3 3 5 3 | | 9 | |
| | | | | | | 10 | |
| SS | 24/24 | | Y3/10 | 11 / 2 3 ~ 6 | | 1 | |
| | | | | | | 2 | |
| | | | | | | 3 | |
| | | | | | | 4 | |
| | | | | | | 5 | |
| | | | | | | 6 | |
| | | | | | | 7 | |
| | | | | | | 8 | |
| | | | | | | 9 | |
| | | | | | | 0 | |

SURFACE CONDITIONS: Facing South (Y to A) Coring on left side of storm drain

DARK GRAY SILTY CLAY TRACE SAND, SOME IRON STAINS

BY _____ DATE _____ CHK'D BY _____

(88-4 (3) (REV 11-86)

00240

# NAS MEMPHIS
# TECHNICAL MEMORANDUM
# SWMUs 4 and 5

**Prepared for:**

**ALLISON DREW, RPM**
**EPA REGION IV**

**Prepared by:**

**SOUTHERN DIVISION**
**AND ENSAFE/ALLEN & HOSHALL**
**5720 SUMMER TREES DRIVE**
**MEMPHIS, TENNESSEE 38134**
**(901) 383-9115**

**FEBRUARY 23, 1993**

# TECHNICAL MEMORANDUM

TO: Allison Drew, RPM, EPA Region IV

FROM: Mark Taylor, EIC, SOUTHNAVFACENGCOM

SUBJECT: NAS Memphis RFI — Interim Measures Field and Analytical Summary

DATE: February 23, 1993

---

## INTRODUCTION

Field work for the NAS Memphis Interim Measures activity at the Aircraft Fire Fighting Training Area (FFTA) was conducted by the U.S. Geological Survey (USGS) during October 19-25, 1992 with additional sampling accomplished on December 17, 1992. This work was conducted in support of two planned Military Construction Projects (Firemat Training Mock-Up Facility/Shore Aircraft Fire and Rescue Training Facility [SATF]). The field work was designed to determine if activities at Solid Waste Management Units (SWMUs) 4 and 5 have impacted the soils and sediments in the planned construction areas, and also the potential impact that any contaminants would have on site workers during construction.

## FIELD WORK SUMMARY

Field work consisted of drilling 10 shallow soil borings from the surface to the water table. Three subsurface soil samples were collected from each boring and nine sediment samples were collected from the ditches and drainageways that traverse the investigation area. On December 17, five supplemental sediment samples were collected from the drainage ditch upgradient of the investigation area to further characterize the limited portion of SWMU 4 affected by the proposed construction of the SATF.

Each soil boring location was laid out by compass and tape measure consistent with the locations identified on Interim Measures Work Plan (IMWP) Figure 3-5. Minor adjustments had to be made to the location of Boring #3 because it was not possible to position the drill rig directly over the SWMU 4 drainage ditch. The locations of all soil borings are shown in Figure TM-1 (Attachment A) of this technical memorandum.

In accordance with Sections 2.2 and 4.5 of the IMWP, samples were collected from the intervals of 0-2 feet, 5-7 feet, and 10-12 feet below land surface in all the borings except Boring #1 and Boring #10. Boring #1 was the first soil boring drilled and samples were collected from intervals of 0-2 feet, 4-6 feet, and 16-18 feet below land surface to determine the approximate depth that water could be expected to be encountered in each of the subsequent borings. In Boring #10, the deepest sample interval was 11-13 feet below land surface because of an increase in land-surface altitude of approximately 1-2 feet from the location of Boring #9.

In most of the soil borings, visual confirmation of water table intersection occurred in the 10-12 foot sampling interval. Due to the shallow depth of the water table and for consistency, the intermediate samples for analysis were collected from the 5-7 foot range in all borings. Nine sediment samples were collected from the drainage ditches following the methods described in Sections 2.2 and 4.5 of the IMWP. Seven of the sediment sample locations conformed to the locations shown in Figure 4-4 of the IMWP. Two additional sediment samples were collected from a low area parallel to Access Road No. 2 because this appeared to be a pathway for runoff to the SWMU 4 ditch. Five additional locations were sampled in the ditch upgradient of the FFTA. The five additional samples were needed to characterize a limited section of the ditch that will be re-contoured in conjunction with planned construction of the SATF. The locations of all sediment samples are shown in Figure TM-2 (Attachment A).

## ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

In all, 50 solid-phase environmental samples were collected, including 30 subsurface soil samples, three soil duplicates, one soil matrix spike, one soil matrix spike duplicate, 14 sediment samples, and one sediment duplicate. All samples were shipped under chain of custody by overnight carrier to the Enseco-Rocky Mountain Analytical Laboratory (RMAL) in Arvada, Colorado, for determination of the following RCRA Facility Investigation (RFI) analytes:

- Volatile Organic Compounds (EPA Method 8240)
- Semivolatile Organic Compounds (EPA Method 8270)
- Total Petroleum Hydrocarbons (EPA Method 418.1)
- Total Cyanide (EPA Method 9010)
- Organochlorine Pesticides/PCBs (EPA Method 8080)
- RCRA Part 264, Appendix IX Metals (EPA Method 6010/7000 series)

Quality assurance/quality control protocols were adhered to throughout the investigation as described in the IMWP. In addition to the solid-phase samples listed above, QA/QC included the collection of potable and deionized/organic-free water field blanks, five sets of rinsate blanks, and one trip blank for each of the 13 coolers used to ship samples to the lab. All expendable field sampling supplies (i.e., bottles, preservatives, labels, chain-of-custody forms, and trip blanks) used in the investigation were supplied by RMAL.

Potable and deionized/organic-free water for field blanks were obtained from the NAS Memphis public water system and the Memphis Subdistrict Office of the USGS, respectively. All pertinent data from the field investigation was recorded in a bound field logbook, or on boring logs and specially designed forms for recording field equipment calibration and data results.

## INTERIM MEASURES FIELD INVESTIGATION DATA SUMMARIES

Tables TM-1 through TM-5 (Attachment B) summarize validated positive results for volatile organic compounds, semivolatile organic compounds, pesticides, total petroleum hydrocarbons, and inorganic analytical data, respectively.

Tables TM-1 and TM-2 indicate that the only significant hits for volatile and semivolatile organic compounds were outside the area where the proposed fire mat will be physically located. Petroleum constituents were detected in samples from Boring #10 at depths of 5 feet and greater. As Figure TM-1 illustrates, Boring #10 is located southwest of the proposed area of construction.

Boring #10 was also the only boring with positive results for total petroleum hydrocarbons (TPH), as shown in Table TM-3. At the mid-boring interval of 5 to 7 feet, a concentration of 1,010 mg/kg TPH was obtained. Other significant TPH hits were obtained in sediment samples in the SWMU #4 ditch east of the FFTA (samples IM-M-6-0, IM-M-6R-0, and IM-M-10-0) and in a side ditch leading from the existing fire mat area to SWMU #4 (sample IM-M-5-0). Sample IM-M-6R-0 was a set of duplicate samples collected during the second sampling event to check the accuracy of the original sample from that location. Sample results were approximately 50 percent lower for the second sampling event. The presence of TPH in these ditches could be attributable to ongoing training activities at both the FFTA and the Carrier Deck FFTA which is northeast of SWMU #5. TPH was not detected in the sediment sample (IM-M-9-0) which was collected farthest downstream toward Big Creek.

Dieldrin was detected near the surface in 8 of 10 borings and in two sediment samples. Its widespread presence near the surface is a result of soil treatment around runways in the early 1970s. The treatment was part of a U.S. Department of Agriculture (USDA) quarantine program aimed at controlling the spread of white fringed beetles. The presence of dieldrin should be prevalent over the entire north side of NAS Memphis due to aerial application of this pesticide during the USDA program. Of the contaminants detected at the site, construction workers are more likely to be exposed to dieldrin because of its presence near the surface. The presence of dieldrin may not be a significant problem because the area of construction is lower than the rest of the FFTA, so excavation activities should be limited, if required at all. A more likely scenario is bringing in fill material to raise the elevation of the new fire mat, decreasing the likelihood of exposure.

To further evaluate the risk of dieldrin exposure, a risk calculation (Attachment C) was performed for ingestion and dermal contact of dieldrin in an industrial area assuming a 25-year duration (260 days/year). The amount of dieldrin required in an air pathway exposure (soil suspended in air) that would exceed the PEL for a worker equals 287 grams/$m^3$ (assumes 100 percent transfer to the bloodstream). This worst-case exposure concentration should not occur. However, engineering controls such as dust suppression or real-time air monitoring could be implemented to protect workers, if deemed necessary by a health and safety professional.

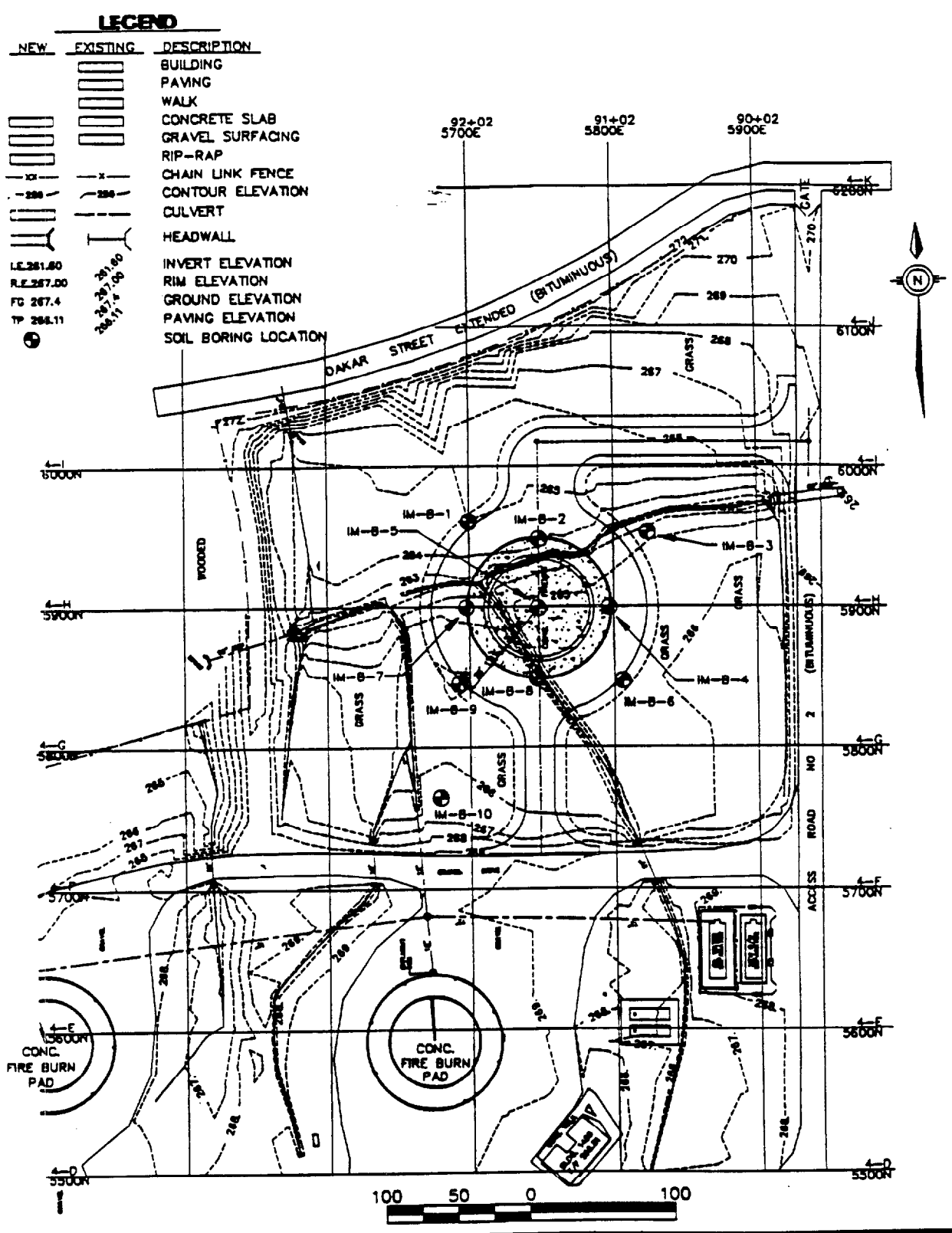
Results of inorganic analyses for metals and cyanide are summarized in Table TM-5. In general, concentrations were higher in the sediment samples than in the subsurface samples. However, a literature search indicates that all of the values are within the range of typical concentrations found in uncontaminated soils. The values for inorganic analytes were also compared to the RCRA Subpart S action levels in 40 CFR Part 264.521(a)(2)(i-iv). With the exception of beryllium, all values were well below their respective action levels. All of the beryllium values exceeded the 0.2 mg/kg action level for soil. Naturally occurring levels of beryllium could easily exceed this low action level. All but one of the beryllium values reported for the Interim Measure samples were less than 1 mg/kg which is well within the typical range of 0 to 5 mg/kg beryllium found in uncontaminated soils (*Criteria for Contaminated Soil/Sediment Cleanup*, J. Fitchko, 1989). Soil samples from the Interim Measure Investigation at SWMU 1 had similar beryllium concentrations. Therefore, the beryllium that was reported for samples from SWMUs 4 and 5 is believed to be naturally occurring.

## CONCLUSIONS AND RECOMMENDATIONS

After reviewing the data generated from the Interim Measures Investigation, SOUTHDIV does not feel that workers involved in construction of the additional fire mat and SATF will be exposed to adverse health risks from surficial contamination in the areas proposed for construction. SOUTHDIV believes the risk is low because construction of the new fire mat will be more likely to require filling in low areas than excavating new areas. Also, the SATF will fill approximately 400 feet of SWMU 4, and a new ditch will be constructed to reroute storm water. Therefore, SOUTHDIV recommends that no further action be required in the Interim Measures Investigation area and all data generated under this investigation be cataloged as supplemental data for use in the RFI for SWMUs 4 and 5. Corrective measures, if any, should be included with those for the entire site following complete RFI characterization.

# ATTACHMENT A

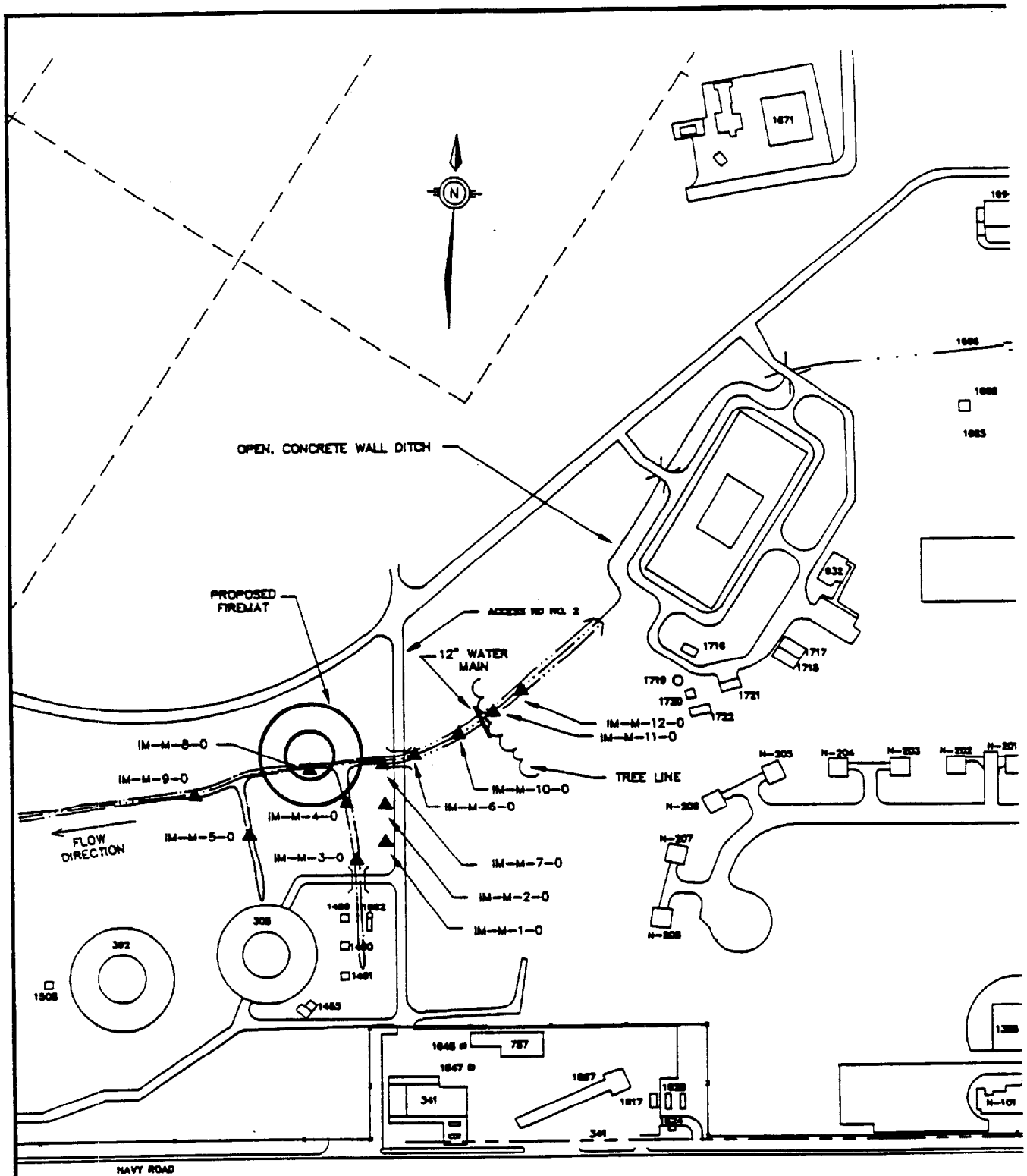
## Figures




INTERIM MEASURE
TECHNICAL MEMO
NAS MEMPHIS
MILLINGTON, TENNESSEE

FIGURE TM-1
INTERIM MEASURE
SOIL BORING
LOCATION MAP

DATE: 02/01/93 | DWG NAME: 016-TM1




INTERIM MEASURE
TECHNICAL MEMO
NAS MEMPHIS
MILLINGTON, TENNESSEE

FIGURE TM-2
SEDIMENT SAMPLE
LOCATION MAP

DATE: 02/01/93 | DWG NAME: 016-TM

000257

# ATTACHMENT B

## Data Summary Tables

# NAS Memphis RFI
## Interim Measure - SWMUs 4 & 5

**Table TM-1**
**Summary of Validated Positive Results**
**Volatile Organic Compounds**
**(mg/kg)**

| | Sample IM-B-1-0 (0-2 ft) | Sample IM-B-1-4 (4-6 ft) | Sample IM-B-1-16 (16-18 ft) | Sample IM-B-6-0 (0-2 ft) | Sample IM-B-6-5 (5-7 ft) | Sample IM-B-7-5 (5-7 ft) | Sample IM-B-10-5 (5-7 ft) | Sample IM-B-10-11 (11-13 ft) (duplicates) | Sample IM-M-8-0 (Sediment) |
|---|---|---|---|---|---|---|---|---|---|
| Acetone | 4.60 | | 0.35 | 0.34 | 0.22 | 0.96 | 6.70 | 0.43/0.15 | |
| Benzene | | | | | | | 5.20 | 0.17/0.10 | |
| 1,1-Dichloroethene | | | | | | 0.27/0.29 MS/MSD | | | |
| 1,2-Dichloroethene | | | | | | | | | 0.10 |
| Xylenes (total) | | 0.52 | | | | | 14.00 | | |

**Table TM-2**
**Summary of Validated Positive Results**
**Semivolatile Organic Compounds**
**(mg/kg)**

| | Sample IM-B-10-5 (5-7 ft) | Sample IM-B-10-11 (11-13 ft) (duplicates) | Sample IM-M-2-0 (Sediment) |
|---|---|---|---|
| Naphthalene | 10.00 | | |
| 2-Methylnaphthalene | 44.00 | 1.20/ND | |
| Benzo(b)fluoranthene | | | 1.80 |
| Fluoranthene | | | 2.30 |

000250

**Table TM-3**
**Summary of Validated Positive Results**
**Total Petroleum Hydrocarbons**
**(mg/kg)**

| Sample I.D. Number | Sample Depth | TPH Concentration |
|---|---|---|
| IM-B-10-5 | 5-7 ft | 1,010 |
| IM-B-10-11 (duplicates) | 11-13 ft | 33.1/ND |
| IM-M-1-0 | Sediment | 23.0 |
| IM-M-2-0 | Sediment | 28.6 |
| IM-M-3-0 | Sediment | 29.7 |
| IM-M-4-0 | Sediment | 45.4 |
| IM-M-5-0 | Sediment | 292 |
| IM-M-6-0 | Sediment | 660 |
| IM-M-6R-0 (duplicates) | Sediment | 279/332 |
| IM-M-7-0 | Sediment | 50.9 |
| IM-M-10-0 | Sediment | 261 |
| IM-M-11-0 | Sediment | 43.9 |
| IM-M-12-0 | Sediment | 32.1 |

**Table TM-4**
**Summary of Validated Positive Results**
**Pesticides**
**(mg/kg)**

| Sample I.D. Number | Sample Depth | Dieldrin Concentration | Data Qualifier |
|---|---|---|---|
| IM-B-1-0 | 0-2 ft | 0.31 | V |
| IM-B-2-0 | 0-2 ft | 0.78 | V |
| IM-B-2-5 | 5-7 ft | 0.07 | V |
| IM-B-3-0 | 0-2 ft | 1.0 | V |
| IM-B-5-0 | 0-2 ft | 0.14 | |
| IM-B-5-5 | 5-7 ft | 0.04 | |
| IM-B-6-0 | 0-2 ft | 0.24 | |
| IM-B-6-5 | 5-7 ft | 0.07 | |
| IM-B-7-0 | 0-2 ft | 0.46 | |
| IM-B-7-5 (MS/MSD) | 5-7 ft | 0.11/0.10 | |
| IM-B-7-5 | 5-7 ft | 0.10 | |
| IM-B-10-0 | 0-2 ft | 0.48 | |
| IM-M-1-0 | Sediment | 3.0 | |
| IM-M-2-0 | Sediment | 1.4 | |

V = Second column value

Dieldrin was only pesticide detected.

000262

# NAS Memphis RFI
## Interim Measure - SWMUs 4 & 5

**Table TM-5 (1 of 3)**
**Summary of Validated Positive Results**
**Inorganic Analytical Data**
**(mg/kg)**

| | Sample IM-B-1-0 (0-2 ft) | Sample IM-B-1-4 (4-6 ft) | Sample IM-B-1-16 (16-18 ft) | Sample IM-B-2-0 (0-2 ft) | Sample IM-B-2-5 (5-7 ft) | Sample IM-B-2-10 (10-12 ft) | Sample IM-B-3-0 (0-2 ft) | Sample IM-B-3-5 (5-7 ft) | Sample IM-B-3-10 (10-12 ft) |
|---|---|---|---|---|---|---|---|---|---|
| Lead | 6.2 | 7.3 | 6.2 | 19.0 | 6.2 | 6.2 | 19.3 | 6.3 | 5.2 |
| Nickel | 14.0 | 12.6 | 8.9 | 17.2 | 12.9 | 17.3 | 12.8 | 22.9 | 11.7 |
| Silver | 1.1 | | | 1.2 | | | | 1.2 | |
| Arsenic | | 0.57 | 0.57 | | 1.8 | 9.7 | | 4.6 | 6.0 |
| Barium | 154 | 173 | 58.4 | 273 | 158 | 152 | 146 | 276 | 76.1 |
| Beryllium | 0.51 | 0.66 | 0.27 | 0.95 | 0.57 | 0.36 | 0.51 | 0.49 | 0.27 |
| Cadmium | 0.61 | | | | | | 0.87 | 0.78 | |
| Chromium | 12.0 | 12.0 | 6.4 | 10.3 | 11.8 | 9.4 | 14.5 | 9.8 | 8.8 |
| Cobalt | 6.6 | 2.5 | 4.9 | 7.3 | 2.3 | 5.0 | 5.5 | 7.8 | 3.8 |
| Copper | 17.8 | 11.2 | 7.7 | 11.3 | 10.4 | 11.3 | 12.8 | 12.9 | 9.7 |
| Vanadium | 18.4 | 8.6 | 10.6 | 21.5 | 12.0 | 14.5 | 15.9 | 17.9 | 11.5 |
| Zinc | 46.5 | 61.3 | 31.4 | 47.9 | 53.3 | 47.9 | 53.4 | 53.2 | 33.8 |

# NAS Memphis RFI
## Interim Measure - SWMUs 4 & 5

**Table TM-5 (2 of 3)**
**Summary of Validated Positive Results**
**Inorganic Analytical Data**
**(mg/kg)**

| | Sample IM-B-5-0 (0-2 ft) | Sample IM-B-5-5 (5-7 ft) | Sample IM-B-5-10 (10-12 ft) | Sample IM-B-6-0 (0-2 ft) | Sample IM-B-6-5 (5-7 ft) | Sample IM-B-6-10 (10-12 ft) | Sample IM-B-7-0 (0-2 ft) | Sample IM-B-7-5 (5-7 ft) (MS) | Sample IM-B-7-5 (5-7 ft) |
|---|---|---|---|---|---|---|---|---|---|
| Mercury | | | | | | | | 0.57 | |
| Lead | 14.4 | 10.6 | 7.8 | 12.3 | 14.8 | 3.9 | 22.6 | 9.5 | 7.4 |
| Nickel | 13.8 | 11.4 | 16.5 | 22.5 | 13.5 | 11.6 | 11.1 | 57.3 | 13.8 |
| Silver | 1.0 | | | | | | | | |
| Arsenic | 5.7 | 1.5 | 6.8 | 3.7 | 4.1 | 1.5 | 5.9 | 3.1 | |
| Barium | 194 | 153 | 178 | 273 | 175 | 92.5 | 148 | 298 | 125 |
| Beryllium | 0.72 | 0.54 | 0.38 | 0.75 | 0.59 | 0.38 | 0.60 | 5.0 | 0.47 |
| Cadmium | | | | 0.76 | | | 0.97 | 5.1 | |
| Chromium | 9.6 | 11.4 | 9.2 | 12.3 | 12.2 | 10.4 | 10.7 | 29.4 | 11.2 |
| Cobalt | 6.8 | 4.0 | 8.8 | 7.4 | 5.4 | 3.2 | 4.5 | | 2.5 |
| Copper | 11.1 | 10.7 | 11.8 | 12.7 | 13.1 | 8.6 | 10.7 | 30.9 | 8.8 |
| Vanadium | 19.7 | 12.0 | 16.4 | 19.6 | 14.7 | 10.8 | 18.1 | 57.1 | 12.0 |
| Zinc | 44.5 | 53.2 | 44.2 | 58.4 | 58.8 | 47.3 | 50.9 | 90.7 | 47.8 |

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**Table TM-5 (3 of 3)**
**Summary of Validated Positive Results**
**Inorganic Analytical Data**
**(mg/kg)**

| | Sample IM-B-10-0 (0-2 ft) | Sample IM-B-10-5 (5-7 ft) | Sample IM-B-10-11 (11-13 ft) Duplicates | Sample IM-M-1-0 (Sediment) | Sample IM-M-2-0 (Sediment) | Sample IM-M-3-0 (Sediment) | Sample IM-M-4-0 (Sediment) | Sample IM-M-5-0 (Sediment) | Sample IM-B-6-0 (Sediment) | Sample IM-B-7-0 (Sediment) |
|---|---|---|---|---|---|---|---|---|---|---|
| Cyanide | | | | | | | | | 3.6 | |
| Mercury | | | | | | | | | 0.62 | 0.20 |
| Tin | | 249 | | | | | 94.6 | 450 | | |
| Lead | 14.9 | 5.9 | 6.2/5.8 | 44.0 | 25.2 | 31.2 | 39.0 | 18.8 | 63.7 | 66.6 |
| Nickel | 7.2 | 33.1 | 11.2/10.5 | 10.2 | 11.2 | 11.5 | 22.0 | 47.0 | 32.8 | 14.9 |
| Silver | | | | | | | | | | |
| Arsenic | 4.6 | 8.3 | 1.4/2.1 | 5.7 | 6.9 | 3.6 | 3.5 | 1.9 | 12.2 | 5.3 |
| Barium | 80.3 | 201 | 35.5/33.2 | 105 | 111 | 162 | 235 | 200 | 196 | 106 |
| Beryllium | 0.50 | 0.45 | 0.25/0.23 | 0.44 | 0.47 | 0.56 | 0.59 | 0.61 | 0.61 | 0.43 |
| Cadmium | | | | | | 0.82 | 1.0 | 2.3 | 5.7 | 4.8 |
| Chromium | 5.9 | 44.8 | 6.7/6.9 | 8.0 | 8.0 | 10.3 | 25.5 | 83.5 | 25.6 | 18.7 |
| Cobalt | 4.4 | 4.7 | 3.7/3.1 | 3.9 | 4.8 | 4.0 | 4.1 | 2.9 | 19.9 | 4.8 |
| Copper | 8.7 | 11.4 | 9.1/9.8 | 11.1 | 11.2 | 16.7 | 28.6 | 29.0 | 21.4 | 21.4 |
| Vanadium | 13.7 | 17.6 | 11.1/12.7 | 14.9 | 16.1 | 15.3 | 14.5 | 10.1 | 22.8 | 12.6 |
| Zinc | 25.9 | 34.3 | 29.5/33.2 | 63.0 | 49.9 | 82.2 | 85.1 | 96.2 | 170 | 80.5 |

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# ATTACHMENT C

## Risk Calculation

TABLE 1 – SOIL EXPOSURE RISK (HAZARD INDEX)
UNDER A INDUSTRIAL/COMMERCIAL EXPOSURE SCENARIO
NAS – MEMPHIS, MEMPHIS, TENNESSEE

| PARAMETER | SLOPE FACTOR ORAL (MG/KG/DAY)-1 | REFERENCE DOSE ORAL (MG/KG/DAY) | CANCER RISK @ AVERAGE | CANCER RISK @ MAXIMUM | HAZARD INDEX @ AVERAGE | HAZARD INDEX @ MAXIMUM | AVERAGE SOIL CONCENTRATION (0 TO 3 FEET) (MG/KG) | MAXIMUM SOIL CONCENTRATION (0 TO 3 FEET) (MG/KG) |
|---|---|---|---|---|---|---|---|---|
| PESTICIDES | | | | | | | | |
| Dieldrin | 16 | 0.00005 | 8.22E-08 | 2.15E-05 | 1.26E-02 | 4.10E-01 | 0.87 | 2 |

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST (1991 & 1993); IRIS Search Date 1/19/93.
Inhalation exposure is not a factor for these parameters; inhalation exposure pathway risk is not considered appropriate due to the non-volatility (or limited volatility) of the compounds in the soil sorbed state.
The highest concentration of each parameter detected in site soils (at a depth of three feet or less) and the average concentrations were used to compute risk (or hazard quotient); average was computed on the basis of positive results only.
Exposure assumed to be similar in nature to an agricultural scenario, therefore a daily ingestion of 100 mg soil was assumed at a frequency of 200 days/year.

TABLE 2 – AIR PATHWAY EXPOSURE EVALUATION
REQUIRED MASS OF SOIL TO EXCEED TLVs
PARTICULATES – NOT OTHERWISE REGULATED
NAS – MEMPHIS
MEMPHIS, TENNESSEE

| SOURCE CONSTITUENT | SOIL AVERAGE CONCENTRATION (UG/KG) | THRESHOLD LIMIT VALUE (MG/M3) | PEL TLV DESIGNATION OR QUALIFIER | SUSPENDED SOIL REQUIRED TO EXCEED PEL (MG/M3) | (GRAMS/M3) | COMPUTED LIGHT OBSCURATION (%) |
|---|---|---|---|---|---|---|
| PESTICIDES/PCBS; (UG/KG) | | | | | | |
| DIELDRIN | 870.0 | 0.25 | TWA | 2.87E+05 | 2.87E+02 | 99.2069 |

## Appendix B

## Technical Memorandum — Discussion of Dieldrin Risk Management Issues

## DISCUSSION OF DIELDRIN RISK MANAGEMENT ISSUES

Chlorinated pesticides (specifically dieldrin) were used extensively in the 1950s and 1960s during a white fringed beetle quarantine. NAS Memphis has record that the agents were applied aerially for their intended purpose over the majority of the base. During the RCRA Facility Investigation, dieldrin and other chlorinated pesticides were detected in most surface soil and some vadose soil samples collected at specific SWMUs and background locations. Due to the ubiquitous presence of dieldrin in site soils, the following assessment was performed to support risk management decisions to be made by the BCT.

Figure 1 shows reported surface (0-1 ft.) soil dieldrin concentrations across the northern portion of the base. As shown in the figure, levels at SWMUs ranged from below quantitation limits to 609 $\mu$g/kg (average of duplicate results at SWMU 5, boring 4). At background locations, concentrations ranged from below quantitation limits to 311 $\mu$g/kg with a mean of 131 $\mu$g/kg.
In order to provide an evaluation of the significance of the reported levels, standard risk assessment methods were employed. Default assumptions for residential and occupational exposure scenarios were used to project dieldrin-related carcinogenic risk through incidental ingestion and dermal contact soil pathways. For each exposure scenario, risk was computed using the maximum and mean SWMU-specific dieldrin concentrations. The results of this process are provided in the attached table.

As shown in the table, SWMU 5 had the highest projected soil pathway risk associated with dieldrin at maximum concentrations (2.2E-5). The SWMU 5 risk estimate was approximately twice that of the corresponding background. When mean concentrations were used as the exposure point concentration, SWMU 8 dieldrin risk was found to be the highest although it did not differ appreciably from background. In no instance (onsite or background) did dieldrin risk projections exceed 1E-4. This finding indicates that dieldrin levels found at each SWMU do not necessitate remedial action in the absence of other significant carcinogenic risk contributors. USEPA's generally acceptable range for carcinogenic risk is 1E-4 to 1E-6.

Soil dieldrin is not expected to pose a substantial threat to shallow groundwater at any SWMU or background location. This conclusion is based on the strong soil binding properties of the compound as well as empirical data for vadose soils which show no significant vertical migration has occurred.

A historical use discussion is also helpful to provide a frame of reference for evaluating reported soil dieldrin (and other chlorinated pesticide) concentrations. Information provided by NAS Memphis states that chlorinated pesticides (primarily chlordane) were previously used until the late 1980's for termite control around buildings. Although chlordane was used as a single active ingredient application, mixtures including dieldrin, aldrin and heptachlor

were also common in the pest control trade. Standard application rates resulted in soil concentrations of 500 to 1,000 mg/kg total chlorinated pesticides (or 500,000 $\mu$g/kg to 1,000,000 $\mu$g/kg). For comparison, a 10:1 chlordane:dieldrin mixture used for general subterranean termite control would have resulted in residual soil dieldrin concentration of 50 to 100 mg/kg. These residual application levels are 50 to 100 times higher than the maximum soil dieldrin concentration reported in the RFI.

It should be mentioned that Aroclor-1260 (a polychlorinated biphenyl or PCB) was detected in four soil samples collected at SWMU 5 and one sample from SWMU 7. In each instance, dieldrin was also detected although no strong concentration correlation was observed. Concentrations at SWMU 5 ranged from non-detect to 223 $\mu$g/kg. The single hit reported at SWMU 7 was 20,000 $\mu$g/kg in the boring 7 surface soil sample. Boring 7 at SWMU 7 is actually closer to Building N-16. As a result, the RFI workplan for N-16 should include provisions for further delineating the soil PCB contamination.

This memo was intended to provide a risk-based framework for decision making regarding how the dieldrin issue is resolved. Although standard risk assessment techniques were applied, final resolution of this issue will require a consensus risk management decision. Of paramount importance is the determination of what level of risk is acceptable in light of the extent of the dieldrin. EnSafe/Allen & Hoshall as the contractor can only provide the facts and suggestions for a viable risk management strategy. The following paragraph outlines suggestions based on currently available information and the preceding risk evaluation.

Due to the ubiquitous presence and documented proper historical use, institutional controls are considered the most appropriate means of dealing with the dieldrin issue from a human health perspective. These controls may include (but are not limited to) public/worker awareness, access restrictions and maintenance of adequate vegetative cover to minimize contact. The focus of future investigative efforts should center around prevention of further migration (i.e. surface runoff) and evaluation of sensitive ecological receptor points (i.e. terrestrial habitats, drainage systems, streams, lakes and pond). These areas should be emphasized as little control can be exercised over the animals who use them.

NAS-Memphis Dieldrin Risk Projections

| Location | Maximum Dieldrin (mg/kg) | Mean Dieldrin (mg/kg) | Residential @ Max | Residential @Mean | Industrial @ Max | Industrial @Mean |
|---|---|---|---|---|---|---|
| SWMU 1 | 0.192 | NA | 7.04E-06 | NA | 1.12E-06 | NA |
| SWMU 3 | 0.023 | 0.0072 | 8.43E-07 | 2.64E-07 | 1.34E-07 | 4.19E-08 |
| SWMU 5 | 0.609 | 0.126 | 2.23E-05 | 4.62E-06 | 3.54E-06 | 7.33E-07 |
| SWMU 7 | 0.055 | 0.0095 | 2.02E-06 | 3.48E-07 | 3.2E-07 | 5.52E-08 |
| SWMU 8 | 0.471 | 0.144 | 1.73E-05 | 5.28E-06 | 2.74E-06 | 8.37E-07 |
| SWMU 60 | 0.069 | 0.0155 | 2.53E-06 | 5.68E-07 | 4.01E-07 | 9.01E-08 |
| Background | 0.311 | 0.131 | 1.14E-05 | 4.8E-06 | 1.81E-06 | 7.62E-07 |

Oral Slope Factor (mg/kg-d)-1 16

# Appendix C

## Technical Memorandum on Potential Impact to Off-Base Drainage Systems

**EnSafe / Allen & Hoshall**
a joint venture for professional services

5720 Summer Trees Dr. Suite 8 Memphis, TN 38134
(901) 383-9115 Fax (901) 383-1743

TECHNICAL MEMORANDUM

TO: Mark Taylor/David Porter, SOUTHDIV
Tonya Barker/Rob Williamson, NSA Memphis
Jack Carmichael, USGS
David Williams/Brian Donaldson, EPA Region IV
Jim Morrison/Clint Willer, TDEC
Brenda Duggar, MSCHD

FROM: Lawson Anderson, E/A&H
Fred Swan, E/A&H

DATE: March 19, 1996

RE: Potential Impact to Off-Base Drainage Systems (North Fork Creek, Big Creek Drainage Canal); NSA Memphis RFI; CTO-094/CTO-0106

NSA Memphis storm water flows through a series of basewide drainage ditches into two principal offsite drainage systems — North Fork Creek and the Big Creek Drainage Canal. The Draft Assembly B RFI Report (E/A&H, November 22, 1995) concludes that the current state of the NSA Memphis Northside drainage ditches does not warrant further action. However, as discussed at the February BRAC Cleanup Team (BCT) meeting, the BCT is concerned that the offsite systems may have been impacted by the years of discharges from the on-base ditches.

**North Fork Creek**

Solid Waste Management Units (SWMUs) 4, 6, and 38 are drainage ditches/storm sewers that flow into North Fork Creek in the southwestern corner of the Northside. As described in the Assembly B report, analytical results for sediment/soil samples indicate the presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), metals, pesticides, and herbicides in the on-base drainage ditches and in North Fork Creek. In most samples, the extent of contamination was limited to sediments in the upper 6 inches of the ditches. Sample 38-7, collected from North Fork Creek north of Navy Road and above the confluence of the on-base drainage system, had no contamination above 2X mean background, Risk Based Concentrations (RBCs), or EPA Region IV Sediment Screening Values (SSVs). Sample 38-8 (Figure 1), collected from North Fork Creek on off-base property just south of Navy Road and below the confluence of the on-base drainage system, had a number of SVOCs and metals concentrations exceeding RBCs and/or SSVs. As the Assembly B report states, it is possible that runoff from Navy Road is a major contributor to the contamination detected in sample 38-8.

**Big Creek Drainage Canal**

Big Creek is the primary receptor for the NSA Memphis drainage system, including North Fork Creek. The drainage canal forms the southern boundary of NSA Memphis (with the exception of SWMU 9, the sewage lagoons, which is south of the canal), and is one of the major drainage systems for the surrounding area. Sediment/soil sample data from the ongoing RFI at SWMUs 2 (the Southside Landfill) and 9 indicate the presence of VOCs, SVOCs, TPH, metals, pesticides, and herbicides. However, all contaminant concentrations for SWMU 2 samples were less than those measured upstream of the base. With the exception of metals results, this was also true for SWMU 9 samples. Beryllium exceeded residential RBCs and cadmium exceeded SSVs in most SWMU 9 samples and in the upstream sample. One SWMU 9 sample also had exceedances for arsenic (RBC and SSV) and nickel (SSV).

**Off-Base Impact**

Historical impacts to offsite drainage systems may be difficult to assess and delineate primarily because of past channelization of the creek and canal. It is likely that any potentially contaminated sediments deposited in North Fork Creek or the Big Creek Drainage Canal by flow from NSA drainage ditches are now at the bottom of the spoil piles that make up a part of their steep banks due to channelization.

E/A&H personnel recently walked North Fork Creek (between its confluence with Big Creek Drainage Canal and Navy Road) and the Big Creek Drainage Canal (between its confluence with North Fork Creek and SWMU 9). Other than a wide area at the Navy Road bridge, the channels of both the creek and the canal are deep with steep banks. The wide area at the bridge represents the sampling location with the greatest potential for ponding and sedimentation. This is where sample 38-8 was collected.

The site visit and followup telephone calls to the U.S. Army Corps of Engineers, the City of Millington, and the Shelby County Engineer, identified several other factors that should be considered when evaluating the potential for offsite contamination. These are presented in Figure 1 and listed below.

For North Fork Creek, the potential concerns are:

- Channelization.
- Domestic trash scattered throughout the gully behind the MAPCO station at Navy and Easley roads.
- Domestic trash and construction debris have been dumped into the creek near the Shady Grove Mobile Home Community.
- Runoff from the agricultural field located on the eastern bank.
- Behind D&S Redi-Mix Concrete Co., concrete truck clean-out has been poured down the steep bank at the confluence of North Fork Creek and the Big Creek Drainage Canal.

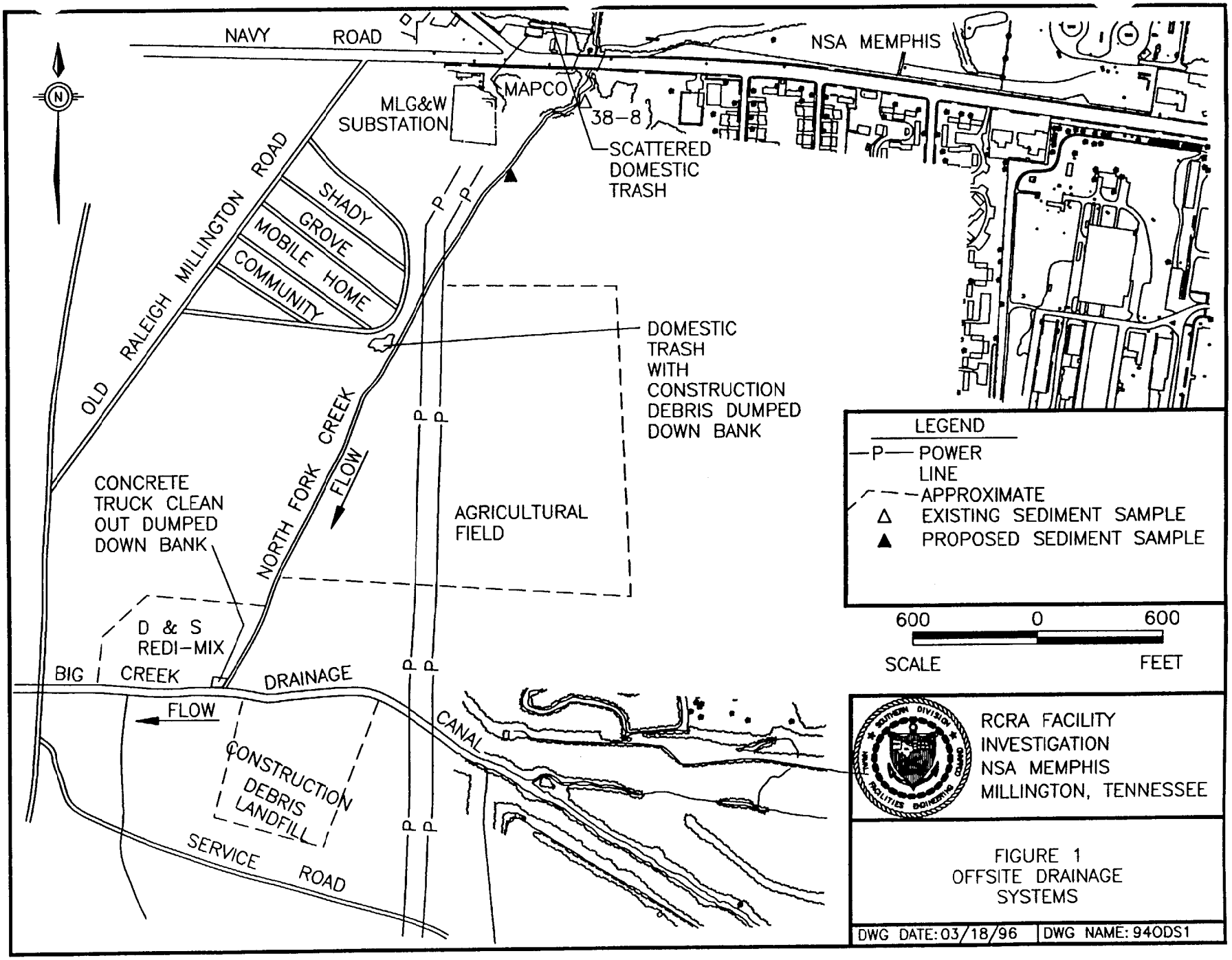
For Big Creek Drainage Canal, the potential concerns are:

- Channelization.
- In most cases, the sample collected upstream of NSA Memphis contained contaminants at concentrations greater than those detected downstream.
- A construction debris landfill on the south bank of Big Creek Drainage Canal east of NSA Memphis.

## Recommendations

Because of the relatively low concentrations of contaminants in Big Creek Drainage Canal and the presence of upstream contamination, E/A&H recommends that no additional samples be collected from the canal at this time. This recommendation may be revised after further evaluation of the data from SWMUs 2 and 9.

One additional sample location (Figure 1) is recommended for North Fork Creek between the sample 38-8 location and the mobile home park. Two intervals will be sampled — 0 to 6 inches and 18 to 24 inches. The samples will be collected, managed, and analyzed (full scan analysis) as described in the Assembly B site investigation plan for the Northside drainage ditches.


NAVY ROAD
NSA MEMPHIS
MAPCO
MLG&W SUBSTATION
38-8
SCATTERED DOMESTIC TRASH
OLD RALEIGH MILLINGTON ROAD
SHADY GROVE MOBILE HOME COMMUNITY
DOMESTIC TRASH WITH CONSTRUCTION DEBRIS DUMPED DOWN BANK
NORTH FORK CREEK
FLOW
CONCRETE TRUCK CLEAN OUT DUMPED DOWN BANK
AGRICULTURAL FIELD
D & S REDI-MIX
BIG CREEK DRAINAGE
FLOW
CANAL
CONSTRUCTION DEBRIS LANDFILL
SERVICE ROAD
LEGEND
POWER LINE
APPROXIMATE
EXISTING SEDIMENT SAMPLE
PROPOSED SEDIMENT SAMPLE
600 0 600
SCALE FEET
RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 1
OFFSITE DRAINAGE SYSTEMS
DWG DATE: 03/18/96
DWG NAME: 94ODS1

# Appendix D

## Review of Field Notes on Habitat Conditions

Field Observations:

The following field observations were recorded by Mr. Chuck Mason of E/A&H during the May 1 through May 5, 1995 sampling event of the NSA Memphis Northside drainage ditches. In general, the drainage ditches around the NSA Memphis Northside contained relatively little water, which appeared stagnant and only flowed in direct response to precipitation. The ditches were surrounded almost exclusively by maintained fields and parking lots. These features limit the retention of rainwater and hence contribute to the ditches flowing only in immediate response to precipitation. Most portions of the ditches have narrow, 20 to 50 foot bands of trees and similar vegetation surrounding them.

The lack of a constant source of water and the high level of development in the area reduces the value of the drainage ditches as a potential habitat for fish or other aquatic species. It is possible that bird species or mammalian species may use the drainage ditches as a source of water, but there were no animal tracks noted in the area of the creek beds during the sampling event. Other creeks and ditches in the area may be more preferable as a source of water than the Northside Drainage Ditches.

There is no record of any threatened or endangered species which use the drainage ditches as a source of food or habitat. A database search conducted by the Tennessee Department of Environment and Conservation (Appendix E) indicates that there are no threatened or endangered species known to inhabit NAS Memphis.

Specific observations about specific portions of the drainage ditches are included:

SWMU 31- There were no ditches noted in the area of this SWMU. The area was a maintained field and an asphalt parking lot with a few buildings. One soil sample was collected near a drainage culvert which led from the field and the parking lot. This area did not appear to be a viable habitat for any ecological receptors. It is possible that the area may be used for burrowing animals or passerine birds. Other animals may also use the area on a periodic basis but it did not appear suitable as a permanent habitat.



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SWMU 6- Seven samples were collected from five locations in the area of SWMU 6. This portion of the drainage ditches appeared to have shallow stagnant water which only flowed in response to the storm events which occurred during the field sampling effort. There was no evidence of aquatic life in the ditches such as larval midges, minnows, or other aquatic life typically associated with small streams. The sediment was a coarse brown sand underlain by a tight gray clay, neither of which would be expected to maintain a viable aquatic community.

SWMU 4- Three samples were collected from two locations in the area of SWMU 4. The stream banks in this area had a very steep slope and there was a lot of gravel in the upper six inch interval and tight clay in the 18 to 24 inch interval. No evidence of aquatic life was seen.

SWMU 10- Five samples were collected from four locations in the area of SWMU 10. The sediment was a hard silty clay and no evidence of aquatic life was seen.

SWMU 38- Seven samples were collected from four locations within North Fork Creek and the drainage ditch that leads directly into it. Sample location 38-5 and others downgradient had a steady flow of water, possibly due to the thunderstorms which had come through the area during the early morning of May 4th. The sediment within the drainage ditch leading to North Fork Creek was very rocky and was composed of hard clay below. No evidence of aquatic life was seen in the drainage ditch.

Sediment samples were collected along the edge of North Fork Creek. Sediment within the creek channel was not observed, but it appears that it could support aquatic life. There was no evidence of aquatic life seen.



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## Appendix E

## TDEC Review of Endangered Species and Critical or Sensitive Habitat

STATE OF TENNESSEE
**DEPARTMENT OF ENVIRONMENT AND CONSERVATION**
401 Church Street
Nashville, Tennessee 37243

August 27, 1996

Mr. Chuck Mason
Ensafe / Allen & Hoshall
303 Butler Farm Road
Suite 113
Hampton VA 23666

**Subject: Project review information for rare, threatened, or endangered species and critical or sensitive habitat**

Dear Mr. Mason:

Please be advised that a review of our Departmental data bases indicates **no** recorded threatened and/or endangered species within the project boundaries nor within a one mile radius of the proposed project. Our records do indicate several other species occurrence records within an approximate four mile radius of the proposed project site(s). The review is for the proposed **RCRA Facility Investigation, Millington U.S. Naval Air Station, near Millington, Shelby County, TN** project site(s). As per your request, the species that have recorded occurrences near the project site(s) are listed by quad map and are attached.

Please do not make public the exact location of any element listed here-in, as this could lead to possible over-collection and abuse.

The results of our review do not mean that a comprehensive biological survey has been completed. Should you consider a survey of the project sites, prior to project implementation, we would appreciate you notifying our office of your findings.

In order to comply with the National Environmental Policy Act consideration should be given to the comprehensive and *cumulative* impacts associated with the project actions. Based upon the information provided, it is probable that any proposed stream crossing will impact instream, aquatic, habitat and riparian habitat as part of the project implementation.

Any restoration activities should include the use of native plant species. Restoration should be accomplished by using native plant species consistent with local community types.

Techniques for sediment retention and streamside reconstruction are outlined in the following documents prepared by our Department:

1. **Tennessee Erosion Control Handbook, July 1992.**

2. **Reducing Nonpoint Source Water Pollution by Preventing Soil Erosion and Controlling Sediment on Construction Sites, March 1992.**

3. **Riparian Restoration and Streamside Erosion Control Handbook, November 1994.**

Please refer to these documents when planning measures to lessen any project or construction impacts.

We appreciate the opportunity to assist you with your pre-project planning. If we can be of further assistance with your project please contact our office in Nashville, telephone 615/532-0431.

Respectfully,

Andrew N. Barrass Ph. D.,
Environmental Review Coordinator
Division of Natural Heritage

Attachments: (3)

***HABITAT INFORMATION FOR ENDANGERED SPECIES AND CRITICAL OR SENSITIVE HABITAT FOR LOCATIONS NEAR THE PROJECT SITE AND WITHIN ONE MILE OF THE PROJECT SITE:***

The following habitat description has been retrieved from our Department national data base for the purpose of scientific field review and population determinations.

**Northern Pine Snake;**
**PITUOPHIS MELANOLEUCUS** *Lowlands to mountains; desert, prairie, brushland, woodland, open coniferous forest, farmland, marshes. Eastern populations occupy sandy pine woods and dry shaly ridges; midwestern population inhabit prairies; western and Mexican populations occur from coastal grasslands and forests through deserts into montane forests (Sweet and Parker 1990). Terrestrial, fossorial, and arboreal. Underground in cold weather. See Burger and Zapplorti (1988, 1989) for information on habitat use in New Jersey. Hibernacula and summer dens in New Jersey usually were beside old fallen logs, with entrance tunnels following decaying roots into soil; snakes in hibernacula were at depths of 50-110 cm; see Burger et al. (1988) for further details. **usually found in sandy pine woods or dry mountain ridges (B80EA01TNUS)

Note: This species currently does not have any State or Federal protection status. The species and habitat sites are considered significant and are tracked by our Division staff.

Because the habitat for the animal species listed is very specific, you may wish to request further information from our zoologist, Mr. David Withers, in our office in Nashville. He may be reached by telephone at **615/532-0431**.

LIST OF RARE, THREATENED, AND ENDANGERED SPECIES FOR THE BRUNSWIC

| SCIENTIFIC NAME | COMMON NAME | FEDERA STATUS |
|---|---|---|
| PLANTS | | |
| PANAX QUINQUEFOLIUS | AMERICAN GINSENG | |
| PRENANTHES CREPIDINEA | NODDING RATTLESNAKE-ROOT | |
| VERTEBRATES | | |
| LIMNOTHLYPIS SWAINSONII | SWAINSON'S WARBLER | |
| LUTRA CANADENSIS | NORTHERN RIVER OTTER | |
| PITUOPHIS MELANOLEUCUS MELANOLEUCUS | NORTHERN PINE SNAKE | |

5 Records Processed

| QUADNAME:..... | SCOMNAME:..... | SNAME:..... |
|---|---|---|
| | NORTHERN RIVER OTTER | LUTRA CANADENSIS |
| NSWICK | NORTHERN RIVER OTTER | LUTRA CANADENSIS |
| BRUNSWICK | NODDING RATTLESNAKE-ROOT | PRENANTHES CREPIDINEA |
| MILLINGTON | SWAINSON'S WARBLER | LIMNOTHLYPIS SWAINSONII |
| MILLINGTON | SWAINSON'S WARBLER | LIMNOTHLYPIS SWAINSONII |
| | NORTHERN RIVER OTTER | LUTRA CANADENSIS |
| MILLINGTON | NORTHERN PINE SNAKE | PITUOPHIS MELANOLEUCUS |
| MILLINGTON | AMERICAN GINSENG | PANAX QUINQUEFOLIUS |
| | NORTHERN RIVER OTTER | LUTRA CANADENSIS |

9 Records Processed

# Federal Status Definitions of Tennessee's Rare Plants and Animals

Federally listed species are protected by the Endangered Species Act of 1973 (as amended) and the list is administered and determined by the US Fish and Wildlife Service.

E/SA - Endangered by similarity of appearance.

LE - **Listed Endangered**, the taxon is threatened by extinction throughout all or a significant portion of its range.

LT - **Listed Threatened**, the taxon is likely to become an endangered species in the foreseeable future.

PE - **Proposed Endangered**, the taxon is proposed for listing as endangered.

PT - **Proposed Threatened**, the taxon is proposed to be listed as threatened.

Y - **Synonyms**

C - **Candidate Species**, These 'Candidate' species are not currently proposed for listing, but development and publication of proposed rules for such candidate species is anticipated. The US Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. The US Fish and Wildlife Service will determine the relative listing priority of these candidate species, and encourages other agencies, groups and individuals to give consideration to these taxa in environmental planning.

C2 - DESIGNATION DISCONTINUED
C3 - DESIGNATION DISCONTINUED
  3A - DESIGNATION DISCONTINUED
  3B - DESIGNATION DISCONTINUED
  3C - DESIGNATION DISCONTINUED

__NL - status varies for different populations or parts of range with at least one part not listed.

__XN - non-essential experimental population

__XE - essential experimental population

**(Modified From Federal Register, 50 CFR Part 17, Feb. 28, 1996, Vol. 61, No. 40, pp. 7596 - 7613.)**

**Note:** The taxa listed as candidate species may be added to the list of Endangered and Threatened plants and animals, and, as such, consideration should be given them in environmental planning. Taxa listed as LE, LT, PE and PT must be given consideration in environmental planning involving federal funds, lands, or permits, and should be given consideration in all non-federal activities. For further information contact the Region 4, Endangered Species Coordinator, at the US Fish and Wildlife Service, 1875 Century Boulevard, Atlanta, Georgia 30345, phone (404)679-7096; or an Endangered Species Specialist at the US Fish and Wildlife Service, 446 Neal Street, Cookeville, Tennessee 38501, phone (615)528-6481.

## State Status Definitions of Tennessee's Rare Plants

State Status indicates which plants are formally listed as state **Endangered**, **Threatened**, or **Special Concern** under the authority of the **Tennessee Department of Environment and Conservation** The Department has the valuable assistance of the State's best field botanists, twelve of whom serve on the Scientific Advisory Committee which periodically reviews the list.

**E - Endangered**, species now in danger of becoming extinct in Tennessee because of:
(a) their rarity throughout their range, or
(b) their rarity in Tennessee as a result of sensitive habitat destruction or restricted area of distribution.

**E* -** Taxa considered to be **Endangered** in Tennessee due to evidence of large numbers being taken from the wild and lack of commercial success with propagation or transplantation.

**T - Threatened**, species likely to become endangered in the immediately foreseeable future as a result of rapid habitat destruction or commercial exploitation.

**S - Special Concern**, species requiring concern because of:
(a) their rarity in Tennessee because the State represents the limit or near-limit their geographic range, or
(b) their status is undetermined because of insufficient information.

**P - Possibly Extirpated**, species that have not been seen in Tennessee for the past 20 years.

**(Adapted from Somers, Paul. 1989. Revised List of the Rare Plants of Tennessee. Journal of the Tennessee Academy of Sciences, 64(3): 179-184.)**

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## State Status Definitions of Tennessee's Rare Wildlife

State Status indicates which animals are formally listed as state endangered or threatened under the authority of the Tennessee Wildlife Resources Agency (T.C.A. 70-8-104, 70-8-105, and 70-8-107).

**E - Endangered-** any species or subspecies of wildlife whose prospects of survival or recruitment within the state are in jeopardy or are likely within the foreseeable future to become so due to any of the following factors:
(a) The destruction, drastic modification, or severe curtailment of its habitat;
(b) Its overutilization for scientific, commercial or sporting purposes;
(c) The effect on it of disease, pollution, or predation;
(d) Other natural or man-made factors affecting its prospects of survival or recruitment within the state; or
(e) Any combination of the foregoing factors.

**T- Threatened-** any species or subspecies of wildlife which is likely to become an endangered species within the foreseeable future.

**D - Deemed in Need of Management-** any species or subspecies of nongame wildlife which the executive director of the TWRA believes should be investigated in order to develop information relating to population, distribution, habitat, needs, limiting factors, and other biological and ecological data to determine management measures necessary for their continued ability to sustain themselves successfully.

**Note: Species with no State Status designation are considered rare in the state by the Division of Natural Heritage. Information is collected on these species in order to minimize their formal listing as Endangered or Threatened.**

# State Rank Definitions of Tennessee's Rare Wildlife

As a supplement to the official State and Federal status designations, the **Division of Natural Heritage (Tennessee Department of Environment & Conservation)** publishes this accompanying list of **State Ranks** as determined using methodology developed by The Nature Conservancy. Where possible, State Ranks are assigned based upon known occurrences of rare animals and published range maps. Otherwise ranks are assigned based upon the best available information, with all State Ranks being periodically reviewed and updated. Many species which have neither federal nor state protected status are tracked by the Heritage Program based upon their State Rank. In particular, these include species which are state endemics, have a narrow range in Tennessee, or which are facing particular threats, and for which neither state nor federal laws have extended legal protection. **State Ranks** are defined as follows:

**S1 = Critically imperiled in the state** because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state (Typically 5 or fewer occurrences or very few remaining individuals).

**S2 = Imperiled in the state** because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state (6 to 20 occurrences or few remaining individuals).

**S3 = Rare and uncommon in the state** (21 to 100 occurrences).

**S4 = Widespread, abundant, and apparently secure in state**, with many occurrences, but of long-term concern (Usually more than 100 occurrences).

**S5 = Demonstrably widespread, abundant, and secure in the state**, with stable and sustainable populations under present conditions.

**SA = Accidental**: Accidental or casual in the state (i.e., infrequent and far outside usual range).
**SH = Historical**: Occurred historically in the state, and suspected to be extant.
**SP = Potential**: Potential that the species occurs in the state, but no occurrences reported.

**SR = Reported**: Reported in the state but without conclusive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report. Also includes species for which the Tennessee Divison of Natural Heritage does not have data to allow accurate mapping of the occurrence.

**SSYN = Synonym**: Reported from the state, but has been synonymized with another taxon.

**SU = Unrankable**: Possibly in peril in the state, but status uncertain; need more information.
**SX = Extirpated**: Believed to be extirpated from the state.

**S#S# = Numeric range rank**: A range between two of the numeric ranks (e.g. S1S2, Smoky Dace).
**S? = Unranked**: Species not yet ranked in the state.

**HYB = Hybrid**: Taxon represents a hybrid between species.

**B = Breeding**: Considered a breeding population within the state.
**N = Non-breeding**: Considered a non-breeding population within the state.
**? = Inexact** or uncertain rank.

Note: DNH has responsibility for assigning state ranks. Those species having an **SRANK** of **S1** to **S3**, **state endemics**, and species with **limited distribution** in Tennessee should be given special consideration in environmental planning. For further information contact DNH at (615) 532-0431.

# ASSEMBLY B RFI REPORT
# NAVAL SUPPORT ACTIVITY MEMPHIS
# MILLINGTON, TENNESSEE

## RCRA FACILITY INVESTIGATION
## SWMU 40 — SALVAGE YARD NO. 1

Revision 1

CTO-094
Contract No. N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

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5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

October 7, 1996

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## EXECUTIVE SUMMARY

This RCRA Facility Investigation (RFI) Report provides the results of a Direct Push Technology (DPT) investigation at SWMU 40. During the investigation, EnSafe/Allen & Hoshall and the U.S. Geological Survey collected soil and groundwater samples throughout the site and submitted them to a mobile onsite laboratory for the analysis of volatile organic compounds (VOCs). The VOC results indicate a petroleum release has occurred at the site, likely related to the operation of a former service station during the 1940s. The highest petroleum-related constituent concentrations were in subsurface soil samples between 5 and 11 feet below land surface at DPT locations 8, 13, and 14. These sampling locations are within a 50-square-foot area near the estimated location of the former service station's two underground storage tanks (USTs) and their associated fuel lines. A recent geophysical survey indicates the USTs and fuel lines still may be present.

The residential risk-based concentration (RBC) was exceeded for at least one of the following compounds at DPT locations 8, 13, and 14: 1,2,4-trimethylbenzene (RBC = 39,000 ppb, detected concentrations 65,000 ppb to 186,000 ppb); 1,3,5-trimethylbenzene (RBC = 33,000 ppb, detected concentrations 40,800 ppb to 94,500 ppb); and 1,2,3-trichloropropane (RBC = 91 ppb, detected concentration 650 ppb). No VOCs exceeded the industrial RBC for soil.

The ethylbenzene concentration from the loess groundwater sample at location 8 (1,150 ppb) exceeds the maximum contaminant level (MCL) for drinking water (700 ppb) but not the RBC for tap water (1,300 ppb). The 1,2,4-trimethylbenzene concentration in the loess groundwater sample from location 9 (107 ppb) exceeded the tap water RBC (3 ppb) (no MCL exists for this compound). The 1,2,4-trimethylbenzene concentration in the fluvial deposits groundwater sample from location 18 (5.1 ppb) also exceeds the tap water RBC (3 ppb). No VOCs were detected above a practical quantitation limit of 5 ppb in three USGS monitoring wells just north of the northcentral boundary of SWMU 40. Groundwater in the loess and fluvial deposits is not used for drinking water at NSA Memphis.



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Because the limited contamination at the site appeared to be associated with a petroleum UST system release, the BRAC Cleanup Team (BCT) recommended that SWMU 40 be closed under the UST program, with a separate work plan prepared for the closure. The BCT also recommended the collection and analysis of five surface-soil samples at various locations around SWMU 40 to evaluate exposure potential at the site. These samples were collected on September 25, 1995, and a preliminary risk evaluation (PRE) was prepared based on the analytical results. Based on the PRE performed, the property was deemed suitable for lease in industrial or residential scenarios.

During June 1996, the USTs and associated lines at SWMU 40 were removed. Based on the analytical results and the PRE prepared, no further action is recommended under the RFI at SWMU 40.



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## 1.0 INTRODUCTION

As part of the U.S. Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report has been prepared for Solid Waste Management Unit (SWMU) 40, the former Salvage Yard No. 1, located on the Northside of Naval Support Activity (NSA) Memphis, Millington, Tennessee. Figures 1-1 and 1-2 provide a vicinity map and an aerial photograph of SWMU 40, respectively. As a result of the Base Closure and Realignment Act of 1990, a portion of NSA Memphis, which includes SWMU 40, will be closed and prepared for transfer to the City of Millington.

Eight SWMU assemblies (i.e., groups) have been defined for the NSA Memphis RCRA Corrective Action Program. Four of these assemblies (A, B, C, and D) are on closing portions of NSA Memphis and have been categorized and prioritized according to their Base Realignment and Closure (BRAC) status. SWMU 40, an Assembly B SWMU, is one of the 15 SWMUs at NSA Memphis which require an RFI because of known or suspected surface releases of contaminants. The remaining four assemblies (E, F, G, and H) are located within those portions of NSA Memphis which will remain open.

The RFI was performed by EnSafe/Allen and Hoshall (E/A&H) and the U.S. Geological Survey (USGS). The first phase of the RFI consisted of collecting soil and groundwater samples using Direct Push Technology (DPT) equipment. The analytical results of the DPT investigation indicate the presence of petroleum constituents in subsurface soil and, to a lesser extent, groundwater near the former location of a service station which occupied the north central portion of the site during the 1940s. Based on the DPT survey results, the BRAC Cleanup Team (BCT) recommended that SWMU 40 be closed under the underground storage tank (UST) program, with a separate work plan prepared for the closure. The BCT also recommended the collection and analysis of five surface-soil samples at various locations around SWMU 40 to



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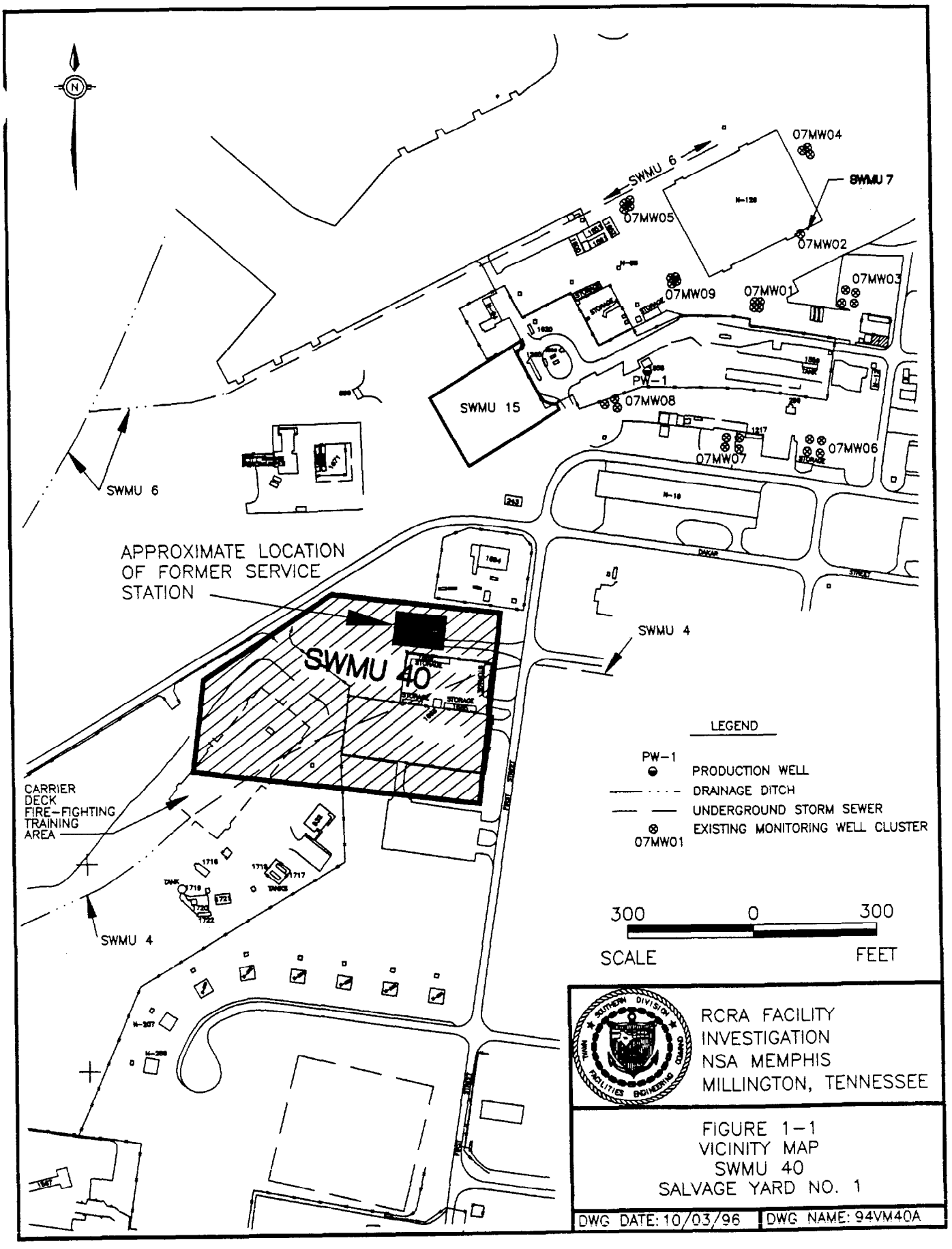
evaluate exposure potential at the site. These samples were collected on September 25, 1995, and a preliminary risk evaluation (PRE) was prepared based on the analytical results. The PRE prepared is included as Section 7 of this RFI report.



000294


N
07MW04
SWMU 6
SWMU 7
07MW05
07MW02
07MW03
07MW09
07MW01
PW-1
07MW08
SWMU 15
07MW07
07MW06
SWMU 6
APPROXIMATE LOCATION
OF FORMER SERVICE
STATION
SWMU 40
SWMU 4
CARRIER
DECK
FIRE-FIGHTING
TRAINING
AREA
SWMU 4
LEGEND
PW-1
PRODUCTION WELL
DRAINAGE DITCH
UNDERGROUND STORM SEWER
07MW01
EXISTING MONITORING WELL CLUSTER
300
0
300
SCALE
FEET
RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 1-1
VICINITY MAP
SWMU 40
SALVAGE YARD NO. 1
DWG DATE: 10/03/96
DWG NAME: 94VM40A

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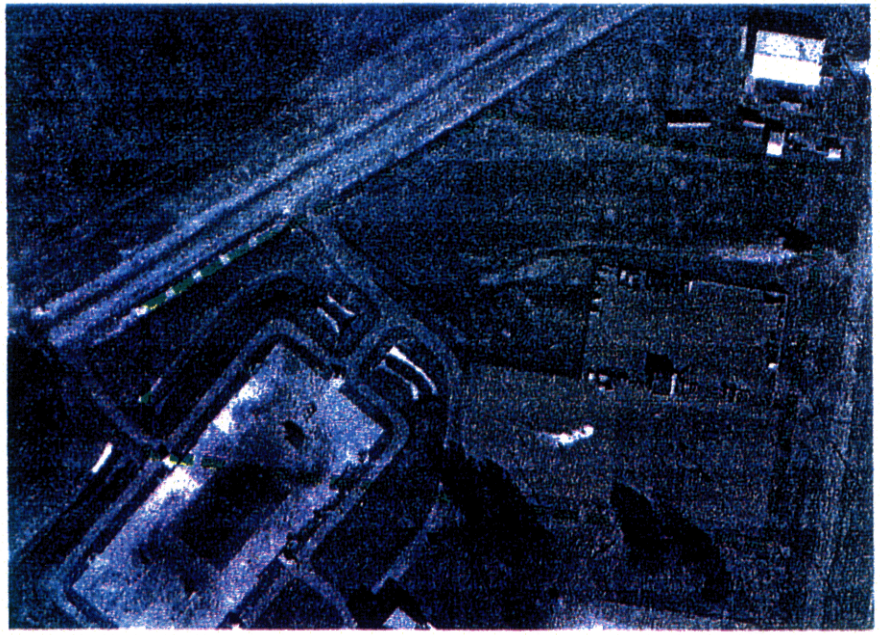
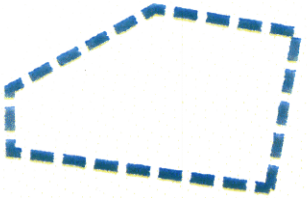
000296

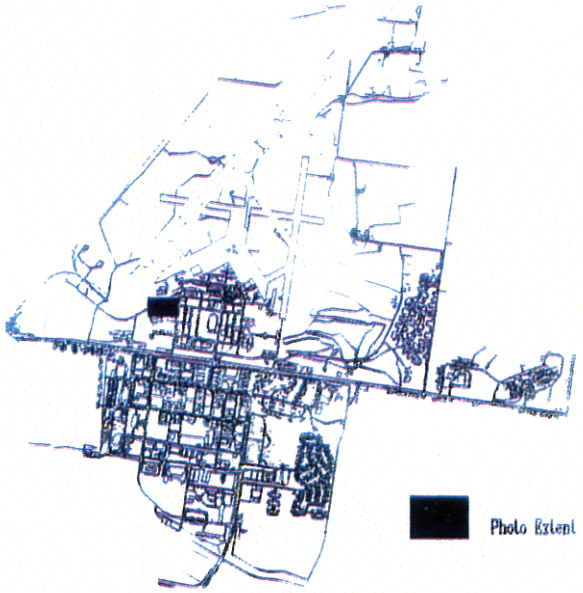


SWMU 40
BOUNDARY



Photograph Scale

0 250 500 Ft.




RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 1-2
DIGITAL ORTHOPHOTOGRAPH
SALVAGE YARD NO. 1
SWMU 40

AMLI home1/ed1/store/dlk_dtrl

000237

00608E07X

# 2.0 SITE DESCRIPTION AND HISTORICAL SITE INFORMATION

## 2.1 Site Description

SWMU 40 consists of two formerly fenced-in, open storage areas designated as Areas N-813 and N-1666. SWMU 40 is located in the southern portion of NSA Memphis Northside, southwest of Building N-1694 (Hazardous Waste Storage Facility) and east of the Carrier Deck Fire Fighting Training Area. First Avenue runs along the east boundary of the site and Dakar Street Extended along the northwest side. Figure 2-1 provides a site map of the area.

The SWMU 40 area has been disturbed by past activities but generally is level. A shallow drainage ditch that follows Dakar Street along the northern border of the site drains southwest. Surface drainage across the site is in a southwesterly direction toward SWMU 4 (Figure 1-1), a tributary to SWMU 38, which discharges to North Fork Creek near the southwestern corner of the NSA Northside.

## 2.2 Historical Site Operations

Salvage Yard No. 1 was used from 1945 until 1989 and, based on historical information, was not used for burying waste. Area N-813 (unpaved) formerly was used to store scrap airplane parts, anchor chains, and other equipment. Area N-1666 (asphalt-paved) was used for long-term, personally-owned vehicle parking and storage. The asphalt surface is low-quality paving consisting primarily of asphalt tailings generated from resurfacing runways. In 1988 and 1989, this area was converted into an asphalt parking area for mobile trailers and used for electronic communications training. The parking area has changed location and now consists of a fenced, concrete parking area in the southeastern portion of the site.

According to NSA Memphis Department of Public Works records, a service station formerly occupied the north-central portion of the SWMU 40 area. The service station building, designated as Building 244, was constructed in 1946. The service station was approximately



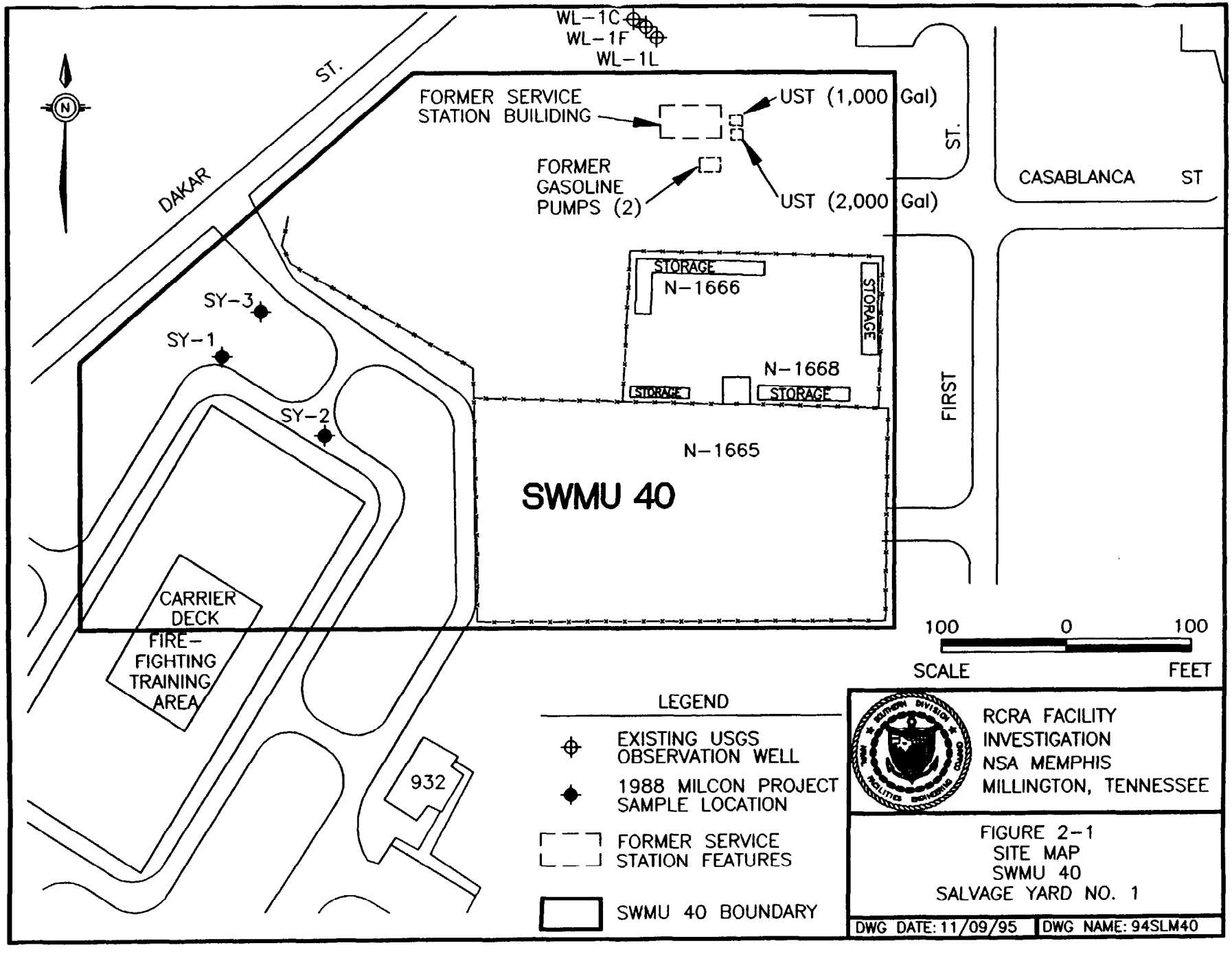
000203

40 feet long, 26.5 feet wide, and 10.8 feet high, with a concrete foundation and a lean-to type roof. According to a 1947 base map (Figure 2-2), a 1,000-gallon and a 2,000-gallon capacity UST were located east of the building, and a fuel island was located to the south of the building. Records indicate the USTs were abandoned in-place in 1949. NSA Memphis personnel reviewed a 1965 wall map of the base archived in the Public Works Engineering Department. According to this map, the site is designated as an equipment storage area and does not show the service station, USTs, or fuel island. No maps showing the SWMU 40 area are available for the time period 1948 through 1965; therefore, the demolition date of the service station and associated features is unknown.

The USTs at SWMU 40 were removed in June 1996, as part of the Navy's UST program.



000233


WL-1C
WL-1F
WL-1L
FORMER SERVICE STATION BUILIDING
UST (1,000 Gal)
UST (2,000 Gal)
FORMER GASOLINE PUMPS (2)
DAKAR
ST.
ST.
CASABLANCA ST
FIRST
STORAGE
N-1666
STORAGE
N-1668
STORAGE
STORAGE
N-1665
SWMU 40
SY-3
SY-1
SY-2
CARRIER DECK FIRE-FIGHTING TRAINING AREA
932
100 0 100
SCALE FEET
LEGEND
EXISTING USGS OBSERVATION WELL
1988 MILCON PROJECT SAMPLE LOCATION
FORMER SERVICE STATION FEATURES
SWMU 40 BOUNDARY
RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 2-1
SITE MAP
SWMU 40
SALVAGE YARD NO. 1
DWG DATE: 11/09/95
DWG NAME: 94SLM40

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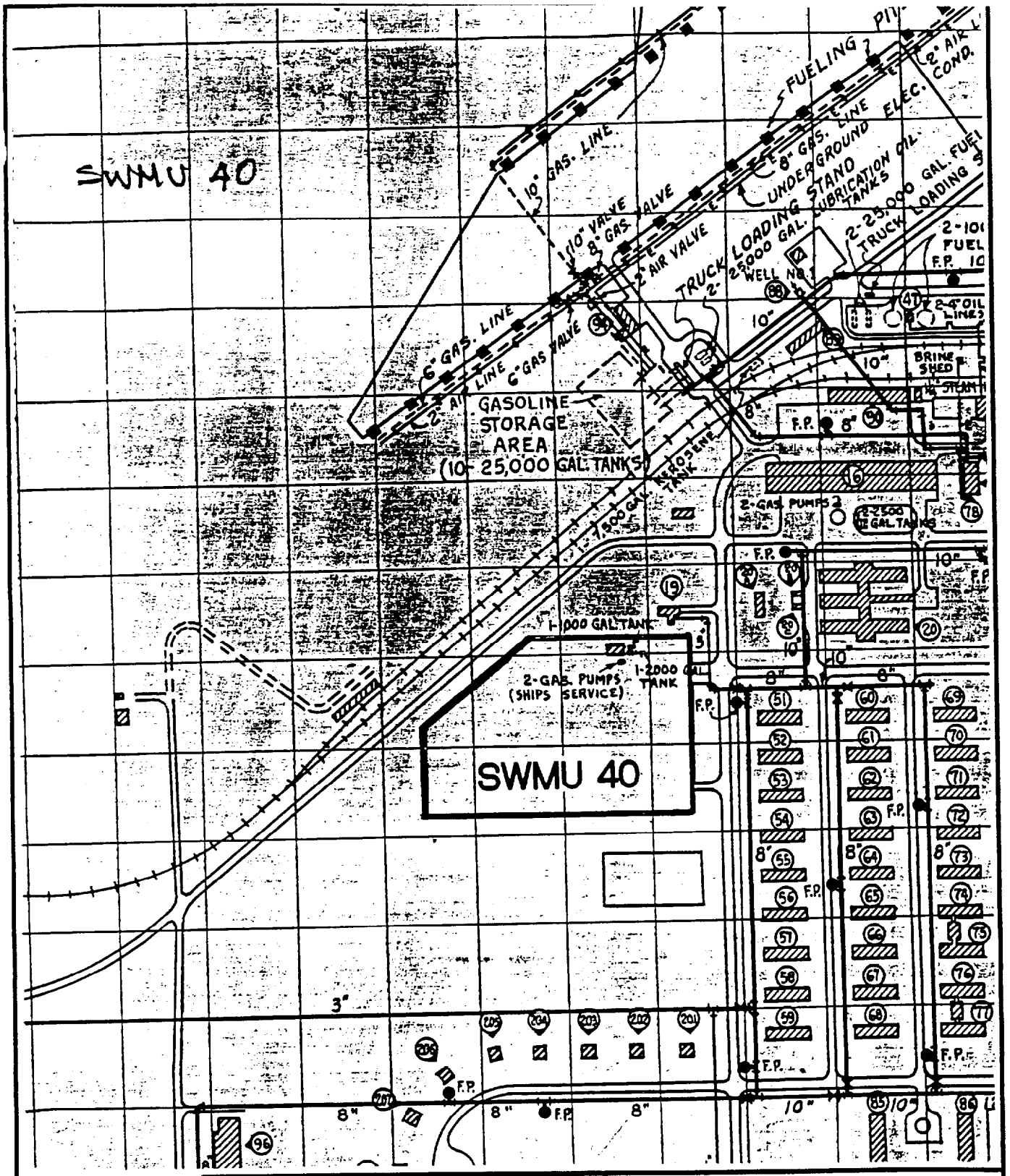


RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 2-2
1947 BASE MAP OF
NSA MEMPHIS WITH
SWMU 40 LOCATION INDICATED

DWG DATE: 11/09/95 | DWG NAME: C-8X11

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000303

## 3.0 PRELIMINARY INVESTIGATIONS

Investigations conducted previous to the RFI consist of the following:

- Sampling Report (Southern Division Naval Facilities Engineering Command [SOUTHDIV], 1988)
- Visual Site Inspection (ERC/EDGe, April 1990)
- Electromagnetic Geophysical Survey (E/A&H, 1994)

### 3.1 Sampling Report (SOUTHDIV, 1988)

SWMU 40 was investigated in August of 1988 in anticipation of a Military Construction (MILCON) project. Part of the MILCON project consisted of constructing the Carrier Deck Fire Fighting Training Area which encompasses the southwest portion of SWMU 40 (see Figure 2-1). Although SWMU 40 was scheduled to be investigated during the RFI, the MILCON project created a need for an expedited investigation while awaiting official approval of a previous RFI work plan (dated April 1987).

According to the Sampling Report dated August 11, 1988, a visual inspection identified "wide-spread discoloration of surface soils." Soil samples were collected from three locations and two depth intervals (0 to 1-foot and 1 to 3-feet below land surface [bls]) at SWMU 40. Figure 2-1 shows the sampling locations. The samples collected from the 0- to 1-foot interval were analyzed for total petroleum hydrocarbons (TPH) and total lead. Samples collected from the 1 to 3-foot interval were analyzed for TPH, lead, EP Toxicity, benzene, toluene, ethylbenzene, and xylenes (BTEX), and polychlorinated biphenyls (PCBs). Background TPH and lead concentrations were also established during this investigation. Soil samples were collected and analyzed from a background soil boring at the southwest corner of the intersection



000334

of Bougainville Street and First Avenue (see background sample location on Figure 1 in Appendix A).

Table 3-1 summarizes the analytical data for the three MILCON project sampling locations. Table 3-2 provides the background soil sample results, and Appendix A contains the relevant portions of the 1988 Sampling Report.

**Table 3-1**
**Soil Sample Analytical Summary — 1988 MILCON Project**

| Parameter | SY1 0-1 ft. | SY2 0-1 ft. | SY3 0-1 ft. | SY1 1-3 ft. | SY2 1-3 ft. | SY3 1-3 ft. |
|---|---|---|---|---|---|---|
| TPH (ppm[a]) | 1100 | 1850 | 839 | < 1 | < 1 | < 1 |
| Total Lead (ppm) | 70.3 | 15.7 | 17.9 | 7.49 | 6.79 | 10.0 |
| Lead (EP Toxicity) (ppm) | NA[b] | NA | NA | < 1 | < 1 | < 1 |
| Benzene (ppb[c]) | NA | NA | NA | < 10 ppb | < 10 ppb | < 10 ppb |
| Ethylbenzene (ppb) | NA | NA | NA | < 10 ppb | < 10 ppb | < 10 ppb |
| Toluene (ppb) | NA | NA | NA | < 10 ppb | < 10 ppb | < 10 ppb |
| Xylenes (ppb) | NA | NA | NA | < 10 ppb | < 10 ppb | < 10 ppb |
| PCBs (ppm) | NA | NA | NA | < 1 | < 1 | < 1 |

*Notes:*
ppm[a] = parts per million
NA[b] = sample was not analyzed for this parameter
ppb[c] = parts per billion

**Table 3-2**
**Background TPH and Total Lead Concentrations**
**Background Soil Boring Near SWMU 40**

| Parameter | 1-3 ft. | 7-8 ft. | 8-10 ft. | 10-12 ft. |
|---|---|---|---|---|
| TPH (ppm) | 389 | <1 | 9 | <1 |
| Total Lead (ppm) | 12.3 | 4.65 | 5.20 | 4.80 |



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As shown on Table 3-1, the samples collected from the 0 to 1-foot interval indicated the presence of TPH at concentrations ranging from 839 ppm to 1,850 ppm in the 0- to 1-foot interval. These samples reportedly contained asphalt fragments. No TPH was detected in soil samples from the 1- to 3-foot interval. The parking area where vehicles and equipment historically have been stored is paved with asphalt. Potential sources of the elevated TPH concentrations in the 0- to 1-foot interval samples may be the presence of asphalt in the samples collected or leakage from vehicles and equipment formerly stored in the area.

Lead concentrations in surface soil samples from the 0- to 1-foot interval ranged from 15.7 ppm to 70.3 ppm; however, no comparison to background concentrations can be made since the 0- to 1-foot interval was not sampled at the background location. The total lead concentration in soil samples from the 1- to 3-foot interval ranged from 6.79 ppm to 10.0 ppm, which is less than the background lead concentration (12.3 ppm) for the same interval.

The area of discolored soil noted in 1988 is no longer evident because it was disturbed during construction of the Carrier Deck Fire Fighting Training Facility.

### 3.2 Visual Site Inspection (SOUTHDIV, 1990)

During a 1990 visual site inspection, remnants of the foundation and fuel islands of a former service station were identified on the north-central portion of SWMU 40. According to the 1947 map of the area obtained from NSA Memphis Public Works, the service station area contained one 2,000-gallon tank and one 1,000-gallon tank (Figure 2-2).

### 3.3 Geophysical Survey (EnSafe/Allen & Hoshall, 1994)

A geophysical survey was performed by E/A&H in December 1994. The service-station location was confirmed using both engineering drawings and preliminary geophysical data

generated using frequency-domain electromagnetic instrumentation (EM-31). The EM-31 data show two well-defined anomalies consistent with areas within the service station boundaries.

The anomaly produced by the in-phase data from the survey (metal detection mode) encompasses an area about 10 by 13 feet and is similar to that produced by a large metallic tank or tanks. A relatively weak response from the conductivity part of the survey suggests that the tanks may be heavily corroded. Based on the geophysical data, it is believed that the USTs have not been removed. The conductivity survey also identified a relatively weak linear anomaly leading away from the UST area to the south-southwest. The length, width, and orientation of this anomaly suggest that it may be a former fuel-line trench connecting the USTs with the former pump island shown on Figure 2-2. However, the anomaly appears to be non-metallic in nature, suggesting that the lines either have been removed or are extensively corroded. The slightly conductive response is most likely due to moisture retention in disturbed soil along the fuel-line trench. Appendix B provides maps of the in-phase and conductivity portions of the geophysical survey.



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## 4.0 FIELD INVESTIGATIONS AND METHODOLOGY

The RFI soil and groundwater sampling program was intended to confirm the absence or presence of contaminants associated with past activities at SWMU 40. Specifically, the RFI objectives were to:

- Evaluate the nature and extent of surface and subsurface soil contamination associated with equipment storage, vehicle parking, and service-station activities.

- Evaluate the nature and extent of groundwater contamination in the loess and upper fluvial deposits (refer to Section 5.0 for a discussion of the geology and hydrogeology of the area).

- Determine the status of the underground storage tanks associated with the former service station.

This section summarizes the field sampling protocols employed during the first phase of the RFI, which were based on the USEPA and TDEC approved *Comprehensive RFI Work Plan* (E/A&H, 1994) and *Assembly B Site Investigation Plans* (SIP) (E/A&H, 1995). The SIP for SWMU 40 included a second phase of investigation, consisting of drilling and sampling soil borings and installing and sampling monitoring wells. However, this second phase was not implemented; after reviewing the results of the first phase, the BCT decided to postpone boring and well installations until the presence of the USTs has been confirmed, as well as to transfer the site to the UST program.

The subsurface soil and groundwater sampling tasks performed during the first phase followed the procedures outlined in the SIP, except where site conditions and field decisions warranted changes. Sampling locations were revised and additional sample locations were added to provide



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adequate coverage around SWMU 40, particularly in the former service-station area. Figure 4-1 shows the sampling locations. General sampling protocols and rationale for the subsurface soil and groundwater investigation are organized and presented in Sections 4.1 and 4.2, respectively, of this report. Specific sampling protocols (sample handling, field QA/QC and decontamination) are presented in Section 4.3.

**Analytical Methods**

Subsurface soil and groundwater samples were collected and analyzed to assess the nature and extent of contaminants at SWMU 40. Hydrologic, Inc. of Frankfort, Kentucky, operated an onsite mobile laboratory and tested the subsurface soil and groundwater samples for volatile organic compounds (VOCs) using USEPA Method 8021. As outlined in the work plan, approximately 25 percent of the samples submitted for onsite analysis were split (duplicates) and submitted to National Environmental Testing, Inc. (NET) in Bedford, Massachusetts for confirmation analysis by Solid Waste (SW) 846 Method 8240.

During the DPT investigation, onsite laboratory testing identified VOCs in several subsurface soil samples. For confirmation analysis, the onsite Hydrologic chemist split select samples and shipped them to their offsite laboratory in Frankfort, Kentucky for VOC analysis by one of the following methods: Method 8240, Method 8260, or Method 624.

To provide additional information regarding hydrocarbon contamination identified during the DPT investigation, the E/A&H geologist submitted one subsurface soil sample from each of two sampling locations (locations 8 and 13, see Figure 4-1) to NET for total petroleum hydrocarbons — gasoline and diesel-range organics (TPH GRO/DRO) analysis by the Tennessee Modified GRO.BTEX/DRO method and semivolatile organic compounds (SVOC) analysis by SW-846 Method 8270. These two locations are where the most significant hydrocarbon



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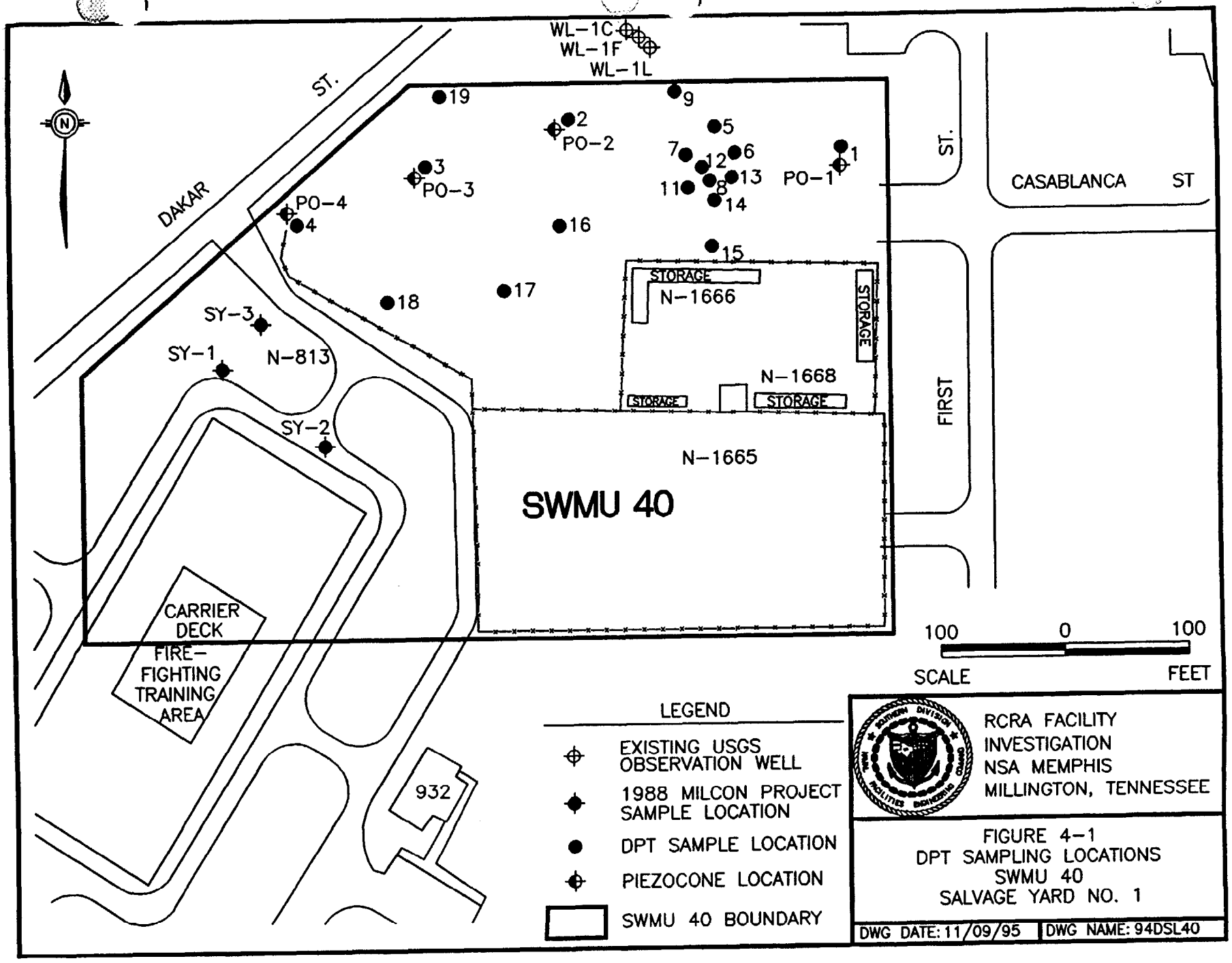
WL-1C
WL-1F
WL-1L
DAKAR
ST.
ST.
CASABLANCA
ST
FIRST
PO-1
PO-2
PO-3
PO-4
SY-1
SY-2
SY-3
N-813
N-1666
N-1668
N-1665
STORAGE
STORAGE
STORAGE
STORAGE
SWMU 40
CARRIER DECK FIRE-FIGHTING TRAINING AREA
932
100 0 100
SCALE
FEET
LEGEND
EXISTING USGS OBSERVATION WELL
1988 MILCON PROJECT SAMPLE LOCATION
DPT SAMPLE LOCATION
PIEZOCONE LOCATION
SWMU 40 BOUNDARY
RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 4-1
DPT SAMPLING LOCATIONS
SWMU 40
SALVAGE YARD NO. 1
DWG DATE: 11/09/95
DWG NAME: 94DSL40

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contamination had been detected with organic vapor field screening and onsite VOC analyses. Onsite and offsite laboratory analysis by Hydrologic was performed using a Level II-equivalent Data Quality Objective (DQO). NET performed offsite analyses using a Level IV-equivalent DQO for VOC and SVOC analyses and a Level III-equivalent DQO for TPH analyses.

**Direct Push Technology Methodology**

Between May 8 and 13, 1995, E/A&H and the USGS conducted the DPT survey at SWMU 40 to obtain subsurface soil and groundwater samples for VOC analyses. Subsurface Technologies, Inc. (SST) of Orlando, Florida provided and operated the DPT equipment.

The DPT investigation was conducted using truck-mounted, hydraulically operated probes to collect subsurface information. The *piezocone system*, which consists of an electronic cone penetrometer, was used to obtain lithologic information by obtaining and plotting measurements of point-stress, sleeve friction, and pore pressure as the tool was advanced from ground surface, through the loess, and into the upper part of the fluvial deposits. The *geocone sampler*, which is a 2-inch diameter split-spoon sampler with a push plug on the leading end, was advanced and retracted to retrieve relatively undisturbed subsurface soil samples from specific depths at various locations throughout the SWMU. The *GS-1* groundwater sampler obtained groundwater samples from discrete depths in the loess and upper part of the fluvial deposits (a vacuum had to be applied in some instances to obtain groundwater samples) and generated horizontal hydraulic conductivity information. Additional information regarding the DPT sampling methodology is provided in Section 4.4.4.3 of the *Comprehensive RFI Work Plan*.

## 4.1 Subsurface Soil Investigation

Fourteen initial DPT sampling locations were proposed in the *Assembly B Site Investigation Plans*. Based on field observations and the geophysical survey, USGS and E/A&H revised the

proposed sampling locations and added one additional location to provide adequate coverage throughout the SWMU.

An area of hydrocarbon contamination was identified at location 8 (see Figure 4-1) near the former fuel island south of the former service-station building. To obtain additional subsurface-soil information around this area, four sampling locations (locations 11, 12, 13, and 14; Figure 4-1) were added to the sampling effort.

### 4.1.1 Subsurface Soil-Sampling Rationale

Prior to subsurface soil and groundwater sample collection, SST completed four piezocone soundings (PO-1 through PO-4) from the east to the west side of the site to develop a lithologic profile. Figure 4-1 shows the piezocone locations, and Appendix C contains the piezocone-file information and plots. Based on the lithologic information generated by the piezocone plots, previous investigations at other NSA Memphis Northside sites, and the installation of nearby USGS monitoring wells, groundwater in the loess was anticipated to be between 11 and 12 feet bls, and the top of the fluvial deposits was anticipated to be approximately 40 feet bls. As outlined in the SIP, at least three subsurface soil and/or groundwater samples were collected from each proposed sampling location and submitted for onsite VOC analyses. The following sections provide details of the subsurface soil sampling procedures and deviations in the sampling scheme.

### 4.1.2 Subsurface Soil Sample Collection Methodology

Either an E/A&H or USGS geologist logged and processed the subsurface soil samples for field screening and submittal to the analytical laboratory. Subsurface soil samples were collected with the DPT rig using a 2-foot long, 2-inch outside diameter, split-spoon *geocone sampler*. Upon retrieval, the sampler was opened, and the soil was immediately screened for VOCs using an HNu (model GP 101, with a 10.2 or 11.7 eV lamp) photoionization detector (PID).



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A representative sample of the soil was collected and placed in a 4-ounce jar for onsite VOC analysis. Twenty-five percent of the soil samples were split for offsite laboratory analysis. A description of each subsurface soil sample, the field screening results, and sample location, designation, and time collected were recorded in the field logbook.

Subsurface soil samples were collected as outlined in the SIP from the shallow interval (1 to 3 feet bls) and from just above the water table (in the event that a loess water sample could not be collected). Exceptions to the soil sampling intervals occurred at sampling locations 18 and 19, where the shallow subsurface soil samples were collected from 2 to 4 feet due to poor sample recovery.

As previously mentioned, an area of hydrocarbon contamination was identified at location 8 (Figure 4-1). Four additional sampling locations (locations 11, 12, 13, and 14) were selected around location 8. The protocol used for the four additional sample locations was to collect split-spoon soil samples at two-foot intervals from 3 to 11 feet bls for field screening and potential onsite VOC analyses. No organic vapors were detected in samples from locations 11 and 12; therefore, samples were not submitted for analysis from these two locations. Samples from locations 13 and 14 were submitted for onsite VOC analyses based on field screening readings and visual observations of hydrocarbon staining. One sample from location 8 (7- to 9-foot interval) and one from location 13 (9- to 11-foot interval) were also submitted to NET for SVOC and TPH GRO/DRO analyses.

## 4.2 Groundwater Investigation

The DPT groundwater investigation focused on two water-bearing zones: the zone of saturation in near-surface loess (the zone most likely to contain contaminants associated with equipment storage and former service station activities) and the underlying fluvial deposits (which are the preferential zone of groundwater flow and a potential route for contaminant transport). To

provide additional groundwater information, the three USGS monitoring wells north of and adjacent to SWMU 40 also were sampled for VOCs. The USGS wells are screened in the loess, fluvial deposits, and Cockfield Formation. The water-bearing zones at NSA Memphis are described in Section 5 of this report.

### 4.2.1 Groundwater Sampling Rationale

As described in Section 4.1.1, four DPT *piezocone soundings* were completed from east to west across SWMU 40 in an attempt to determine the depth of the water-bearing zone in the loess and the top of the fluvial deposits in order for sample intervals to be selected. The piezocone logs were not useful in defining the saturated zone in the loess. Based on the piezocone results and observations made during nearby monitoring-well installations, depth to groundwater in the loess was anticipated to be between 11 and 12 feet bls and depth to the top of the fluvial deposits approximately 40 feet bls. Thirteen groundwater samples were obtained from the loess and 15 groundwater samples from the fluvial deposits at SWMU 40. No loess groundwater samples could be collected at locations 16 and 18; therefore, a subsurface soil sample was collected instead as outlined in the SIP. Groundwater samples were not collected from locations 11 though 14, which were designated as soil-sampling-only locations because of their proximity (less than 20 feet away) to location 8.

### 4.2.2 Groundwater Sample Collection Methodology

**DPT Groundwater Sampling**

Groundwater samples were collected during the DPT investigation using the *GS-1* groundwater sampler. The SST technician advanced the *GS-1* to approximately 11 feet bls at each sampling location to collect a groundwater sample from the loess and to sampler refusal (between 42 and 54 feet bls) to obtain a groundwater sample from the fluvial deposits. E/A&H and USGS monitored the volume of groundwater entering the *GS-1* using the on-board computer. When at least 300 milliliters of groundwater had entered the sampler, sample collection was



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stopped and the *GS-1* was retrieved. Groundwater samples were collected directly from the sampler by inserting a new piece of Teflon tubing into the bottom port of the GS-1 and decanting the groundwater directly into the sample vials to minimize the loss of VOCs.

In the event that groundwater did not enter the *GS-1* after a period of 30 minutes, a vacuum was applied to the sampling device. After 20 minutes, if no water had entered the sampler, it was raised in 1-foot increments every 15 minutes for a period of one hour in an attempt to collect a sample. In certain instances (when time permitted), SST left the *GS-1* in the ground overnight to collect a loess groundwater sample. Where loess groundwater samples could not be obtained, a soil sample was collected just above the anticipated depth of the soil/water interface in the loess (between 11 and 12 feet bls).

Loess groundwater samples were collected from all locations, except locations 11 through 14 (soil-sampling only locations) and locations 16 and 18 (where soil samples were collected from the loess because of no groundwater recovery). Fluvial deposits groundwater samples also were collected at all locations except locations 11 through 14 (soil-sampling-only locations).

### USGS Observation Wells

On May 9, 1995, groundwater samples were collected from USGS monitoring wells WL-1L, WL-1F, and WL-1C, which are located just north of the north-central boundary of SWMU 40 (Figure 4-1). The initial samples were obtained by lowering a 2-inch diameter, disposable Teflon bailer into each well, retrieving the bailer, and carefully decanting the groundwater sample into the appropriate containers. The wells were not purged prior to collection of the initial samples. The groundwater samples were then transported directly to Hydrologic's onsite laboratory for VOC analysis. After reviewing the analytical results (toluene was present at a concentration below the practical quantitation limit [PQL] of 5 parts per billion [ppb] in USGS observation well WL-1F), WL-1F was resampled on May 11, 1995, after purging three

well volumes of water with a 2-inch submersible pump. This sample was transported to the onsite laboratory for analysis. A duplicate of this sample also was obtained and shipped to Hydrologic's Frankfort, Kentucky laboratory for confirmation analysis.

## 4.3 Sampling Protocol

All sampling activities were conducted in accordance with the approved *Comprehensive RFI Work Plan* and the *Assembly B Site Investigation Plans*. Sampling handling was kept to a minimum. When transferring material from the sampling device to containers, the operation was conducted expediently, in as clean an environment as possible. A new pair of disposable gloves was donned before collecting each subsurface soil and groundwater sample. Empty containers were kept packaged until used, at which time they were immediately chilled and isolated in coolers. Subsurface soil samples for VOC analysis were containerized immediately upon collection to minimize the loss of volatile constituents. Samples for TPH and SVOC analyses were homogenized in a stainless-steel mixing bowl and placed in the appropriate containers. Groundwater samples were obtained directly from the GS-1 groundwater sampler.

### 4.3.1 QA/QC Samples

During the DPT investigation, quality assurance/quality control (QA/QC) samples were collected to test the level of reproducibility attainable in the sampling and analytical process, the quality of source water, and the effectiveness of equipment decontamination. QA/QC samples were analyzed for VOCs onsite, as were the associated environmental samples. Soil and groundwater *duplicate* samples were collected at a frequency of 25 percent during the DPT investigation and submitted to the offsite laboratory (NET) for confirmation analysis. The analytical results of the duplicate samples are provided in Attachment 1 (Data Validation Report) to this report and are discussed in Section 6.0, Nature and Extent of Contamination. An *equipment rinsate blank* and a *field blank* (deionized water) also were collected during the DPT investigation and analyzed for VOCs by the onsite laboratory. No VOCs were detected in the blanks.



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### 4.3.2 Sample Processing and Chain-of-Custody Procedure

Sample containers requiring chemical preservation (i.e., hydrochloric acid for aqueous VOC samples) were pre-preserved by NET and shipped to E/A&H in sealed packages. Sample containers were labeled with the sample identification number, date, sampler's name, and requested analytical method, and placed in a cooler immediately following sample collection. Each sample was logged in the Assembly B Sample Log Book. Samples for onsite analysis were transported by the E/A&H or USGS geologist directly to the laboratory for immediate analysis. The Hydrologic chemist recorded each sample in a sample log book immediately upon receipt.

Samples for offsite laboratory analysis were prepared for shipment by wrapping samples individually in bubble wrap, placing them in resealable plastic bags, and packing them on ice inside sturdy coolers. Cooler lids were secured with packing tape and sealed with signed custody seals. Packaged samples then were shipped overnight via FedEx priority service for next-morning delivery. The offsite laboratory was notified the day of shipment of the number of samples to be submitted. All sample shipments were reported to have arrived at NET in good condition and at the appropriate temperatures.

To ensure the integrity of the sample transfer process, a strict chain-of-custody procedure was implemented. This procedure was initiated in the field for each sampling event and conducted through custody transfer to the analytical laboratory. A chain-of-custody form was completed for each batch of samples, itemizing sample numbers, containerization, preservatives, analyses requested, date and time of sampling, and Federal Express shipping number. Custody transfers were recorded by signature, date, time of relinquishment, and receipt of custody by the parties involved.

### 4.3.3 Sample Labeling

All samples collected in the field were labeled with an alphanumeric code that identifies the site, sample type, and sample location. The first two digits identify the site location, and the second two digits identify the sample matrix and collection method. The sample matrix and collection method codes used during the DPT investigation were "GH" (groundwater sample collected with the GS-1, or hydrocone), "SG" (soil sample collected with the geocone), and "SS" (soil sample collected with the geocone from soil-sampling-only locations 11 through 14). The third two digits identify the sample location, and the fourth two digits identify the deepest point of the sample interval. For example, the sample label "40GH1012" designates a sample from SWMU 40, groundwater sample obtained with a hydrocone, sample location 10, collected from 11 to 12 feet bls.

## 4.4 Grouting Procedures

SST filled each DPT boring with neat cement grout following completion of all sample collection.

## 4.5 Decontamination Procedures and Investigation-Derived Waste

SST's downhole field equipment was decontaminated in accordance with guidelines set forth in the SIP. All downhole and sampling equipment was decontaminated before and after each use at either the central decontamination pad set up at the N-7 aircraft wash rack or at a temporary decontamination pad set up east of SWMU 40 across First Avenue for the DPT investigation. Rinse water generated from decontamination activities was containerized in a 1,200-gallon holding tank at the central decontamination pad and discharged to the sanitary sewer system after a VOC scan and approval from the City of Millington's wastewater consultant, Fisher & Arnold, Inc.



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Decontamination procedures for downhole equipment consisted of the following steps:

- High pressure wash with a hot mixture of soap and water
- Rinse with potable water
- Rinse with deionized organic-free water
- Rinse twice with pesticide-grade isopropyl alcohol
- Rinse with deionized organic-free water
- Wrap with aluminum foil or plastic

A new pair of disposable latex gloves was donned before handling decontaminated sampling equipment. Subsurface soil samples were collected directly from the split-spoon sampler and groundwater samples directly from the GS-1 groundwater sampler; therefore, no IDW was generated from these sampling activities.



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# 5.0 GEOLOGY AND HYDROGEOLOGY

## 5.1 Regional Geology and Hydrogeology

The general hydrogeology of the Memphis area is discussed in detail in Section 2.11 and a conceptual model of the hydrogeology at the NSA is presented in Section 2.12 of the *Comprehensive RFI Work Plan*. Updated information is available in the *Hydrogeology of Post-Wilcox Group Stratigraphic Units in the Area of the Naval Air Station Memphis, Near Millington, Tennessee* (Kingsbury and Carmichael, 1995). On the basis of this updated information, the hydrogeology of NSA Memphis is re-summarized below.

The two stratigraphic units investigated during the RFIs at NSA Memphis are the loess/alluvial deposits of Pleistocene and Holocene age and the underlying fluvial deposits of Pleistocene to Pliocene age. The loess — eolian deposits consisting of silt, silty clay, clay, and minor amounts of sand — is the principal unit occurring at land surface throughout the NSA Memphis Northside. Alluvium, which is restricted to stream valleys, includes alluviated or reworked loess. The loess is typically 0 to 65 feet in the Memphis area; at NSA Memphis it ranges from 15 to 45 feet in thickness. Water-bearing zones are present in the loess primarily in the upper part of this unit; however, yields are low and water quality analyses performed during the water use survey portion of previous UST investigations indicate that loess groundwater does not meet many primary and secondary drinking water standards. Previous investigations at NSA Memphis have found depth to water in the loess varying between 5 and 15 feet bls and vertical hydraulic conductivities to range from $10^{-6}$ to $10^{-8}$ centimeter per second (cm/sec). Although the loess may be considered an aquitard on the basis of the relatively low hydraulic conductivities, this shallowest water-bearing zone is present within this interval and, therefore, the target depth of the shallow groundwater investigation at SWMU 40. Groundwater flow in the loess is primarily downward, although locally some groundwater in the loess may discharge to nearby streams, drainage ditches, and other surface-water bodies.



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The fluvial deposits underlie the loess in upland areas and consist of sand, gravel, and some clay, with thin layers of ferruginous sandstone and conglomerate at the base. This unit ranges in thickness from 0 to 100 feet in the Memphis area; on the Northside of NSA Memphis it ranges from 10 to 35 feet in thickness and represents the most significant component of the surficial aquifer. Many shallow domestic wells in the Memphis rural areas are completed in the fluvial deposits. Relative groundwater elevations between wells completed in the loess/alluvium and fluvial deposits indicate semiconfined to confined conditions in the fluvial deposits. Typically a downward vertical gradient exists between water in the loess and the fluvial deposits. Sediments in the fluvial deposits generally coarsen with depth, and typically, the upper portion consists of a mixture of very fine sand with varying degrees of silt and clay and becomes increasingly less silty with depth, grading into a fine to medium sand near the middle of the unit. Grain sizes typically coarsen below this interval, grading into a gravelly sand near the fluvial deposits basal section.

The fluvial deposits are underlain by the Cockfield Formation, a part of the Jackson-upper Claiborne confining unit, which is a heterogeneous formation consisting of very fine silty sand interbedded with clay and silt lenses or clay with interbedded fine sand lenses. The more-permeable characteristics of the fluvial deposits, compared to the relatively impermeable properties of the overlying loess/alluvium and the underlying Jackson-upper Claiborne confining unit, result in the fluvial deposits being the preferential zone of groundwater flow and the route for contaminant transport in NSA Memphis's subsurface.

## 5.2 Site-Specific Geology and Hydrogeology

The following sections provide site-specific geologic and hydrogeologic information obtained from stratigraphic test borings, previous investigations, USGS observation wells, and the SWMU 40 DPT investigation.



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### 5.2.1 Stratigraphic Test Borings

In 1994, the U.S. Geological Survey drilled the 200-foot deep stratigraphic test hole 4 approximately 500 feet south of the main runway and about 600 feet northwest of SWMU 40 (Figure 1-1). The test hole was originally to be advanced approximately 15 feet into the Cook Mountain Formation (the confining unit separating the Memphis Aquifer from the overlying Cockfield Formation and shallower units). However, due to the unanticipated thinness of the Cockfield Formation, this borehole was advanced approximately 50 feet into the Memphis Sand. Cuttings from the test hole were visually logged by a field geologist during drilling, and geophysical logs were run following completion of the test hole. Lithologies encountered in the test hole were as follows:

| | |
|---|---|
| **Loess:** | Approximately 39 feet of wind-blown silt and clay deposits. |
| **Fluvial Deposits:** | Approximately 30 feet of sand and gravel. |
| **Cockfield Formation:** | Approximately 35 feet of alternating sand, clay and some lignite. |
| **Cook Mountain Formation:** | The Cook Mountain, characterized as a gray to blue-gray dense clay approximately 49 feet thick, is defined as the upper confining unit between the surficial aquifers and the Memphis Aquifer. |
| **Memphis Sand:** | The Memphis Sand, characterized as a thick (between 865 and 880 feet) deposit of primarily fine to very coarse sand with lenses of clay, silt, and lignite, supplies water to industries and municipalities throughout Shelby County. |

### 5.2.2 Assembly A RFI

Subsurface soil information was collected during the Assembly A RFI for SWMU 7, the Building N-126 Plating Shop Dry Well. Nine monitoring well clusters (designated 07MW01 through 07MW09) were installed at various locations around SWMU 7, which is



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approximately 1,200 feet northeast of SWMU 40 (Figure 1-1). 07MW07 and 07MW08 are the SWMU 7 monitoring well clusters closest to SWMU 40 (approximately 650 feet to the northeast). The general lithology encountered in the soil borings associated with these two well clusters is as follows:

- Clayey silt, silty clay, and sandy clay from ground surface to between 33 and 35 feet bls (loess).
- Sand with gravel, silt, and clay from between 33 and 35 feet bls to between 76 and 78.5 feet bls (fluvial deposits).
- Silty sand, clayey sand, sandy clay, and clay from between 76 and 78.5 feet to the termination depth of the borings (between 105 to 125 feet bls) (Cockfield Formation).

Laboratory-measured vertical hydraulic conductivities for subsurface soil samples associated with the SWMU 7 monitoring wells are as follows:

| Well Cluster | Associated Soil Sample ID | Sampling Depth (in feet) | Hydraulic Conductivity (in cm/sec) |
|---|---|---|---|
| 07MW01 | 07S000177 | 75 - 77 (lower fluvial deposits) | $6.8 \times 10^{-5}$ |
| | 07S0001112 | 110 to 112 (Cockfield Formation) | $4.1 \times 10^{-8}$ |
| 07MW03 | 07S0003117 | 115 to 117 (Cockfield Formation) | $1.6 \times 10^{-8}$ |
| 07MW08 | 07S0008127 | 125 to 127 (Cockfield Formation) | $8.7 \times 10^{-7}$ |
| 07MW09 | 07S000922 | 10 - 22 (loess) | $9.5 \times 10^{-7}$ |



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The boring and monitoring-well logs and hydraulic-conductivity data sheets for SWMU 7 well clusters are provided in Appendix D.

### 5.2.3 USGS Observation Wells

In April 1995, the USGS installed three observation wells just north of SWMU 40 and approximately 500 feet south of SWMU 15. One well is screened in the loess (WL-1L), one in the fluvial deposits (WL-1F), and the third in the Cockfield Formation (WL-1C). Based on verbal and written communication the USGS, the following lithologic units were encountered in the boring associated with monitoring well WL-1C:

- Silty clay from 0 to 2 feet bls (fill)
- Silt and clayey silt from 2 to 36 feet bls (loess)
- Sand and gravel from 36 to 74 feet bls (fluvial deposits)
- Clayey sand, silty clay, and clay from 74 feet to the termination depth of the boring at 122 feet bls (Cockfield Formation). The base of the Cockfield Formation was not reached.

The lithology observed in the USGS observation wells are consistent with the lithology encountered while installing the SWMU 7 monitoring wells described in the previous section.

The USGS measured several rounds of water levels in the three wells. Table 5-1 lists selected water-elevation measurements.



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**Table 5-1**
**Groundwater Level Data — USGS Observation Wells**

| USGS Well Designation | Screened Interval (ft. bls)[a] | Land Surface Altitude (msl)[b] | Date[a] | Depth to Water (feet bls)[a] | Groundwater Altitude (msl)[c] |
|---|---|---|---|---|---|
| WL-1L (SH:U-100) | 8 - 18' bls, loess | 274.97 | 05-08-95 | 4.98 | 269.99 |
| | | | 06-13-95 | 6.17 | 268.80 |
| | | | 06-21-95 | 6.50 | 268.47 |
| | | | 08-22-95 | 6.45 | 268.52 |
| WL-1F (SH:U-101) | 59 - 69' bls, fluvial deposits | 275.19 | 05-08-95 | 17.98 | 257.21 |
| | | | 06-13-95 | 18.48 | 256.71 |
| | | | 06-21-95 | 18.57 | 256.62 |
| | | | 08-22-95 | 19.15 | 256.04 |
| WL-1C (SH:U-102) | 105 - 115' bls, upper Cockfield Fm. | 275.05 | 05-08-95 | 17.94 | 257.11 |
| | | | 06-13-95 | 18.09 | 256.96 |
| | | | 06-21-95 | 18.01 | 257.04 |
| | | | 08-22-95 | 18.65 | 2556.40 |

*Notes:*

[a] = Screened interval, date, and depth to water data were obtained through verbal and written communication with Mr. Jack Carmichael of the USGS.

[b] = Ground-surface altitudes were obtained using Global Positioning System (GPS) survey equipment; altitudes reported with respect to mean sea level (msl).

[c] = Water-level altitudes were obtained by subtracting depth to water from land surface altitude (msl).

Based on 1995 water-level measurements in monitoring wells on the Northside, there is very little vertical head difference in groundwater levels wells completed in the upper part of the fluvial deposits, lower part of the fluvial deposits, and the upper part of the Cockfield Formation on the Northside of NSA Memphis.

Based on the topography, the information contained in the conceptual model of the NSA Memphis hydrogeology (Section 2.12 of the *Comprehensive RFI Work Plan*), recent data collected during investigations at Assembly A SWMUs, and communication with USGS representatives, groundwater in the fluvial deposits flows locally toward the northwest in the vicinity of SWMU 40. Groundwater flow in the loess is primarily downward, although locally, some groundwater in the loess may discharge to nearby streams, drainage ditches, and other surface water bodies.



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### 5.2.4 DPT Piezocone Soundings

As outlined in Section 4.1.1 of this document, four piezocone soundings (designated PO-1 through PO-4, refer to Figure 2-1) were completed from east to west across SWMU 40 to obtain information regarding the lithology and potential water-bearing zones prior to sample collection. E/A&H and the USGS used (with limited success) the information generated from the piezocone soundings to select soil and groundwater sampling intervals for the DPT investigation. The piezocone logs and plots for SWMU 40 are provided in Appendix C. As shown on these logs and plots, the fluvial deposits can readily be identified from approximately 40 feet bls to the termination depth of each piezocone sounding. The fluvial deposits are described as a clayey to silty fine sand on the lithologic logs and visually may be identified on the plots due to the higher point stress values. As mentioned previously, the water-bearing zone in the loess was not readily identifiable on the lithologic logs and plots.

### 5.2.5 DPT Hydrocone Plots

During the DPT investigations, the *GS-1* obtained groundwater samples from selected depths in the loess and upper part of the fluvial deposits (a vacuum had to be applied in some instances). The sampling device, which included a transducer attached to an on-board computer system via an umbilical cable, recorded data regarding the fill rate, hydrostatic pressure, and argon gas pressure applied to operate the tool. An estimate of horizontal hydraulic conductivity was calculated by applying the time rate of filling data to the Bouwer and Rice (June 1976) equation. Horizontal hydraulic conductivity measurements for the loess ranged from $2.69 \times 10^{-5}$ to $7.63 \times 10^{-4}$ cm/sec. Horizontal hydraulic conductivity for the upper part of the fluvial deposits ranged from $5.71 \times 10^{-6}$ to $2.89 \times 10^{-4}$ cm/sec. Appendix C provides the *GS-1* sample plots and hydraulic conductivity measurements for the groundwater samples collected during the DPT investigation.



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## 6.0 NATURE AND EXTENT OF CONTAMINATION

The following sections provide the analytical results for soil and groundwater samples collected during the DPT investigation and the groundwater results for samples collected from the USGS observation wells. As stated in the *Assembly B Site Investigation Plans*, 25% of the collected samples were split and submitted for offsite laboratory analysis for confirmation purposes. Hydrologic's mobile onsite laboratory analyzed the DPT soil and groundwater samples and the groundwater samples collected from the USGS observation wells for VOCs by Method 8021. NET performed the primary offsite confirmation analyses. In addition, the Hydrologic chemist submitted selected samples exhibiting VOC contamination to its laboratory in Frankfort, Kentucky, for confirmation purposes. Attachment 1 of this report provides the laboratory analytical data. Organic contaminant concentrations detected in soil and groundwater are compared with residential and industrial risk-based concentrations (RBCs) (USEPA — Region III Risk-Based Concentration Table, January - June, 1995). The following sections discuss the analytical results by media.

### 6.1 DPT Subsurface Soil Samples

Subsurface soil samples were collected from 19 locations at SWMU 40 and field screened for organic vapors. Based on the field screening results, samples from 17 of the 19 locations were submitted to the onsite laboratory for VOC analysis. As noted above, 25% of the samples were split and submitted to NET for confirmation analyses. Visual observations, organic vapor field screening readings, and onsite laboratory analyses identified hydrocarbon contamination in subsurface soils at DPT locations 8, 13, and 14. Based on the highest detected organic vapor field screening readings, one soil sample from location 8 and one from location 13 were submitted to the offsite laboratory for TPH and SVOC analyses. Table 6-1 summarizes the detected concentrations of VOCs in the soil samples, and Table 6-2 summarizes the detected concentrations of TPH and SVOCs.



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**Table 6-1**
**Concentrations of VOCs Detected in Soil**
**SWMU 40 — Salvage Yard No. 1**
**(data in parts per billion)**

| Compound | Sample Location and Depth | Sample ID | Field Lab Result[a] | Offsite Lab Result[b] | Offsite Lab Result[c] | RBC - Residential Soil[d] | RBC - Industrial Soil[d] |
|---|---|---|---|---|---|---|---|
| Benzene | 13 (9 - 11') | 40SS1311 | ND[a] | 6 J[b] | ND | 22,000 | 200,000 |
| Toluene | 8 (7 - 9') | 40SG0809 | ND | 53 J | ND | 16,000,000 | 410,000,000 |
| | 13 (9 - 11') | 40SS1311 | ND | 990 DJ | ND | | |
| | 14 (9 - 11') | 40SS1411 | 507 | N/A[b] | ND | | |
| Ethylbenzene | 8 (1 - 3') | 40SG0803 | 15 | 120 | 245 | 7,800,000 | 200,000,000 |
| | 8 (3 - 5') | 40SG0805 | 530 | N/A | 3,600 | | |
| | 8 (5 - 7') | 40SG0807 | 1,000 | N/A | 21,000 | | |
| | 8 (7 - 9') | 40SG0809 | ND | 7,700 D | 6,000 | | |
| | 13 (7 - 9') | 40SS1309 | 1,100 | N/A | 645 | | |
| | 13 (9 - 11') | 40SS1311 | 1,300 | 1,300 DJ | 400 | | |
| | 14 (5 - 7') | 40SS1407 | 520 | N/A | 3,300 | | |
| | 14 (7 - 9') | 40SS1409 | 2,800 | N/A | 1,600 | | |
| | 14 (9 - 11') | 40SS1411 | 1,300 | N/A | 800 | | |
| Total Xylenes (m+p+o isomers) | 8 (1 - 3') | 40SG0803 | 201 | 210 | 400 | 160,000,000 | 1,000,000,000 |
| | 8 (3 - 5') | 40SG0805 | 3,500 | N/A | 14,400 | | |
| | 8 (5 - 7') | 40SG0807 | 2,470 | N/A | 126,700 | | |
| | 8 (7 - 9') | 40SG0809 | 20,200 | 33,000 DJ | 28,000 | | |
| | 10 (1 - 3') | 40SG1003 | ND | ND | 10 | | |
| | 13 (7 - 9') | 40SS1309 | ND | N/A | 2,735 | | |
| | 13 (9 - 11') | 40SS1311 | ND | 260 DJ | 253 | | |
| Total Xylenes (m+p+o isomers) | 14 (5 - 7') | 40SS1407 | 20,000 | N/A | 17,500 | 160,000,000 | 1,000,000,000 |
| | 14 (7 - 9') | 40SS1409 | 17,000 | N/A | 10,280 | | |
| | 14 (9 - 11') | 40SS1411 | 10,200 | N/A | 4,800 | | |

**Table 6-1**
**Concentrations of VOCs Detected in Soil**
**SWMU 40 — Salvage Yard No. 1**
**(data in parts per billion)**

| Compound | Sample Location and Depth | Sample ID | Field Lab Result[a] | Offsite Lab Result[b] | Offsite Lab Result[c] | RBC - Residential Soil[d] | RBC - Industrial Soil[d] |
|---|---|---|---|---|---|---|---|
| n-Propylbenzene | 8 (1 - 3') | 40SG0803 | 101 | ND | ND | None | None |
| | 8 (3 - 5') | 40SG0805 | 1,500 | N/A | 16,800 | | |
| | 8 (5 - 7') | 40SG0807 | 1,200 | N/A | ND | | |
| | 8 (7 - 9') | 40SG0809 | 1,900 | ND | ND | | |
| | 13 (7 - 9') | 40SS1309 | 1,600 | N/A | 700 | | |
| | 13 (9 - 11') | 40SS1311 | 2,000 | ND | 765 | | |
| | 14 (5 - 7') | 40SS1407 | 1,700 | N/A | 5,450 | | |
| | 14 (7 - 9') | 40SS1409 | 5,100 | N/A | 3,000 | | |
| | 14 (9 - 11') | 40SS1411 | 2,700 | N/A | ND | | |
| 1,3,5-Trimethylbenzene | 8 (1 - 3') | 40SG0803 | 122 | ND | ND | 31,000 | 820,000 |
| | 8 (3 - 5') | 40SG0805 | 1,200 | N/A | 40,800 | | |
| | 8 (5 - 7') | 40SG0807 | 7,400 | N/A | 34,500 | | |
| | 8 (7 - 9') | 40SG0809 | ND | ND | 26,600 | | |
| | 13 (9 - 11') | 40SS1311 | ND | ND | 65 | | |
| | 14 (5 - 7') | 40SS1407 | ND | N/A | 17,200 | | |
| | 14 (7 - 9') | 40SS1409 | 13,000 | N/A | 10,600 | | |
| | 14 (9 - 11') | 40SS1411 | 4,400 | N/A | 2,400 | | |
| Isopropylbenzene/ Bromobenzene | 8 (5 - 7') | 40SG0807 | ND | N/A | 8,800 | None | None |
| | 8 (7 - 9') | 40SG0809 | ND | ND | 2,000 | | |
| | 13 (7 - 9') | 40SS1309 | 1,600 | N/A | ND | | |
| | 13 (9 - 11') | 40SS1311 | 2,100 | ND | 495 | | |
| | 14 (5 - 7') | 40SS1407 | ND | N/A | 1,460 | | |
| | 14 (7 - 9') | 40SS1409 | 4,900 | N/A | ND | | |
| | 14 (9 - 11') | 40SS1411 | 2,800 | N/A | 1,400 | | |



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**Table 6-1**
**Concentrations of VOCs Detected in Soil**
**SWMU 40 — Salvage Yard No. 1**
**(data in parts per billion)**

| Compound | Sample Location and Depth | Sample ID | Field Lab Result[a] | Offsite Lab Result[b] | Offsite Lab Result[c] | RBC - Residential Soil[d] | RBC - Industrial Soil[d] |
|---|---|---|---|---|---|---|---|
| tert-Butylbenzene | 8 (1 - 3') | 40SG0803 | 122 | ND | ND | 780,000 | 20,000,000 |
| | 8 (3 - 5') | 40SG0805 | 5,200 | N/A | 13,200 | | |
| | 8 (5 - 7') | 40SG0807 | 4,100 | N/A | ND | | |
| | 8 (7 - 9') | 40SG0809 | 5,900 | ND | ND | | |
| | 13 (7 - 9') | 40SS1309 | 710 | N/A | ND | | |
| | 13 (9 - 11') | 40SS1311 | 1,000 | ND | ND | | |
| | 14 (7 - 9') | 40SS1409 | 2,600 | N/A | ND | | |
| | 14 (9 - 11') | 40SS1411 | 1,500 | N/A | ND | | |
| 1,2,4-Trimethylbenzene | 8 (1 - 3') | 40SG0803 | 81 | ND | ND | 39,000 | 1,000,000 |
| | 8 (3 - 5') | 40SG0805 | 1,500 | N/A | **186,000** | | |
| | 8 (5 - 7') | 40SG0807 | 1,200 | N/A | **316,000** | | |
| | 8 (7 - 9') | 40SG0809 | 2,100 | ND | **95,200** | | |
| | 13 (7 - 9') | 40SS1309 | 4,800 | N/A | 8,150 | | |
| | 13 (9 - 11') | 40SS1311 | 5,200 | ND | 4,300 | | |
| | 14 (5 - 7') | 40SS1407 | 1,500 | N/A | **65,000** | 39,000 | 1,000,000 |
| | 14 (7 - 9') | 40SS1409 | 20,000 | N/A | 38,700 | | |
| | 14 (9 - 11') | 40SS1411 | 7,700 | N/A | 15,700 | | |
| s-Butylbenzene | 8 (1 - 3') | 40SG0803 | 89 | ND | ND | 780,000 | 20,000,000 |
| | 8 (3 - 5') | 40SG0805 | 12,000 | N/A | 87,200 | | |
| | 8 (5 - 7') | 40SG0807 | 14,000 | N/A | 148,000 | | |
| | 8 (7 - 9') | 40SG0809 | 26,000 | ND | 44,400 | | |
| | 13 (7 - 9') | 40SS1309 | 2,000 | N/A | 3,800 | | |
| | 13 (9 - 11') | 40SS1311 | 2,300 | ND | ND | | |
| | 14 (5 - 7') | 40SS1407 | 23,000 | N/A | 30,000 | | |
| | 14 (7 - 9') | 40SS1409 | 5,600 | N/A | 18,100 | | |
| | 14 (9 - 11') | 40SS1411 | 3,300 | N/A | 7,300 | | |

**Table 6-1**
**Concentrations of VOCs Detected in Soil**
***SWMU 40 — Salvage Yard No. 1***
**(data in parts per billion)**

| Compound | Sample Location and Depth | Sample ID | Field Lab Result[a] | Offsite Lab Result[b] | Offsite Lab Result[c] | RBC - Residential Soil[d] | RBC - Industrial Soil[d] |
|---|---|---|---|---|---|---|---|
| n-Butylbenzene | 8 (1 - 3') | 40SG0803 | 113 | ND | ND | None | None |
| | 8 (3 - 5') | 40SG0805 | 3,700 | N/A | ND | | |
| | 8 (5 - 7') | 40SG0807 | 7,100 | N/A | 18,800 | | |
| | 8 (7 - 9') | 40SG0809 | 14,000 | ND | 4,000 | | |
| | 13 (7 - 9') | 40SS1309 | ND | N/A | 450 | | |
| | 14 (5 - 7') | 40SS1407 | 11,000 | N/A | 2,000 | | |
| | 14 (7 - 9') | 40SS1409 | 14,000 | N/A | 2,000 | | |
| | 14 (9 - 11') | 40SS1411 | 2,900 | N/A | 900 | | |
| p-Isopropyltoluene | 8 (3 - 5') | 40SG0805 | ND | N/A | 7,600 | None | None |
| | 13 (9 - 11') | 40SS1311 | ND | ND | 55 | | |
| | 14 (5 - 7') | 40SS1407 | 2,900 | N/A | 1,200 | | |
| Naphthalene | 8 (1 - 3') | 40SG0803 | 78 | ND | ND | 3,100,000 | 82,000,000 |
| | 8 (3 - 5') | 40SG0805 | 2,000 | N/A | 20.8 | | |
| | 8 (5 - 7') | 40SG0807 | 3,800 | N/A | 71,000 | | |
| | 8 (7 - 9') | 40SG0809 | 6,400 | 15,000 D | 15,200 | | |
| | 13 (7 - 9') | 40SS1309 | 1,700 | N/A | 2,400 | | |
| | 13 (9 - 11') | 40SS1311 | 1,800 | 3,100 | 815 | | |
| | 14 (5 - 7') | 40SS1407 | 6,300 | N/A | 9,100 | | |
| | 14 (7 - 9') | 40SS1409 | 6,900 | N/A | 8,300 | | |
| | 14 (9 - 11') | 40SS1411 | 2,900 | N/A | 6,400 | | |
| 1,2,3-Trichloropropane | 13 (7 - 9') | 40SS1309 | ND | N/A | 650 | 91 | 820 |
| 1,2,4-Trichlorobenzene | 14 (7 - 9') | 40SS1409 | 11,000 | N/A | ND | 780,000 | 20,000,000 |
| p-Isopropyltoluene | 14 (5 - 7') | 40SS1407 | ND | N/A | 1,200 | None | None |
| Methylene chloride | 5 (1 - 3') | 40SG0503 | ND | 2 J | N/A | 85,000 | 760,000 |
| | 7 (1 - 3') | 40SG0703 | ND | 2 J | ND | | |
| | 8 (1 - 3') | 40SG0803 | ND | 2 J | ND | | |
| | 13 (9 - 11') | 40SS1311 | ND | 4 J | ND | | |
| | 15 (1 - 3') | 40SG1503 | ND | 1 J | N/A | | |



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**Table 6-1**
**Concentrations of VOCs Detected in Soil**
**SWMU 40 — Salvage Yard No. 1**
**(data in parts per billion)**

| Compound | Sample Location and Depth | Sample ID | Field Lab Result[a] | Offsite Lab Result[b] | Offsite Lab Result[c] | RBC - Residential Soil[d] | RBC - Industrial Soil[d] |
|---|---|---|---|---|---|---|---|
| Acetone | 5 (1 - 3') | 40SG0503 | ND | 10 J | N/A | 7,800,000 | 200,000,000 |
| | 7 (1 - 3') | 40SG0703 | ND | 5 J | ND | | |
| | 8 (1 - 3') | 40SG0803 | ND | 38 | ND | | |

***Notes:***

**Concentrations in bold exceed the Residential Risk-Based Concentration (RBC) but not the Industrial RBC.**

[a] = Hydrologic Inc.'s mobile onsite laboratory analyzed the samples for VOCs by Method 8021.
[b] = NET's Bedford, Massachusetts laboratory analyzed the samples for VOCs by Method 8240. Approximately 25 percent of the samples analyzed onsite were split and submitted to NET for confirmation analysis.
[c] = Hydrologic Inc.'s Frankfort, Kentucky laboratory analyzed the samples for VOCs for confirmation analysis by one of the following methods: Method 624, Method 8240, or Method 8260.
[d] = Risk-Based Concentrations obtained from the USEPA Region III Risk-Based Concentration Table, January - June, 1995.
[e] = ND denotes parameter not detected, or data validation determined that compound is not present.
[f] = J denotes estimated concentration.
[g] = D denotes results are from diluted sample.
[h] = N/A denotes sample was not analyzed by this laboratory.



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**Table 6-2**
**Concentrations of SVOCs and TPH Detected in Selected Soil Samples**
**SWMU 40 — Salvage Yard No. 1**
**(data in parts per billion)**

| Analyte[a] | Location 8 (7 - 9') 40SG0809/40SG0809DL | Location 13 (9 - 11') 40SS1311D | RBC - Residential Soil[b] | RBC - Industrial Soil[b] | TN TPH Cleanup Standard[c] Non-Drinking Water |
|---|---|---|---|---|---|
| TPH - Gasoline-Range Organics | 770,000 | 17,000 | N/A[d] | N/A | 1,000,000 |
| TPH - Diesel-Range Organics | 600,000 | 80,000 | N/A | N/A | 1,000,000 |
| Naphthalene | 15,000D | 3,100 | 31E+5 | 82,000,000 | N/A |
| 2-Methylnaphthalene | 11,000D | 1,600 J | N/A | N/A | N/A |
| Fluorene | 45 J | ND[e] | 31E+5 | 82,000,000 | N/A |
| Phenanthrene | 48 J | ND | N/A | N/A | N/A |
| bis(2-ethylhexyl)phthalate | 62 J | 380 J | 46E+3 | 410,000 | N/A |

***Notes:***

[a] = NET's Bedford, Massachusetts laboratory analyzed the samples for total petroleum hydrocarbons (TPH) by the TN Modified 8015 Method for gasoline and diesel-range organics, and semivolatile organic compounds (SVOC) by the Modified 8270 method.

[b] = *Risk-based concentrations (RBCs) obtained from the USEPA Region III Risk-Based Concentration Table, January - June, 1995.*

[c] = The Tennessee Department of Environment and Conservation's Underground Storage Tank Division has established the soil cleanup level for nondrinking water aquifers as $1 \times 10^6$ parts per billion. Previous investigations at NSA Memphis have classified the uppermost groundwater in the loess as "nondrinking" due to the lack of use, low yield, and poor water quality.

[d] = N/A denotes RBC or other standard is not available for this constituent(s).

[e] = ND denotes parameter was not detected.



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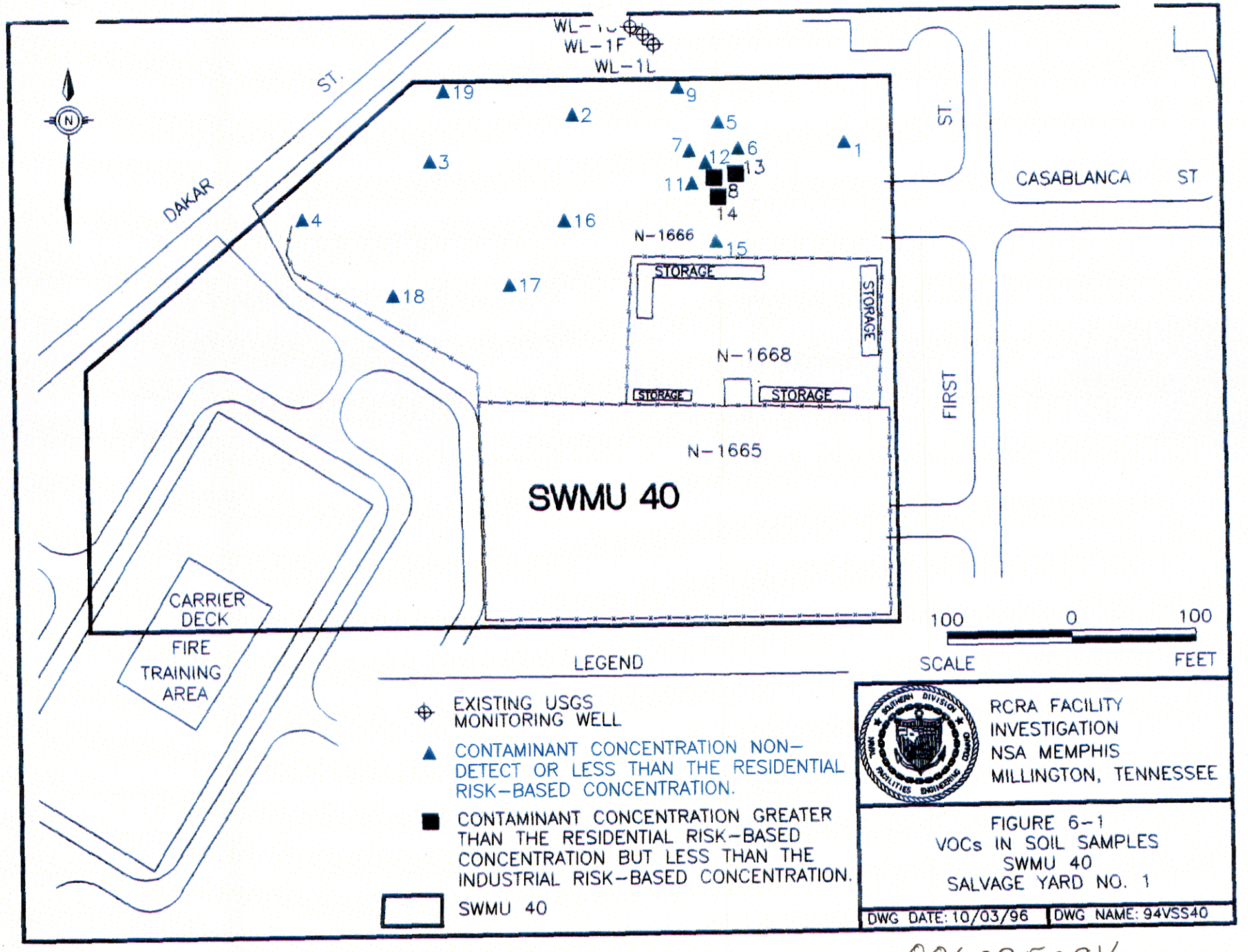
### 6.1.1 VOC Results — Soil Samples

Twenty-seven subsurface soil samples were submitted to the onsite laboratory to characterize the nature and extent of contamination in SWMU 40 soil. Of these samples, seven were split and submitted to the offsite laboratory for confirmation analysis. Analytical results indicate a petroleum release has occurred at the site. The following VOCs were detected in soil samples: benzene, toluene, ethylbenzene, total xylenes, isopropylbenzene/bromobenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, styrene, tert-butylbenzene, sec-butylbenzene/ 1,3-dichlorobenzene, p-isopropyltoluene, n-butylbenzene, and naphthalene. Methylene chloride, acetone, and 2-butanone also were detected, but these compounds likely are laboratory artifacts.

The industrial RBCs for VOCs were not exceeded in any soil sample. However, the residential RBCs for selected VOCs were exceeded at DPT locations 8, 13, and 14 (Figure 6-1). The residential RBC for 1,3,5-trimethylbenzene (31,000 ppb) was exceeded at location 8 in the 3- to 5-foot (40,800 ppb) and the 5- to 7-foot (94,500 ppb) intervals, with decreasing concentrations observed in deeper samples. The residential RBC for 1,2,4-trimethylbenzene (39,000 ppb) was exceeded at location 8 in the 3- to 5-foot (186,000 ppb), 5- to 7-foot (316,000 ppb), and 7- to 9-foot (95,200 ppb) intervals; and at location 14 in the 5- to 7-foot (65,000 ppb) interval. The residential RBC for 1,2,3-trichloropropane (91 ppb) was exceeded in the soil sample collected from the 7- to 9-foot (650 ppb) interval of location 13. This was the only detection of 1,2,3-trichloropropane in the soil samples.

### 6.1.2 SVOC Results — Soil Samples

As previously discussed, two soil samples were selected for SVOC analysis; one from the 5- to 7-foot interval at location 8 and one from the 9- to 11-foot interval at location 13. At least one of the following SVOCs was detected in each soil sample: naphthalene, 2-methylnaphthalene, fluorene, phenanthrene, and bis(2-ethylhexyl)phthalate. The detected concentrations were well below residential RBCs.

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### 6.1.3 TPH Results — Soil Samples

The offsite laboratory analyzed the following samples for TPH - GRO/DRO: the 7-to 9-foot interval at location 8 and the 9-to 11-foot interval at location 13. Table 6-2 shows the TPH results. RBCs do not exist for TPH in soil; however, the TDEC UST Division has established 100 and 1,000 ppm soil cleanup levels for soil classified as being within "drinking" and "nondrinking" water aquifers, respectively. Previous groundwater investigations at NSA Memphis have classified groundwater in the uppermost loess deposits as "nondrinking" due to the lack of use, low yield, and poor water quality. Based on this classification, TPH concentrations found in SWMU 40 soil are below the 1,000 ppm cleanup level.

## 6.2 Groundwater Analytical Results

Groundwater samples were obtained from the loess and upper part of the fluvial deposits during the DPT investigation and analyzed by the onsite laboratory for VOCs by Method 8021. In addition, groundwater samples were collected from the three USGS observation wells which are located a few feet north of the north-central boundary of SWMU 40. The onsite laboratory also analyzed these samples for VOCs. The following sections describe the results of the groundwater analyses.

### 6.2.1 DPT Groundwater Sample Results

Thirteen groundwater samples were collected from the loess and 15 groundwater samples were collected from the upper part of the fluvial deposits during the DPT investigation. As shown in Table 6-3, VOCs were detected in only two loess groundwater samples and two fluvial deposits groundwater samples. Tap-water RBCs were exceeded at two groundwater sampling locations: location 9 and location 18. Maximum contaminant levels (MCLs) were exceeded at only one location (location 8). Figure 6-2 shows the locations of the RBC exceedances for groundwater samples at SWMU 40.



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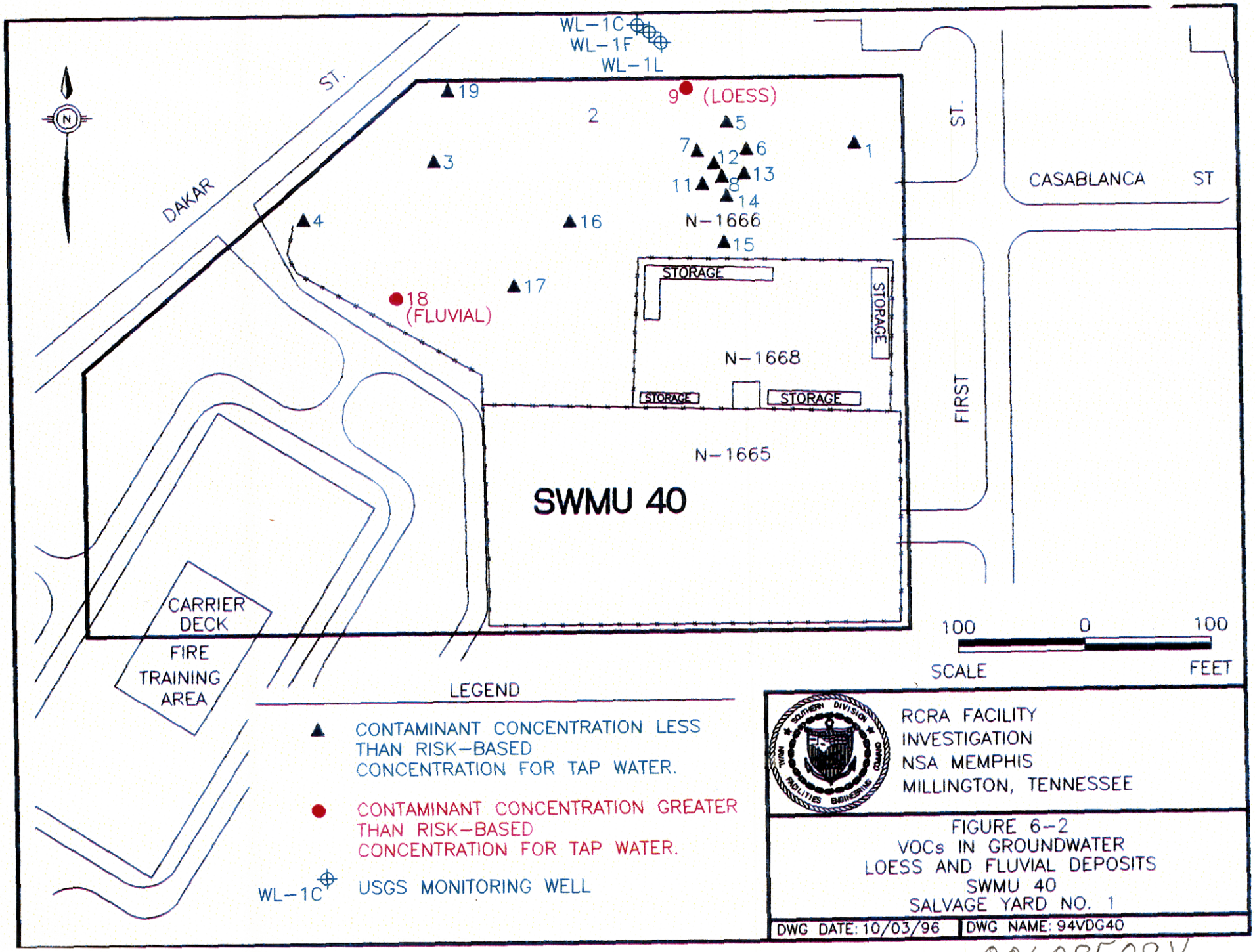
**Table 6-3**
**Concentrations of VOCs Detected in Loess and Fluvial Deposits Groundwater**
**DPT Investigation — SWMU 40, Salvage Yard No. 1**
**(data in parts per billion)**

| Compound | Location 8, 40GH0812 (Loess) | Location 9, 40GH0912 (Loess) | Location 8, 40GH0844 (Fluvial Deposits) | Location 18, 40GH1847 (Fluvial Deposits) | Tap Water RBC[a] (μg/L) | MCL[b] (μg/L) |
|---|---|---|---|---|---|---|
| Ethylbenzene | *1,150* | 9 | ND | ND | 1,300 | 700 |
| m,p-Xylenes | ND | 14 | 11 | 10 | 520 | 10,000 |
| Isopropylbenzene/Bromobenzene | ND | 8 | ND | ND | N/A | N/A |
| n-Propylbenzene | ND | 25 | ND | ND | N/A | N/A |
| tert-Butylbenzene | ND | 6 | ND | ND | 61 | N/A |
| 1,2,4-Trimethylbenzene | ND | 107 | 5 | 5 | 3 | N/A |
| sec-Butylbenzene/1,3-Dichlorobenzene | ND | 26 | ND | ND | 61/540 | N/A |
| n-Butylbenzene | ND | 7 | ND | ND | N/A | N/A |
| Naphthalene | ND | 9 | 25 | ND | N/A | N/A |

*Notes:*
**Bold** = indicates contaminant exceeds the residential risk-based concentration for tap water.
*Italics* = indicates contaminant exceeds the maximum contaminant level for drinking water.
RBC[a] = Risk-based concentration (EPA Region III, January - June, 1995).
MCL[b] = Maximum contaminant level from the Safe Drinking Water Act.
ND[c] = Parameter was not detected.

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**Concentrations of VOCs in Loess Groundwater**

The following VOCs were detected in loess groundwater: ethylbenzene, m,p-xylenes, isopropylbenzene/bromobenzene, n-propylbenzene, tert-butylbenzene, 1,2,4-trimethylbenzene, sec-butylbenzene/1,3-dichlorobenzene, n-butylbenzene, and naphthalene. The ethylbenzene concentration in the groundwater sample collected from the loess at location 8 (1,150 ppb) exceeded the MCL for drinking water (700 ppb) but not the RBC for tap water (1,300 ppb). As previously mentioned, groundwater in the loess is not considered to be drinking water. The 1,2,4-trimethylbenzene concentration in the loess groundwater sample at location 9 (107 ppb) exceeded the tap water RBC (3 ppb). No MCL exists for 1,2,4-trimethylbenzene.

**Concentrations of VOCs in Upper Fluvial Deposits Groundwater**

The following VOCs were detected in groundwater samples collected from the upper fluvial deposits: m,p-xylenes, 1,2,4-trimethylbenzene, and naphthalene. The 1,2,4-trimethylbenzene concentration in the fluvial groundwater sample from location 18 (5 ppb) exceeded the tap water RBC (3 ppb).

### 6.2.2 USGS Observation Well Sample Results

On May 9, 1995, groundwater samples were collected from the USGS observation wells WL-1L (screened in the loess), WL-1F (screened in the fluvial deposits), and WL-1C (screened in the Cockfield Formation). The water samples were containerized and immediately transported to Hydrologic's onsite laboratory and analyzed for VOCs by Method 8021. No VOCs were present above the practical quantitation limit (PQL) of 5 ppb; however, toluene was identified in the groundwater sample from WL-1F at an estimated concentration of 4.6 ppb. To confirm the presence of toluene in the well, on May 11, 1995, USGS representatives resampled well WL-1F after removing approximately 3 well volumes of standing water. The sample was split, with one portion submitted to Hydrologic's onsite laboratory and the other portion to Hydrologic's Frankfort, Kentucky, laboratory. No VOCs were detected by the onsite laboratory at a PQL of 5 ppb; however, toluene was tentatively identified below the PQL at an estimated concentration of 2.9 ppb. No VOCs were detected by Hydrologic's Frankfort, Kentucky, laboratory at a 1 ppb PQL. The MCL for toluene in drinking water is 1,000 ppb.



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## 7.0 PRELIMINARY RISK EVALUATION

In accordance with the USEPA Region IV Memorandum *Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease (FOSL)* (USEPA, November 1994), a PRE was conducted for SWMU 40 using data from five surface soil samples collected on September 25, 1995. The samples were collected from the unpaved empty lot surrounding and west of the former service station which once occupied the north-central portion of the site (refer to Figure 7-1). Based on RFI results and previous investigations, these unpaved areas and the former service station area would have received the majority of site contaminants. The five samples were analyzed for semivolatile organic compounds, pesticides/polychlorinated biphenyls, and Appendix IX metals.

Previously, DPT sample analysis (refer to Section 6) confirmed the presence of petroleum constituents (VOCs and SVOCs) in subsurface soil and, to a lesser extent, groundwater near the former service station location. Upon reviewing the results, the BCT agreed that the tanks could be removed under the UST program and that surface soil samples should be collected to prepare a PRE. Analytical results for the five surface soil samples are detailed in the tables within this section and in Attachment 2 (Data Validation Report) of this report.

A PRE is conducted by constructing a table for carcinogenic and systemic (noncarcinogenic) compounds. The maximum concentration for each detected chemical and its corresponding RBC concentration are entered into the table to calculate cumulative human health risk. Sample data collected across the surface soil interval (0 to 1 foot bls) are exclusively used in the calculations. Proportionate risk is calculated for each detected site chemical by comparing its maximum reported concentration with the corresponding RBC value. Risk and hazard for residential and industrial scenarios were calculated separately. RBC values were calculated by USEPA based on a risk threshold of $10^{-6}$ for carcinogens or a hazard quotient threshold of 1.0 for

noncarcinogens. Therefore, a risk ratio is calculated for each contaminant by one of the following two equations:

**Carcinogenic Risk Ratio:**

$$RR = \frac{\text{media concentration}}{\text{screening value}} \times TR$$

**Noncarcinogenic Risk Ratio:**

$$RR = \frac{\text{media concentration}}{\text{screening value}} \times THQ$$

**where:**

| | | |
|---|---|---|
| RR | = | the risk ratio |
| Media Concentration | = | the maximum concentration of a site chemical |
| Screening Value | = | the RBC value for that particular chemical |
| TR | = | target risk used by USEPA to calculate RBCs for carcinogens ($10^{-6}$) |
| THQ | = | target hazard quotient used by USEPA to calculate RBCs for noncarcinogens (1.0) |

Tables 7-1 and 7-2 summarize PRE results for SWMU 40 for carcinogens and noncarcinogens, respectively. The risk ratios for each chemical are summed separately for both residential and industrial scenarios to determine the overall site risk. Cumulative risk (for carcinogens) and cumulative hazard index (HI) (for noncarcinogens) are calculated separately, and the cumulative risk and HI are each compared to the corresponding cumulative threshold in accordance with the November 1994 USEPA Region IV Memorandum.

If the carcinogenic Incremental Excess Lifetime Cancer Risk (ILCR) is greater than $10^{-4}$ (the cumulative risk threshold) or the noncarcinogenic HI is greater than 1 (the cumulative HI threshold), the site may require additional investigation for the corresponding land use scenario (USEPA Region IV Memorandum, November 1994). If neither threshold is exceeded, the property is considered suitable to lease for the specified land use scenario.

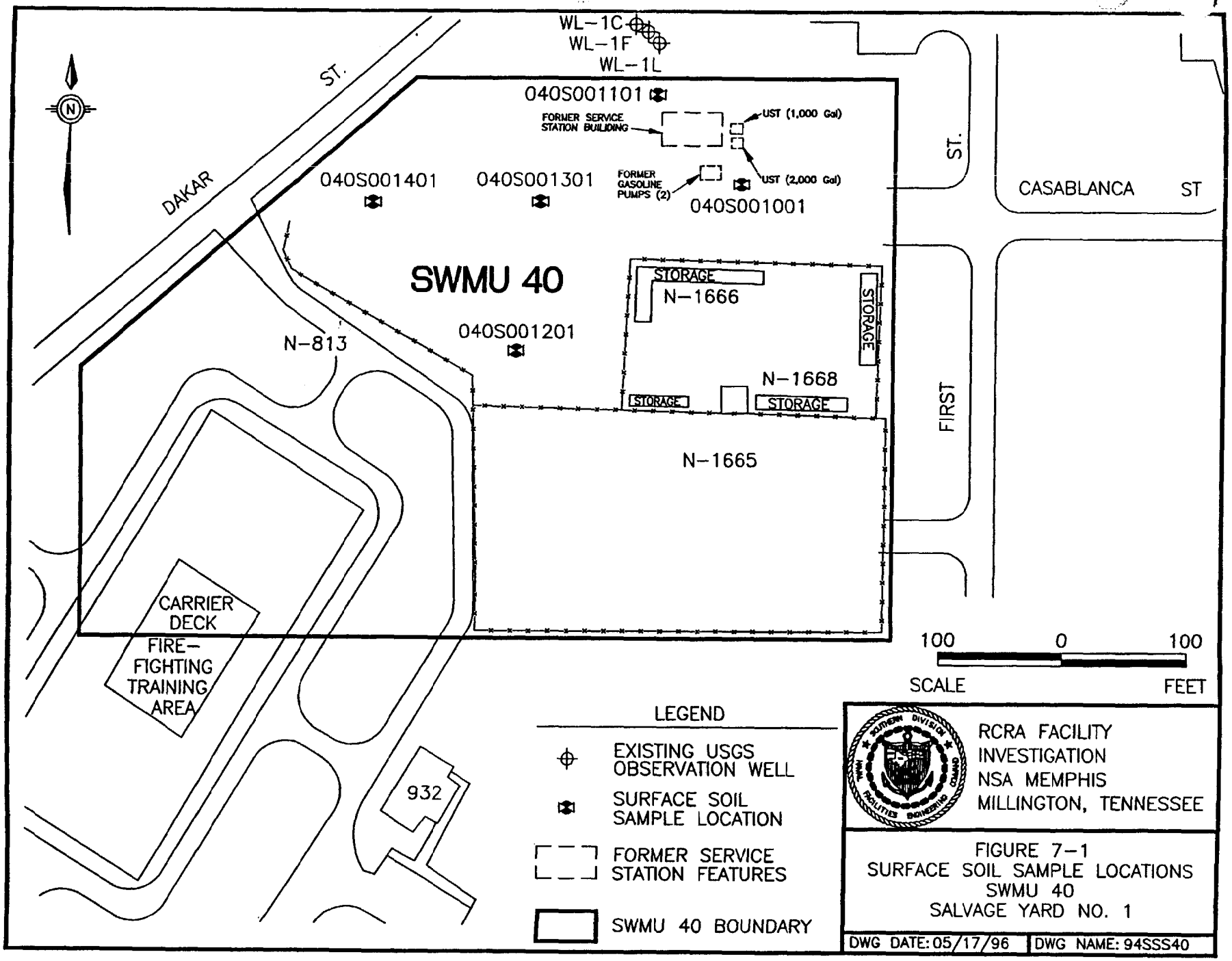
WL-1C
WL-1F
WL-1L
040S001101
FORMER SERVICE STATION BUILDING
UST (1,000 Gal)
UST (2,000 Gal)
FORMER GASOLINE PUMPS (2)
040S001001
040S001401
040S001301
DAKAR
ST.
SWMU 40
STORAGE
N-1666
STORAGE
040S001201
N-813
N-1668
STORAGE
STORAGE
N-1665
ST.
CASABLANCA
ST
FIRST
CARRIER DECK
FIRE-FIGHTING TRAINING AREA
932
100
0
100
SCALE
FEET
LEGEND
EXISTING USGS OBSERVATION WELL
SURFACE SOIL SAMPLE LOCATION
FORMER SERVICE STATION FEATURES
SWMU 40 BOUNDARY
RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE
FIGURE 7-1
SURFACE SOIL SAMPLE LOCATIONS
SWMU 40
SALVAGE YARD NO. 1
DWG DATE: 05/17/96
DWG NAME: 94SSS40

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Table 7-2
Residential and Commercial Noncarcinogens
NSA Memphis RFI
SWMU 40 PRE

| Parameter | Reference Concentration (mg/kg) | Maximum (mg/kg) | Residential RBC Noncarcinogen (mg/kg) | Hazard Ratio | Commercial RBC Noncarcinogen (mg/kg) | Hazard Ratio |
|---|---|---|---|---|---|---|
| Aldrin | | 0.0018 | 0.038 | 0.047 | 0.34 | 0.0053 |
| Arsenic | 13.1 | 15 | | | | |
| Barium | 19.1 | 105 | 5500 | 0.019 | 140000 | 0.00075 |
| Benzo(a)anthracene | | 0.061 | | | | |
| Benzo(a)pyrene | | 0.067 | | | | |
| Benzo(b)fluoranthene | | 0.07 | | | | |
| Benzo(g,h,i)perylene | | 0.036 | 2300 | 1.57E-05 | 61000 | 5.90E-07 |
| Benzo(k)fluoranthene | | 0.073 | | | | |
| Beryllium | 0.96 | 1.4 | | | | |
| Bis(2-Ethylhexyl)phthalate | | 0.41 | | | | |
| Cadmium | ND | 9.3 | 39 | 0.24 | 1000 | 0.0093 |
| * Chromium | 26.4 | 19.5 | 390 | | 10000 | |
| Chrysene | | 0.097 | | | | |
| * Cobalt | 15 | 8.5 | 4700 | | 120000 | |
| * Copper | 23.6 | 13.6 | 2900 | | 76000 | |
| 4,4'-DDE | | 0.021 | | | | |
| 4,4'-DDT | | 0.04 | | | | |
| Dieldrin | | 0.23 | | | | |
| Fluoranthene | | 0.38 | 3100 | 0.00012 | 82000 | 4.63E-06 |
| Indeno(1,2,3-cd)pyrene | | 0.035 | | | | |
| Lead | 28.7 | 133 | | | | |
| * Mercury | 1.1 | 0.14 | 23 | | 610 | |
| Nickel | ND | 8.2 | 1600 | 0.0051 | 41000 | 0.0002 |
| Phenanthrene | | 0.062 | 2300 | 2.70E-05 | 61000 | 1.02E-06 |
| Pyrene | | 0.16 | 2300 | 6.96E-05 | 61000 | 2.62E-06 |
| Selenium | ND | 0.23 | 390 | 0.00059 | 10000 | 2.30E-05 |
| Tin | | 13.8 | 47000 | 0.00029 | 1000000 | 1.38E-05 |
| * Vanadium | 49.6 | 22.8 | 550 | | 14000 | |
| * Zinc | 88.3 | 62.5 | 23000 | | 610000 | |
| | | ILCR | SUM | 0.31 | SUM | 0.016 |

NOTES:

ILCR Incremental excess lifetime cancer risk
HI Hazard index
blank spaces Indicate not applicable
ND Not detected

- All concentrations are in parts per million (mg/kg).
- The maximum concentration reported for each contaminant was used to develop the table above.
- Soil sample data were from the surface (0-1') interval only.
- Screening values (RBCs) are from the July to December 1995 Risk-Based Concentration (RBC) Table (October 20, 1995 USEPA Region III RBC memo).
- The maximum lead (Pb) concentration reported at SWMU 40 was 133 mg/kg. This is less than the 400 mg/kg residential soil screening level for total lead (USEPA OSWER Directive 9355.4-12).
- The RBC for pyrene was used as a surrogate for phenanthrene and benzo(g,h,i)perylene, which do not have RBCs.
- * Compound was excluded from the risk ratio because the maximum reported concentration is less than the corresponding reference concentration.

Table 7-1
Residential and Commercial Carcinogens
NSA Memphis RFI
SWMU 40 PRE

| Parameter | Reference Concentration (mg/kg) | Maximum (mg/kg) | Residential RBC Carcinogen (mg/kg) | Risk Ratio | Commercial RBC Carcinogen (mg/kg) | Risk Ratio |
|---|---|---|---|---|---|---|
| Aldrin | | 0.0018 | | | | |
| Arsenic | 13.1 | 15 | 0.43 | 3.5E-05 | 3.8 | 3.9E-06 |
| Barium | 19.1 | 105 | | | | |
| Benzo(a)anthracene | | 0.061 | 0.88 | 6.9E-08 | 7.8 | 7.8E-09 |
| Benzo(a)pyrene | | 0.067 | 0.088 | 7.6E-07 | 0.78 | 8.6E-08 |
| Benzo(b)fluoranthene | | 0.07 | 0.88 | 8.0E-08 | 7.8 | 9.0E-09 |
| Benzo(g,h,i)perylene | | 0.036 | | | | |
| Benzo(k)fluoranthene | | 0.073 | 8.8 | 8.3E-09 | 78 | 9.4E-10 |
| Beryllium | 0.96 | 1.4 | 0.15 | 9.3E-06 | 1.3 | 1.1E-06 |
| Bis(2-Ethylhexyl)phthalate | | 0.41 | 46 | 8.9E-09 | 410 | 1.0E-09 |
| Cadmium | ND | 9.3 | | | | |
| * Chromium | 26.4 | 19.5 | | | | |
| Chrysene | | 0.097 | 88 | 1.1E-09 | 780 | 1.2E-10 |
| * Cobalt | 15 | 8.5 | | | | |
| * Copper | 23.6 | 13.6 | | | | |
| 4,4'-DDE | | 0.021 | 1.9 | 1.1E-08 | 17 | 1.2E-09 |
| 4,4'-DDT | | 0.04 | 1.9 | 2.1E-08 | 17 | 2.4E-09 |
| Dieldrin | | 0.23 | 0.04 | 5.8E-06 | 0.36 | 6.4E-07 |
| Fluoranthene | | 0.38 | | | | |
| Indeno(1,2,3-cd)pyrene | | 0.035 | 0.88 | 4.0E-08 | 7.8 | 4.5E-09 |
| Lead | 28.7 | 133 | 400 | | 1000 | |
| * Mercury | 1.1 | 0.14 | | | | |
| Nickel | ND | 8.2 | | | | |
| Phenanthrene | | 0.062 | | | | |
| Pyrene | | 0.16 | | | | |
| Selenium | ND | 0.23 | | | | |
| Tin | | 13.8 | | | | |
| * Vanadium | 49.6 | 22.8 | | | | |
| * Zinc | 88.3 | 62.5 | | | | |
| | | ILCR | SUM | 5E-05 | SUM | 6E-06 |

NOTES:

ILCR Incremental excess lifetime cancer risk
HI Hazard index
blank spaces Indicate not applicable
ND Not detected

- All concentrations are in parts per million (mg/kg).
- The maximum concentration reported for each contaminant was used to develop the table above.
- Soil sample data were from the surface (0-1') interval only.
- Screening values (RBCs) are from the July to December 1995 Risk-Based Concentration (RBC) Table (October 20, 1995 USEPA Region III RBC memo).
- The maximum lead (Pb) concentration reported at SWMU 40 was 133 mg/kg. This is less than the 400 mg/kg residential soil screening level for total lead (USEPA OSWER Directive 9355.4-12).
- The RBC for pyrene was used as a surrogate for phenanthrene and benzo(g,h,i)perylene, which do not have RBCs.

* Compound was excluded from the risk ratio because the maximum reported concentration is less than the corresponding reference concentration.

This PRE does not include an acute or subchronic assessment of subsurface soil data. USEPA uses an exposure duration of 25 years — a chronic exposure scenario. Exposure durations less than seven years, such as what would be assumed for a construction worker scenario, are considered acute or subchronic. USEPA used chronic-based toxicological information when calculating RBCs, or USEPA makes conservative adjustments to reflect chronic exposure. In addition to the effect the exposure duration differences would have on a construction worker's cumulative risk and hazard estimates, toxicological information used by USEPA to calculate RBCs would be adjusted to reflect acute or subchronic toxicological endpoints rather than the chronic endpoints typically used. Acute and subchronic thresholds are based on lower exposure durations than chronic thresholds, and higher concentrations are generally necessary to elicit observable toxic effects. Higher thresholds for toxic effects result in less conservative toxicological information, which would be used to adjust RBCs for either acute or subchronic exposure. Because a construction worker would be exposed under either acute or subchronic conditions, and RBCs based on chronic exposure are generally more conservative, the industrial site worker scenario presented in this PRE would be a more conservative scenario than that for a construction worker.

The Preferred Reuse Alternative in the *Base Reuse and Economic Development Plan* (RKG Associates Inc., 1995), indicates the most likely reuse of the parcel of land containing SWMU 40 will be for retail, office, and commercial businesses. Due to the nature of this proposed use, an industrial setting can be assumed to evaluate risk. With respect to the industrial scenario, the resulting ILCR and HI were well below the established criteria of $10^{-4}$ and 1, respectively. In addition, the resulting ILCR and HI for the residential scenario were below the established $10^{-4}$ ILCR threshold and the HI threshold of 1.

**Conclusions and Recommendations**

Based on the information gathered during this investigation, the following conclusions and recommendations have been reached:

- SWMU 40 will likely be developed for retail, office, and commercial business land use.

- A combination of 29 semivolatile organic compounds, pesticides, and inorganics were detected in five soil samples collected from the surface interval.

- The maximum reported concentrations of arsenic, beryllium, and dieldrin exceeded residential soil RBCs, and the concentrations reported for arsenic and beryllium exceeded their corresponding industrial soil RBCs. However, the detected concentrations of arsenic and beryllium are similar to background (reference) concentrations as shown on Tables 7-1 and 7-2. NSA Memphis background concentrations are explained in more detail in the Technical Memorandum *Assemblies A through D Background Reference Concentrations* (E/A&H, 1996). In addition, dieldrin has been shown to be widespread at NSA Memphis due to its application during the 1950s and 1960s to control the spread of white-fringed beetles.

- Based on a PRE performed on data from samples collected from the 0 to 1-foot bls interval:

  — Carcinogens — Neither the *industrial* nor *residential* ILCRs exceeded the $10^{-4}$ threshold, indicating suitability for lease for either industrial or residential land use.



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— Noncarcinogens — Neither the *industrial* nor *residential* HI's exceeded 1, indicating suitability for lease for either industrial or residential land use.

- Based on data from surface soil samples collected from SWMU 40, the *Base Reuse and Development Plan*, and in accordance with PRE methodology, the property is suitable for either the proposed commercial use or residential use.



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## 8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information gathered during this investigation, the following conclusions and recommendations have been reached.

- Elevated concentrations of VOCs, SVOCs, and TPH were detected in subsurface soil samples in the north-central portion of the site. The detected contaminants are typical constituents of petroleum products, likely released during the operation of a former service station which occupied the north-central portion of the SWMU in the 1940s. E/A&H performed a geophysical survey at SWMU 40 in 1994. The geophysical survey identified significant anomalies in the north-central portion of the SWMU and indicated at least one of the USTs associated with the former service station may still be present.

- The highest concentrations of petroleum constituents were in the 5- to 11-foot interval bls in an area less than 50 square feet near the UST area and former pump island. The following petroleum-related constituents were present in subsurface soil samples: benzene, toluene, ethylbenzene, total xylenes, isopropylbenzene/bromobenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, styrene, tert-butylbenzene, sec-butylbenzene/1,3-dichlorobenzene, p-isopropyltoluene, n-butylbenzene, naphthalene, 2-methylnaphthalene, fluorene, phenanthrene, and TPH.

- The industrial RBCs for VOCs were not exceeded in any soil sample. However, the residential RBCs for selected VOCs were exceeded at three of the DPT locations: locations 8, 13, and 14 (Figure 6-1). The residential RBC for 1,3,5-trimethylbenzene (31,000 ppb) was exceeded at location 8 in the 3- to 5-foot (40,800 ppb) and the 5- to 7-foot (94,500 ppb) intervals, with decreasing concentrations observed in deeper sample collected from location 8. The residential RBC for 1,2,4-trimethylbenzene (39,000 ppb) was exceeded at location 8 in the 3- to 5-foot (186,000 ppb), 5- to 7-foot (316,000 ppb),

and 7- to 9-foot (95,200 ppb) intervals; and at location 14 in the 5- to 7-foot (65,000 ppb) interval. The residential RBC for 1,2,3-trichloropropane (91 ppb) was exceeded in the soil sample collected from the 7- to 9-foot (650 ppb) interval of location 13.

- The following VOCs were detected in groundwater samples collected from the loess at two sampling locations: ethylbenzene, m,p-xylenes, isopropylbenzene/bromobenzene, n-propylbenzene, tert-butylbenzene, 1,2,4-trimethylbenzene, sec-butylbenzene/ 1,3-dichlorobenzene, n-butylbenzene and naphthalene. The ethylbenzene concentration in the loess groundwater sample at location 8 (1,150 ppb) exceeds the MCL for drinking water (700 ppb) but not the RBC for tap water (1,300 ppb). The 1,2,4-trimethylbenzene concentration in the loess groundwater sample from location 9 (107 ppb) exceeded the tap water RBC (3 ppb), but no MCL exists for this compound. Groundwater in the loess is not used for drinking water.

- The following VOCs were detected in groundwater samples collected from the fluvial deposits at two locations: m,p-xylenes, 1,2,4-trimethylbenzene, and naphthalene. The 1,2,4-trimethylbenzene concentration in the fluvial deposits groundwater sample from location 18 (5 ppb) exceeds the tap water RBC (3 ppb).

- No VOCs were detected above a PQL of 5 ppb in the three USGS observation wells just north of the north-central boundary of the SWMU.

- The BCT recommended that the USTs be removed under the Navy's UST program. The USTs and associated lines at SWMU 40 were removed in June 1996.



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- To determine exposure potential at SWMU 40 and whether additional investigation would be required, the BCT recommended the collection and analysis of five surface-soil samples at various locations around the SWMU. These samples were collected on September 25, 1995, and a PRE was prepared based on the analytical results. With respect to the industrial scenario, the resulting ILCR and HI were well below the established criteria of $10^{-4}$ and 1, respectively. In addition, the resulting ILCR and HI for the residential scenario were below the established $10^{-4}$ ILCR threshold and the HI threshold of 1. Based on the data from the surface soil samples collected at SWMU 40 and in accordance with PRE technology, the SWMU 40 property is suitable for either the proposed commercial use or for residential use.

- Based on the information gathered during this RFI and the PRE conducted for SWMU 40, risk to human health and the environment associated should be minimal. As presented in the PRE, the carcinogenic ICLR was below $10^{-4}$ and the noncarcinogenic HI was less than 1. No further action is recommended under the RFI at SWMU 40.



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## 9.0 REFERENCES

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# Appendix A

## Sampling Report — Naval Air Station Memphis

# SAMPLING REPORT - NAVAL AIR STATION MEMPHIS

## MILLINGTON, TENNESSEE

Prepared by

Southern Division
Naval Facilities Engineering Command

11 August 1988

Prepared by:

Robert W. Moser, PE

Robert W. Moser

Reviewed by:

James Malone, PE

J. B. Malone

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LIST OF FOOTNOTE REFERENCES


(1) 100% ADDITIONAL SAMPLING REPORT - NAS MEMPHIS (NORTHSIDE STORM DRAIN) Prepared by Environmental & Safety Designs, Inc. August 9, 1988

(2) INITIAL ASSESSMENT STUDY OF NAVAL AIR STATION MEMPHIS, MILLINGTON, TENNESSE, NEESA 13-038, NOVEMBER 1983

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## 1.0 INTRODUCTION

"Environmental and Safety Designs (EnSafe) was contracted by Southern Division Naval Facilities Engineering Command to investigate certain uncontroled hazardous waste disposal sites located at Naval Air Station (NAS) Memphis. The investigation was designed to identify possible contamination at the following Navy locations:

Site 1.) Soils adjacent to a 60" RCP (4' sections) storm sewer from its outfall and continuing upstream a distance of 660 linear feet. The site received approximately 17,000 gallons/day of cyanide electroplating waste daily from the fifties to the seventies.

Site 2.) An outside storage yard which stored lead acid batteries and gasoline, and;

Site 3.) An area adjacent to an existing storm sewer manhole located immediately west of 7th Avenue and south Casablanca street, near the former electroplating shop. The location of these site is shown on Figure 1." 1

The investigation was conducted in order to determine the proper handling of any contaminated soils within the limits of the Navy's Military Construction (MILCON) Project No. 283, SHIPBOARD AIRCRAFT CRASH CREW LIVE FIRE TRAINING FACILITY. The location of this facility and the location of the sites investigated are shown on Figure 1.

Sites 1, 2, and 3 are solid waste management units (SWMU) that have been identified in the Hazardous Solid Waste Amendments Permit No. TN 002, dated 15 September 1986. Site 1 of this report is SWMU site 4 - N-121 Plating Shop Ditch. Site 2 of this report is SWMU site 40 -Salvage Yard No. 1. Site 3 of this report is associated with SWMU site 3 - N-121 Plating Shop Dry well. A RCRA Facility Investigation Work Plan was submitted to both the state of Tennessee and EPA region IV in April 1987. We have been waiting for EPA's comments on the work plan since then. In June of 1988 we could not wait any longer, so we proceeded to investigate the three sites. If we can not award the below MILCON project this September 1988, we could lose the project.

## 2.0 MILCON PROJECT NO. 283

This project's primary facility consists of a concrete simulated flight deck for aircraft crash and rescue crew firefighting training. The primary facility will be underlined with a 40 mil impervious material. Support facilities will include an asphalt road which will circle the primary facility.



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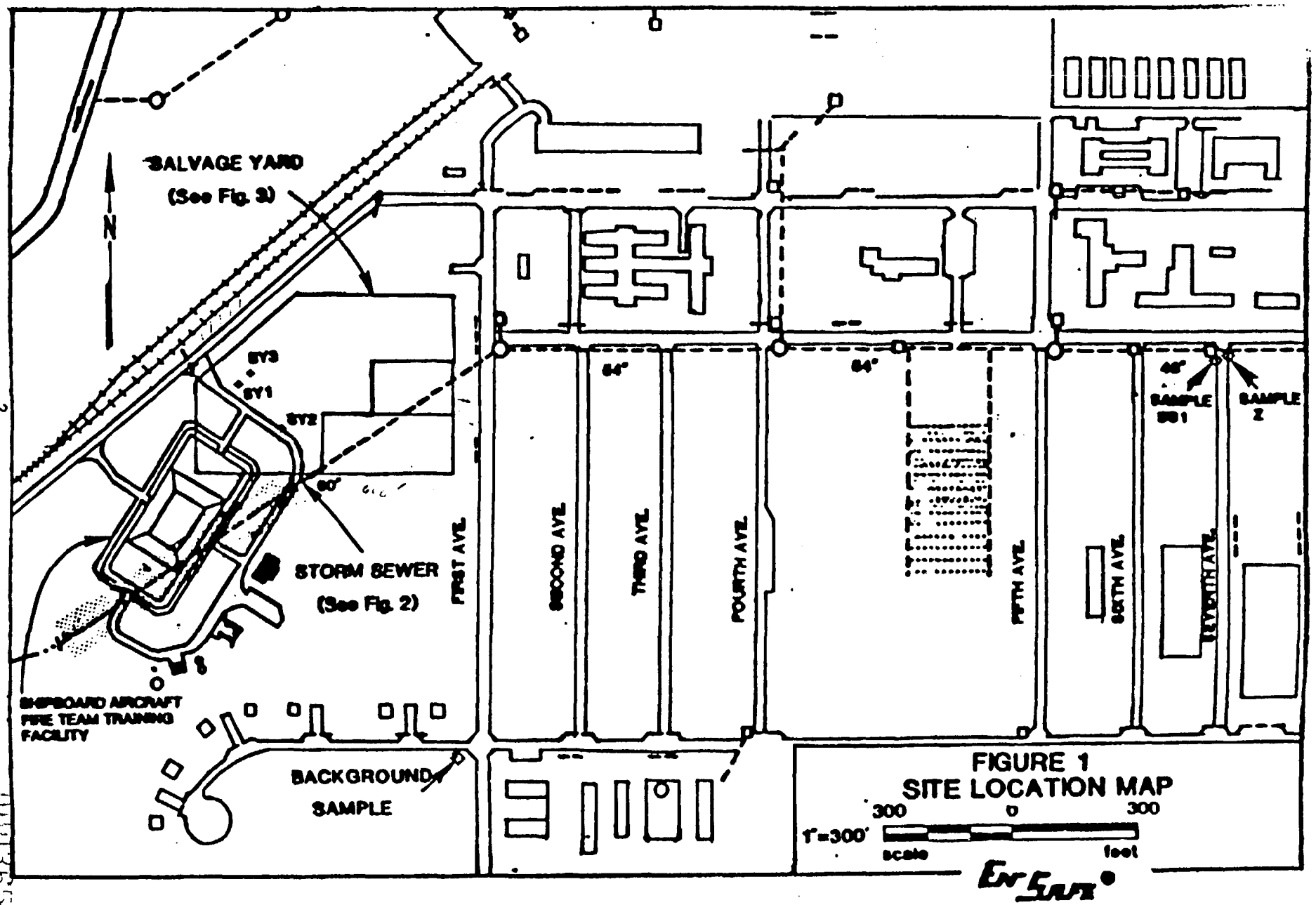


FIGURE 1
SITE LOCATION MAP

Currently there is not a facility of this type for a Navy aircraft crash and salvage crew to train under live fire conditions. This project was developed from the findings of the investigation into the problems associated with extinguishing the catastrophic fire onboard the USS NIMITZ. Investigators discovered that the current level of training for aircraft crash crews was inadequate because no facility exist where an aircraft crash crew can receive live fire training. This project will enable a team to receive live firefighting training with the unique hazards associated with shipboard aircraft firefighting. This team training will develop confidence in the crew's ability to extinguish large, complex shipboard aircraft deck fires, thus potentially saving thousands of lives aboard our ships.

3.0 SAMPLING RATIONALE

"The sampling target for site 1 was to sample soils surrounding the storm sewer at all defective joints. An internal inspection of the sewer was performed by Industrial Clean-up Inc. (ICI) and all suspect joints were marked and recorded (Table 1). Photographs of the joints are located in Appendix A. All joint locations were then transposed to the ground surface measured from the outfall. Sampling was performed by drilling to depths of 0-1 feet, 1-3 feet, and 3-5 feet below the pipe's invert. Two additional borings were taken at the entrance and exit of the storm sewer at the same depth interval as the defective joints. One final sample was taken from the sediment that had collected within the system. All of the 0-1 foot samples were analyzed for EP Toxicity Metals (EPA METHOD SW-846) and Total Cyanide." 1

"Site 2, the salvage yard, was visually inspected and monitored using a hNu photoionization detector. The visual inspection of the property indicated widespread discoloration of surface soils on the site. Consequently, three composite samples were collected from areas that showed staining or discoloration on the surface. An organic vapor background concentration of 0.1 ppm was established using the hNu and at sampling location SY1 there was a slight deflection to 0.3ppm. Sample locations SY2 and SY3 were determined by staining only. Composite samples were collected at each of these locations from depths of 0-1 feet, 1-3 feet, and 3-5 feet below the surface. Samples collected from the 0-1, and 1-3 foot level were analyzed for Total Petroleum Hydrocarbons and Total Lead." 1 Samples collected from the 1-3 foot level were also analyzed for EP Toxicity Lead and BTX.

During the field investigation site 2 was found to be covered with a good growth of grass. The grass had to be cut so that the salvage yard could be visually inspected. Asphalt was detected at the surface of the salvage yard and appeared to be fine millings. The boring logs are provided in appendix C.

"The sampling target for site 3 was the joint nearest the storm sewer manhole as shown on the attached location map (Figure 1). A composite sample was taken from a boring at depths 0-1 foot, 1-3 feet, and 3-5 feet below the pipe's invert. The storm sewer samples (from the 0-1 feet below the invert) were also analyzed for EP Toxicity Metals and Total Cyanide." 1

TABLE 1
SAMPLE DESIGNATION
AND JOINT LOCATIONS

| SUSPECT JOINT NUMBER | FEET FROM OUTFALL | SAMPLE DESIGNATION |
|---|---|---|
| 2 | 8 | A |
| 3 | 12 | B |
| 9 | 36 | C |
| 13 | 52 | D |
| 18 | 72 | E |
| 20 | 80 | F |
| 25 | 100 | G |
| 32 | 128 | H |
| 40 | 160 | I |
| 45 | 180 | J |
| 53 | 212 | K |
| 61 | 244 | L |
| 70 | 280 | M |
| 77 | 308 | N |
| 85 | 340 | O |
| 89 | 356 | P |
| 95 | 380 | Q |
| 110 | 440 | R |
| 125 | 500 | S |
| 132 | 528 | T |
| 140 | 560 | U |
| 145 | 580 | V |
| 148 | 592 | W |
| 158 | 632 | X |
| 164 | 656 | Y |



000367

"Two additional samples were collected for "background" (BKG and BKGD2). The background samples were analyzed for EP Toxicity Metals, Total Cyanide, Total Petroleum Hydrocarbons and Total Lead for reference criteria for all samples. The samples collected for BKG were analyzed at the 7-8, 8-10, and 10-12 foot intervals. BKGD2 samples were collected at the 0-1, 1-3, and 3-5 foot intervals; however, only the 1-3 foot sample was analyzed for the aforementioned parameters." 1 In addition to the aforementioned parameters, the 1-3 foot sample was analyzed for BTX.

## 3.1 SAMPLING PROCEDURE

"The drilling operations for the sampling were conducted in an orderly and systematic manner in order to optimize the location of each boring. Soil samples were taken through the annulus of a hollow stem auger by driving a twenty-four inch split-spoon sampler. Upon withdrawal of the sampler, a composite sample was collected and placed in a labeled one quart wide mouth jar, covered with an aluminum foil seal, and capped." 1

"To prevent cross contamination the split spoon sampler was decontaminated between samples. Decontamination followed a three step process: 1) wash in a dilute HCL solution; 2) rinse in clean tap water; and, 3) rinse in distilled water. Also all personnel handling the sampler wore latex surgical gloves which were discarded between each sample. To prevent cross-contamination, all equipment: spatulas, sample jars, etc., as well as work gloves worn by workers were also decontaminated between samples." 1

## 3.2 CUSTODY PROCEDURES

"To assure the samples were maintained in a safe and reliable manner, a strict chain of custody procedure was followed. This was implemented in the field and carried throughout the analytical process. All parties handling the samples signed the chain-of-custody form which becomes a part of the permanent record." 1

## 4.0 ANALYTICAL PROCEDURES

"Soil samples were extracted by Method 1310, Extraction Procedure (EP) Toxicity Method. Samples were then analyzed by direct aspiration atomic absorption techniques, except arsenic and selenium which were analyzed by gaseous hydride methods, and mercury which was analyzed by cold vapor atomic absorption." 1

"Quality control included the analysis of one duplicate and "analytical spikes" at reporting concentrations. Triplicate spikes were performed to provide quality control data both on precision and accuracy of the analysis. Table 2 summarizes the quality control data obtained." 1

"Total Lead analyses were conducted by EPA Method 3050, Acid Digestion of Soils, and then analyzed by direct aspiration atomic absorption. Total Cyanide was analyzed by EPA Method 9010." 1 BTX was analyzed by EPA Method 8020. Total Petroleum Hydrocarbons was analyzed by Standard Method of Testing Water and Wastewater, standard 502-E.

Table 2
Quality Control Data

| Metal | Spike Conc. (mg/l) | Recovery 1 % | Recovery 2 % | Recovery 3 % |
|---|---|---|---|---|
| AS | 1.00 | 104 | 108 | 101 |
| SE | 1.00 | 104 | 108 | 94 |
| BA | 0.10 | 99 | 99 | 98 |
| CD | 0.40 | 95 | 95 | 90 |
| CR | 0.10 | 93 | 93 | 94 |
| PB | 1.00 | 109 | 94 | 94 |
| AG | 1.00 | 88 | 90 | 92 |
| HG | 0.20 | 95 | 85 | 100 |
| CN | 0.80 | 92 | 112 | - |



000369

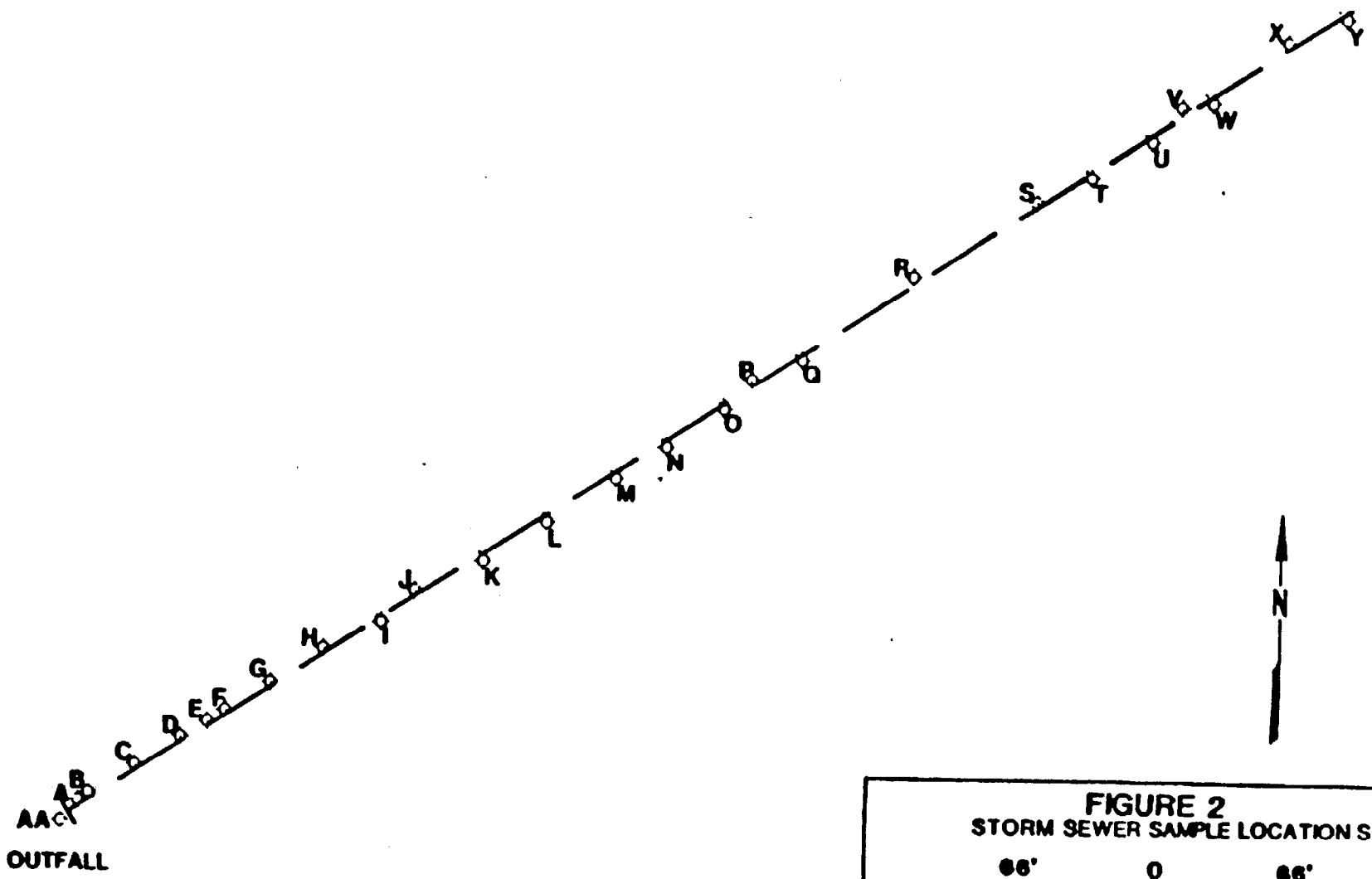


**FIGURE 2**
**STORM SEWER SAMPLE LOCATIONS**

1" = 66'

66' 0 66'

scale feet

EnSafe®

TABLE 3
ANALYTICAL RESULTS OF NAS MEMPHIS
STORM DRAIN INVESTIGATION

| SAMPLE NUMBER | EP TOXICITY AS | BA | CD | CR | PB | HG | SE | AG | TOTAL CYANIDE |
|---|---|---|---|---|---|---|---|---|---|
| | mg/l | | | | | | | | |
| A1 5-6' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| B1 5-6' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| C1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| C1 6-7'Dup | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| D1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| E1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| F1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| G1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| H1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| I1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| J1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| K1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| L1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| M1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| N1 6-7' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| O1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| P1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Q1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| R1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| S1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| T1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| U1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| V1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| W1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| X1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Y1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Z1 0-1' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| AA 0-1' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| Sediment | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| SS1 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 7-8' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 8-10' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |
| BKG 10-12' | <1.0 | <1.0 | <0.5 | <1.0 | <1.0 | <0.2 | <0.5 | <1.0 | <0.1 |



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## 5.0 RESULTS

### 5.1 Site 1

Twenty-eight soil samples were collected from the area corresponding with the storm sewer. Twenty-six samples collected along the course of the storm pipe are identified with an alphabetical designation from A to Y, one sample at the outfall was designated AA, and one composite sediment sample from within the drain pipe itself was labeled as "sediment". (Figure 2 shows each sample location) One additional sample was collected from the approximate entrance area to the storm sewer location and was designated as sample "Z" (Figure 1). As mentioned in section 2.0, each composite sample from 0-1 foot depth below the pipe's invert was analyzed for EP Toxicity Metals and Cyanide and results are found in Table 3. All the Site 1 samples showed no detectable levels of contamination above normal background for metals and/or cyanide. The complete laboratory results are included in Appendix B." 1

### 5.2 Site 2

"Three samples were collected from the salvage yard and were designated SY1, SY2, and SY3. Each composite sample at the 0-1 foot interval was analyzed for Total Petroleum Hydrocarbons and Total Lead. Laboratory results (Table 4) indicate the presence of high levels of hydrocarbons when referenced to the background sample. Laboratory results for composite samples collected at the 1-3 foot interval were below detectable limits. Complete laboratory results are included in Appendix B. Sample locations are shown in Figure 3." 1

Additionally, each composite sample at the 1-3 foot interval was analyzed for Total Petroleum Hydrocarbons, Total Lead, EP Toxicity Lead and BTX.

### 5.3 Site 3

"The final sample collected was adjacent to the storm sewer manhole located west of 7th Avenue and south of Casablanca. The sample, SS1, was collected by drilling to a depth of 0-1 feet, 1-3 feet, and 3-5 feet below the pipe's invert. Analytical results of the uppermost sample show no significant levels of contamination. Data for this sample is shown in Table 3 and complete laboratory results are indicated in Appendix B. Sample location is shown in Figure 1." 1

## 6.0 PHYSICAL FEATURES

### 6.1 General Ecology

The adjacent vegetation of the salvage yard is composed of hardwood/pine forest. The salvage yard ground is covered with grasses in the improved and semi-improved areas, and covered with native grasses and wild flowers in the undisturbed areas.

Table 4
Data Summary for Salvage Yard
And Related Background Tests

| Sample Number | | Total Petroleum Hydrocarbons (ppm) | Total Lead |
|---|---|---|---|
| SY1 | 0-1' | 1100 | 70.3 |
| SY2 | 0-1' | 1850 | 15.7 |
| SY3 | 0-1' | 839 | 17.9 |
| SY1 | 1-3' | <1 | 7.49 |
| SY2 | 1-3' | <1 | 6.79 |
| SY3 | 1-3' | <1 | 10.0 |
| BKG2 | 1-3' | 389 | 12.3 |
| BKG | 7-8' | <1 | 4.65 |
| BKG | 8-10' | 9 | 5.20 |
| BKG | 10-12' | <1 | 4.80 |

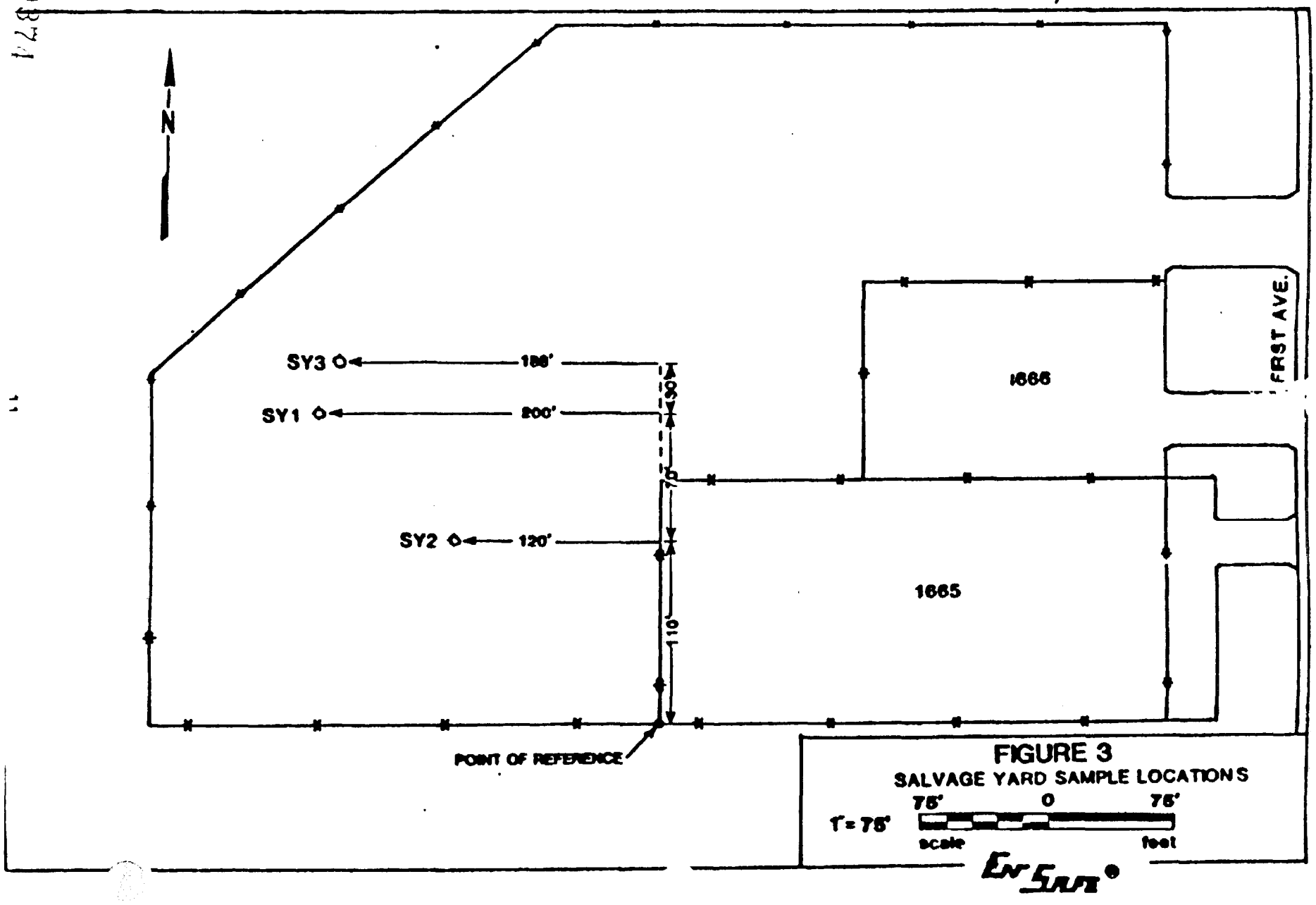


FIGURE 3
SALVAGE YARD SAMPLE LOCATIONS

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## 6.2 Climatology

"The climate of NAS Memphis is characterized by relative mild winters, with snow and ice occurring an average of ten times per year, and hot summers with temperatures above 90 degrees F. The average dates of the last freezing temperature, in spring and the first freezing temperature, in the fall, are 20 March and 10 November, respectively. The average annual precipitation is approximately 49 inches." 2

## 6.3 Topography

The salvage yard is relatively flat with it's elevation being approximately 273 feet above mean sea level. The salvage yard slopes from east to west at approximately 0.6 percent grade.

## 6.4 Geology

The geology of the site consists of fill materials at the surface of Pleistocene and Holocene alluvium and terrace deposits underlain by Eocene clastic sediments. Pleistocene deposits consist of alluvial sands and gravels while Holocene alluvium are composed of wind-blown silts of low permeability. The upper most units of Eocene clastic sediments, the Jackson formation, in the area of NAS consist of approximately 190 feet of gray, bluish-gray, greenish-gray, and tan clays. This is evident by the boring logs (see Appendix C) of the samples taken within the salvage yard.

## 6.5 Soils

The soils underneath the gravel and rock fragments are typical of Falaya soils. They are medium textured and appear to have locally-low infiltration rates.

## 6.6 Hydrology

The surface water flows slowly towards existing drainages along the north-west side of the site which drain into the tributary system of North Fork Creek. The salvage yard is located above the 100 year flood plain which is at elevation 257.8 feet mean sea level (MSL). The site is also above the standard project flood elevation of 260.6 feet MSL. 2

"The Memphis metropolitan area potable water sources are mostly obtained from the Memphis Sand ("500-foot sand") and the Fort Pillow sand ("1,400-foot sand"). There are small-capacity domestic wells in the Memphis area but are seldom considered due to hardness, high iron, and total dissolved solids contents." 2

## 6.7 Migration Potential

Surface water runoff has the most potential for migration since the site is underlain with clays which have been tested and found to contain no measurable Total Petroleum Hydrocarbons, BTX and EP Toxicity Lead and the hNu meter field results indicate that there is

not a signif[illegible] air migration potential. However, runoff potential is lessened [illegible] the climate and topography.

The salvage yard is secured with a fence which is secured by the stations security fence. Access to the site is restricted to only base personnel.

Additional information about NAS's physical features may be obtained for the Initial Assessment Study of Naval Air Station Memphis Millington, Tennessee, NEESA 13-038 dated November 1983.

## 7.0 CONCLUSION

"The investigation at the three sites at NAS Memphis indicates that only the former salvage yard (site 2) shows positive contaminant levels in the superficial samples. Laboratory results substantiate the presence of hydrocarbons in only the 0-1 foot sampling interval. Visual inspection of the property indicates the contamination to be continuous throughout the area." 1 Although stains were found on the existing gravel, rock fragments and asphalt covered yard, the site is supporting a healthy growth of grass.

"The positive values obtained for Total Petroleum Hydrocarbons and Total Lead are probably indicative of oil and/or gasoline contamination.... Based on the levels of contamination encountered at the salvage yard and in accordance with the guidelines set forth by the Tennessee Department of Health and Environment Policy on Cleanup Levels for Gasoline and Other Petroleum Hydrocarbons, EnSafe recommends that all excavated soils from the 0-1 foot level within the salvage yard be handled in accordance with Tennessee Policy." 1

"The site location map (Figure 1) shows the aircraft training facility superimposed on the area of the storm sewer and the salvage yard. Excavation of soil ( maximum depth of 1 foot) from the project area would necessitate the removal of approximately 2000 cubic yards of soil." 1

"Due to the exorbitant cost of removal of the soils as hazardous waste, EnSafe recommends working with the Tennessee Department of Health and Environment for onsite remediation."1

Based on the visual inspection of the salvage yard which found the presence of asphalt mixed in with the gravel covering and the levels of hydrocarbons encountered, the presence of vegetation, the climatology, topography, geology, soils, hydrology, migration potential, the lack of BTX constituents and EP Tox. Metals and the policy of Tennessee Department of Health and Environment on the clean up of other petroleum hydrocarbons, the Navy recommends no action for all soils 0-1 foot deep located within the salvage yard which are not to be disturbed by the MILCON project. This will allow the hydrocarbons to continue to decompose naturally. The Navy does propose to handle all excavated soils from the 0-1 foot interval of the salvage yard as either base or sub-base material for the MILCON project. By handling the soil in this manner, the material would be covered with an impervious cap and would become part of the asphalt road way. This will greatly lessen the potential for the hydrocarbon to migrate. We believe this is a viable alternative because the contaminant is similar to oils found in asphalt. One last note, the salvage yard has been a parking lot for the storage of scrap pieces of airplanes, anchor chains and cars.

To do any other remedial action, such as remove the soils as hazardous waste would only spread the Navy's liability and not remediate the Total Petroleum Hydrocarbon. Due to the known soil conditions and the presence of asphalt we ask the state of Tennessee to consider in our favor the Navy's proposed recommendations.

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 06/17/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSA3

Page No.: 1

| Parameter | Sample ID : | SY1 0-1' | SY2 0-1' | SY3 0-1' |
|---|---|---|---|---|
| | | 06/07/88 | 06/07/88 | 06/07/88 |
| | Lab ID : | 88060470 | 88060471 | 88060472 |
| | Sample Type : | 15 | 15 | 15 |
| | Date Received: | 06/09/88 | 06/09/88 | 06/09/88 |
| | Collected by : | ENSA | ENSA | ENSA |
| TOTAL HYDROCARBONS | | 1100 ppm | 1850 ppm | 839 ppm |
| LEAD | | 70.3 ppm | 15.7 ppm | 17.9 ppm |
| ACID DIGESTION | | YES | YES | YES |

# GENERAL ENGINEERING LABORATORIES

**Environmental Engineering and Analytical Services**

Molly P. Greene
President

George C. Greene, P.E., Ph.D.
Vice President
SC Registration No. 9103

Laboratory Certifica
FL E67156
NC
SC
VA
NACIP Ap

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 08/09/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSAJ

Page No. 1 1

| Parameter | Sample ID : | SY1 1-3' | SY2 1-3' | SY3 1-3' |
|---|---|---|---|---|
| | Lab ID : | 88070677 | 88070678 | 88070679 |
| | Sample Type : | 15 | 15 | 15 |
| | Date Received: | 07/18/88 | 07/18/88 | 07/18/88 |
| | Collected by : | ENSA | ENSA | ENSA |
| TOTAL HYDROCARBONS | | <1 ppm | <1 ppm | <1 ppm |
| LEAD | | 7.49 ppm | 6.79 ppm | 10.0 ppm |
| ACID DIGESTION | | YES | YES | YES |
| LEAD | | <1.00 ppm | <1.00 ppm | <1.00 ppm |
| EP TOX EXTRACTION-SOLID | | YES | YES | YES |
| BENZENE | | <5 ppb | <5 ppb | <5 ppb |
| ETHYLBENZENE | | <10 ppb | <10 ppb | <10 ppb |
| TOLUENE | | <10 ppb | <10 ppb | <10 ppb |
| XYLENE | | <10 ppb | <10 ppb | <10 ppb |
| AROCLOR 1016 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1221 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1232 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1242 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1248 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1254 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1260 | | <1 ppm | <1 ppm | <1 ppm |
| AROCLOR 1262 | | <1 ppm | <1 ppm | <1 ppm |
| SAMPLE PREP - PCB'S | | YES | YES | YES |

# GENERAL ENGINEERING LABORATORIES

Environmental Engineering and Analytical Services

## CERTIFICATE OF ANALYSIS

Client: ENVIRONMENTAL & SAFETY DESIGNS, INC
P.O. BOX 341315
MEMPHIS , TN 38184

Date: 07/29/88

Contact: MR. J. SPEAKMAN, PhD, PE

Released by: ALLAN M. CRANE

cc/fc: ENSA/ENSAJ

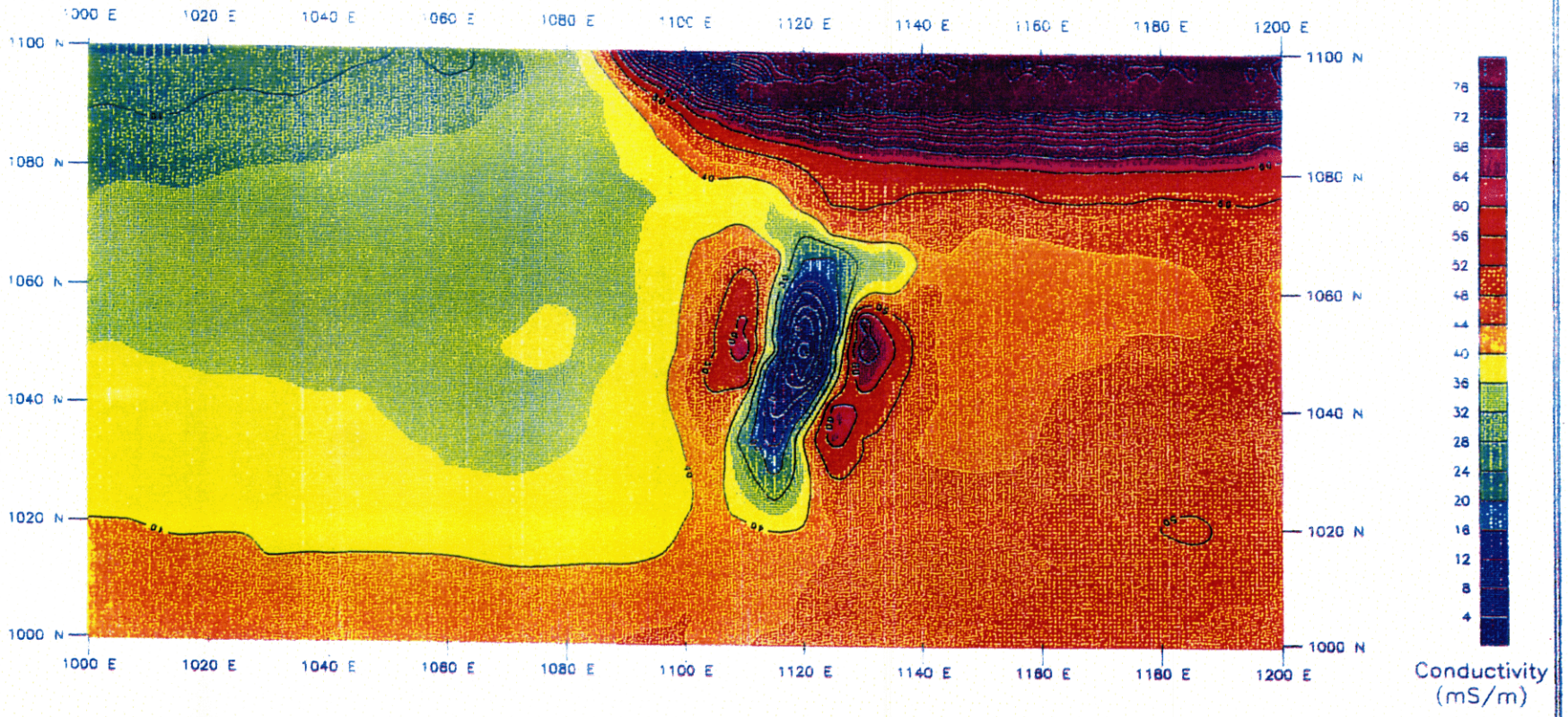
Page No.: 1

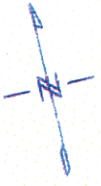
RECEIVED
AUG - 2 1988

| | |
|---|---|
| Sample ID : | BKGD2 1-3' 07/21/88 NAS |
| Lab ID : | 88071073 |
| Sample Type : | 15 |
| Date Received: | 07/22/88 |
| Collected by : | ENSA |

| Parameter | |
|---|---|
| TOTAL HYDROCARBONS | 389 ppm |
| LEAD | 12.3 ppm |
| ACID DIGESTION | YES |
| LEAD | <1.00 ppm |
| EP TOX EXTRACTION-SOLID | YES |
| BENZENE | <5 ppb |
| ETHYLBENZENE | <10 ppb |
| TOLUENE | <10 ppb |
| XYLENE | <10 ppb |
| AROCLOR 1016 | <1 ppm |
| AROCLOR 1221 | <1 ppm |
| AROCLOR 1232 | <1 ppm |
| AROCLOR 1242 | <1 ppm |
| AROCLOR 1248 | <1 ppm |
| AROCLOR 1254 | <1 ppm |
| AROCLOR 1260 | <1 ppm |
| AROCLOR 1262 | <1 ppm |
| SAMPLE PREP - PCB'S | YES |

# Appendix B
# Geophysical Survey Maps




Scale 1:200

10 0 10 20 30 40

(feet)

**CONDUCTIVITY, SWMU 40**

**NSA Memphis**

1994 Geophysics investigation

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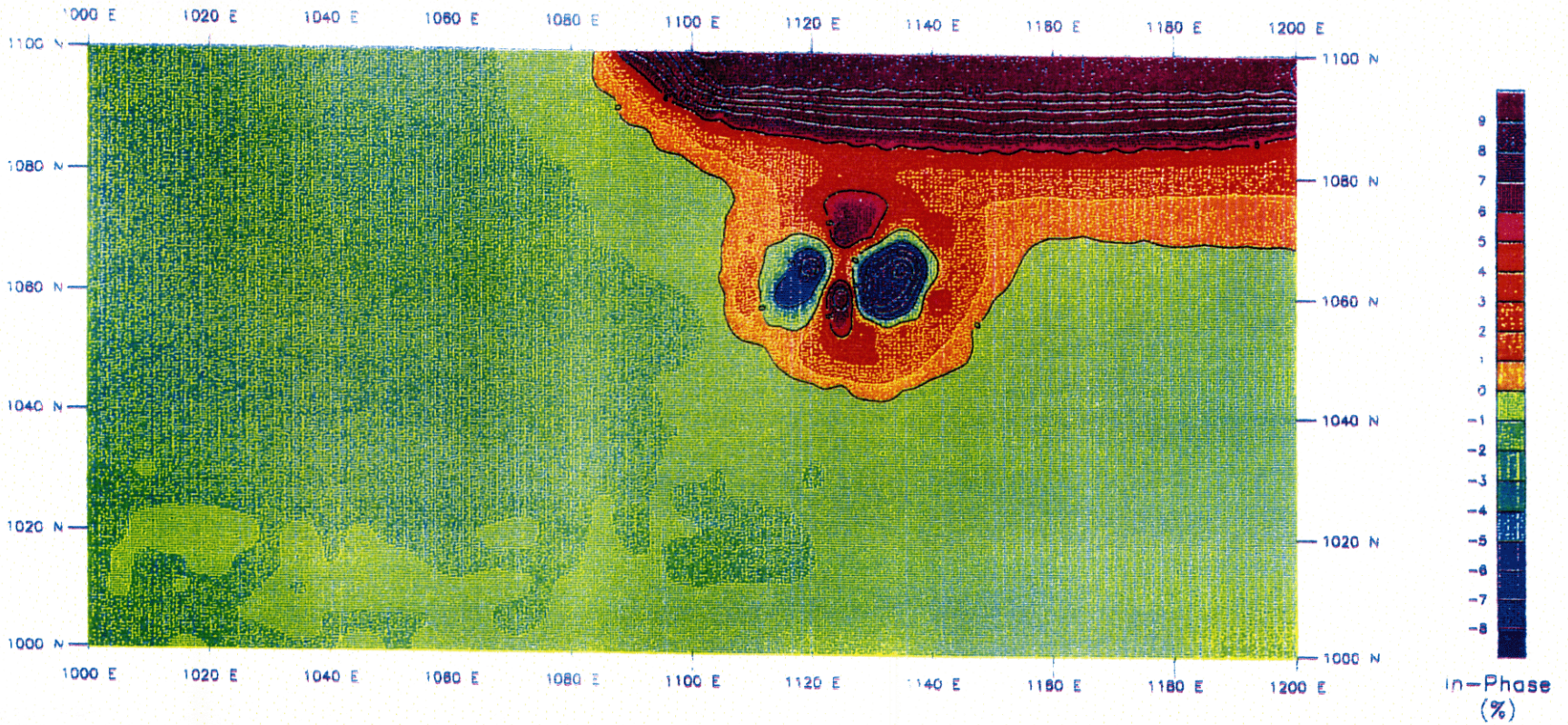


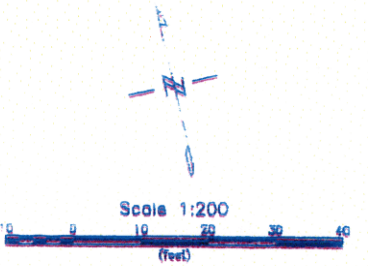


IN-PHASE, SWMU 40

**NSA Memphis**

1994 Geophysics investigation

*ENSAFE/ALLEN & HOSHALL*

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# Appendix C

# DPT Piezocone and Hydrocone Plots

PIEZOCONE SOUNDING LOG



SOUNDING #: 40-P01 CLIENT: ENSAFE DATE: 05-08-1995
JOB NAME OR #: NASM LOCATION: SWMU40 DEPTH OF GROUNDWATER: 18 FEET b

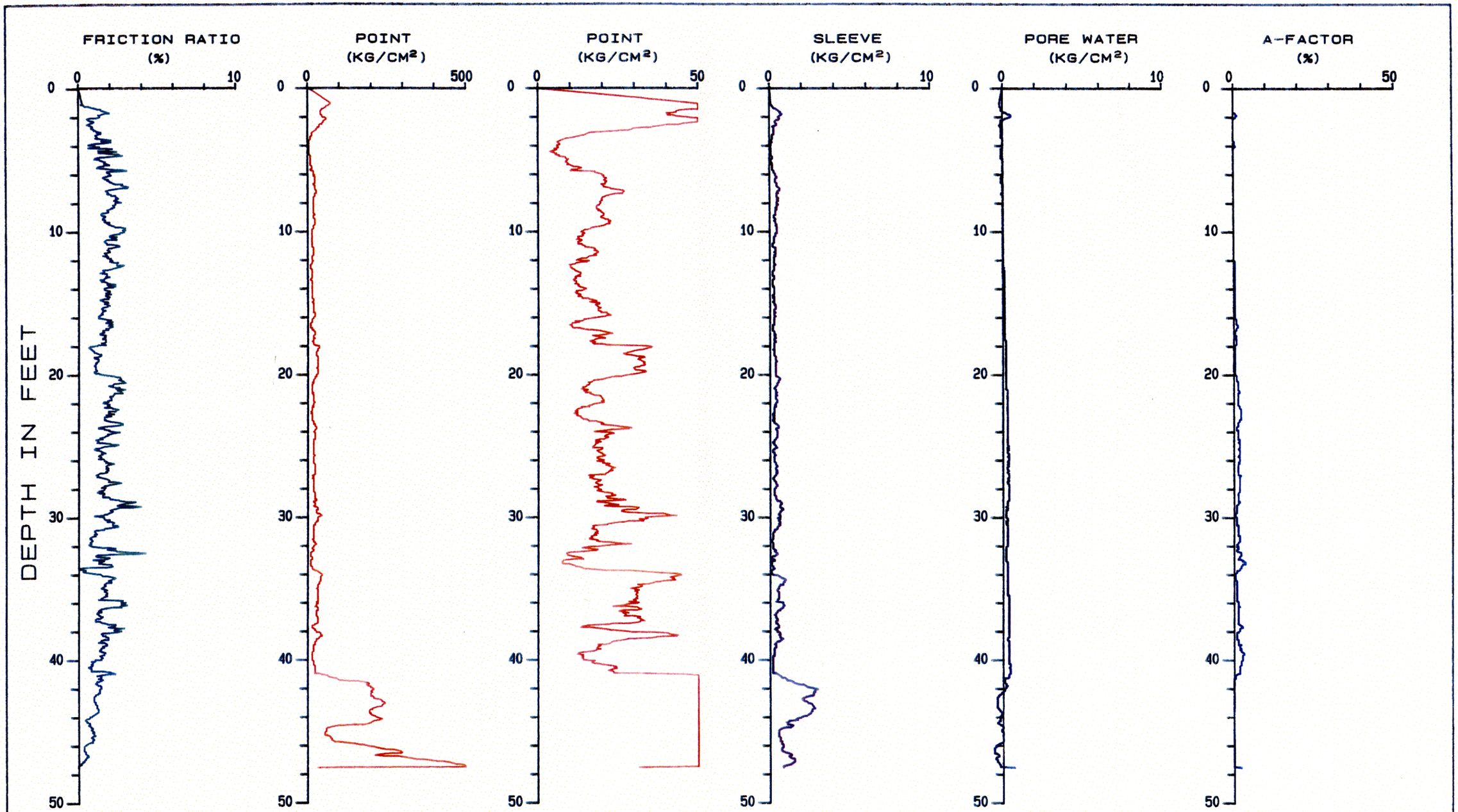
| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 0.51 | 46.01 | 0.62 | 1.34 | Silty to Clayey F.S. | 15 | 0.05 | >45 | 88 | 101 | --- | --- | 276 | --- |
| 3.00 | -0.07 | 22.65 | 0.24 | 1.04 | Clayey Fine Sand | 9 | 0.10 | --- | --- | 301 | 1.5 | 5.8 | 45 | >10 |
| 4.00 | 0.03 | 5.83 | 0.10 | 1.74 | Silty Clay | 4 | 0.14 | --- | --- | 76 | 0.4 | 3.5 | 41 | >10 |
| 5.00 | -0.04 | 9.32 | 0.12 | 1.25 | Sandy Clay | 5 | 0.19 | --- | --- | 122 | 0.6 | 4.8 | 47 | >10 |
| 6.00 | -0.03 | 20.18 | 0.32 | 1.60 | Clayey Fine Sand | 8 | 0.23 | --- | --- | 266 | 1.3 | 3.7 | 40 | >10 |
| 7.00 | -0.04 | 22.89 | 0.60 | 2.60 | Sandy Clay | 11 | 0.28 | --- | --- | 302 | 1.5 | 2.3 | 46 | >10 |
| 8.00 | -0.02 | 19.37 | 0.45 | 2.34 | Sandy Clay | 10 | 0.32 | --- | --- | 254 | 1.3 | 2.6 | 97 | >10 |
| 9.00 | -0.03 | 19.34 | 0.29 | 1.50 | Clayey Fine Sand | 8 | 0.37 | --- | --- | 253 | 1.3 | 4.0 | 97 | >10 |
| 10.00 | -0.01 | 13.21 | 0.47 | 3.57 | Silty Clay | 9 | 0.42 | --- | --- | 171 | 0.9 | 1.7 | 66 | >10 |
| 11.00 | 0.00 | 14.36 | 0.23 | 1.58 | Clayey Fine Sand | 6 | 0.46 | --- | --- | 185 | 0.9 | 3.8 | 72 | >10 |
| 12.00 | 0.00 | 11.91 | 0.28 | 2.37 | Sandy Clay | 6 | 0.51 | --- | --- | 152 | 0.8 | 2.5 | 60 | |
| 16.00 | 0.10 | 18.85 | 0.30 | 1.60 | Clayey Fine Sand | 8 | 0.69 | --- | --- | 242 | 1.2 | 3.8 | 94 | |
| 19.00 | 0.16 | 31.75 | 0.33 | 1.05 | Silty to Clayey F.S. | 11 | 0.82 | 35 | 37 | 70 | --- | --- | 191 | --- |
| 20.00 | 0.19 | 28.83 | 0.33 | 1.14 | Silty to Clayey F.S. | 10 | 0.85 | 34 | 34 | 63 | --- | --- | 173 | --- |
| 21.00 | 0.20 | 13.10 | 0.31 | 2.35 | Sandy Clay | 7 | 0.88 | --- | --- | 163 | 0.8 | 2.6 | 66 | 3 |
| 22.00 | 0.25 | 19.13 | 0.38 | 1.97 | Clayey Fine Sand | 8 | 0.91 | --- | --- | 243 | 1.2 | 3.0 | 96 | 7 |
| .00 | 0.28 | 13.03 | 0.21 | 1.63 | Sandy Clay | 7 | 0.94 | --- | --- | 161 | 0.8 | 3.7 | 65 | 3 |
| 24.00 | 0.27 | 17.34 | 0.46 | 2.64 | Sandy Clay | 9 | 0.97 | --- | --- | 218 | 1.1 | 2.3 | 87 | 5 |
| 25.00 | 0.32 | 17.09 | 0.36 | 2.12 | Sandy Clay | 9 | 0.99 | --- | --- | 215 | 1.1 | 2.8 | 85 | 4 |
| .00 | 0.33 | 20.39 | 0.26 | 1.26 | Clayey Fine Sand | 8 | 1.02 | --- | --- | 258 | 1.3 | 4.8 | 41 | 6 |
| 27.00 | 0.32 | 20.97 | 0.40 | 1.93 | Clayey Fine Sand | 8 | 1.05 | --- | --- | 265 | 1.3 | 3.1 | 42 | 6 |
| 28.00 | 0.33 | 18.58 | 0.31 | 1.67 | Clayey Fine Sand | 7 | 1.09 | --- | --- | 233 | 1.2 | 3.6 | 93 | 4 |
| 29.00 | 0.30 | 21.86 | 0.71 | 3.26 | Sandy Clay | 11 | 1.11 | --- | --- | 277 | 1.4 | 1.8 | 44 | 6 |
| 30.00 | 0.23 | 33.02 | 0.66 | 2.01 | Clayey Fine Sand | 13 | 1.14 | --- | --- | 425 | 2.1 | 3.0 | 66 | >10 |
| 31.00 | 0.28 | 18.62 | 0.27 | 1.47 | Clayey Fine Sand | 7 | 1.17 | --- | --- | 233 | 1.2 | 4.1 | 93 | 4 |
| 32.00 | 0.23 | 20.09 | 0.21 | 1.03 | Clayey Fine Sand | 8 | 1.20 | --- | --- | 252 | 1.3 | 5.8 | 40 | 4 |
| 33.00 | 0.21 | 8.13 | 0.26 | 3.14 | Silty Clay | 5 | 1.23 | --- | --- | 92 | 0.5 | 1.9 | 41 | 1 |
| 34.00 | 0.25 | 44.37 | 0.11 | 0.24 | Silty Fine Sand | 11 | 1.26 | 34 | 40 | 98 | --- | --- | 266 | --- |
| 35.00 | 0.29 | 28.79 | 0.51 | 1.77 | Clayey Fine Sand | 12 | 1.29 | --- | --- | 367 | 1.8 | 3.4 | 58 | 9 |
| 36.00 | 0.37 | 31.42 | 0.84 | 2.68 | Clayey Fine Sand | 13 | 1.32 | --- | --- | 401 | 2.0 | 2.2 | 63 | |
| 38.00 | 0.39 | 26.85 | 0.46 | 1.70 | Clayey Fine Sand | 11 | 1.39 | --- | --- | 340 | 1.7 | 3.5 | 54 | 6 |
| 39.00 | 0.38 | 19.74 | 0.39 | 1.97 | Clayey Fine Sand | 8 | 1.42 | --- | --- | 244 | 1.2 | 3.0 | 99 | 3 |
| 40.00 | 0.40 | 14.29 | 0.22 | 1.51 | Clayey Fine Sand | 6 | 1.45 | --- | --- | 171 | 0.9 | 4.0 | 71 | 2 |
| 41.00 | 0.40 | 45.92 | 0.46 | 1.01 | Silty to Clayey F.S. | 15 | 1.48 | 34 | 39 | 101 | --- | --- | 276 | --- |
| 42.00 | 0.11 | 207.08 | 2.76 | 1.33 | Silty Fine Sand | 52 | 1.51 | 42 | 82 | 456 | --- | --- | 1242 | --- |
| 43.00 | -0.39 | 244.65 | 2.34 | 0.96 | Fine Sand | 49 | 1.54 | 43 | 86 | 538 | --- | --- | 1468 | --- |
| 44.00 | -0.17 | 219.90 | 2.04 | 0.93 | Fine Sand | 44 | 1.58 | 42 | 83 | 484 | --- | --- | 1319 | --- |

SOUNDING #: 40-P01 CLIENT: ENSAFE DATE: 05-08-199
JOB NAME OR #: NASM LOCATION: SWMU40 DEPTH OF GROUNDWATER: 18 F

| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.00 | -0.06 | 57.47 | 0.55 | 0.96 | Silty Fine Sand | 14 | 1.61 | 35 | 44 | 126 | --- | --- | 345 | --- |
| 46.00 | -0.41 | 185.97 | 0.80 | 0.43 | Fine Sand | 37 | 1.64 | 41 | 78 | 409 | --- | --- | 1116 | --- |
| 47.00 | -0.40 | 386.03 | 1.57 | 0.41 | Cemented Sand to HardPan | 64 | 1.68 | 45 | 98 | 849 | --- | --- | 2316 | --- |

PP - Pore Pressure (Kg/cm2)
PT - Point Bearing (Kg/cm2)
SL - Sleeve Friction (Kg/cm2)
FR - Friction Ratio (%)
GWD - Ground Water Depth
N - Equivalent SPT Blow Count (bpf)
VES - Vertical Effective Stress (Kg/cm2)
FA - Friction Angle (Degress)
RD - Relative Density (+ or - 5%)
YM - Youngs Modulus
USS - Undrained Sheer Strength
SEN - Sensitivity
CM - Constrained Modulus
OCR - Estimated Over Consolidation Ratio

The above data was computed utilizing SST's in-house correlations and guidelines published in 'Guidelines for Use and Interpretation of the Electronic Cone Penetration Test', Robertson and Campanella, September, 1989.




SOUNDING #: 40-P01

DATE: 05-08-1995 LOCATION: SWMU40

JOB: NASM CLIENT: ENSAFE

PIEZOCONE SOUNDING LOG

PERFORMED BY:

SUBSURFACE TECHNOLOGY

00608F10Y

PIEZOCONE SOUNDING LOG



**********

SOUNDING #: 40-P02 CLIENT: ENSAFE DATE: 05-08-1995

JOB NAME OR #: NASM094 LOCATION: SWMU40 ST2 DEPTH OF GROUNDWATER: 18 FE

**********

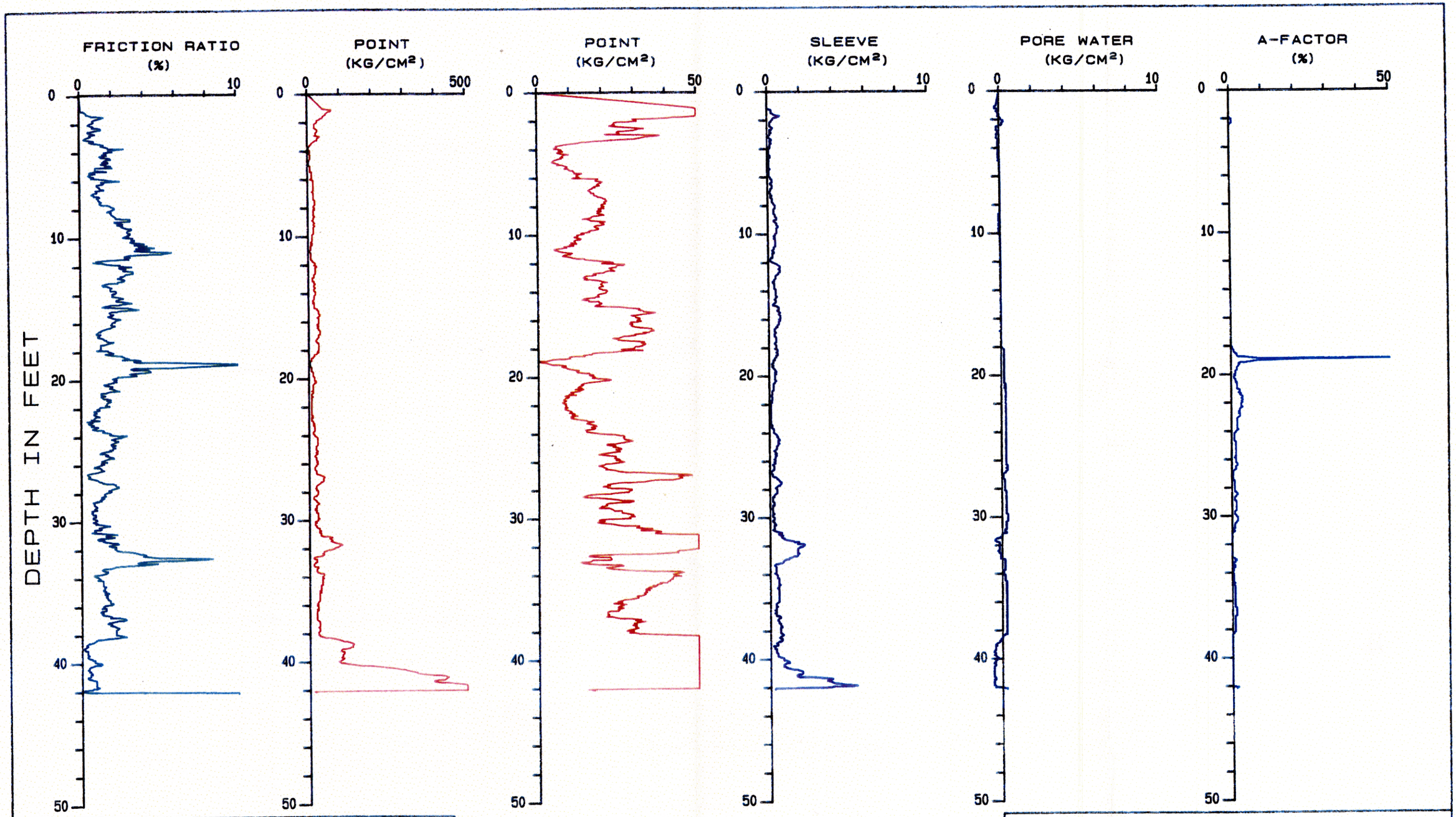
| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 0.11 | 31.33 | 0.34 | 1.08 | Silty to Clayey F.S. | 10 | 0.05 | >45 | 77 | 69 | --- | --- | 188 | --- |
| 3.00 | -0.09 | 38.85 | 0.17 | 0.43 | Silty to Clayey F.S. | 13 | 0.10 | >45 | 73 | 85 | --- | --- | 233 | --- |
| 4.00 | -0.06 | 7.69 | 0.14 | 1.79 | Sandy Clay | 4 | 0.14 | --- | --- | 101 | 0.5 | 3.3 | 38 | >10 |
| 5.00 | -0.04 | 6.81 | 0.07 | 0.97 | Sensitive Fine Grain | 3 | 0.18 | --- | --- | 133 | 0.7 | 6.2 | 48 | >10 |
| 6.00 | -0.03 | 10.84 | 0.09 | 0.82 | Clayey Fine Sand | 4 | 0.22 | --- | --- | 142 | 0.7 | 7.3 | 54 | >10 |
| 7.00 | -0.02 | 16.87 | 0.18 | 1.06 | Clayey Fine Sand | 7 | 0.27 | --- | --- | 221 | 1.1 | 5.7 | 84 | >10 |
| 8.00 | -0.04 | 20.72 | 0.43 | 2.08 | Clayey Fine Sand | 8 | 0.32 | --- | --- | 272 | 1.4 | 2.9 | 41 | >10 |
| 9.00 | -0.05 | 16.74 | 0.53 | 3.16 | Sandy Clay | 8 | 0.37 | --- | --- | 218 | 1.1 | 1.9 | 84 | >10 |
| 10.00 | -0.05 | 12.26 | 0.48 | 3.90 | Clay | 12 | 0.41 | --- | --- | 158 | 0.8 | 1.5 | 61 | >10 |
| 11.00 | -0.03 | 5.04 | 0.37 | 7.33 | Clay | 5 | 0.44 | --- | --- | 61 | 0.3 | 0.8 | 35 | 2 |
| 12.00 | -0.03 | 20.19 | 0.30 | 1.49 | Clayey Fine Sand | 8 | 0.49 | --- | --- | 263 | 1.3 | 4.0 | 40 | >10 |
| 13.00 | -0.02 | 14.24 | 0.42 | 2.98 | Sandy Clay | 7 | 0.54 | --- | --- | 183 | 0.9 | 2.0 | 71 | |
| 15.00 | -0.01 | 17.64 | 0.28 | 1.57 | Clayey Fine Sand | 7 | 0.63 | --- | --- | 227 | 1.1 | 3.8 | 88 | |
| 17.00 | -0.04 | 30.13 | 0.38 | 1.26 | Silty to Clayey F.S. | 10 | 0.73 | 35 | 37 | 66 | --- | --- | 181 | --- |
| 18.00 | -0.02 | 29.85 | 0.41 | 1.39 | Clayey Fine Sand | 12 | 0.78 | --- | --- | 388 | 1.9 | 4.3 | 60 | >10 |
| 19.00 | 0.22 | 2.57 | 0.27 | 10.51 | Organic Material | 3 | 0.80 | --- | --- | --- | --- | --- | --- | --- |
| [illegible].00 | 0.20 | 17.90 | 0.36 | 2.04 | Clayey Fine Sand | 7 | 0.83 | --- | --- | 228 | 1.1 | 2.9 | 90 | 8 |
| [illegible].00 | 0.24 | 12.65 | 0.23 | 1.80 | Sandy Clay | 6 | 0.86 | --- | --- | 157 | 0.8 | 3.3 | 63 | 3 |
| [illegible].00 | 0.28 | 8.56 | 0.13 | 1.57 | Sandy Clay | 4 | 0.88 | --- | --- | 102 | 0.5 | 3.8 | 43 | 2 |
| [illegible].00 | 0.29 | 12.73 | 0.12 | 0.92 | Clayey Fine Sand | 5 | 0.91 | --- | --- | 158 | 0.8 | 6.5 | 64 | 3 |
| 24.00 | 0.29 | 19.02 | 0.28 | 1.45 | Clayey Fine Sand | 8 | 0.94 | --- | --- | 241 | 1.2 | 4.1 | 95 | 6 |
| 25.00 | 0.29 | 24.91 | 0.42 | 1.69 | Clayey Fine Sand | 10 | 0.98 | --- | --- | 319 | 1.6 | 3.5 | 50 | |
| 28.00 | 0.22 | 29.11 | 0.41 | 1.41 | Clayey Fine Sand | 12 | 1.07 | --- | --- | 374 | 1.9 | 4.3 | 58 | |
| 30.00 | 0.35 | 28.72 | 0.27 | 0.93 | Silty to Clayey F.S. | 10 | 1.13 | 32 | 30 | 63 | --- | --- | 172 | --- |
| 31.00 | 0.21 | 36.34 | 0.49 | 1.34 | Silty to Clayey F.S. | 12 | 1.16 | 34 | 36 | 80 | --- | --- | 218 | --- |
| 32.00 | -0.18 | 76.84 | 2.05 | 2.67 | Clayey Fine Sand | 31 | 1.19 | --- | --- | 1009 | 5.0 | 2.2 | 154 | >10 |
| 33.00 | 0.15 | 16.45 | 0.87 | 5.30 | Clay | 16 | 1.22 | --- | --- | 203 | 1.0 | 1.1 | 82 | 3 |
| 34.00 | 0.08 | 42.37 | 0.36 | 0.85 | Silty to Clayey F.S. | 14 | 1.25 | 34 | 39 | 93 | --- | --- | 254 | --- |
| 35.00 | 0.26 | 33.23 | 0.50 | 1.50 | Clayey Fine Sand | 13 | 1.28 | --- | --- | 426 | 2.1 | 4.0 | 66 | |
| 37.00 | 0.28 | 23.89 | 0.59 | 2.48 | Sandy Clay | 12 | 1.34 | --- | --- | 301 | 1.5 | 2.4 | 48 | 5 |
| 38.00 | 0.29 | 28.92 | 0.67 | 2.32 | Clayey Fine Sand | 12 | 1.37 | --- | --- | 367 | 1.8 | 2.6 | 58 | 8 |
| 39.00 | -0.41 | 126.76 | 0.44 | 0.34 | Fine Sand | 25 | 1.40 | 40 | 69 | 279 | --- | --- | 761 | --- |
| 40.00 | -0.32 | 93.30 | 0.85 | 0.91 | Silty Fine Sand | 23 | 1.43 | 38 | 60 | 205 | --- | --- | 560 | --- |
| 41.00 | -0.55 | 430.06 | 2.01 | 0.47 | Cemented Sand to HardPan | 72 | 1.47 | >45 | 100+ | 946 | --- | --- | 2580 | --- |
| 42.00 | -0.50 | 573.95 | 3.68 | 0.64 | Cemented Sand to HardPan | 96 | 1.50 | >45 | 100+ | 1263 | --- | --- | 3444 | --- |

PP - Pore Pressure (Kg/cm2)
PT - Point Bearing (Kg/cm2)
SL - Sleeve Friction (Kg/cm2)
FR - Friction Ratio (%)
GWD - Ground Water Depth

N - Equivalent SPT Blow Count (bpf)
VES - Vertical Effective Stress (Kg/cm2)
FA - Friction Angle (Degress)
RD - Relative Density (+ or - 5%)
YM - Youngs Modulus

USS - Undrained Sheer Strength
SEN - Sensitivity
CM - Constrained Modulus
OCR - Estimated Over Consolidation Ratio

above data was computed utilizing SST's in-house correlations and guidelines published in 'Guidelines for Use and [illegible]terpretation of the Electronic Cone Penetration Test', Robertson and Campanella, September, 1989.




SOUNDING #: 40-P02

DATE: 05-08-1995 LOCATION: SWMU40 ST2

JOB: NASM094 CLIENT: ENSAFE

PIEZOCONE SOUNDING LOG

PERFORMED BY:

SUBSURFACE TECHNOLOGY

00608F11Y

PIEZOCONE SOUNDING LOG



SOUNDING #: 40-P03
JOB NAME OR #: NASM094

CLIENT: ENSAFE
LOCATION: SWMU40 ST3

DATE: 05-08-1995
DEPTH OF GROUNDWATER: 18 FE

| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | -0.29 | 50.30 | 0.40 | 0.80 | Silty to Clayey F.S. | 17 | 0.05 | >45 | 91 | 111 | --- | --- | 302 | --- |
| 3.00 | 0.21 | 12.59 | 0.17 | 1.38 | Clayey Fine Sand | 5 | 0.10 | --- | --- | 167 | 0.8 | 4.4 | 63 | >10 |
| 4.00 | 0.16 | 19.55 | 0.14 | 0.70 | Clayey Fine Sand | 8 | 0.15 | --- | --- | 259 | 1.3 | 8.6 | 98 | >10 |
| 5.00 | 0.13 | 24.80 | 0.45 | 1.83 | Clayey Fine Sand | 10 | 0.20 | --- | --- | 328 | 1.6 | 3.3 | 50 | >10 |
| 6.00 | 0.09 | 23.01 | 0.26 | 1.11 | Clayey Fine Sand | 9 | 0.24 | --- | --- | 304 | 1.5 | 5.4 | 46 | >10 |
| 7.00 | -0.00 | 18.44 | 0.08 | 0.42 | Silty to Clayey F.S. | 6 | 0.29 | 38 | 36 | 41 | --- | --- | 111 | --- |
| 8.00 | -0.13 | 21.75 | 0.12 | 0.55 | Silty to Clayey F.S. | 7 | 0.34 | 38 | 39 | 48 | --- | --- | 131 | --- |
| 9.00 | -0.13 | 21.68 | 0.08 | 0.35 | Silty to Clayey F.S. | 7 | 0.39 | 37 | 37 | 48 | --- | --- | 130 | --- |
| 10.00 | -0.13 | 15.26 | 0.41 | 2.66 | Sandy Clay | 8 | 0.43 | --- | --- | 198 | 1.0 | 2.3 | 76 | >10 |
| 11.00 | -0.07 | 11.61 | 0.42 | 3.60 | Silty Clay | 8 | 0.48 | --- | --- | 148 | 0.7 | 1.7 | 58 | |
| 13.00 | -0.00 | 9.63 | 0.23 | 2.35 | Sandy Clay | 5 | 0.57 | --- | --- | 121 | 0.6 | 2.6 | 48 | 4 |
| 14.00 | -0.03 | 21.74 | 0.34 | 1.57 | Clayey Fine Sand | 9 | 0.62 | --- | --- | 282 | 1.4 | 3.8 | 43 | >10 |
| 15.00 | -0.02 | 24.59 | 0.32 | 1.30 | Clayey Fine Sand | 10 | 0.67 | --- | --- | 319 | 1.6 | 4.6 | 49 | >10 |
| 16.00 | -0.03 | 31.98 | 0.58 | 1.82 | Clayey Fine Sand | 13 | 0.72 | --- | --- | 417 | 2.1 | 3.3 | 64 | >10 |
| 17.00 | 0.04 | 22.80 | 0.44 | 1.95 | Clayey Fine Sand | 9 | 0.77 | --- | --- | 294 | 1.5 | 3.1 | 46 | >10 |
| 18.00 | 0.09 | 15.01 | 0.31 | 2.06 | Sandy Clay | 8 | 0.81 | --- | --- | 189 | 0.9 | 2.9 | 75 | 5 |
| .00 | 0.11 | 27.38 | 0.59 | 2.17 | Clayey Fine Sand | 11 | 0.84 | --- | --- | 354 | 1.8 | 2.8 | 55 | >10 |
| 20.00 | 0.17 | 20.60 | 0.44 | 2.12 | Clayey Fine Sand | 8 | 0.87 | --- | --- | 263 | 1.3 | 2.8 | 41 | |
| [illegible].00 | 0.19 | 10.72 | 0.13 | 1.21 | Sandy Clay | 5 | 0.93 | --- | --- | 131 | 0.7 | 5.0 | 54 | 2 |
| .00 | 0.16 | 23.17 | 0.27 | 1.15 | Clayey Fine Sand | 9 | 0.96 | --- | --- | 296 | 1.5 | 5.2 | 46 | |
| 25.00 | 0.15 | 27.53 | 0.65 | 2.36 | Clayey Fine Sand | 11 | 1.02 | --- | --- | 354 | 1.8 | 2.5 | 55 | |
| 27.00 | 0.12 | 22.49 | 0.28 | 1.25 | Clayey Fine Sand | 9 | 1.08 | --- | --- | 285 | 1.4 | 4.8 | 45 | 7 |
| 28.00 | -0.02 | 35.22 | 0.33 | 0.94 | Silty to Clayey F.S. | 12 | 1.11 | 34 | 36 | 77 | --- | --- | 211 | --- |
| 29.00 | 0.21 | 21.70 | 0.27 | 1.23 | Clayey Fine Sand | 9 | 1.14 | --- | --- | 274 | 1.4 | 4.9 | 43 | 5 |
| 30.00 | -0.02 | 36.13 | 0.07 | 0.18 | Silty Fine Sand | 9 | 1.17 | 34 | 36 | 79 | --- | --- | 217 | --- |
| 31.00 | -0.46 | 176.45 | 1.17 | 0.66 | Fine Sand | 35 | 1.20 | 42 | 81 | 388 | --- | --- | 1059 | --- |
| 32.00 | 0.14 | 71.78 | 2.92 | 4.07 | Sandy Clay | 36 | 1.23 | --- | --- | 941 | 4.7 | 1.5 | 144 | >10 |
| 33.00 | 0.15 | 30.07 | 0.91 | 3.03 | Sandy Clay | 15 | 1.26 | --- | --- | 384 | 1.9 | 2.0 | 60 | |
| 35.00 | 0.23 | 18.67 | 0.30 | 1.59 | Clayey Fine Sand | 7 | 1.32 | --- | --- | 231 | 1.2 | 3.8 | 93 | 3 |
| 36.00 | 0.14 | 23.15 | 0.21 | 0.90 | Silty to Clayey F.S. | 8 | 1.35 | <30 | 21 | 51 | --- | --- | 139 | --- |
| 37.00 | 0.20 | 25.24 | 0.20 | 0.79 | Silty to Clayey F.S. | 8 | 1.38 | 30 | 23 | 56 | --- | --- | 151 | --- |
| 38.00 | 0.21 | 13.98 | 0.36 | 2.61 | Sandy Clay | 7 | 1.40 | --- | --- | 168 | 0.8 | 2.3 | 70 | 2 |
| 39.00 | 0.22 | 8.14 | 0.26 | 3.14 | Silty Clay | 5 | 1.43 | --- | --- | 90 | 0.4 | 1.9 | 41 | 1 |
| 40.00 | 0.21 | 11.40 | 0.22 | 1.93 | Sandy Clay | 6 | 1.46 | --- | --- | 133 | 0.7 | 3.1 | 57 | 1 |
| 41.00 | 0.15 | 21.67 | 0.21 | 0.96 | Clayey Fine Sand | 9 | 1.49 | --- | --- | 269 | 1.3 | 6.2 | 43 | 3 |
| 42.00 | 0.15 | 18.13 | 0.14 | 0.77 | Clayey Fine Sand | 7 | 1.52 | --- | --- | 221 | 1.1 | 7.8 | 91 | 2 |
| 43.00 | -0.02 | 38.03 | 0.28 | 0.73 | Silty to Clayey F.S. | 13 | 1.55 | 32 | 33 | 84 | --- | --- | 228 | --- |
| 44.00 | 0.26 | 11.88 | 0.90 | 7.59 | Clay | 12 | 1.58 | --- | --- | 137 | 0.7 | 0.8 | 59 | 1 |

SOUNDING #: 40-P03 CLIENT: ENSAFE DATE: 05-08-199
JOB NAME OR #: NASH094 LOCATION: SWMU40 ST3 DEPTH OF GROUNDWATER: 1

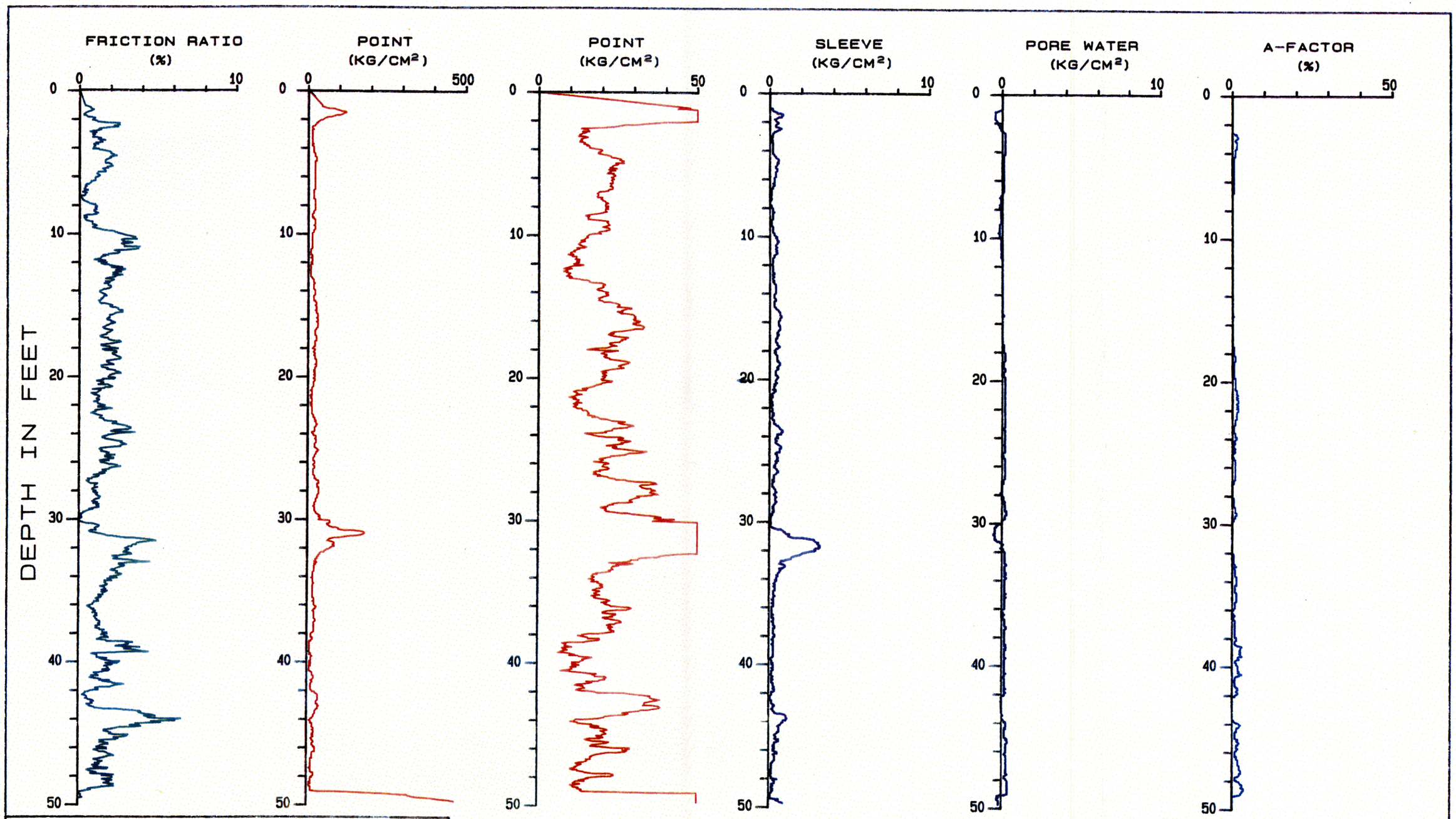
| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.00 | 0.22 | 20.35 | 0.34 | 1.66 | Clayey Fine Sand | 8 | 1.61 | --- | --- | 250 | 1.2 | 3.6 | 41 | 3 |
| 46.00 | 0.23 | 29.23 | 0.24 | 0.81 | Silty to Clayey F.S. | 10 | 1.64 | <30 | 25 | 64 | --- | --- | 175 | --- |
| 47.00 | 0.30 | 12.40 | 0.16 | 1.31 | Clayey Fine Sand | 5 | 1.67 | --- | --- | 143 | 0.7 | 4.6 | 62 | 1 |
| 48.00 | 0.26 | 17.48 | 0.19 | 1.10 | Clayey Fine Sand | 7 | 1.70 | --- | --- | 210 | 1.1 | 5.4 | 87 | 2 |
| 49.00 | 0.36 | 14.71 | 0.15 | 1.00 | Clayey Fine Sand | 6 | 1.73 | --- | --- | 173 | 0.9 | 6.0 | 74 | 1 |

PP - Pore Pressure (Kg/cm2)
PT - Point Bearing (Kg/cm2)
SL - Sleeve Friction (Kg/cm2)
FR - Friction Ratio (%)
GWD - Ground Water Depth

N - Equivalent SPT Blow Count (bpf)
VES - Vertical Effective Stress (Kg/cm2)
FA - Friction Angle (Degress)
RD - Relative Density (+ or - 5%)
YM - Youngs Modulus

USS - Undrained Sheer Strength
SEN - Sensitivity
CM - Constrained Modulus
OCR - Estimated Over Consolidation Ratio

The above data was computed utilizing SST's in-house correlations and guidelines published in 'Guidelines for Use and Interpretation of the Electronic Cone Penetration Test', Robertson and Campanella, September, 1989.




SOUNDING #: 40-P03

DATE: 05-08-1995 LOCATION: SWMU40 ST3

JOB: NASM094 CLIENT: ENSAFE

PIEZOCONE SOUNDING LOG

PERFORMED BY:

SUBSURFACE TECHNOLOGY

00608E12Y

PIEZOCONE SOUNDING LOG



SOUNDING #: 40-P04 CLIENT: ENSAFE DATE: 05-08-1995
JOB NAME OR #: NASM094 LOCATION: SWMU40 ST4 DEPTH OF GROUNDWATER: 18 FE

| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | -0.25 | 28.99 | 0.36 | 1.23 | Silty to Clayey F.S. | 10 | 0.05 | >45 | 75 | 64 | --- | --- | 174 | --- |
| 3.00 | -0.11 | 17.51 | 0.32 | 1.82 | Clayey Fine Sand | 7 | 0.10 | --- | --- | 232 | 1.2 | 3.3 | 88 | >10 |
| 4.00 | -0.03 | 12.93 | 0.42 | 3.28 | Silty Clay | 9 | 0.14 | --- | --- | 170 | 0.9 | 1.8 | 65 | >10 |
| 5.00 | -0.09 | 17.16 | 0.36 | 2.10 | Sandy Clay | 9 | 0.19 | --- | --- | 226 | 1.1 | 2.9 | 86 | >10 |
| 6.00 | -0.04 | 13.99 | 0.50 | 3.55 | Silty Clay | 9 | 0.23 | --- | --- | 184 | 0.9 | 1.7 | 70 | >10 |
| 7.00 | -0.03 | 8.85 | 0.38 | 4.27 | Clay | 9 | 0.27 | --- | --- | 114 | 0.6 | 1.4 | 44 | >10 |
| 8.00 | -0.07 | 15.59 | 0.30 | 1.95 | Sandy Clay | 8 | 0.31 | --- | --- | 204 | 1.0 | 3.1 | 78 | >10 |
| 9.00 | -0.08 | 15.24 | 0.24 | 1.55 | Clayey Fine Sand | 6 | 0.36 | --- | --- | 198 | 1.0 | 3.9 | 76 | >10 |
| 10.00 | -0.07 | 14.82 | 0.22 | 1.50 | Clayey Fine Sand | 6 | 0.41 | --- | --- | 192 | 1.0 | 4.0 | 74 | >10 |
| 11.00 | -0.06 | 25.57 | 0.45 | 1.77 | Clayey Fine Sand | 10 | 0.46 | --- | --- | 335 | 1.7 | 3.4 | 51 | >10 |
| 12.00 | -0.12 | 35.29 | 0.59 | 1.67 | Clayey Fine Sand | 14 | 0.51 | --- | --- | 464 | 2.3 | 3.6 | 71 | >10 |
| 13.00 | -0.17 | 41.60 | 0.79 | 1.91 | Clayey Fine Sand | 17 | 0.56 | --- | --- | 547 | 2.7 | 3.1 | 83 | >10 |
| 14.00 | -0.17 | 33.31 | 1.00 | 3.00 | Sandy Clay | 17 | 0.60 | --- | --- | 436 | 2.2 | 2.0 | 67 | >10 |
| 15.00 | -0.12 | 32.89 | 0.85 | 2.57 | Clayey Fine Sand | 13 | 0.65 | --- | --- | 430 | 2.1 | 2.3 | 66 | >10 |
| [illegible]00 | -0.12 | 24.14 | 0.62 | 2.57 | Sandy Clay | 12 | 0.69 | --- | --- | 313 | 1.6 | 2.3 | 48 | >10 |
| [illegible].00 | -0.06 | 26.15 | 0.67 | 2.57 | Clayey Fine Sand | 10 | 0.74 | --- | --- | 339 | 1.7 | 2.3 | 52 | >10 |
| 18.00 | -0.02 | 20.88 | 0.67 | 3.21 | Sandy Clay | 10 | 0.79 | --- | --- | 268 | 1.3 | 1.9 | 42 | |
| 20.00 | 0.07 | 18.57 | 0.34 | 1.81 | Clayey Fine Sand | 7 | 0.84 | --- | --- | 236 | 1.2 | 3.3 | 93 | 9 |
| [illegible].00 | 0.10 | 12.75 | 0.18 | 1.44 | Sandy Clay | 6 | 0.87 | --- | --- | 158 | 0.8 | 4.2 | 64 | 3 |
| [illegible].00 | 0.10 | 14.84 | 0.26 | 1.72 | Sandy Clay | 7 | 0.90 | --- | --- | 186 | 0.9 | 3.5 | 74 | 4 |
| 23.00 | 0.08 | 17.23 | 0.27 | 1.56 | Clayey Fine Sand | 7 | 0.93 | --- | --- | 217 | 1.1 | 3.8 | 86 | 5 |
| 24.00 | 0.04 | 16.20 | 0.51 | 3.17 | Sandy Clay | 8 | 0.96 | --- | --- | 203 | 1.0 | 1.9 | 81 | 4 |
| 25.00 | 0.15 | 17.80 | 0.86 | 4.86 | Clay | 18 | 0.98 | --- | --- | 224 | 1.1 | 1.2 | 89 | 5 |
| 26.00 | 0.09 | 27.94 | 0.31 | 1.10 | Silty to Clayey F.S. | 9 | 1.01 | 33 | 30 | 61 | --- | --- | 168 | --- |
| 27.00 | 0.09 | 22.02 | 0.24 | 1.09 | Clayey Fine Sand | 9 | 1.04 | --- | --- | 280 | 1.4 | 5.5 | 44 | 7 |
| 28.00 | 0.05 | 30.11 | 0.68 | 2.27 | Clayey Fine Sand | 12 | 1.07 | --- | --- | 387 | 1.9 | 2.6 | 60 | >10 |
| 29.00 | 0.04 | 29.13 | 0.25 | 0.84 | Silty to Clayey F.S. | 10 | 1.11 | 33 | 30 | 64 | --- | --- | 175 | --- |
| 30.00 | 0.18 | 19.23 | 0.21 | 1.08 | Clayey Fine Sand | 8 | 1.14 | --- | --- | 241 | 1.2 | 5.6 | 96 | 4 |
| 31.00 | -0.30 | 40.99 | 0.89 | 2.16 | Clayey Fine Sand | 16 | 1.17 | --- | --- | 531 | 2.7 | 2.8 | 82 | >10 |
| 32.00 | -0.30 | 31.23 | -0.01 | 0.02 | Silty Fine Sand | 8 | 1.20 | 32 | 31 | 69 | --- | --- | 187 | --- |
| 33.00 | -0.32 | 20.51 | 0.57 | 2.76 | Sandy Clay | 10 | 1.22 | --- | --- | 257 | 1.3 | 2.2 | 41 | 4 |
| 34.00 | -0.11 | 24.64 | 0.48 | 1.93 | Clayey Fine Sand | 10 | 1.26 | --- | --- | 312 | 1.6 | 3.1 | 49 | 6 |
| 35.00 | -0.16 | 30.58 | 0.48 | 1.57 | Clayey Fine Sand | 12 | 1.29 | --- | --- | 391 | 2.0 | 3.8 | 61 | |
| 37.00 | 0.01 | 31.40 | 0.23 | 0.75 | Silty to Clayey F.S. | 10 | 1.35 | 32 | 30 | 69 | --- | --- | 188 | --- |
| 38.00 | 0.08 | 29.32 | 0.14 | 0.47 | Silty to Clayey F.S. | 10 | 1.38 | 31 | 27 | 65 | --- | --- | 176 | --- |
| 39.00 | 0.04 | 29.34 | 0.15 | 0.52 | Silty to Clayey F.S. | 10 | 1.41 | 31 | 27 | 65 | --- | --- | 176 | --- |
| 40.00 | 0.02 | 27.20 | 0.05 | 0.18 | Silty to Clayey F.S. | 9 | 1.44 | 30 | 24 | 60 | --- | --- | 163 | --- |
| 41.00 | -0.01 | 28.20 | -0.02 | 0.07 | Silty to Clayey F.S. | 9 | 1.47 | 30 | 25 | 62 | --- | --- | 169 | --- |
| 42.00 | -0.20 | 116.67 | 0.63 | 0.54 | Fine Sand | 23 | 1.50 | 39 | 66 | 257 | --- | --- | 700 | --- |
| 43.00 | -0.36 | 100.43 | 3.24 | 3.23 | Sand to Clayey F.S. | 50 | 1.54 | --- | --- | 1319 | 6.6 | 1.9 | 201 | >10 |
| 44.00 | 0.01 | 34.14 | 0.30 | 0.87 | Silty to Clayey F.S. | 11 | 1.57 | 31 | 30 | 75 | --- | --- | 205 | --- |

PIEZOCONE SOUNDING LOG



SOUNDING #: 40-P04 CLIENT: ENSAFE DATE: 05-08-199
JOB NAME OR #: NASM094 LOCATION: SWMU40 ST4 DEPTH OF GROUNDWATER: 18

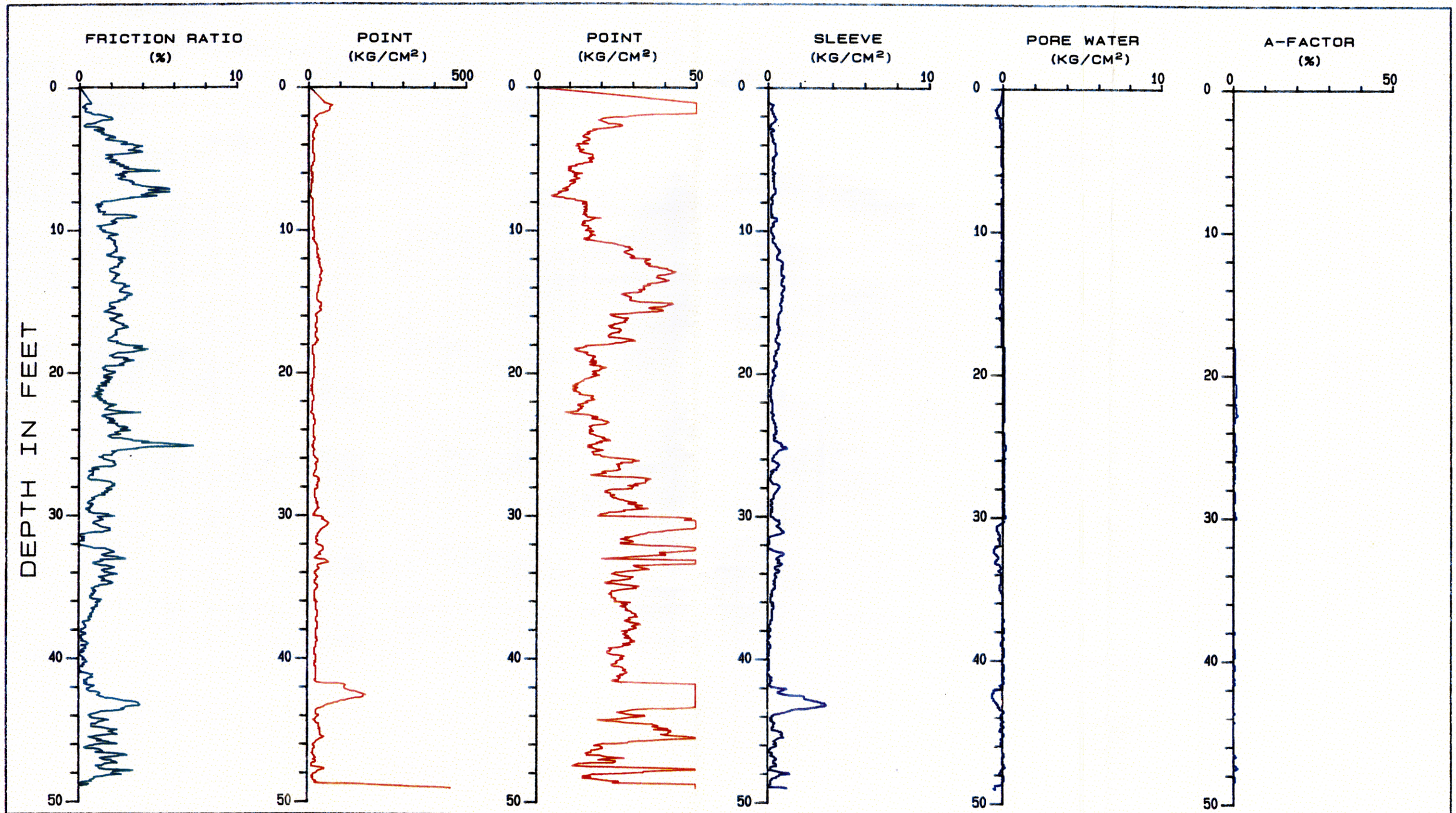
| Depth | PP | PT | SL | FR | Soil Type | N | VES | FA | RD | YM | USS | SEN | CM | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.00 | 0.02 | 42.21 | 0.59 | 1.41 | Silty to Clayey F.S. | 14 | 1.60 | 33 | 36 | 93 | --- | --- | 253 | --- |
| 46.00 | -0.02 | 19.67 | 0.56 | 2.83 | Sandy Clay | 10 | 1.63 | --- | --- | 241 | 1.2 | 2.1 | 98 | 3 |
| 47.00 | 0.02 | 21.33 | 0.52 | 2.43 | Sandy Clay | 11 | 1.65 | --- | --- | 262 | 1.3 | 2.5 | 43 | 3 |
| 48.00 | -0.08 | 27.55 | 1.39 | 5.03 | Clay | 28 | 1.68 | --- | --- | 345 | 1.7 | 1.2 | 55 | 4 |
| 49.00 | -0.49 | 452.66 | 1.17 | 0.26 | Cemented Sand to HardPan | 75 | 1.72 | >45 | 100+ | 996 | --- | --- | 2716 | --- |

PP - Pore Pressure (Kg/cm2)
PT - Point Bearing (Kg/cm2)
SL - Sleeve Friction (Kg/cm2)
FR - Friction Ratio (%)
GWD - Ground Water Depth

N - Equivalent SPT Blow Count (bpf)
VES - Vertical Effective Stress (Kg/cm2)
FA - Friction Angle (Degress)
RD - Relative Density (+ or - 5%)
YM - Youngs Modulus

USS - Undrained Sheer Strength
SEN - Sensitivity
CM - Constrained Modulus
OCR - Estimated Over Consolidation Ratio

The above data was computed utilizing SST's in-house correlations and guidelines published in 'Guidelines for Use and Interpretation of the Electronic Cone Penetration Test', Robertson and Campanella, September, 1989.




SOUNDING #: 40-P04

DATE: 05-08-1995 LOCATION: SWMU40 ST4

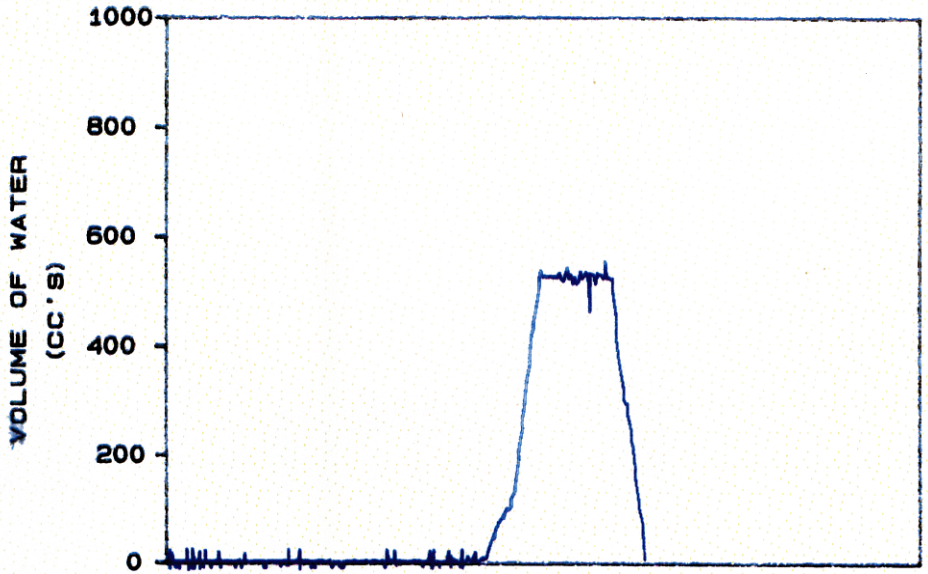
JOB: NASM094 CLIENT: ENSAFE

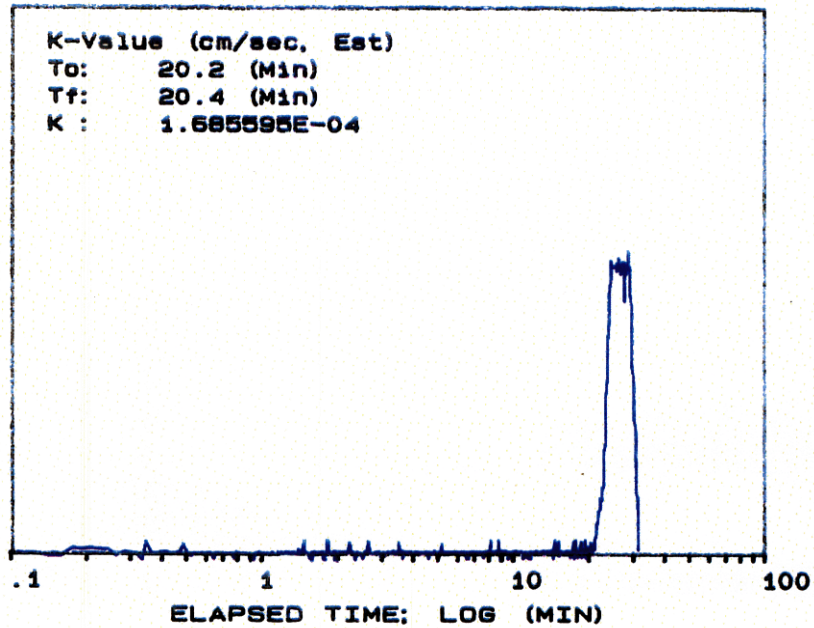
PIEZOCONE SOUNDING LOG

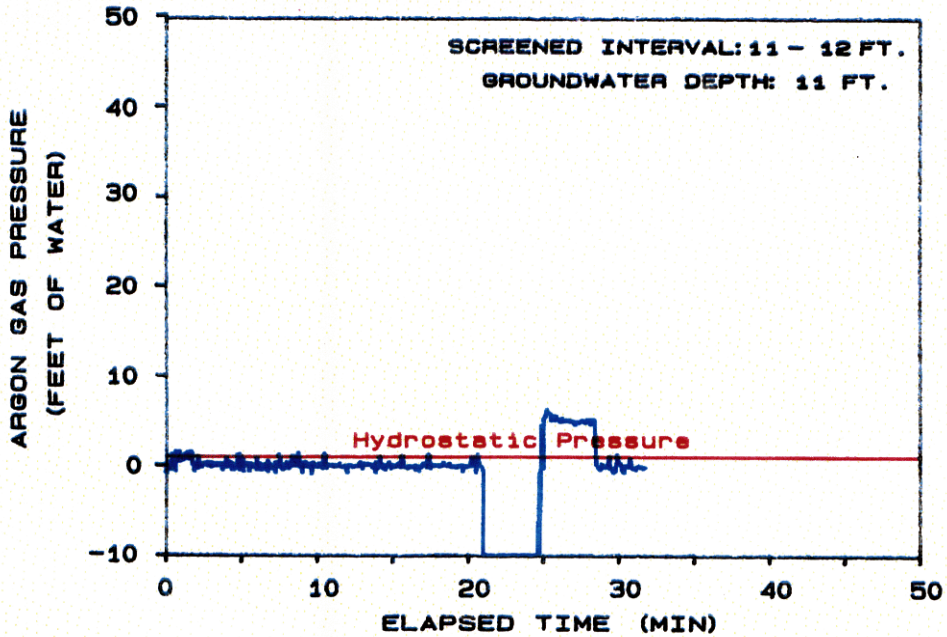
PERFORMED BY:

SUBSURFACE TECHNOLOGY

00608FB4Y 000325




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0112

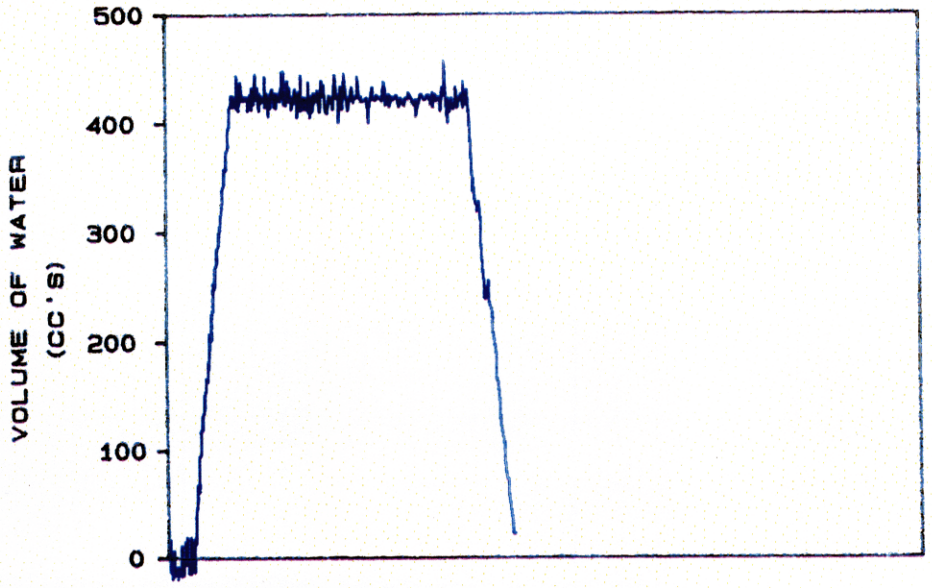
CLIENT: ENSAFE JOB: NASM094

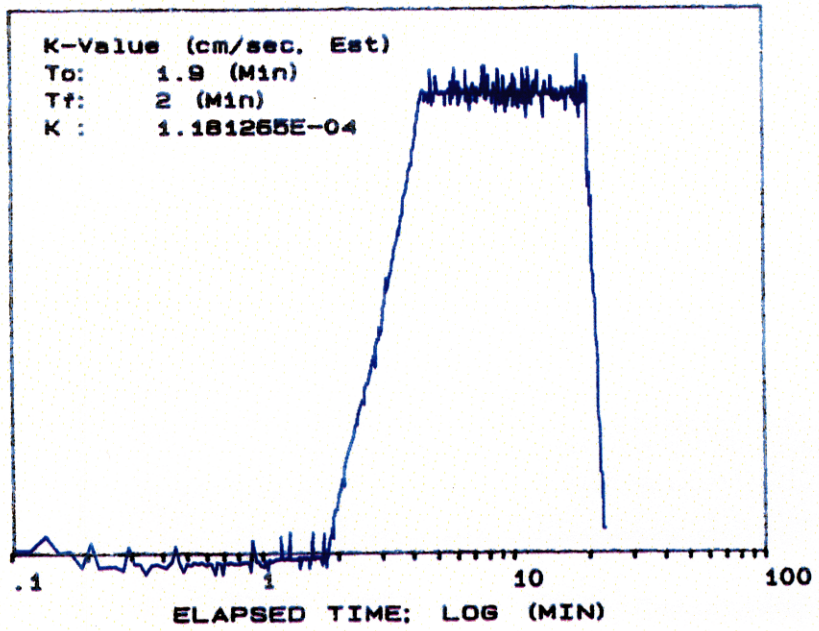
DATE: 05-09-1995 LOCATION: SWMU40 ST1

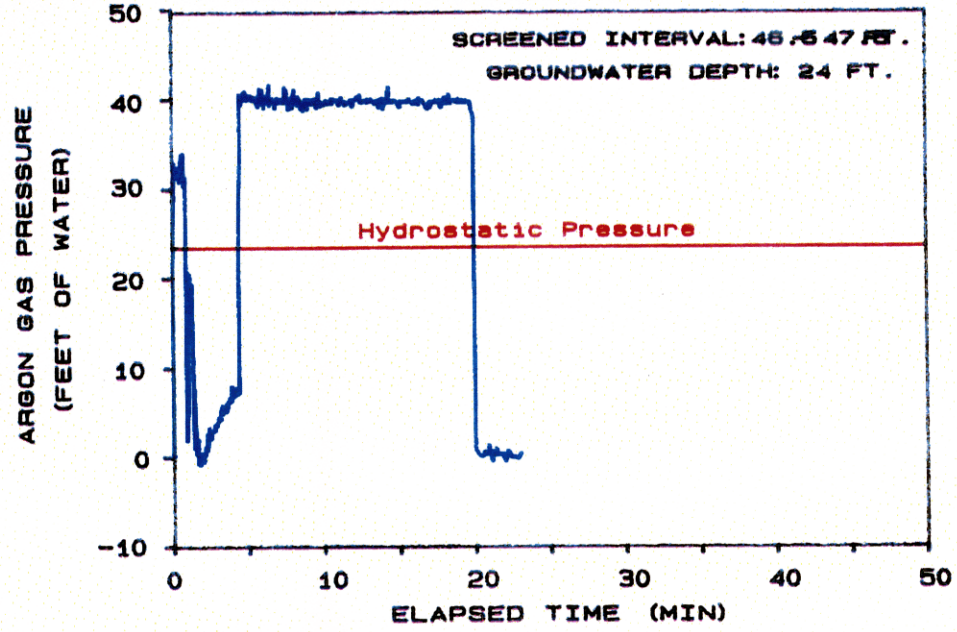
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000396




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0148

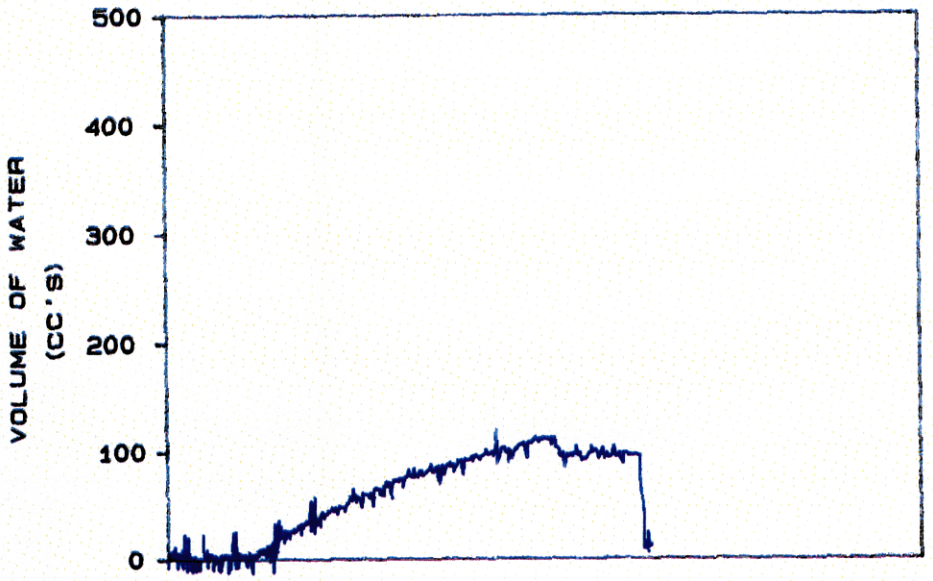
CLIENT: ENSAFE JOB: NASM094

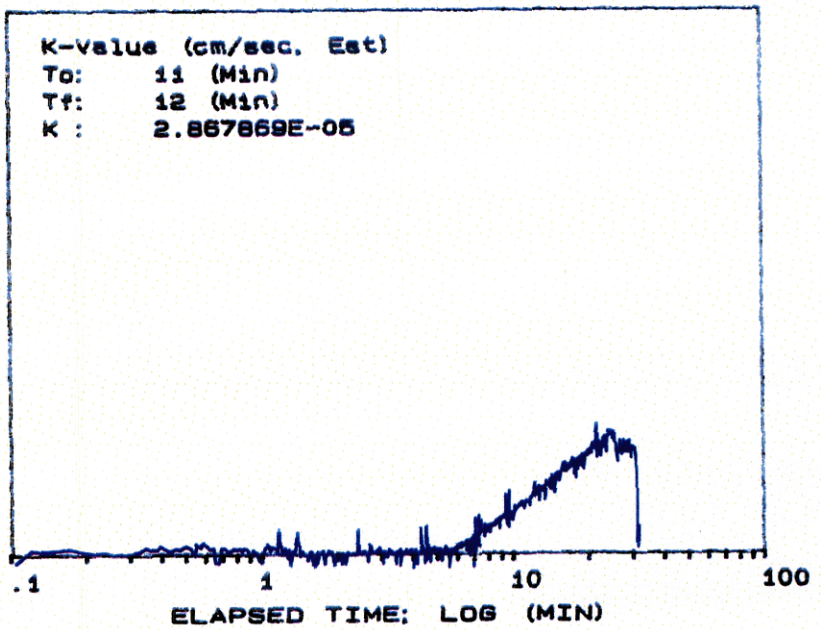
DATE: 6-9-95 LOCATION: SWMU40 ST1

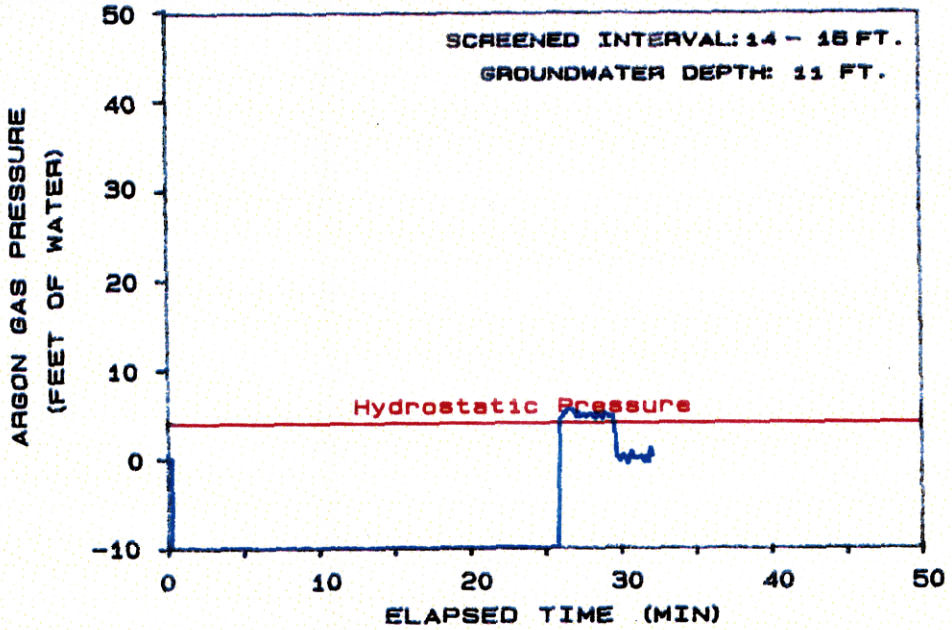
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000037




# GS-1 SAMPLE PLOT

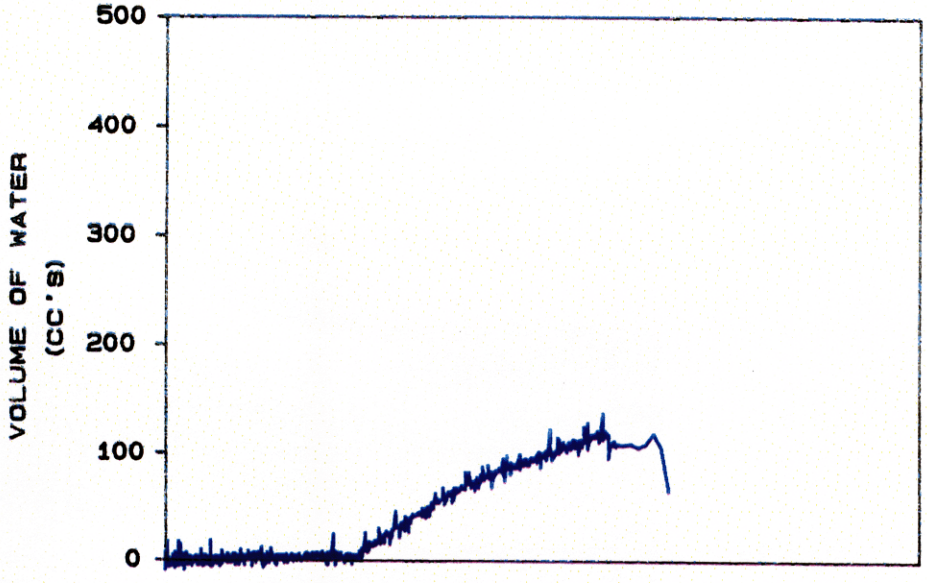
SAMPLE #: 40GH0215

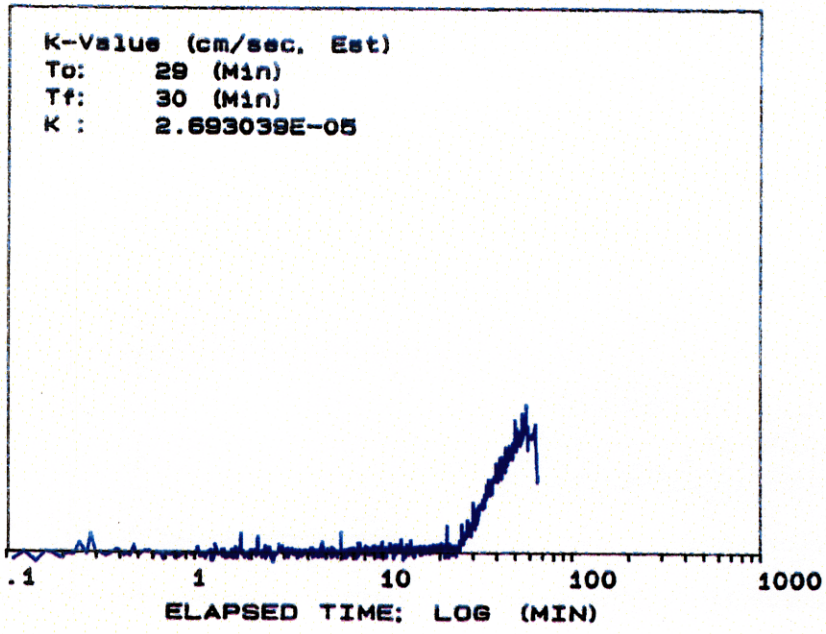
CLIENT: ENSAFE JOB: NASM094

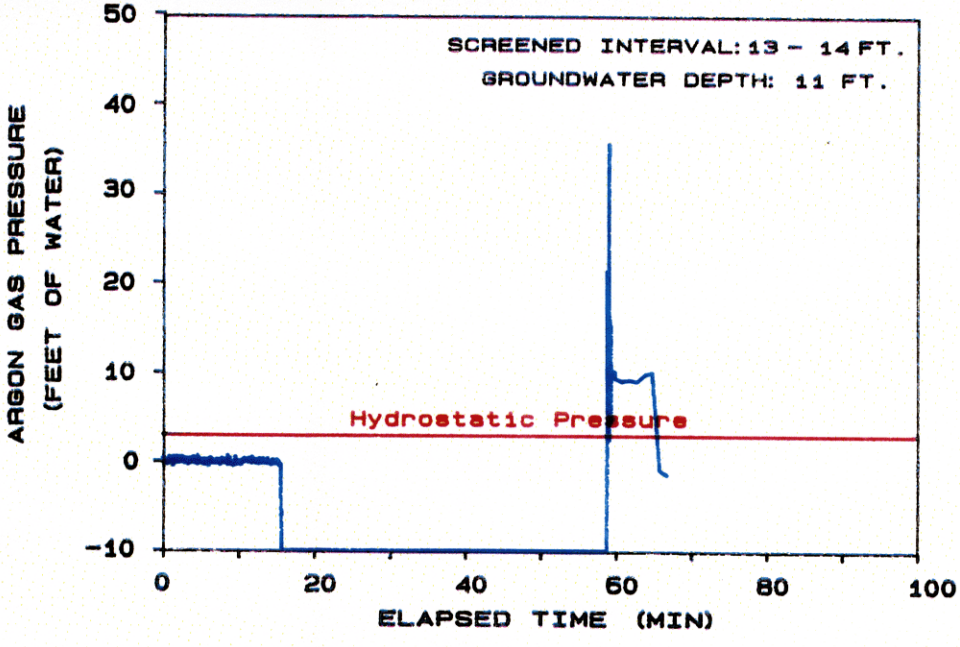
DATE: 05-09-1995 LOCATION: SWMU40 ST2

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0314

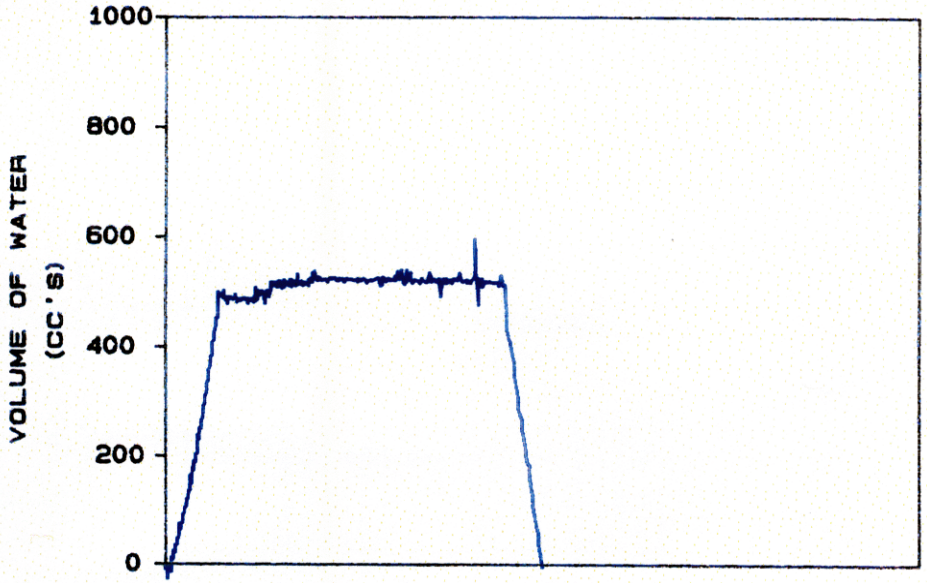
CLIENT: ENSAFE JOB: NASM094

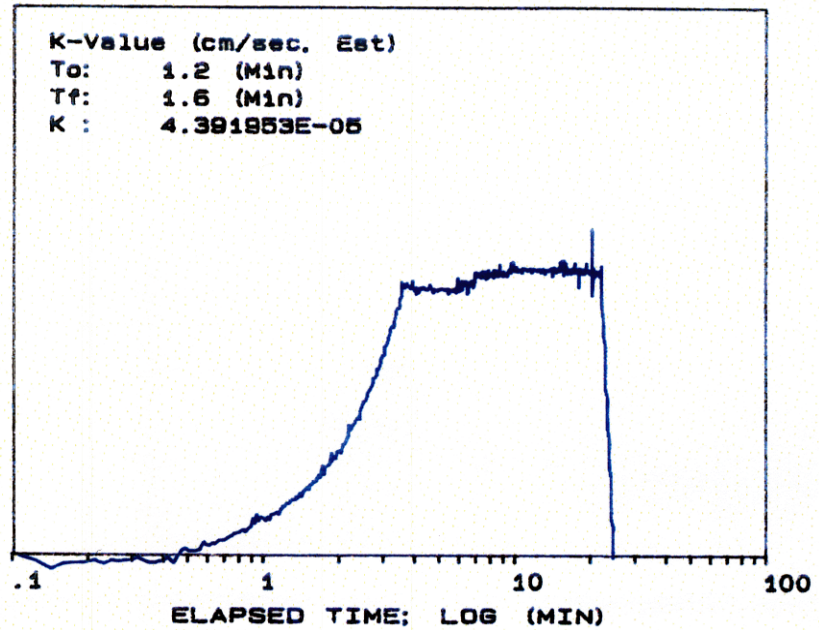
DATE: 05-10-1995 LOCATION: SWMU40 ST3

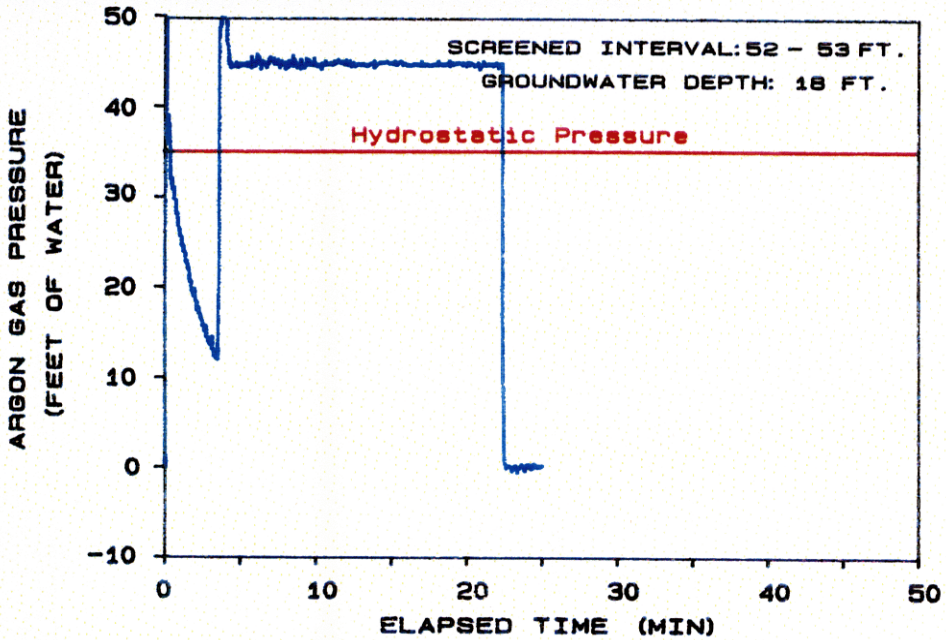
PERFORMED BY:

SUBSURFACE TECHNOLOGY

00032




# GS-1 SAMPLE PLOT

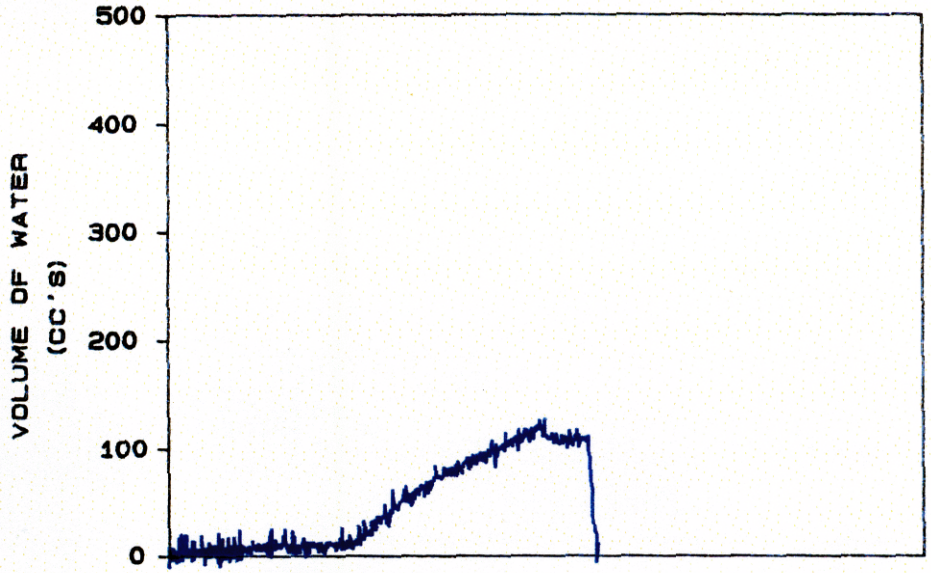
SAMPLE #: 40GH0353

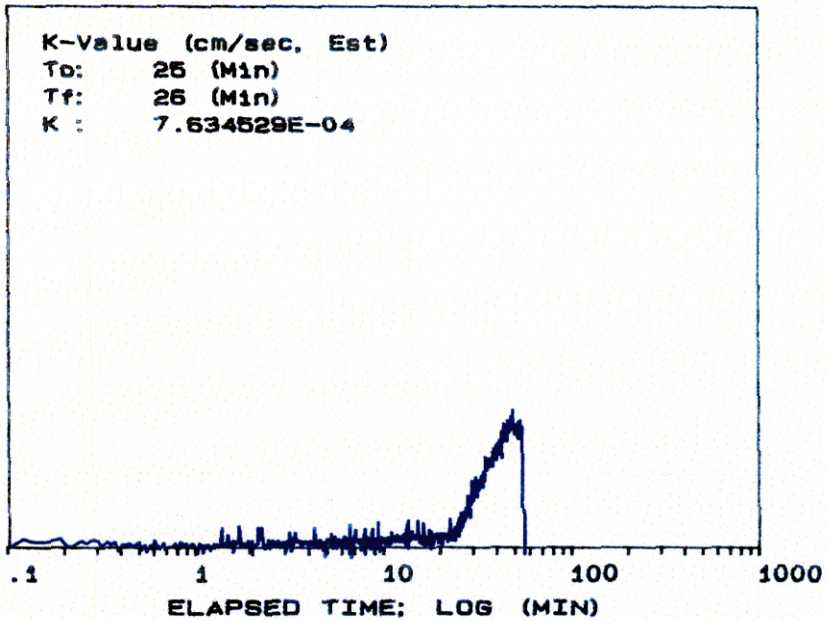
CLIENT: ENSAFE JOB: NASM094

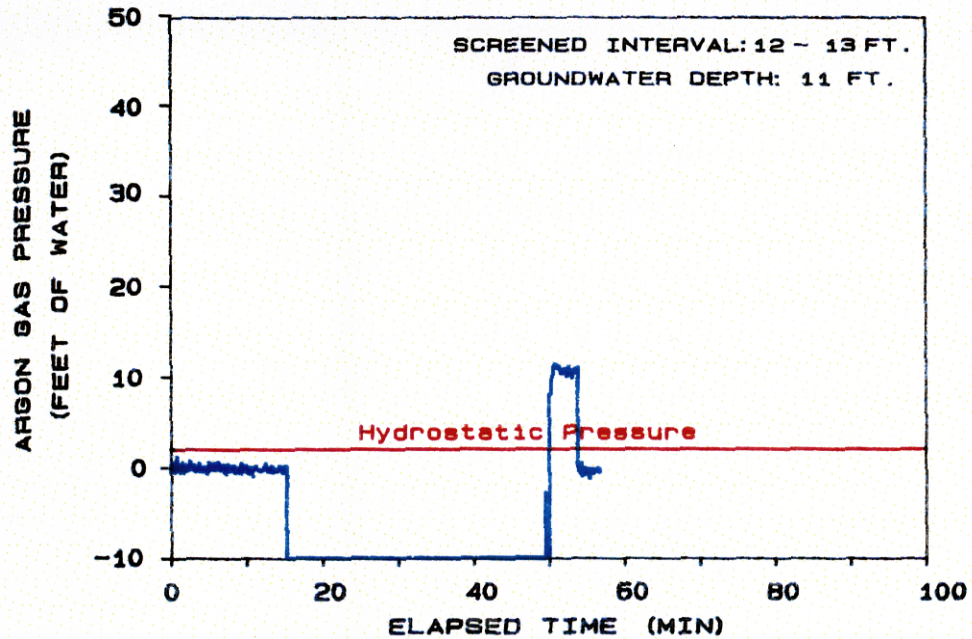
DATE: 05-10-1995 LOCATION: SWMU40 ST3

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

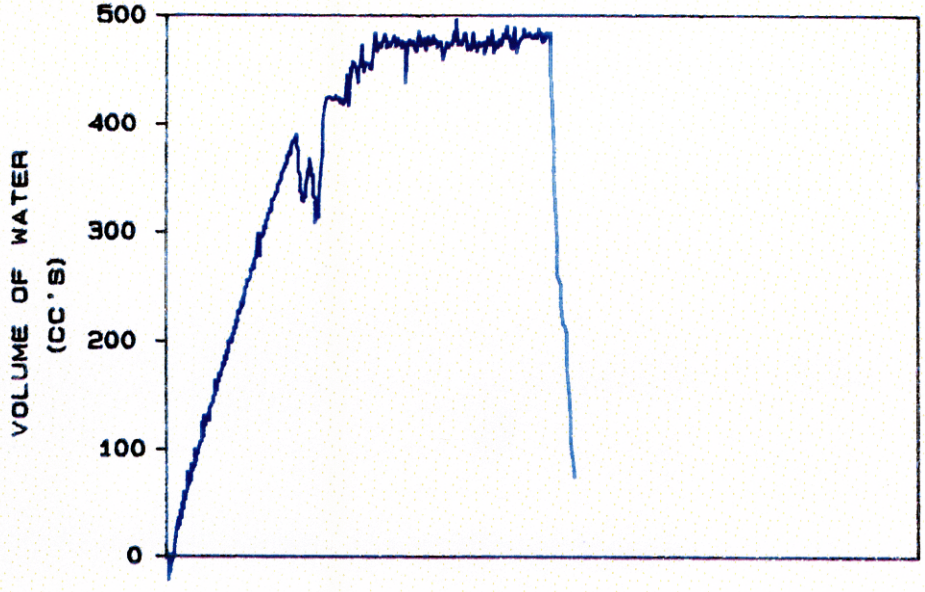
SAMPLE #: 40GH0413

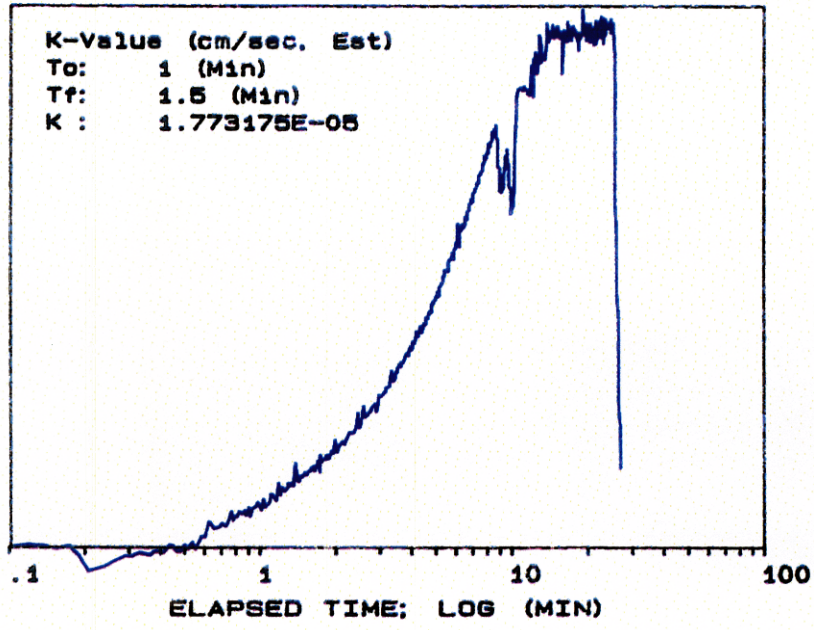
CLIENT: ENSAFE JOB: NASM094

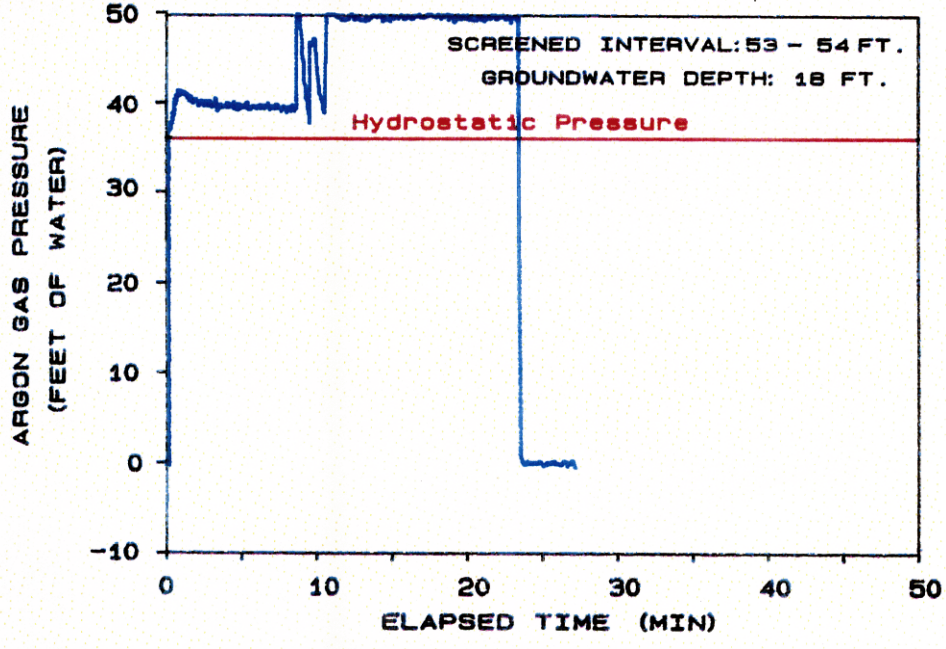
DATE: 05-10-1995 LOCATION: SWMU40ST4

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0454

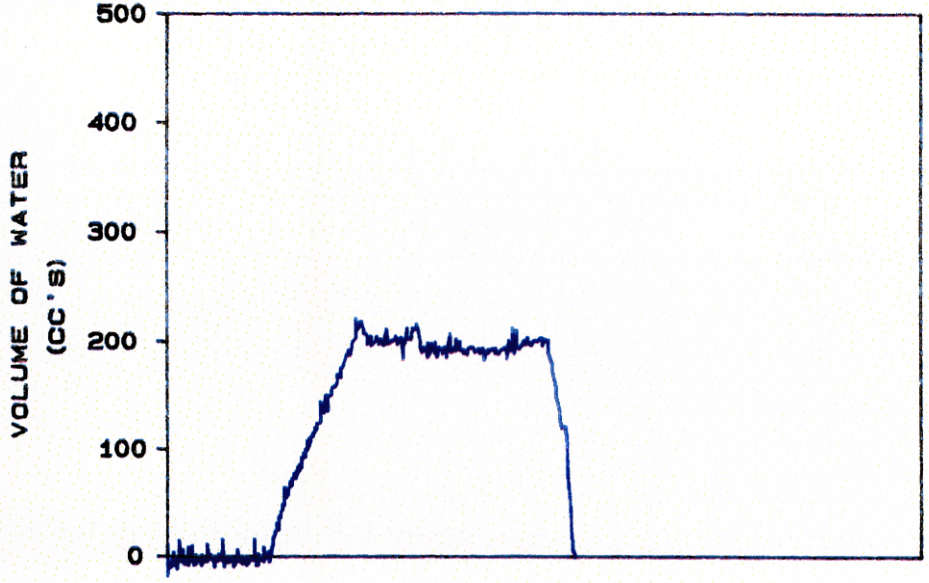
CLIENT: ENSAFE JOB: NASM094

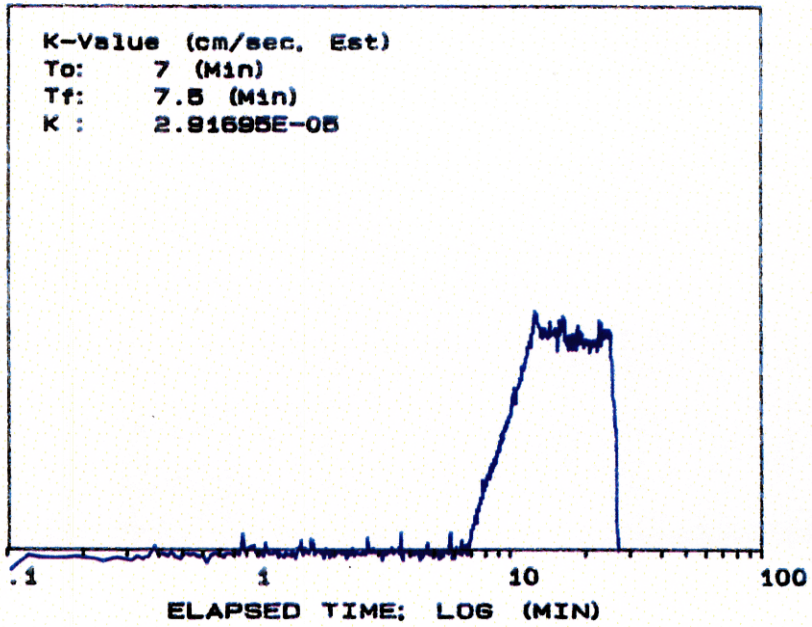
DATE: 05-10-1995 LOCATION: SWMU40 ST4

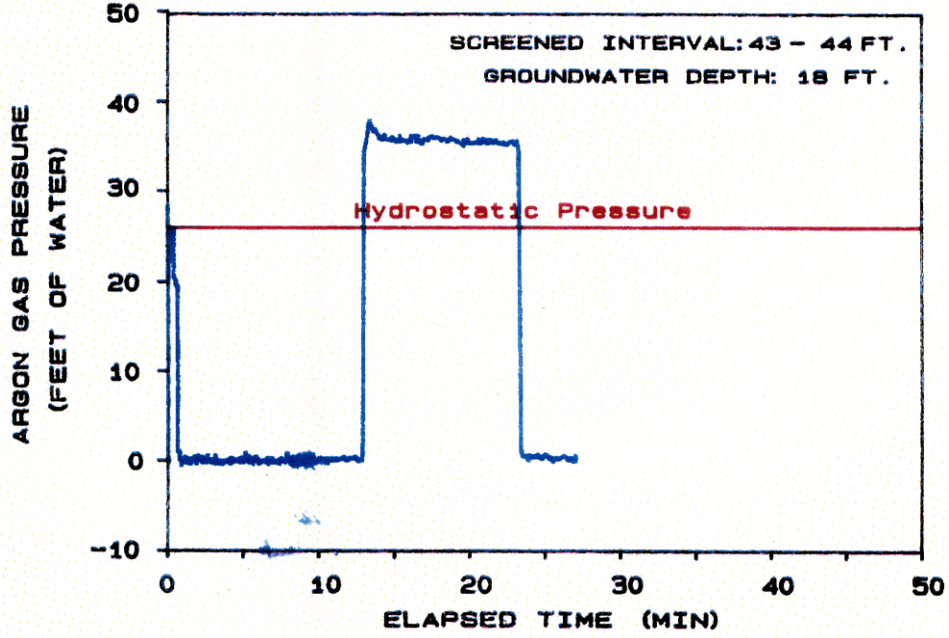
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000402




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0544

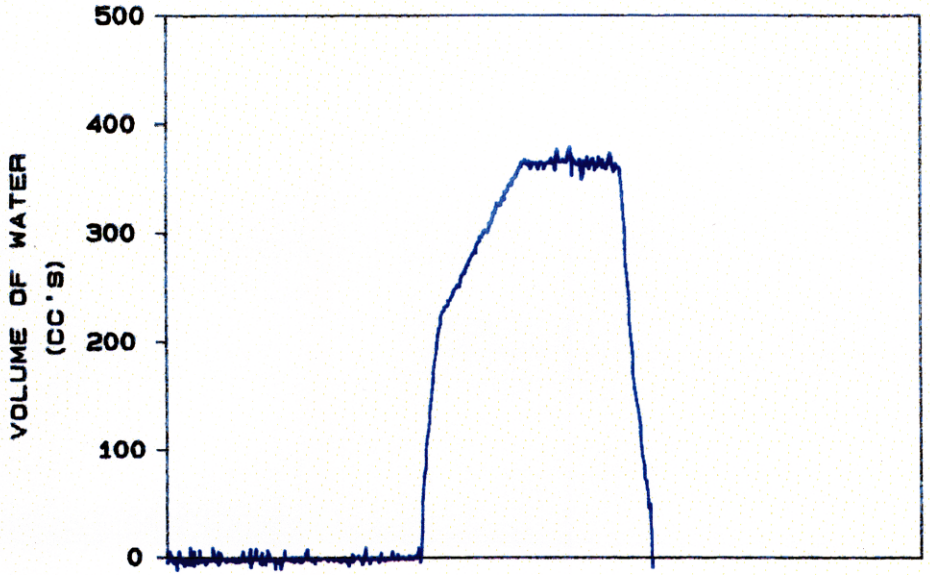
CLIENT: ENSAFE JOB: NASM094

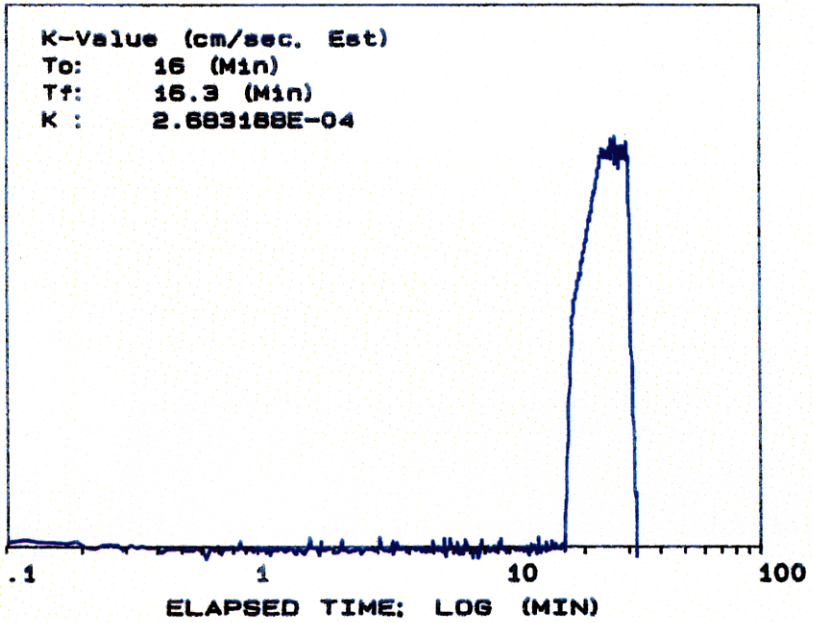
DATE: 05-10-1995 LOCATION: SWMU40 ST5

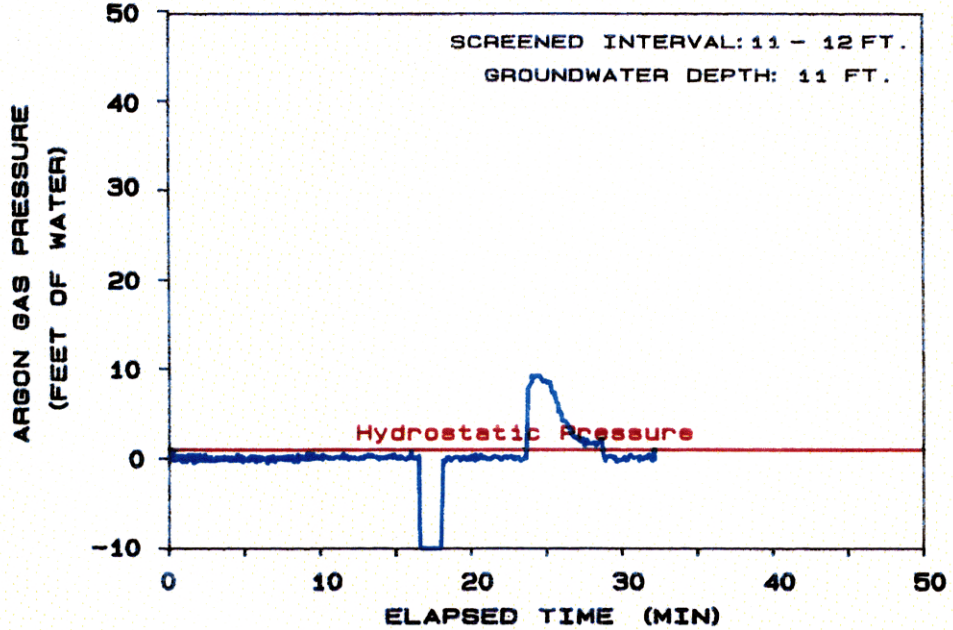
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000403




# GS-1 SAMPLE PLOT

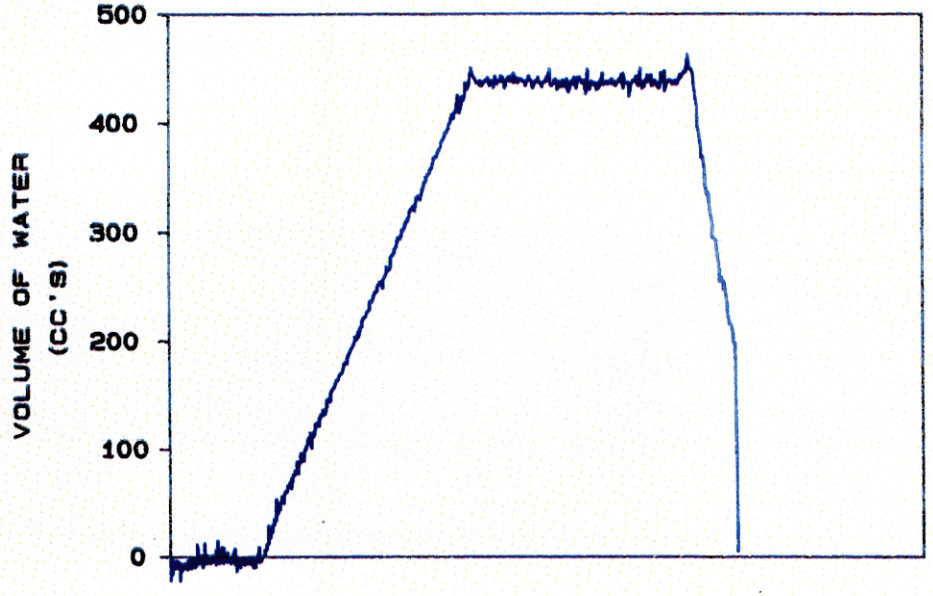
SAMPLE #: 40GH0612

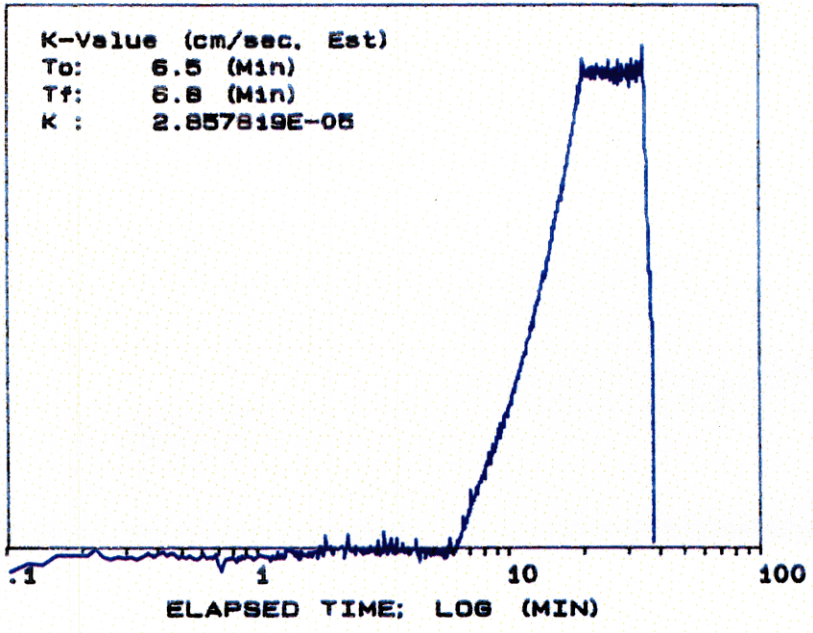
CLIENT: ENSAFE JOB: NASM094

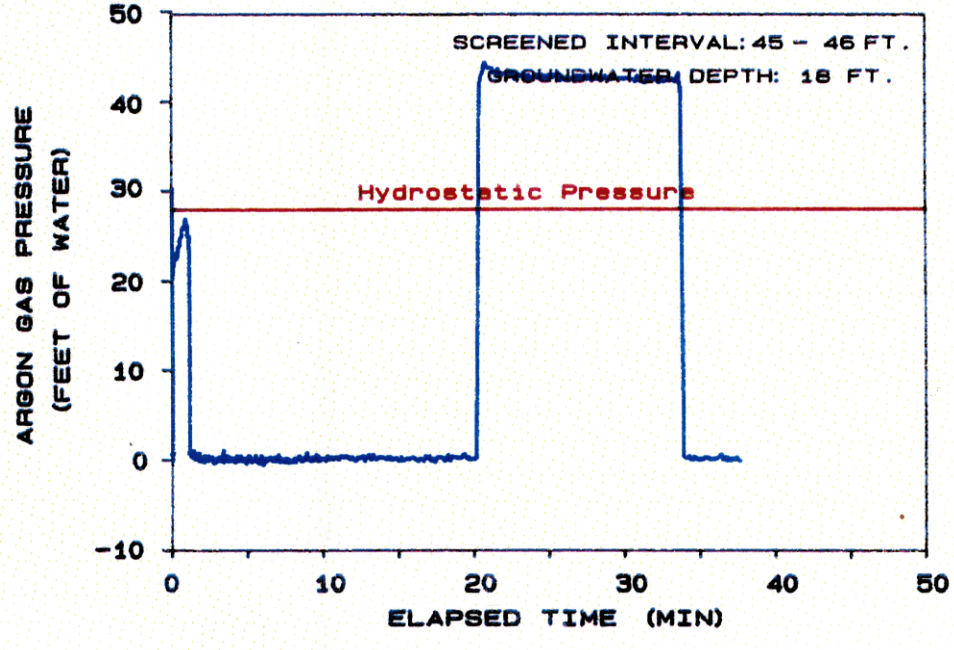
DATE: 05-11-1995 LOCATION: SWMU40 ST6

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0646

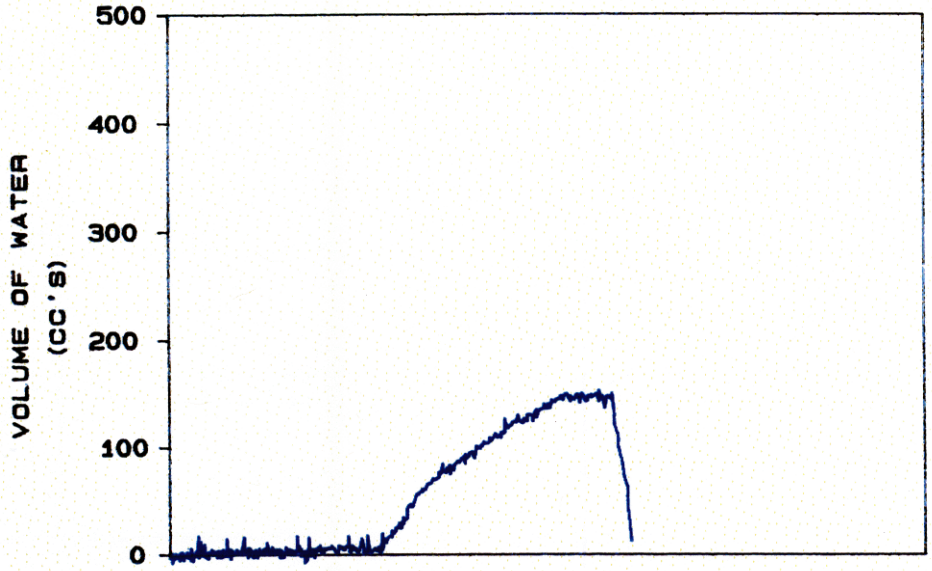
CLIENT: ENSAFE JOB: NASM094

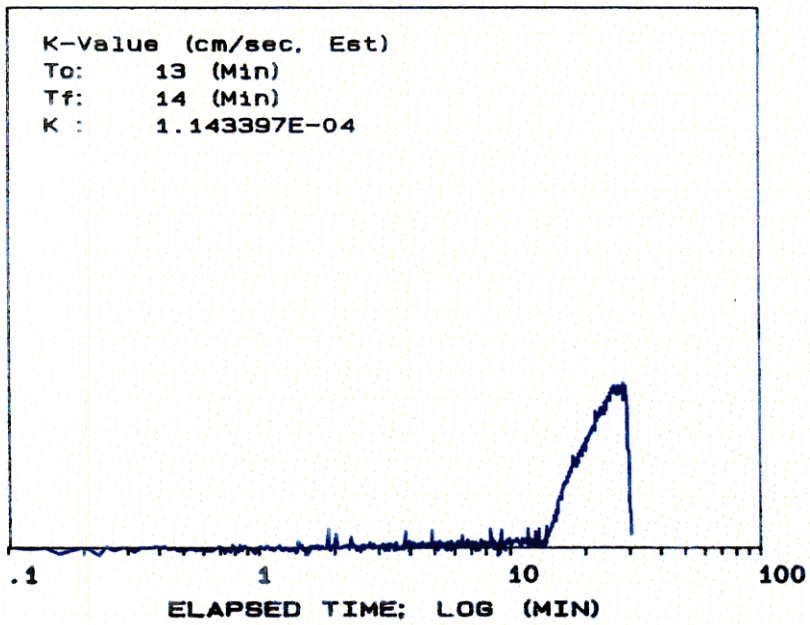
DATE: 05-11-1995 LOCATION: SWMU40 ST6

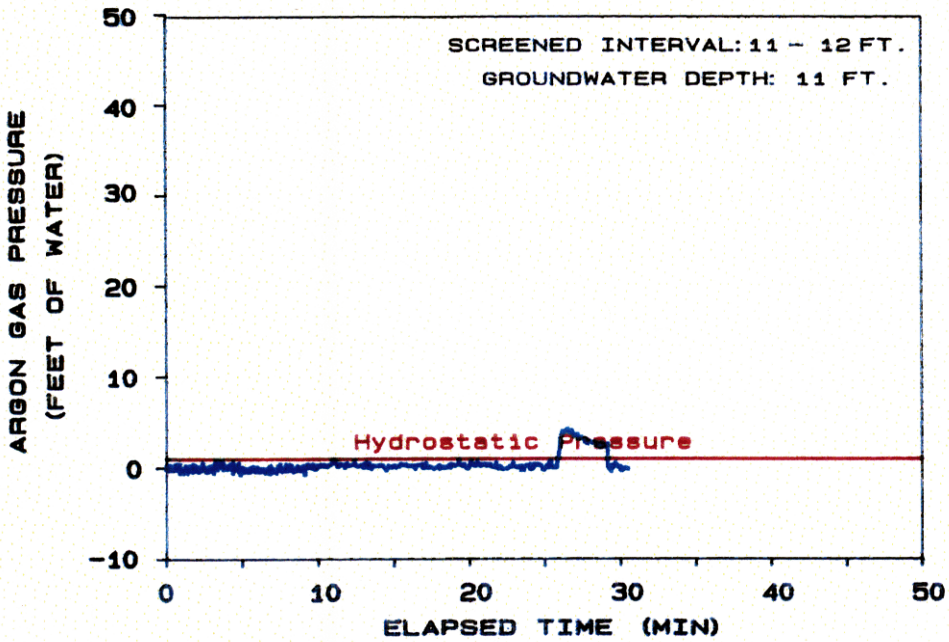
PERFORMED BY:

SUBSURFACE TECHNOLOGY

00045




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0712

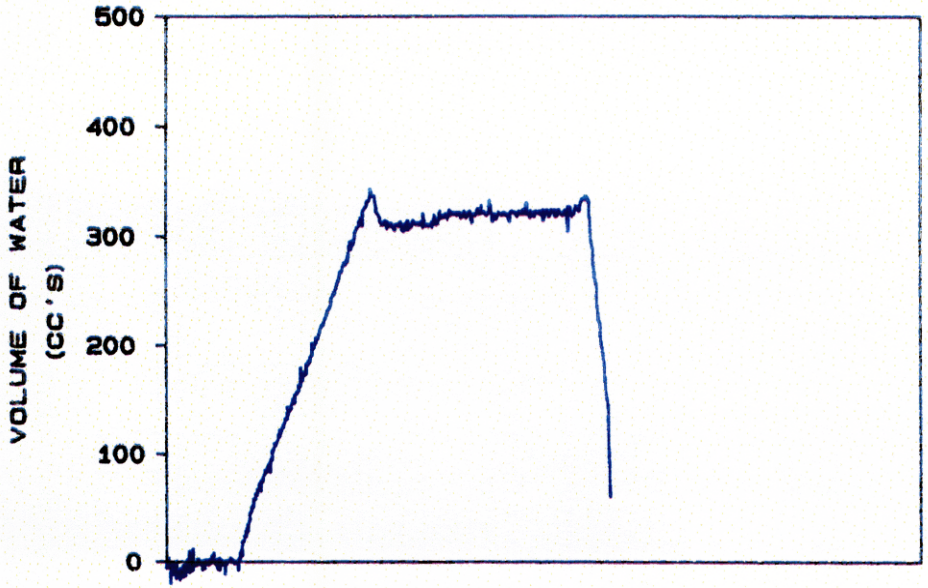
CLIENT: ENSAFE JOB: NASM094

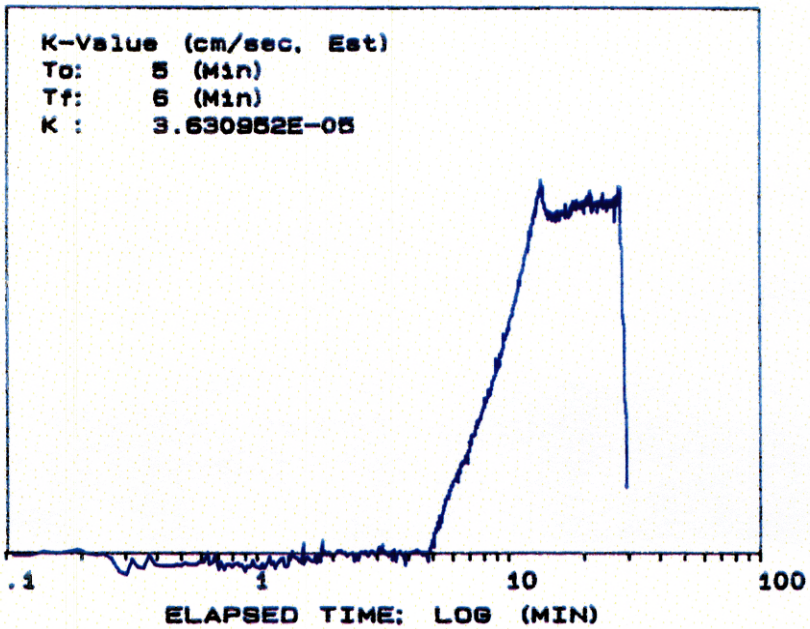
DATE: 05-11-1995 LOCATION: SWMU40 ST7

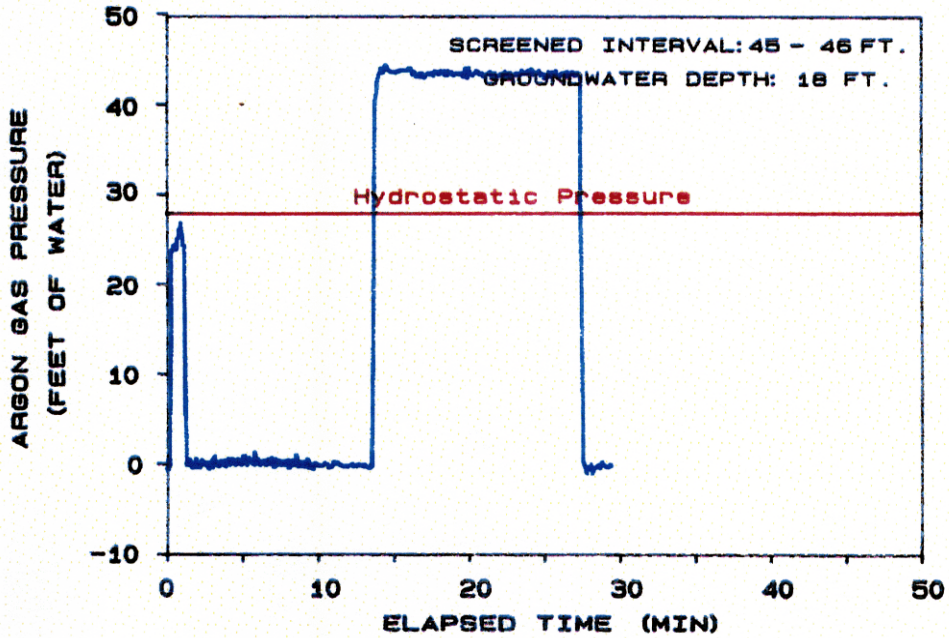
PERFORMED BY:

SUBSURFACE TECHNOLOGY

00043




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0746

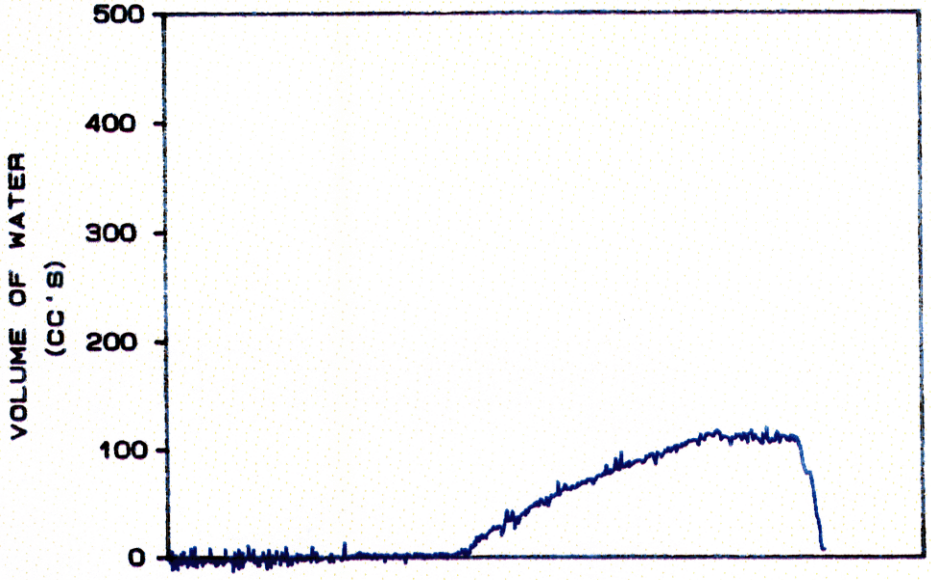
CLIENT: ENSAFE JOB: NASM094

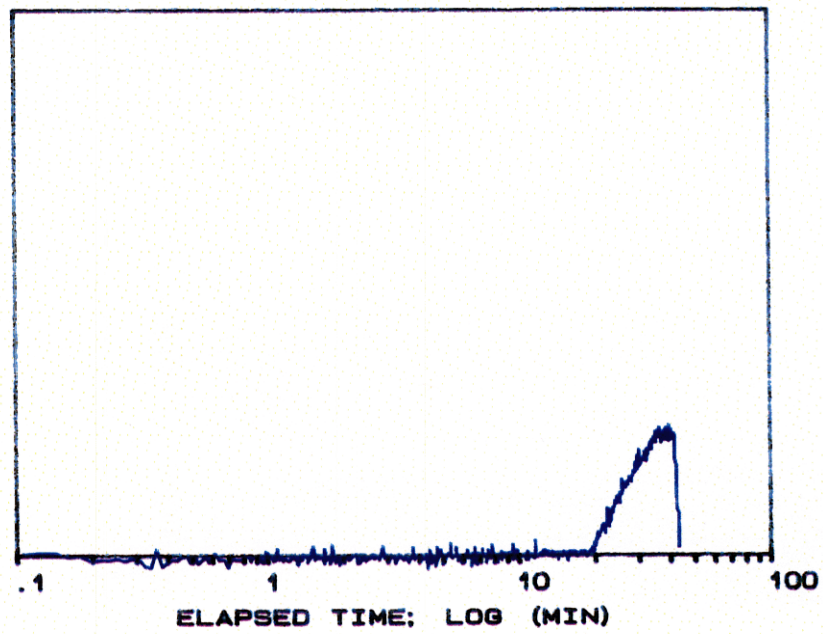
DATE: 05-11-1995 LOCATION: SWMU40 ST7

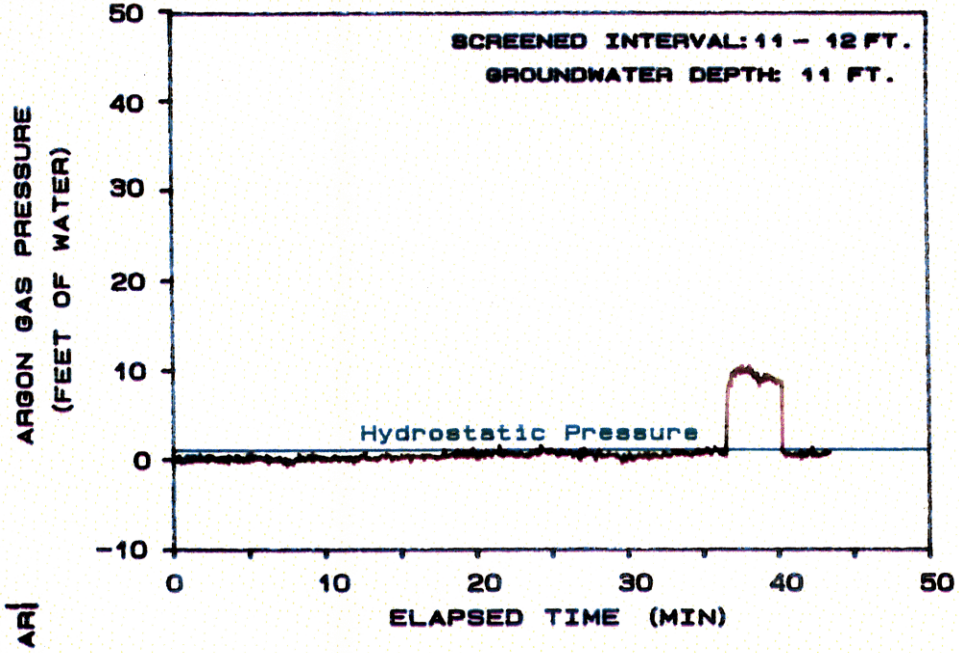
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000407




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0812

CLIENT: ENSAFE JOB: NASM094

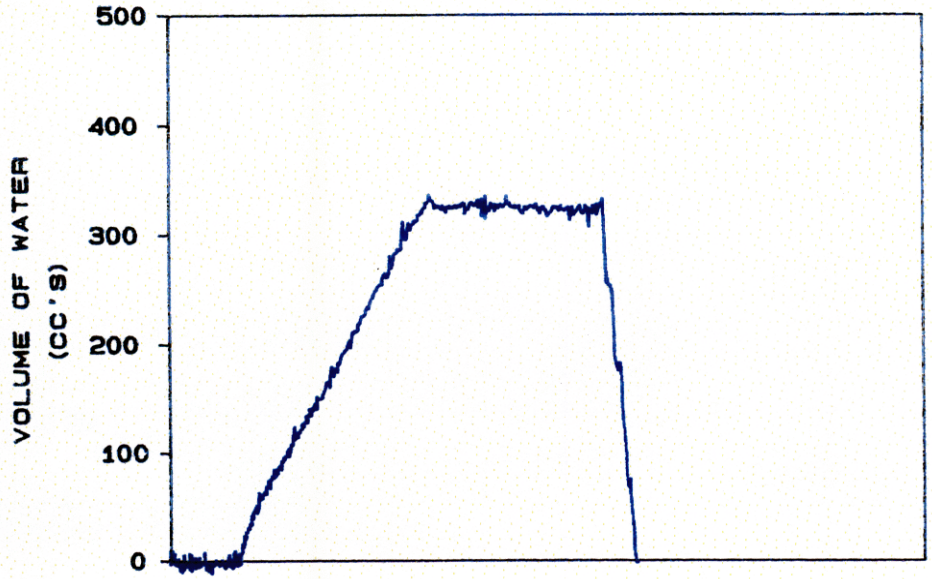
DATE: 05-14-1995 LOCATION: SWMU40 ST8

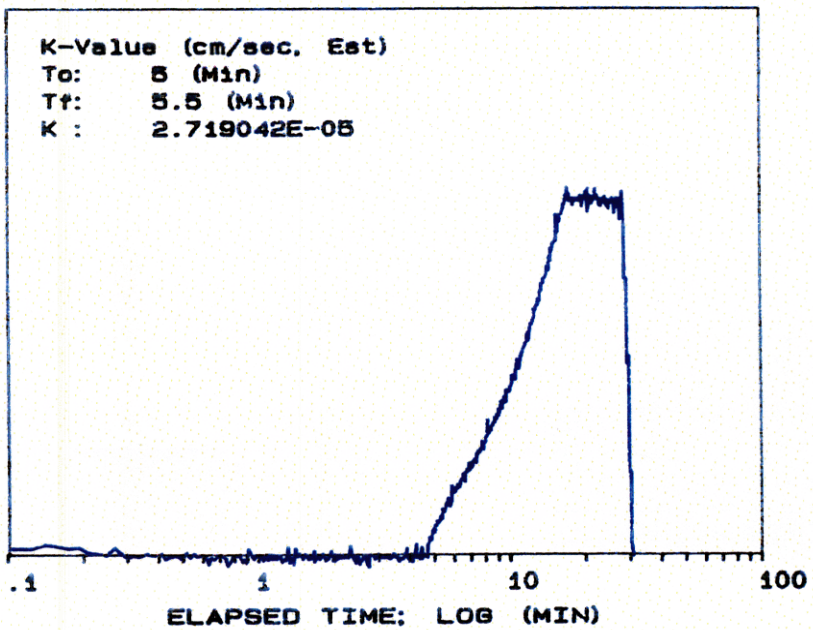
PERFORMED BY:

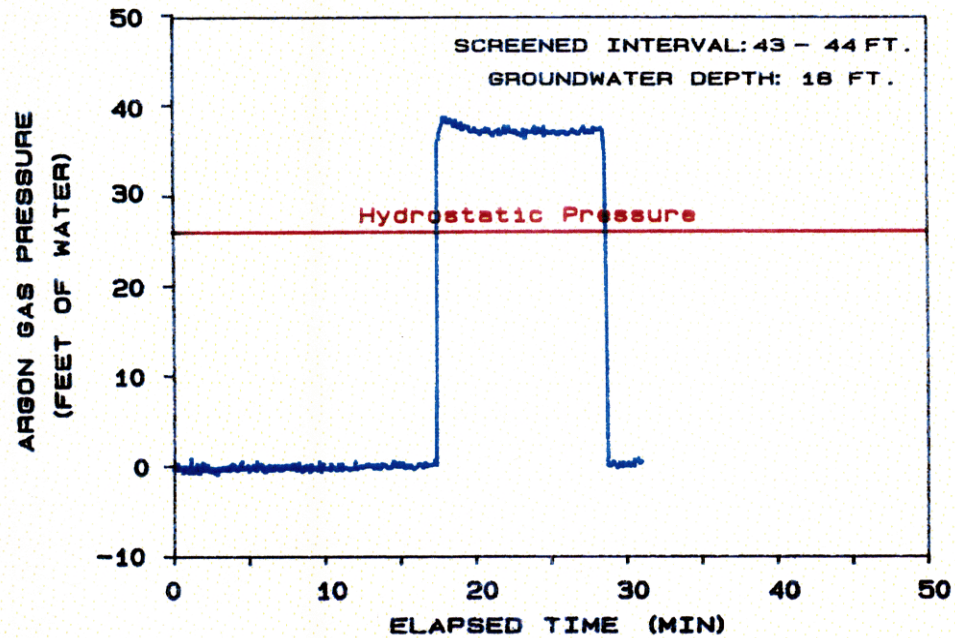
SUBSURFACE TECHNOLOGY

AR

000408




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0844

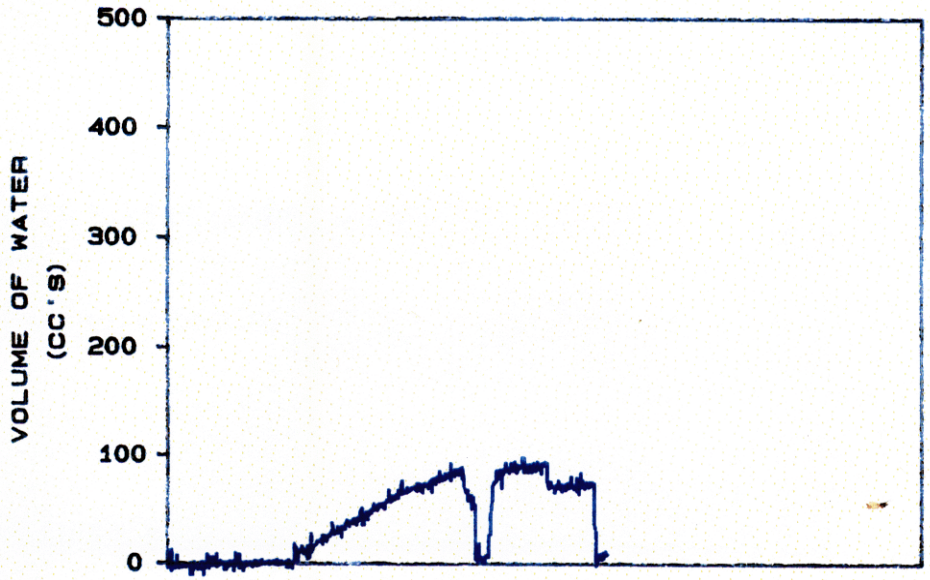
CLIENT: ENSAFE JOB: NASM094

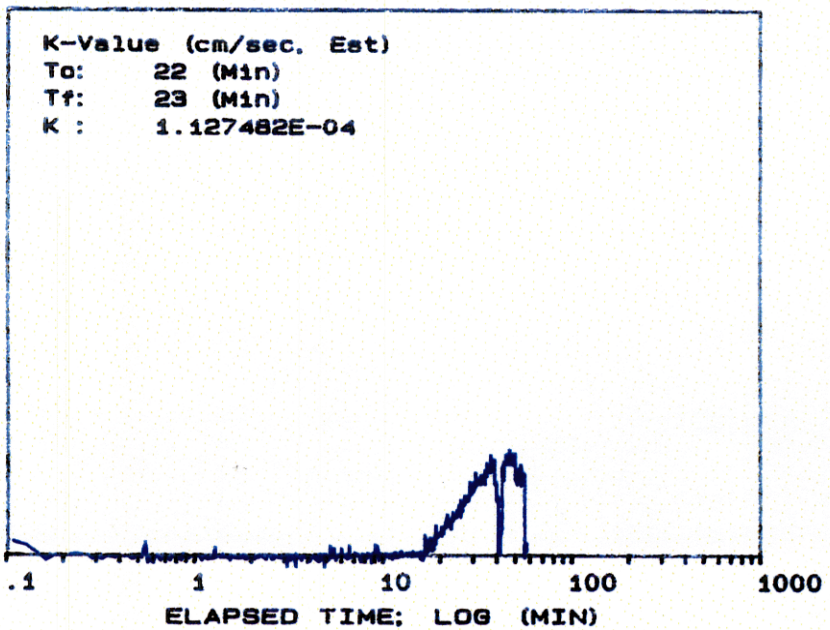
DATE: 05-11-1995 LOCATION: SWMU40 ST8

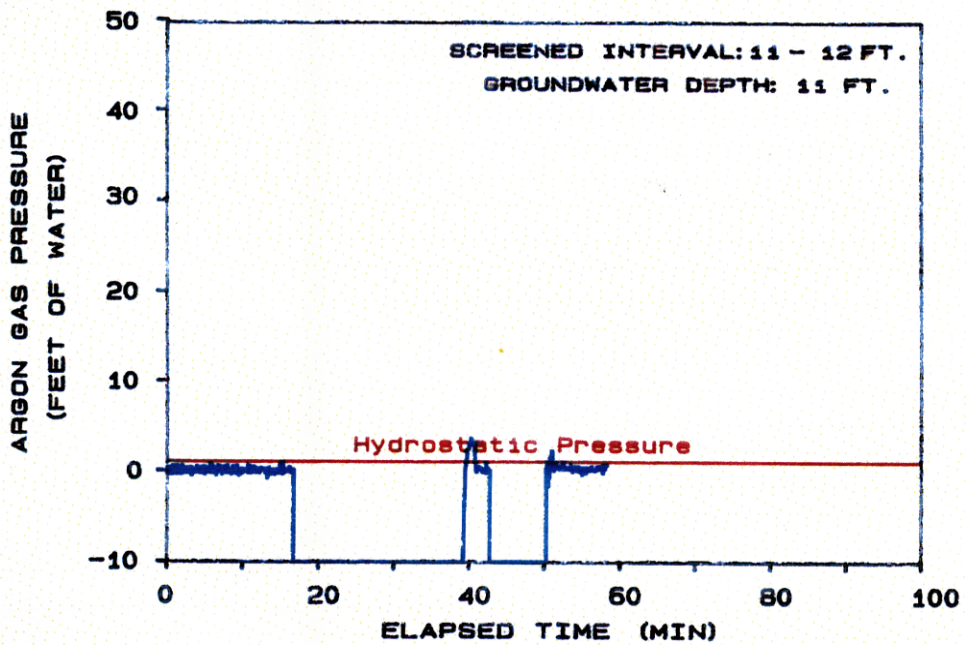
PERFORMED BY:

SUBSURFACE TECHNOLOGY

00049




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH0912

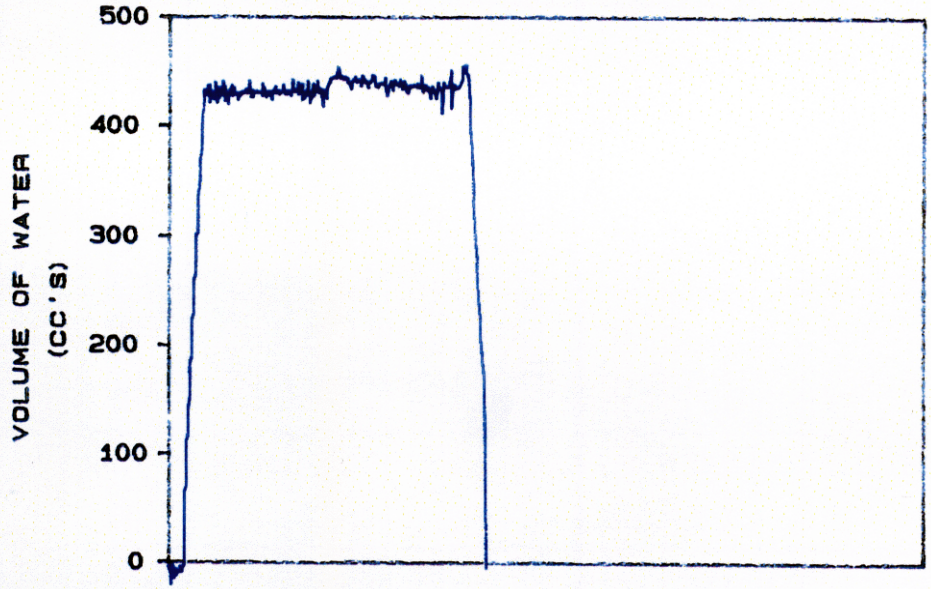
CLIENT: ENSAFE JOB: NASM094

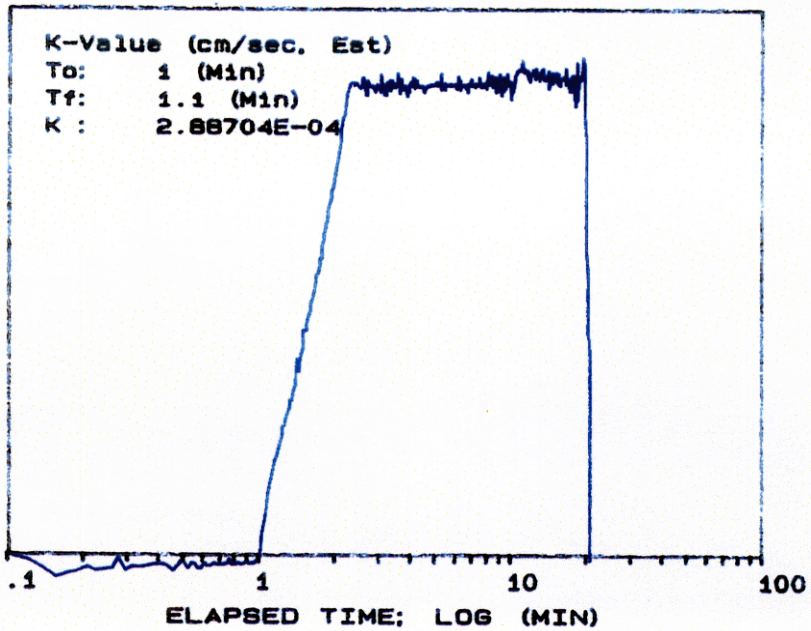
DATE: 05-11-1995 LOCATION: SWMU40 ST9

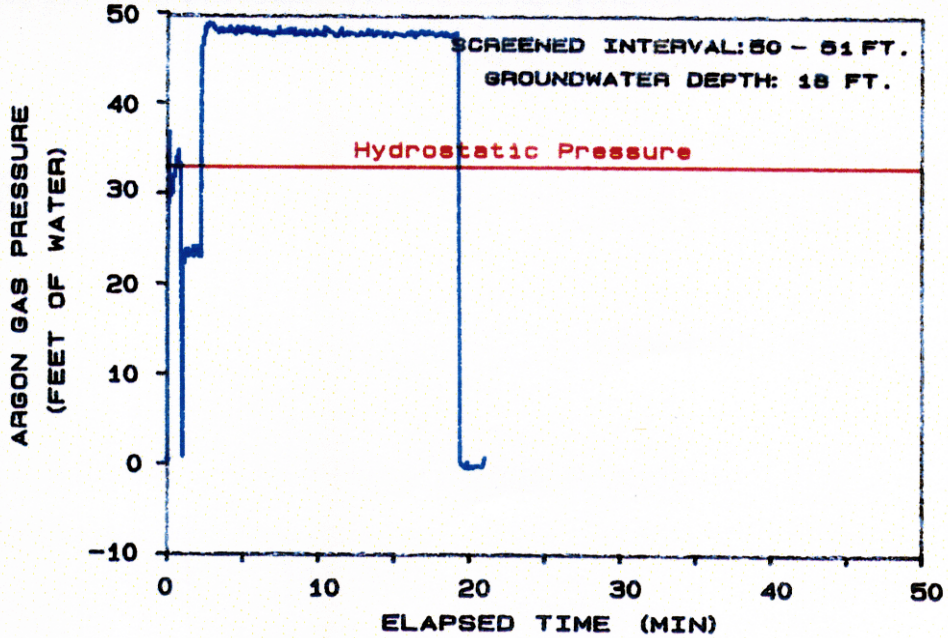
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000410




# GS-1 SAMPLE PLOT

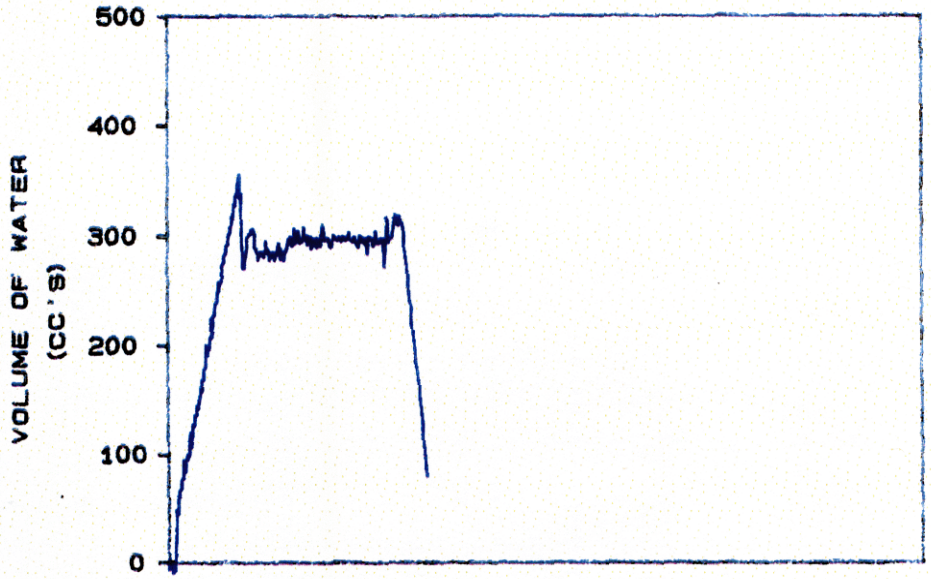
SAMPLE #: 40GH0951

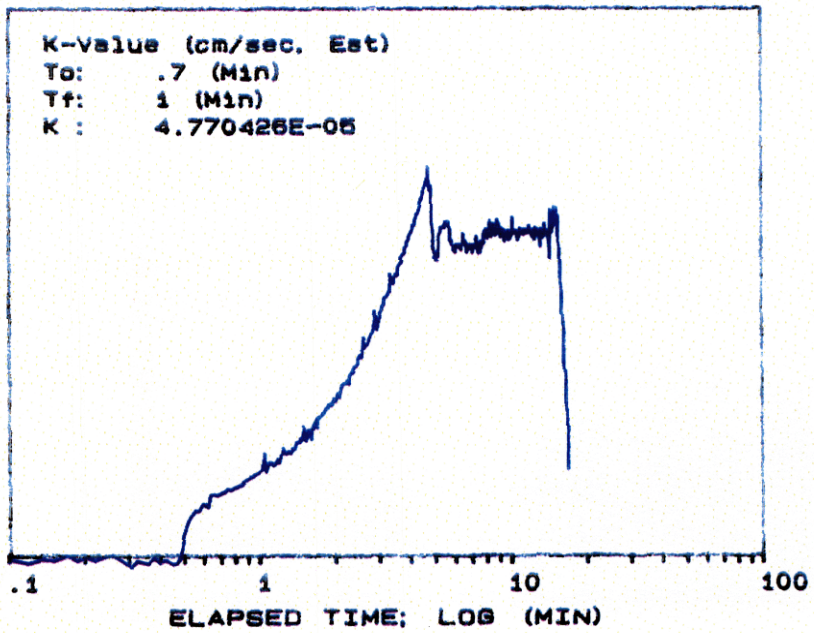
CLIENT: ENSAFE JOB: NASM094

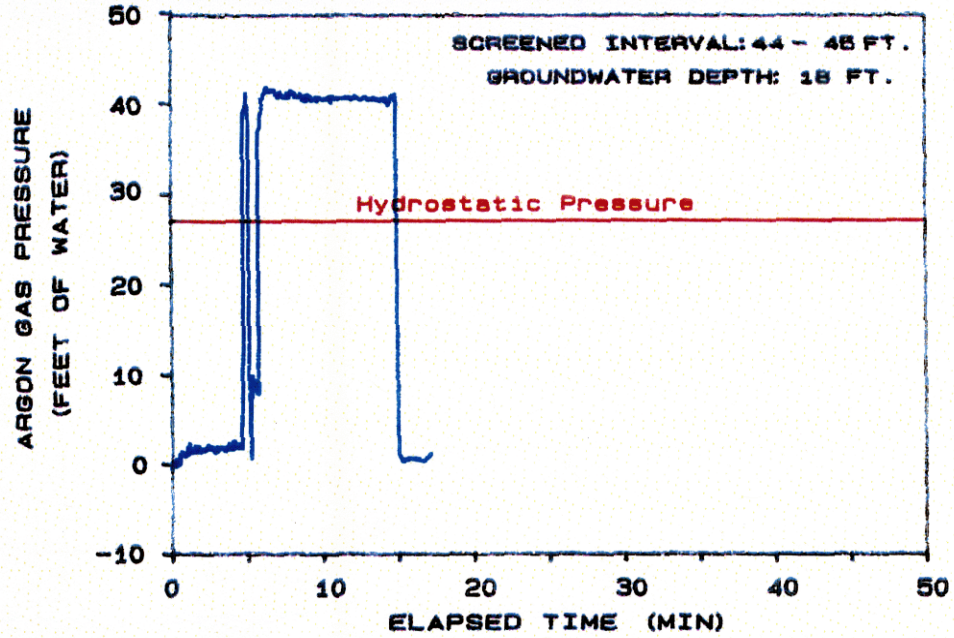
DATE: 05-11-1995 LOCATION: SWMU40 ST9

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH1045

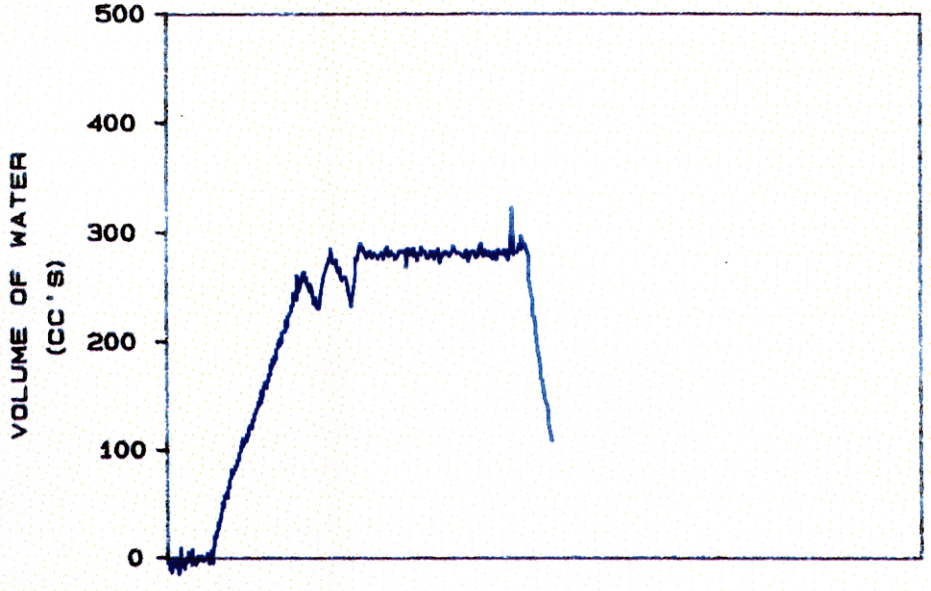
CLIENT: ENSAFE JOB: NASM094

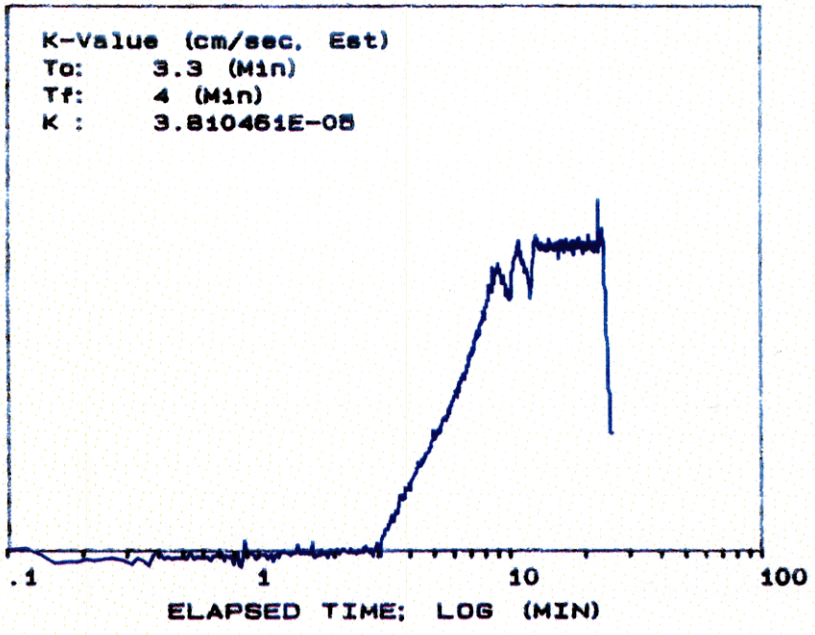
DATE: 05-11-1995 LOCATION: SWMU40 ST1

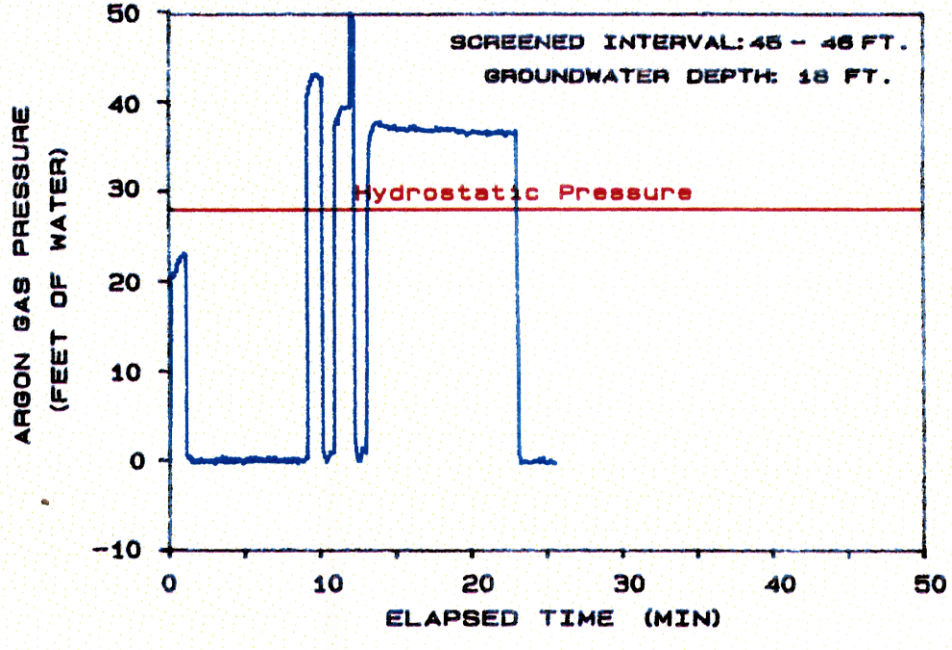
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000412




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH1546

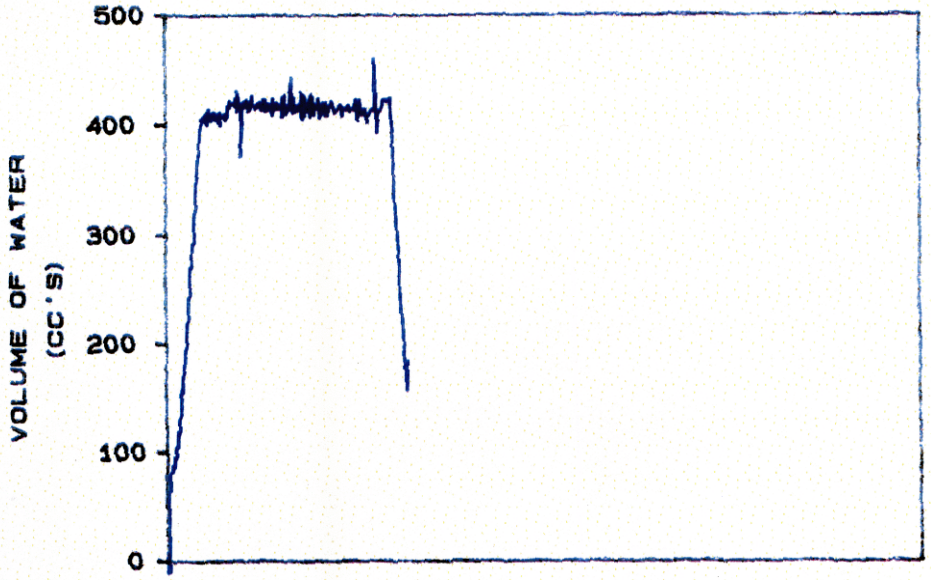
CLIENT: ENSAFE JOB: NASM094

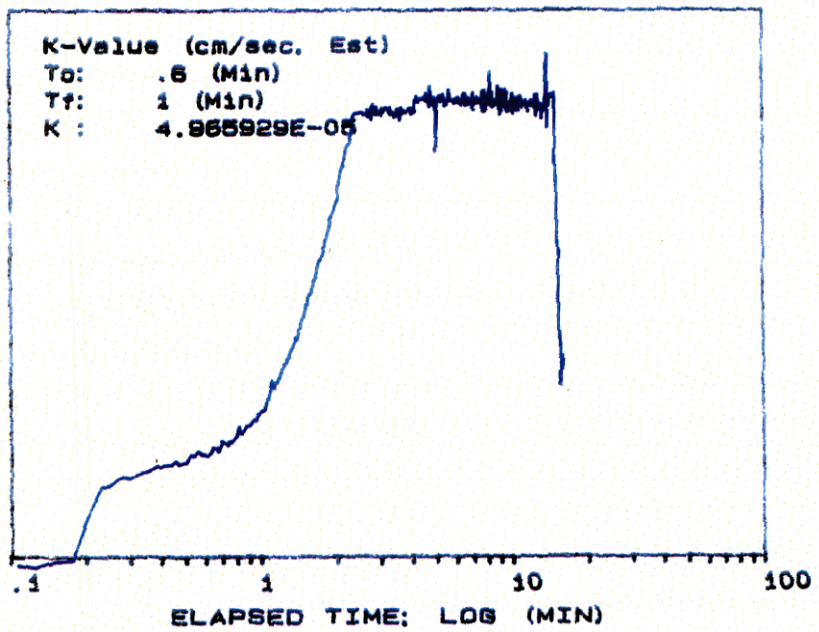
DATE: 05-12-1995 LOCATION: SWMU40 ST1

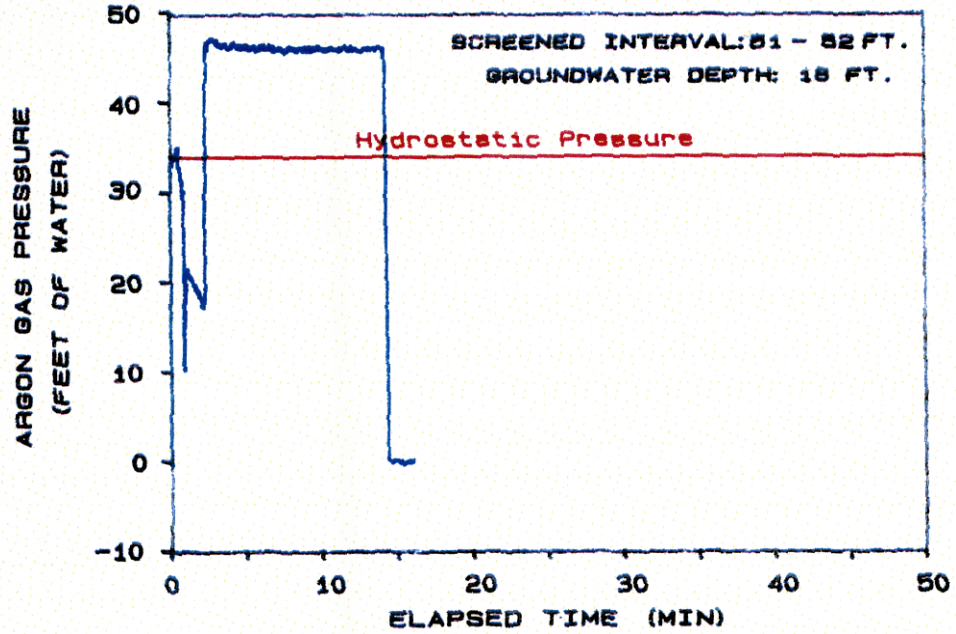
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000413




# GS-1 SAMPLE PLOT

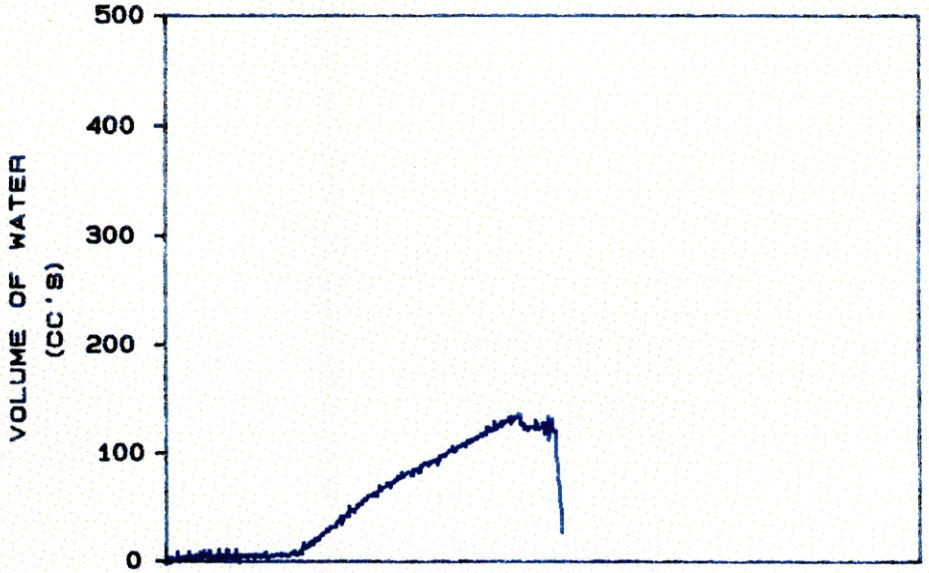
SAMPLE #: 40GH1652

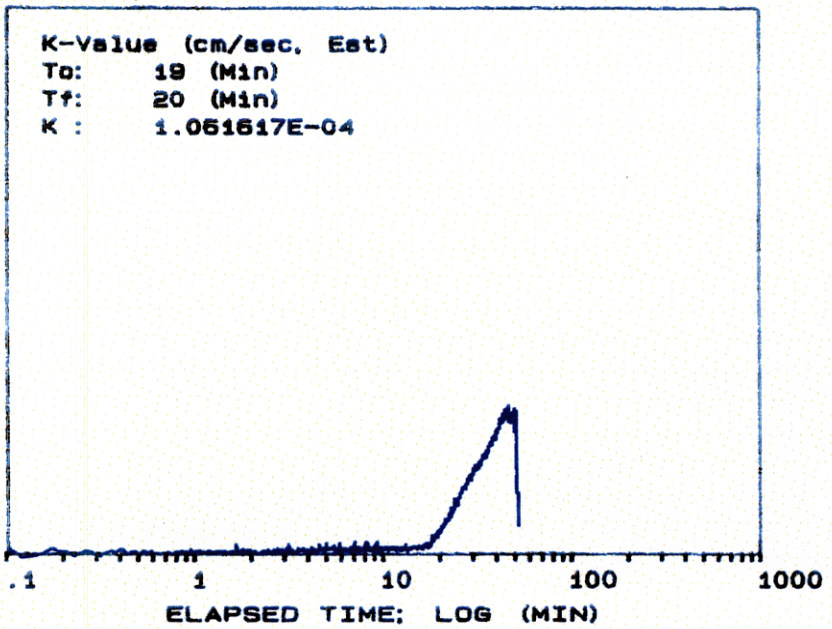
CLIENT: ENSAFE JOB: NASM094

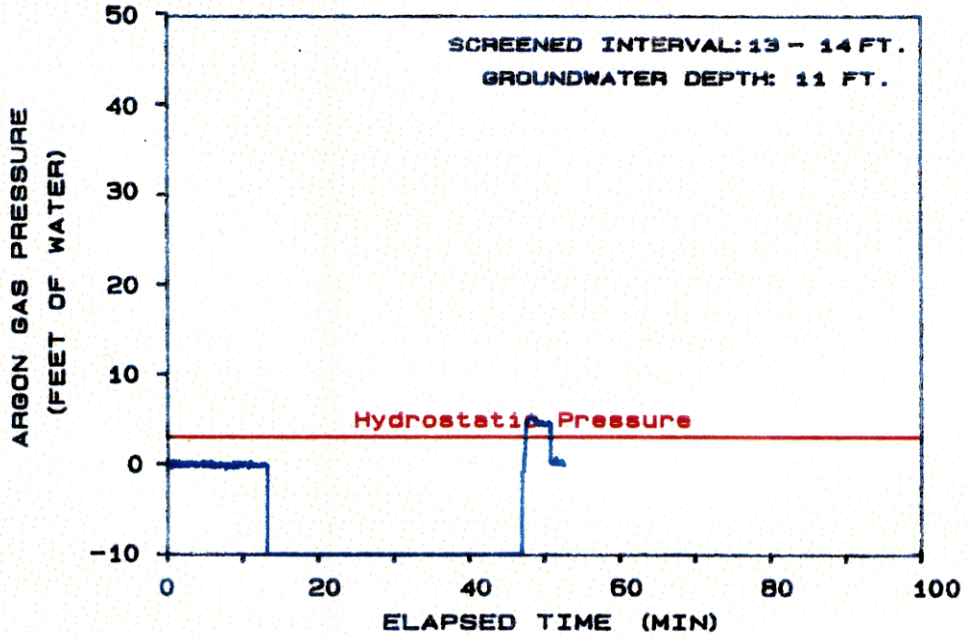
DATE: 05-13-1995 LOCATION: SWMU40 ST1

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH1714

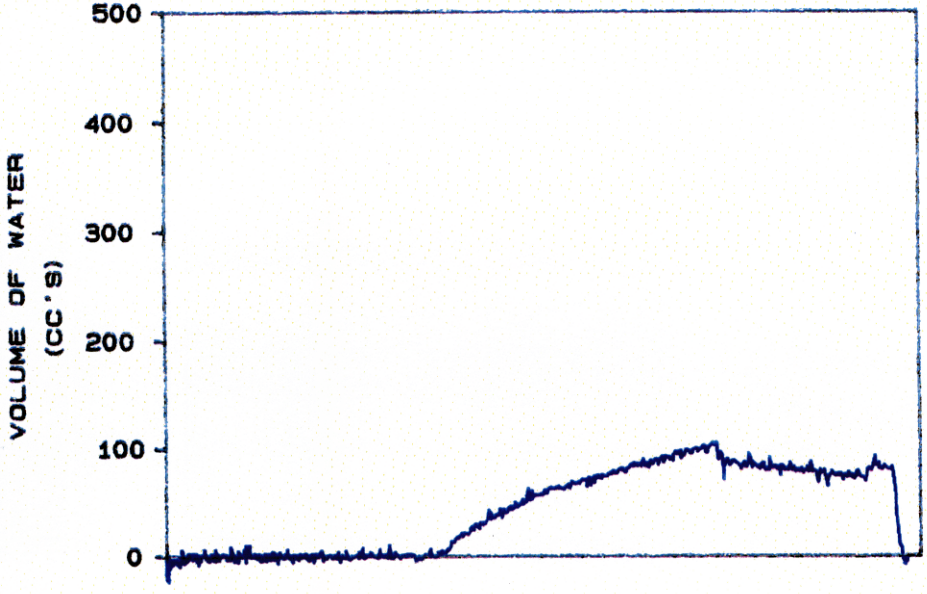
CLIENT: ENSAFE JOB: NASM094

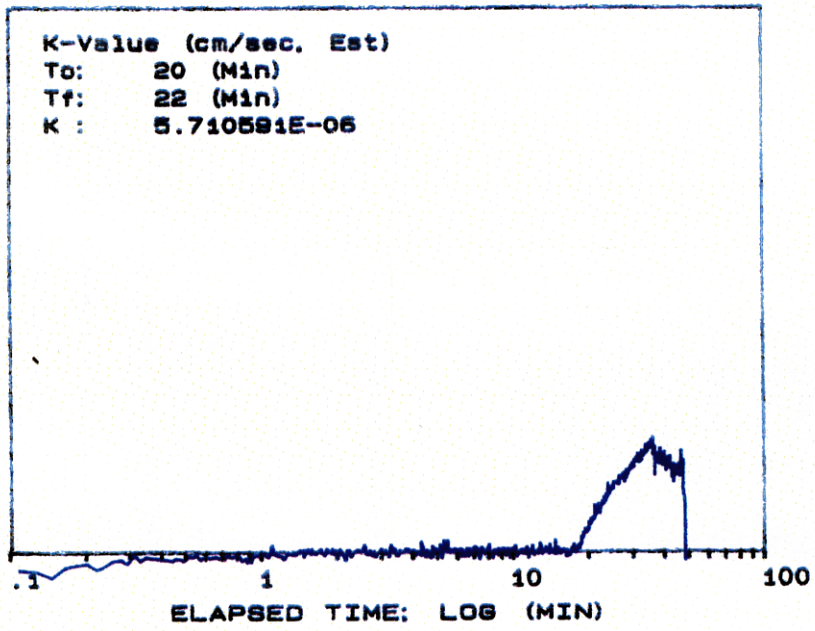
DATE: 05-13-1995 LOCATION: SWMU40 ST1

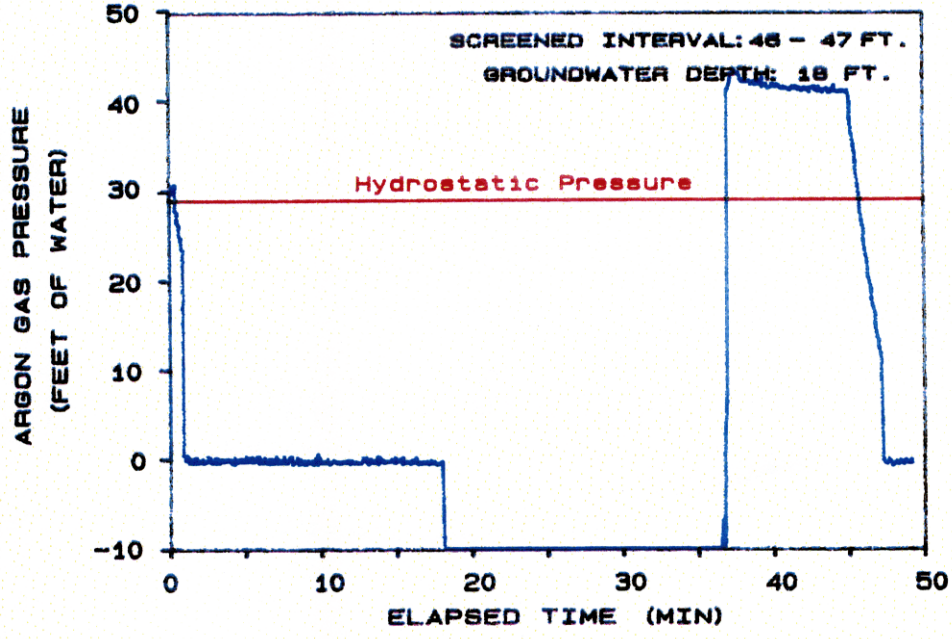
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000415




# GS-1 SAMPLE PLOT

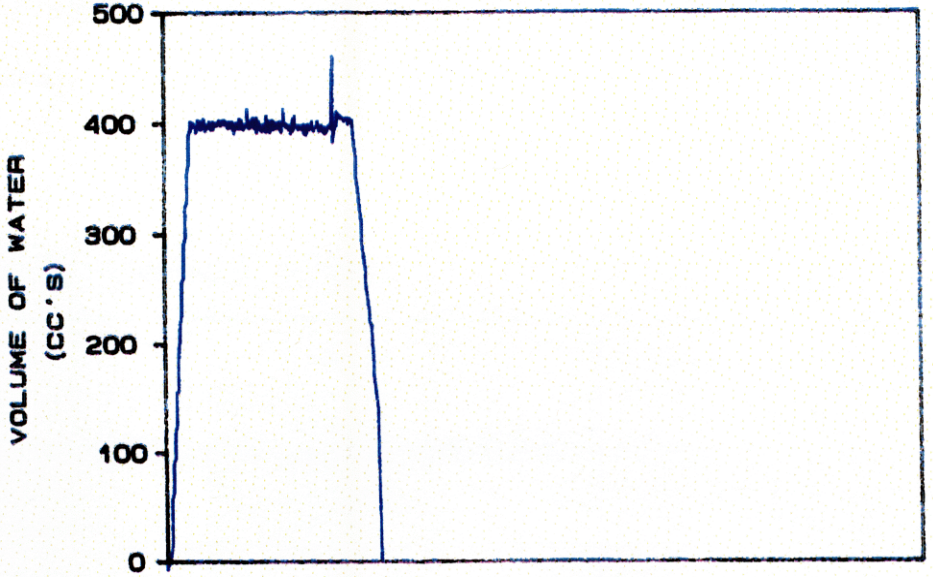
SAMPLE #: 40GH1747

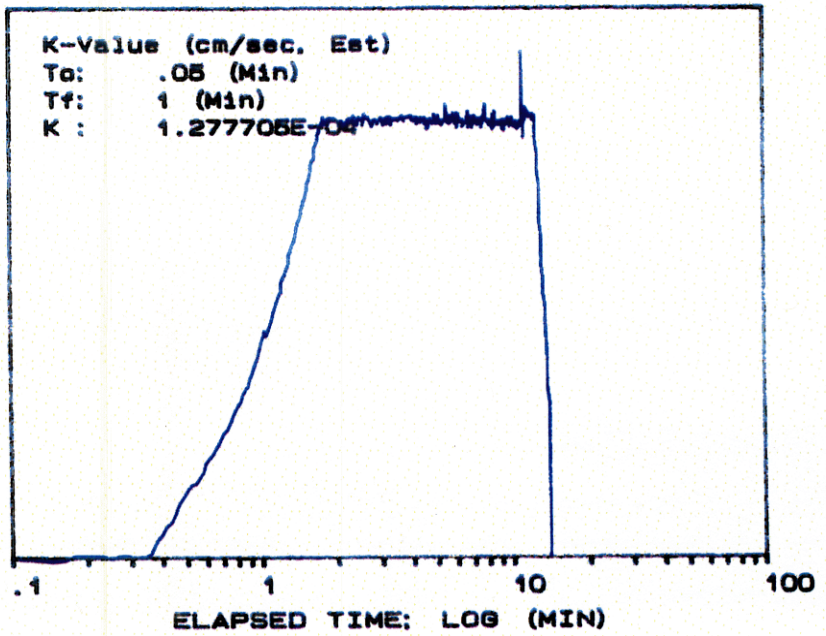
CLIENT: ENSAFE JOB: NASM094

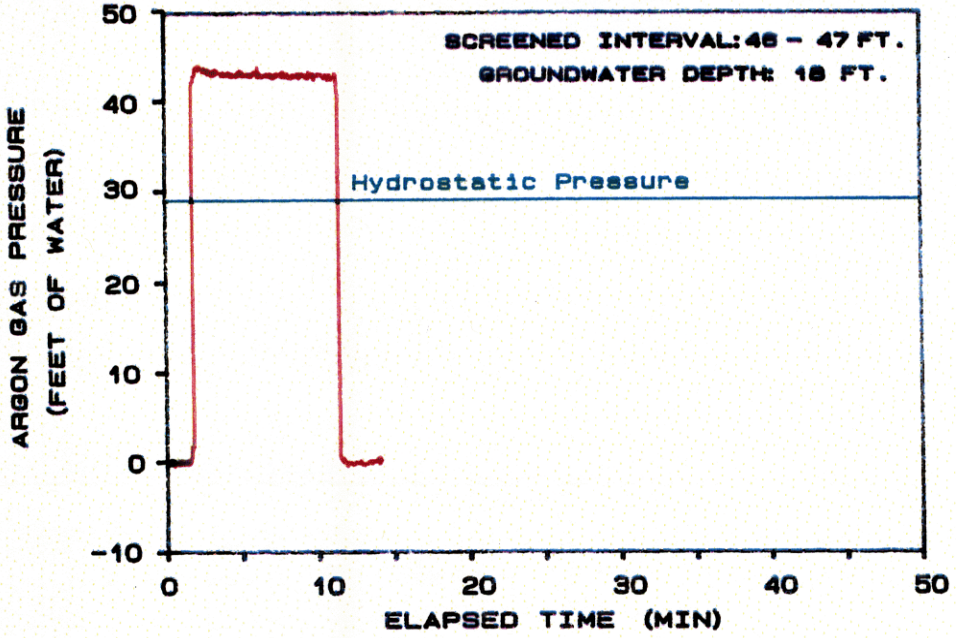
DATE: 05-13-1995 LOCATION: SWMU40 ST1

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

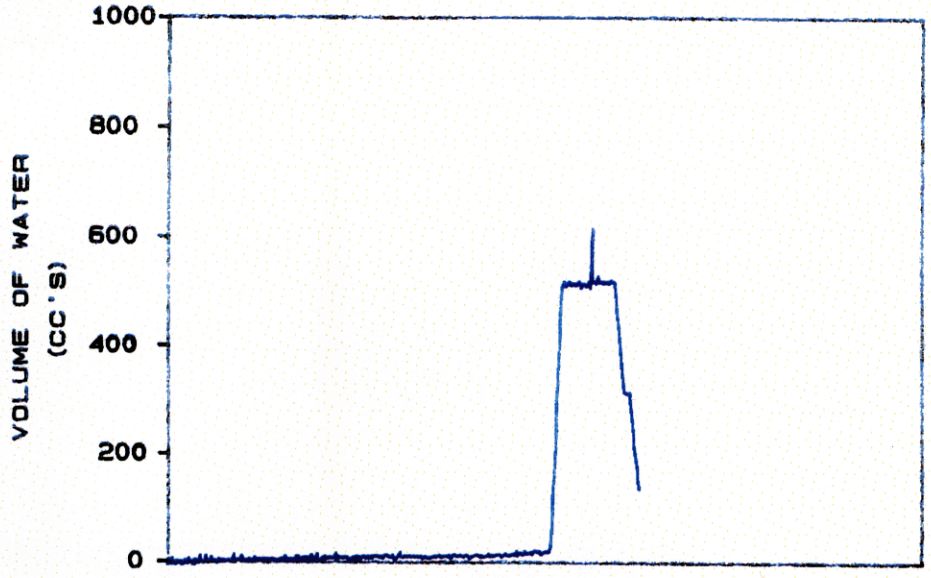
SAMPLE #: 40GH1847

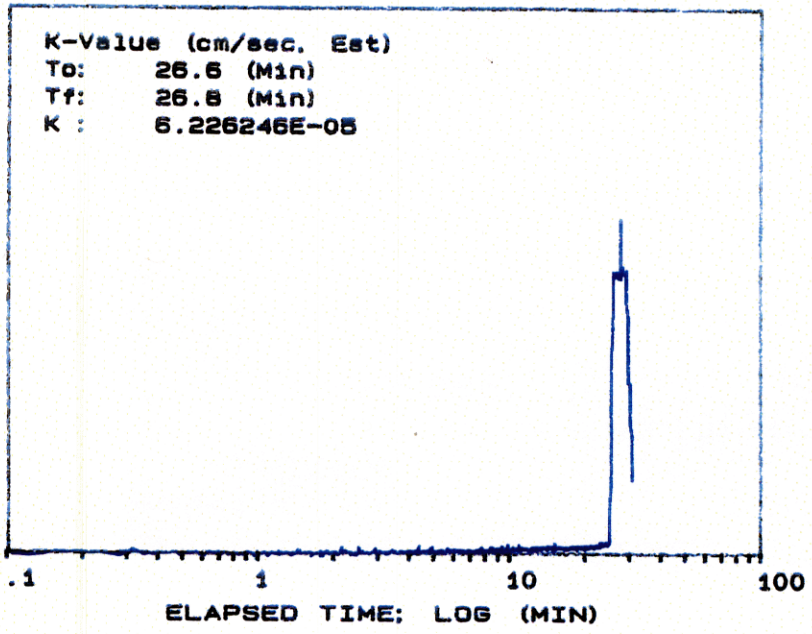
CLIENT: ENSAFE JOB: NASM094

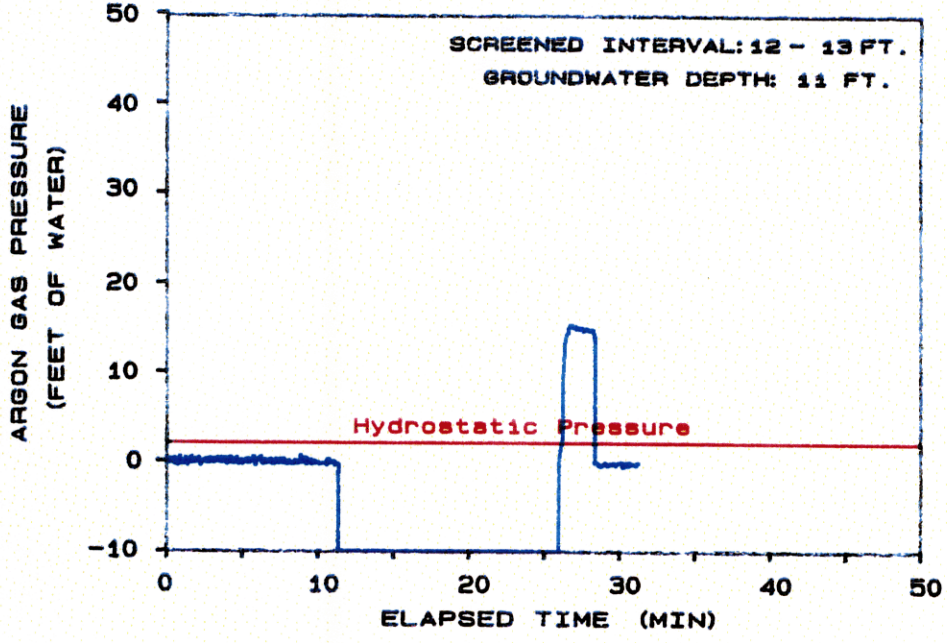
DATE: 05-13-1995 LOCATION: SWMU40 ST1

PERFORMED BY:

SUBSURFACE TECHNOLOGY




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH191B

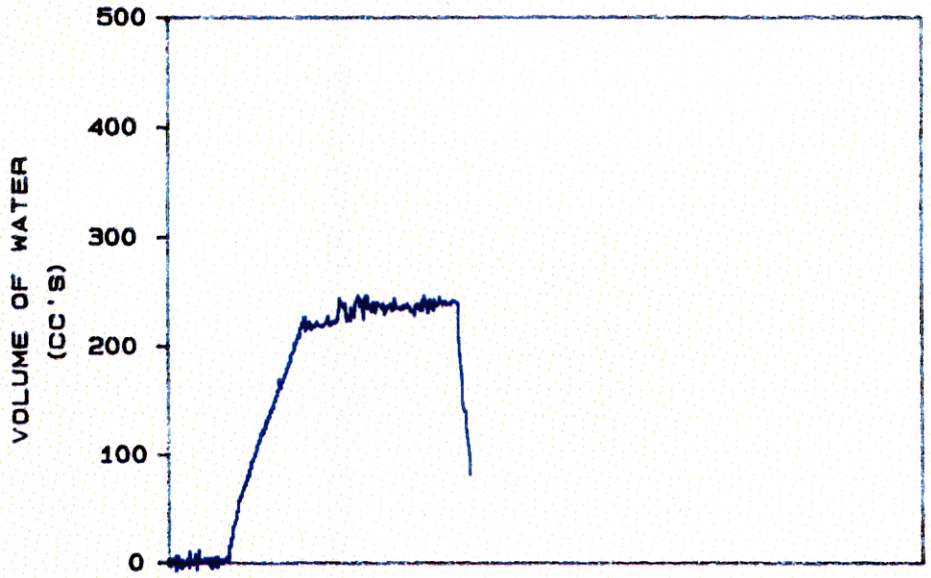
CLIENT: ENSAFE JOB: NASM094

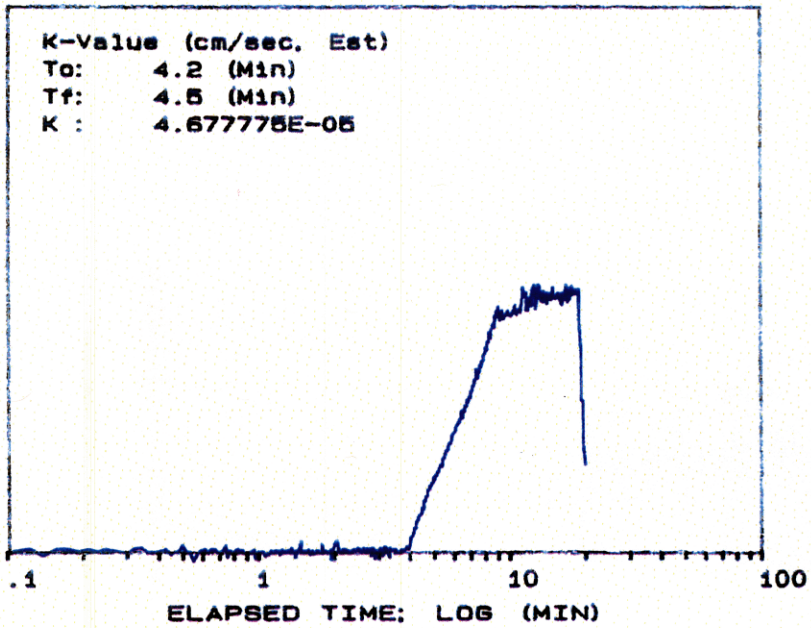
DATE: 05-13-1995 LOCATION: SWMU40 ST1

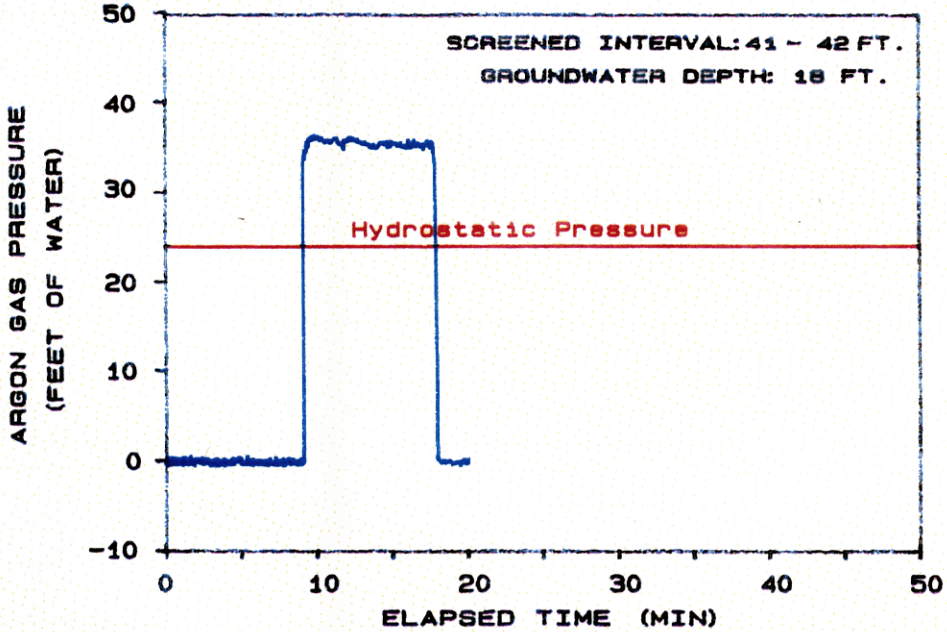
PERFORMED BY:

SUBSURFACE TECHNOLOGY

000418




# GS-1 SAMPLE PLOT

SAMPLE #: 40GH1942

CLIENT: ENSAFE JOB: NASM094

DATE: 05-13-1995 LOCATION: SWMU40 ST1

PERFORMED BY:

SUBSURFACE TECHNOLOGY

# Appendix D

## Miscellaneous Soil Boring Information

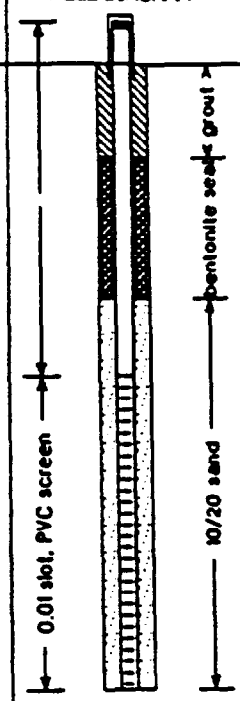
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-1S

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-26* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1015 on 2-07-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-07-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *20.0 feet* |
| Geologist: *Ben Brantley* | Well Screen: *10 to 20 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, grayish blue green, moist. | |
| 5 | | | 1 | 80 | BG | | | | |
| | | | | | | | | Clayey silt, moderate brown, medium stiff. | |
| 10 | | | | | | | | | |
| | | | | | | | ML | Clayey silt, moderate brown to dark yellowish brown, mottled pale yellowish brown. | |
| 15 | | | 2 | 100 | BG | | | | |
| | | | | | | | | Clayey silt, light brown to reddish brown, stiff, dry. | |
| 20 | | | | | | | | Clayey silt, moderate brown, stiff. | |
| 25 | | | 3 | 100 | BG | | | | |
| | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 1. | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



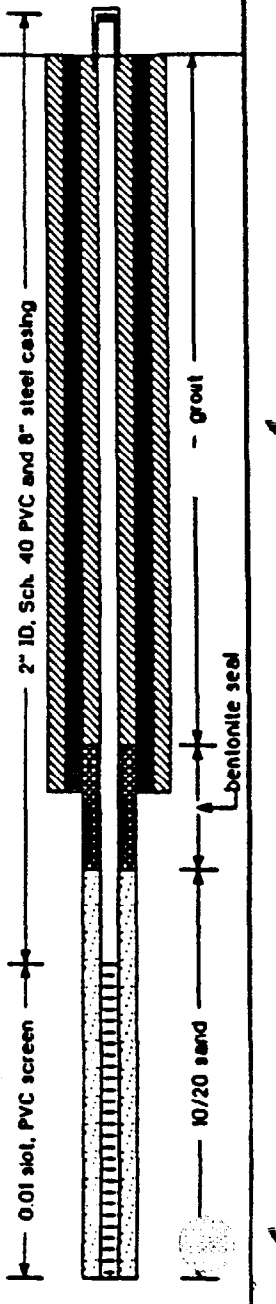
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-1UF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1015 on 2-07-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-07-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *40.0 feet* |
| Geologist: *Ben Brantley* | Well Screen: *29 to 39 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, grayish blue green, moist. | |
| 5 | | | 1 | 80 | BG | | | | |
| | | | | | | | | Clayey silt, moderate brown, medium stiff. | |
| 10 | | | | | | | | | |
| | | | | | | | ML | Clayey silt, moderate brown to dark yellowish brown, mottled pale yellowish brown. | |
| 15 | | | 2 | 100 | BG | | | | |
| | | | | | | | | Clayey silt, light brown to reddish brown, stiff, dry. | |
| 20 | | | | | | | | Clayey silt, moderate brown, stiff. | |
| 25 | | | 3 | 100 | BG | | | | |
| | | | | | | | | Clayey sand, fine to medium, dark yellowish brown to light brown. | |
| 30 | | | | | | | SC | | |
| 35 | | | 4 | 95 | BG | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM





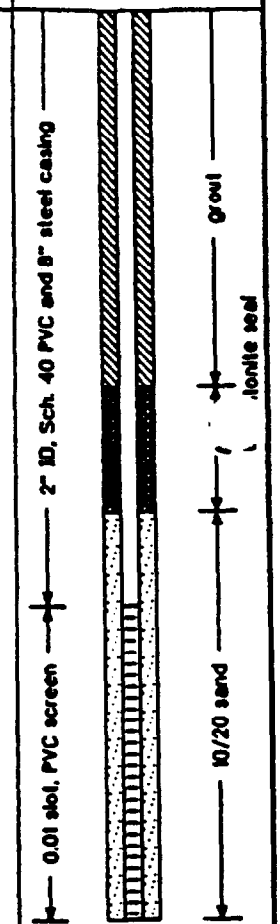

000422

**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-ILF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1015 on 2-07-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-07-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *70 feet* |
| Geologist: *Ben Brantley* | Well Screen: *59 to 69 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| 45, 50 | | | | | | | SC | | | |
| 55, 60, 65 | | | 5 | 90 | BG | | GP | Gravelly sand, coarse, grayish orange to yellowish orange. | | |
| 70, 75, 80 | | | 6 | 87 | BG | | | Log information taken from the boring for the Cockfield well at SWMU#7 site L | | |






000423

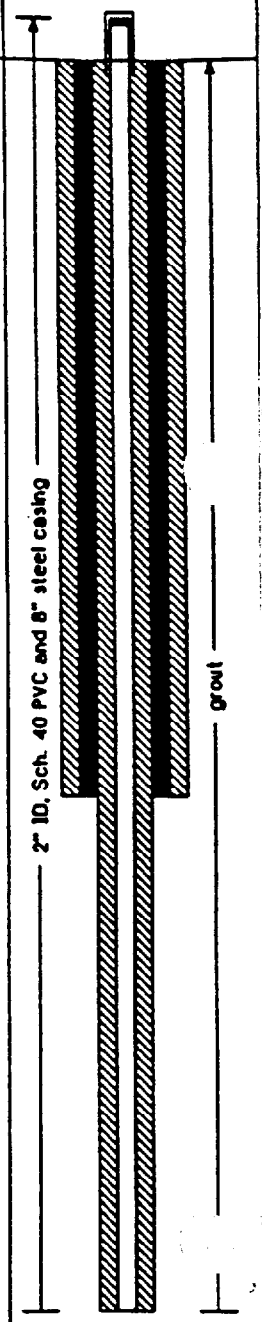
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-1UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1015 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 110.0 feet |
| Geologist: Ben Brantley | Well Screen: 97 to 107 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | 146 | | | Clayey silt, grayish blue green, moist. | |
| | | | 2 | | 89.4 | | | | |
| 5 | | | 3 | 80 | 55 | | | | |
| | | | 4 | | 9.1 | | | Clayey silt, moderate brown, medium stiff. | |
| 10 | | | 5 | | 6.3 | | | | |
| | | | 6 | | 2.9 | | ML | Clayey silt, moderate brown to dark yellowish brown, mottled pale yellowish brown. | |
| | | | 8 | | 24.8 | | | | |
| 15 | | | 9 | 100 | 12.3 | | | Clayey silt, light brown to reddish brown, stiff, dry. | |
| | | | 10 | | 0.3 | | | | |
| 20 | | | 11 | | BG | | | Clayey silt, moderate brown, stiff. | |
| | | | 12 | | BG | | | | |
| 25 | | | 13 | 100 | BG | | | Clayey sand, fine to medium, dark yellowish brown to light brown. | |
| | | | 14 | | BG | | | | |
| | | | 15 | | BG | | | | |
| 30 | | | 16 | | BG | | | | |
| | | | 17 | | BG | | SC | | |
| 35 | | | 18 | 95 | BG | | | | |
| | | | 19 | | BG | | | | |
| | | | 20 | | BG | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM





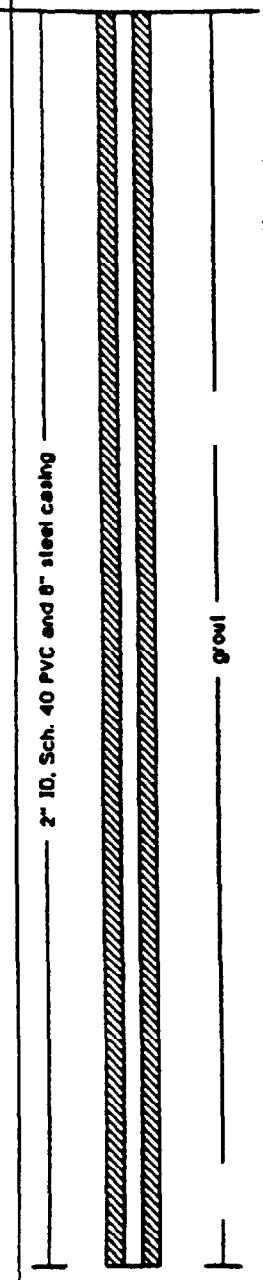

000424

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-1UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1015 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 100.0 feet |
| Geologist: Ben Brantley | Well Screen: 97 to 107 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21 | | BG | | | | | |
| | | | 22 | | BG | | | | | |
| 45 | | | 23 | | BG | | | | | |
| | | | 24 | | BG | | SC | | | |
| | | | 25 | | BG | | | | | |
| 50 | | | 26 | | BG | | | | | |
| | | | 27 | | BG | | | Gravelly sand, coarse, grayish orange to yellowish orange. | | |
| 55 | | | 28 | 90 | BG | | | | | |
| | | | 29 | | 0.8 | | | | | |
| | | | 30 | | | | | | | |
| 60 | | | 31 | | 1.0 | | GP | | | |
| | | | 32 | | 0.8 | | | | | |
| 65 | | | 33 | | 0.8 | | | | | |
| | | | 34 | | 0.8 | | | | | |
| | | | 35 | | BG | | | Sand clayey, fine, pale yellowish orange to moderate orange. | | |
| 70 | | | 36 | | BG | | | Silty clayey sand, fine, medium gray to olive gray, contains marcasite nodules. | | |
| | | | 37 | | BG | | | | | |
| 75 | | | 38 | 87 | BG | | SC | Sand, fine, yellowish gray to light gray, lignite at 79.5'. | | |
| | | | 39 | | BG | | | | | |
| | | | 40 | | BG | | | | | |
| 80 | | | | | | | | | | |






000425

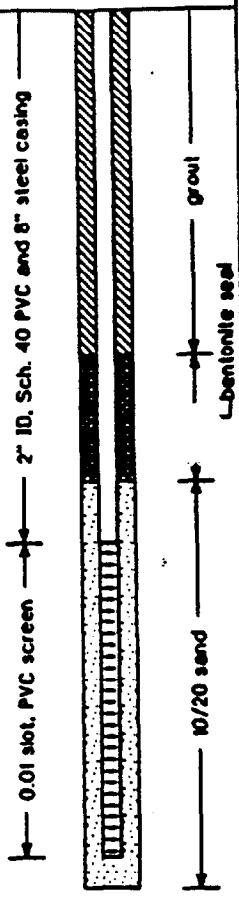
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-1UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1015 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 110.0 feet |
| Geologist: Ben Brantley | Well Screen: 97 to 107 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 41 | | BG | | | Sand, fine, medium gray to olive gray, micaceous. | |
| | | | 42 | | BG | | | | |
| 85 | | | 43 | | BG | | | Sand, fine, light olive gray to gray with dusky brown clay lenses. | |
| | | | 44 | | BG | | | | |
| | | | 45 | | BG | | | | |
| 90 | | | 46 | | BG | | | | |
| | | | 47 | | BG | | SC | | |
| 95 | | | 48 | 110 | BG | | | | |
| | | | 49 | | BG | | | | |
| | | | 50 | | BG | | | Same as above but increasing amounts of clay from 99' to 105'. | |
| 100 | | | 51 | | BG | | | | |
| | | | 53 | | BG | | | | |
| 105 | | | 54 | | BG | | | | |
| | | | 55 | | BG | | CL | Clay, waxy, dusky brown, hard, has olive gray sand lenses. | |
| | | | 56 | | BG | | | | |
| 110 | | | 57 | 100 | | | | End of boring at 110'. | |
| 115 | | | | | | | | | |
| 120 | | | | | | | | | |

**WELL DIAGRAM**






000426

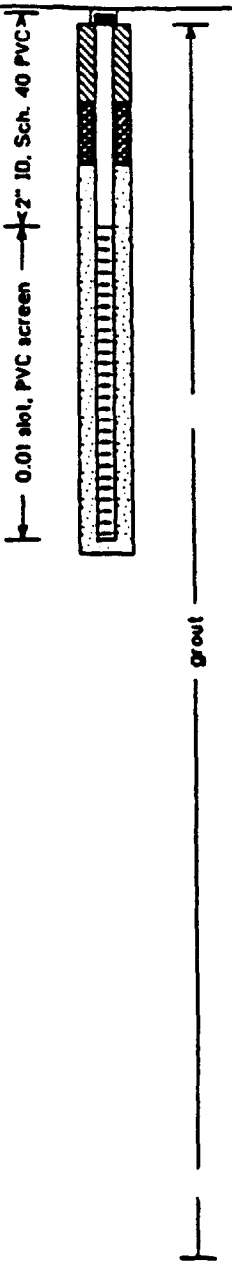
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-2S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU17 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.0 feet |
| Geologist: Ben Brantley | Well Screen: to feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | | Clayey silt, grayish green with dark yellow brown. | |
| 5 | X | | 1 | 90 | BG | | | | |
| 10 | X | | | | | | ML | Clayey silt, dark yellowish brown to light olive gray. | |
| 15 | X | | 2 | 100 | BG | | | Clayey silt, dark yellowish orange to light brown, medium stiff, dry. | |
| 20 | X | | 3 | 100 | BG | | | Clayey silt, moderate brown with organics. End of boring at 20'. | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM






000427

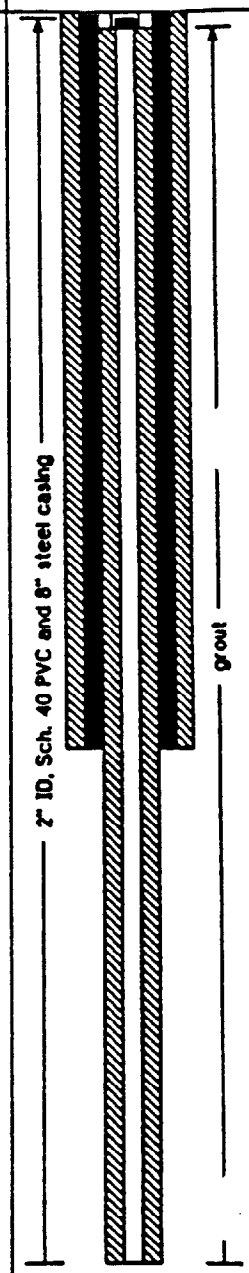
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-2UC

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU17 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1150 on 2-07-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-07-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *125.0 feet* |
| Geologist: *Ben Brantley* | Well Screen: *106 to 116 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | BG | | ML | Clayey silt, grayish green with dark yellow brown. | |
| | | | 2 | | BG | | | | |
| 5 | | | | 90 | | | | | |
| | | | 3 | | BG | | | | |
| | | | 4 | | 41.9 | | | | |
| 10 | | | 5 | | 20.0 | | | | |
| | | | 6 | | BG | | | Clayey silt, dark yellowish brown to light olive gray. | |
| 15 | | | 7 | 100 | BG | | | | |
| | | | 8 | | BG | | | Clayey silt, dark yellowish orange to light brown, medium stiff, dry. | |
| | | | 9 | | BG | | | | |
| 20 | | | 10 | 100 | BG | | | Clayey silt, moderate brown with organics. | |
| | | | 11 | | BG | | | | |
| | | | 12 | | 33.4 | | | | |
| 25 | | | | 100 | | | GM | Sandy clay, moderate reddish to light brown, medium stiff, fine. | |
| | | | 13 | | BG | | | | |
| | | | 14 | | BG | | | | |
| 30 | | | 15 | | BG | | | Silty clayey sand, medium, brown to yellowish orange, a few small gravels. | |
| | | | 16 | | BG | | | | |
| 35 | | | 17 | 80 | BG | | | | |
| | | | 18 | | BG | | | | |
| | | | 19 | | BG | | GP | Sand, medium, yellowish gray to grayish orange, micaceous. | |
| 40 | | | | | | | | | |

WELL DIAGRAM





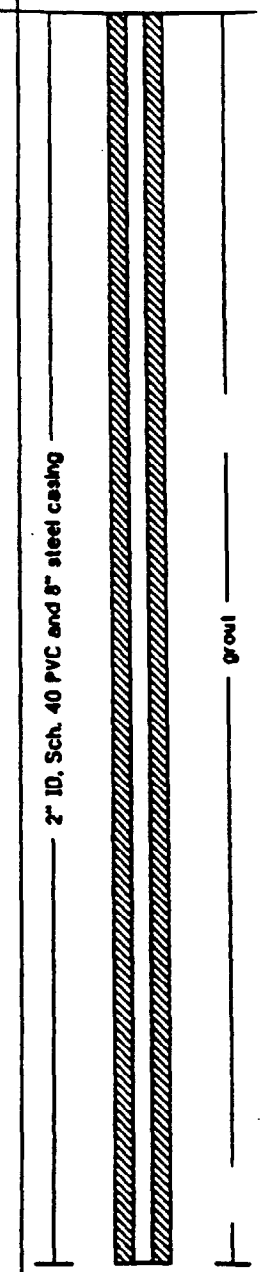

000428

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-2UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1150 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 125.0 feet |
| Geologist: Ben Brantley | Well Screen: 106 to 116 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | | BG | | | | | |
| | | | 21 | | BG | | | | | |
| 45 | | | 22 | | BG | | | | | |
| | | | 23 | | BG | | | | | |
| | | | 24 | | BG | | | Sand, coarse, gravelly, grayish orange to dark yellowish orange, gravels up to 2" in diameter. | | |
| 50 | | | 25 | | BG | | | | | |
| | | | 26 | | BG | | | | | |
| 55 | | | 27 | 87 | BG | | | | | |
| | | | 28 | | BG | | | | | |
| | | | 29 | | BG | | | | | |
| 60 | | | 30 | | BG | | GP | | | |
| | | | 31 | | BG | | | | | |
| 65 | | | 32 | | BG | | | | | |
| | | | 33 | | BG | | | | | |
| | | | 34 | | BG | | | | | |
| 70 | | | 35 | | BG | | | | | |
| | | | 36 | | BG | | | | | |
| 75 | | | 37 | 90 | BG | | | Sand, fine, light gray to pale yellowish orange, with light gray clay lenses. | | |
| 80 | | | | | | | | | | |



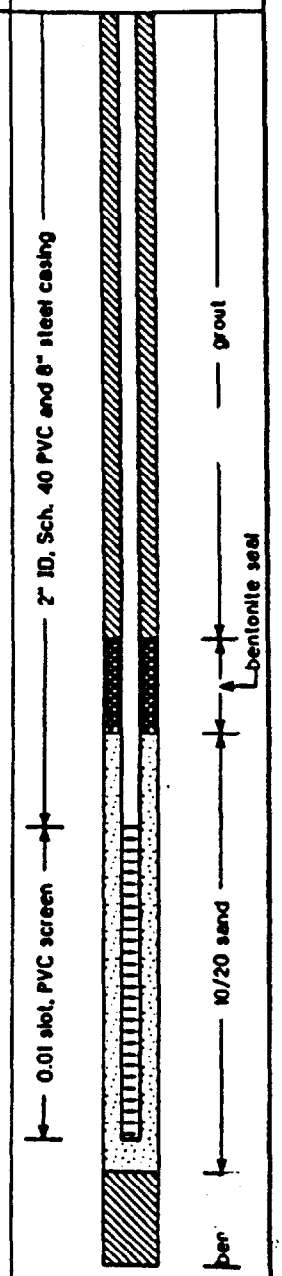
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-2UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1150 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 125.0 feet |
| Geologist: Ben Brantley | Well Screen: 106 to 116 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | GP | | |
| | | | | | | | | Silty sand, fine, light olive gray to grayish brown, conatains dusky brown clay lenses. | |
| 85 | | | | | | | | | |
| 90 | | | | | | | | | |
| 95 | | | 47 | 90 | BG | | | Lignite laminations from 94'-95'. | |
| | | | | | | | | Marcasite present at 98'. | |
| | | | | | | | SM | | |
| 100 | | | | | | | | | |
| 105 | | | | | | | | | |
| 110 | | | | | | | | | |
| 115 | | | 9 | 95 | BG | | | | |
| | | | | | | | OL | Clay, dusky brown, hard, wary, with thin sand laminations. | |
| 120 | | | | | | | | | |

WELL DIAGRAM






000430

**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-2UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1150 on 2-07-95 | TOC Elevation: feet msl |
| Completed at on 2-07-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 125.0 feet |
| Geologist: Ben Brantley | Well Screen: 106 to 116 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | OL | | | bentonite |
| 125 | | | 10 | 90 | BG | | | End of boring at 125'. | | |
| 130 | | | | | | | | | | |
| 135 | | | | | | | | | | |
| 140 | | | | | | | | | | |
| 145 | | | | | | | | | | |
| 150 | | | | | | | | | | |
| 155 | | | | | | | | | | |
| 160 | | | | | | | | | | |

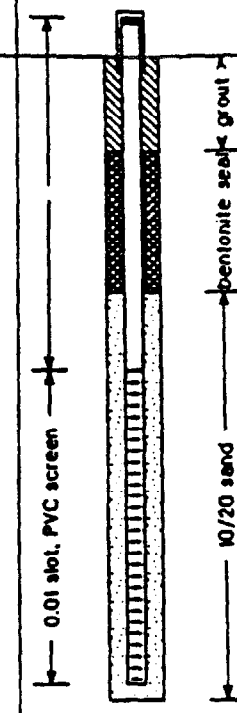
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-3S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-26 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-96 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.0 feet |
| Geologist: Ben Brantley | Well Screen: 10 to 20 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown to moderate yellowish brown, moist. | |
| 5 | | | 1 | 40 | BG | | | | |
| 10 | | | 2 | 120 | BG | | ML | | |
| 15 | | | 3 | 100 | BG | | | Clayey silt, olive black, moist, soft. | |
| 20 | | | 4 | 90 | BG | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 3. | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM






000432

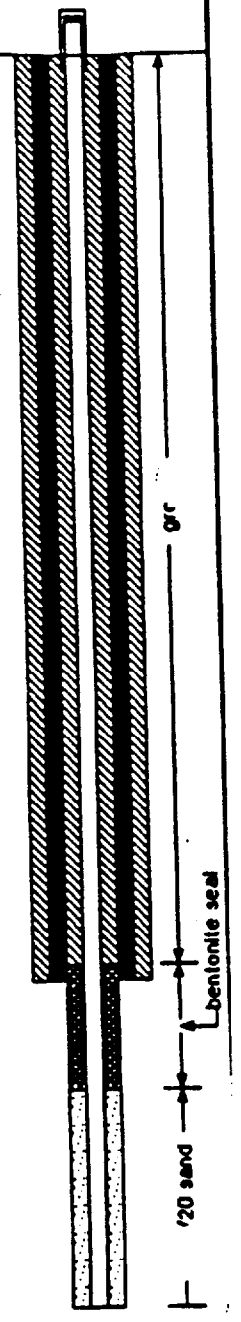
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-3UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-95 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 45.0 feet |
| Geologist: Ben Brantley | Well Screen: to feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown to moderate yellowish brown, moist. | |
| 5 | | | 1 | 40 | BG | | | | |
| 10 | | | 2 | 120 | BG | | | | |
| 15 | | | 3 | 100 | BG | | ML | Clayey silt, olive black, moist, soft. | |
| 20 | | | 4 | 90 | BG | | | Clayey silt, dark yellowish brown, medium stiff. | |
| 25 | | | 5 | 90 | BG | | | Clayey silt, moderate brown with yellow gray silt, organics. | |
| 30 | | | 6 | 100 | BG | | | Clayey silt with sand, moderate brown. | |
| | | | | | | | | Silty clayey sand, yellowish orange to yellowish brown. | |
| 35 | | | 7 | 100 | BG | | SC | Silty sand, yellowish orange to reddish brown, fine to medium grained. | |
| 40 | | | 8 | 120 | BG | | | | |

WELL DIAGRAM



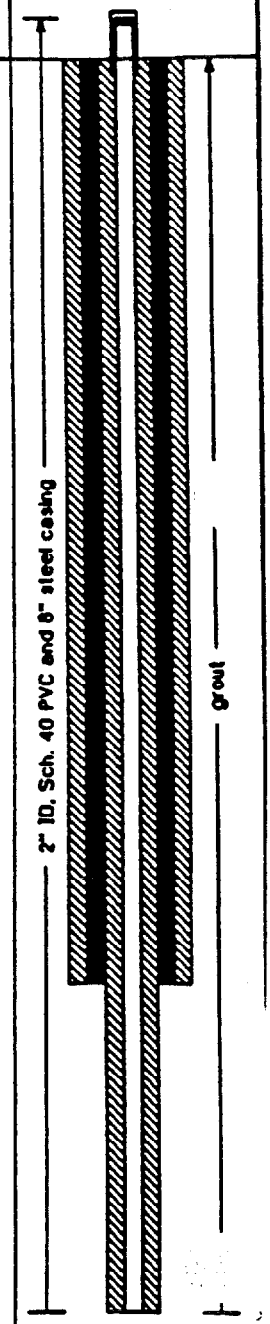
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-3LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-95 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 80.0 feet |
| Geologist: Ben Brantley | Well Screen: 69.5 to 79.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown to moderate yellowish brown, moist. | |
| 5 | | | 1 | 40 | BG | | | | |
| 10 | | | 2 | 120 | BG | | | | |
| 15 | | | 3 | 100 | BG | | ML | Clayey silt, olive black, moist, soft. | |
| 20 | | | 4 | 90 | BG | | | Clayey silt, dark yellowish brown, medium stiff. | |
| 25 | | | 5 | 90 | BG | | | Clayey silt, moderate brown with yellow gray silt, organics. | |
| 30 | | | 6 | 100 | BG | | | Clayey silt with sand, moderate brown. | |
| | | | | | | | | Silty clayey sand, yellowish orange to yellowish brown. | |
| 35 | | | 7 | 100 | BG | | SC | Silty sand, yellowish orange to reddish brown, fine to medium grained. | |
| 40 | | | 8 | 120 | BG | | | | |

WELL DIAGRAM






000434

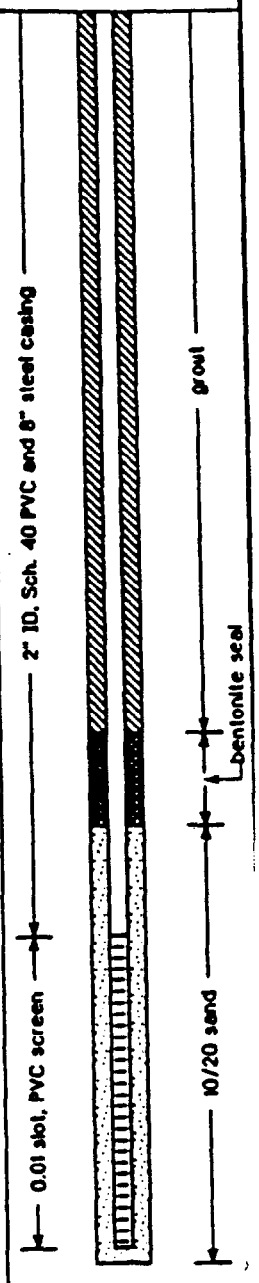
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-3LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-96 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 80.0 feet |
| Geologist: Ben Brantley | Well Screen: 69.5 to 79.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SC | | |
| | | | | | | | | Sand, yellowish gray, fine. | |
| | | | | | | | | Sand, medium, yellowish orange to yellowish brown. | |
| 45 | | | 9 | 120 | BG | | | Sand, medium to coarse, grayish orange to yellow gray, with gravels. | |
| 50 | | | | | | | | | |
| 55 | | | 10 | 75 | BG | | | | |
| 60 | | | | | | | GP | | |
| 65 | | | 11 | 80 | BG | | | | |
| 70 | | | | | | | | | |
| 75 | | | 12 | 80 | BG | | | | |
| | | | | | | | SC | Silty sand, fine, yellowish orange to yellow gray. | |
| 80 | | | | | | | | | |

WELL DIAGRAM






000435

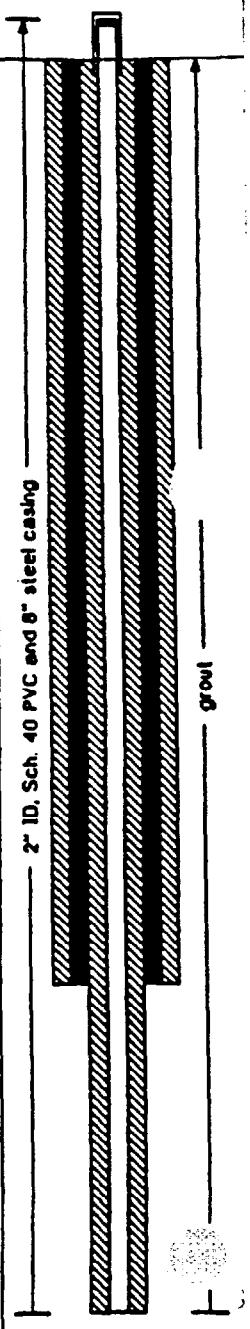
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-3UC

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1630 on 2-07-95* | TOC Elevation: *feet msl* |
| Completed at *1500 on 2-14-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *115.0 feet* |
| Geologist: *Ben Brantley* | Well Screen: *97 to 107 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | BG | | | Clayey silt, moderate brown to moderate yellowish brown, moist. | |
| | | | 2 | | BG | | | | |
| 5 | | | | 40 | | | | | |
| | | | 3 | | BG | | | | |
| | | | 4 | | BG | | | | |
| 10 | | | 5 | 120 | BG | | | | |
| | | | 6 | | BG | | | | |
| | | | 7 | | BG | | | | |
| 15 | | | | 100 | | | ML | Clayey silt, olive black, moist, soft. | |
| | | | 9 | | BG | | | | |
| | | | 10 | | BG | | | | |
| 20 | | | 11 | 90 | BG | | | Clayey silt, dark yellowish brown, medium stiff. | |
| | | | 12 | | BG | | | | |
| | | | 13 | | BG | | | | |
| 25 | | | | 90 | | | | Clayey silt, moderate brown with yellow gray silt, organics. | |
| | | | 14 | | BG | | | | |
| | | | 15 | | BG | | | | |
| 30 | | | 16 | 100 | BG | | | Clayey silt with sand, moderate brown. | |
| | | | 17 | | BG | | | Silty clayey sand, yellowish orange to yellowish brown. | |
| | | | 18 | | BG | | | | |
| 35 | | | | 100 | | | SC | Silty sand, yellowish orange to reddish brown, fine to medium grained. | |
| | | | 19 | | BG | | | | |
| | | | 20 | | BG | | | | |
| 40 | | | 21 | 120 | BG | | | | |

WELL DIAGRAM





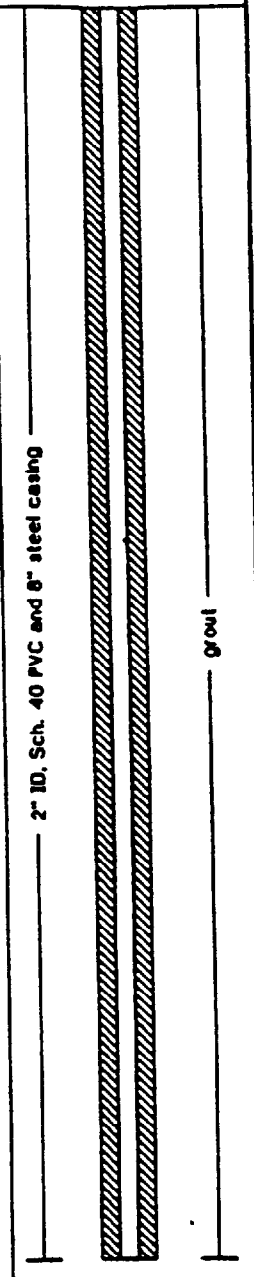

000436

**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-3UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-95 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 115.0 feet |
| Geologist: Ben Brantley | Well Screen: 97 to 107 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 22 | | 0.2 | | SC | | | |
| | | | 23 | | 0.2 | | GP | Sand, yellowish gray, fine. Sand, medium, yellowish orange to yellowish brown. | | |
| 45 | | | 24 | 120 | BG | | | Sand, medium to coarse, grayish orange to yellow gray, with gravels. | | |
| | | | 25 | | 0.2 | | | | | |
| | | | 26 | | 0.2 | | | | | |
| 50 | | | 27 | | 0.2 | | | | | |
| | | | 28 | | BG | | | | | |
| 55 | | | 29 | 75 | BG | | | | | |
| | | | 30 | | BG | | | | | |
| | | | 31 | | BG | | | | | |
| 60 | | | 32 | | BG | | | | | |
| | | | 33 | | BG | | | | | |
| 65 | | | 34 | 80 | BG | | | | | |
| | | | 35 | | BG | | | | | |
| | | | 36 | | BG | | | | | |
| 70 | | | 37 | | BG | | | | | |
| | | | 38 | | 0.2 | | | | | |
| 75 | | | 39 | 80 | 0.2 | | | | | |
| | | | 40 | | BG | | | | | |
| | | | 41 | | BG | | SC | Silty sand, fine, yellowish orange to yellow gray. | | |
| 80 | | | | | | | CL | | | |






000437

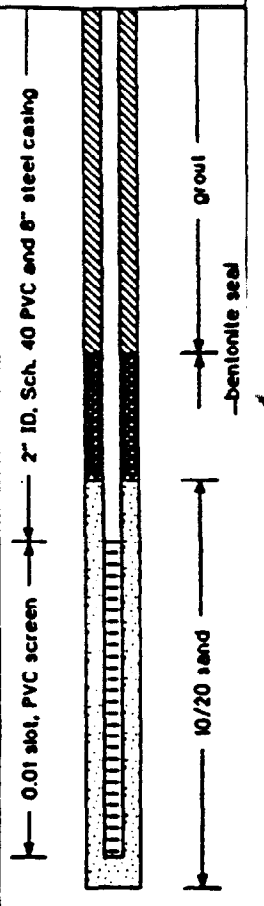
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-3UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1630 on 2-07-95 | TOC Elevation: feet msl |
| Completed at 1500 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 115.0 feet |
| Geologist: Ben Brantley | Well Screen: 97 to 107 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 42 | | BG | | | Clay, dusky brown to olive gray, with light gray sand. | |
| | | | 43 | | BG | | | | |
| 85 | | | 44 | 105 | BG | | | | |
| | | | 45 | | BG | | | | |
| | | | 46 | | BG | | | | |
| 90 | | | 47 | | BG | | | Lignitic from 91'-93'. | |
| | | | 48 | | BG | | | | |
| 95 | | | 49 | 105 | BG | | | | |
| | | | 50 | | BG | | CL | | |
| | | | 51 | | BG | | | | |
| 100 | | | 52 | | BG | | | | |
| | | | 53 | | BG | | | | |
| 105 | | | 54 | 100 | BG | | | Clay, dusky brown, waxy, contains less sand. | |
| | | | 55 | | BG | | | | |
| | | | 56 | | BG | | | | |
| 110 | | | 57 | | BG | | | | |
| | | | 58 | | BG | | | | |
| 115 | | | 59 | 110 | BG | | | End of boring at 115'. | |
| 120 | | | | | | | | | |

WELL DIAGRAM






000438

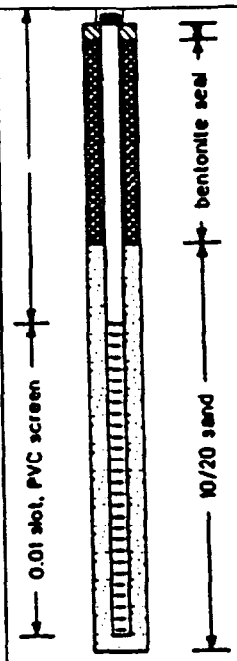
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.0 feet |
| Geologist: Jack Carmichael | Well Screen: 10 to 20 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | | Clayey silt, moderate brown, stiff. | |
| 5 | X | | 1 | 82.5 | BG | | | | |
| 10 | X | | 2 | 50 | BG | | ML | | |
| 15 | X | | 3 | 60 | BG | | | Clayey silt, dark yellow brown, medium stiff, moist. | |
| | | | | | | | | Clayey silt, moderate yellow with reddish brown, hard. | |
| 20 | X | | 4 | 80 | BG | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 4. | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM






000439

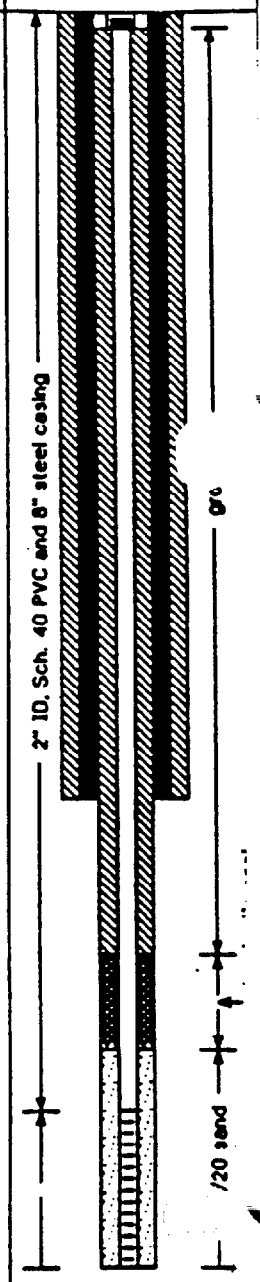
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-4UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU07 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 45.0 feet |
| Geologist: Jack Carmichael | Well Screen: 35 to 45 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown, stiff. | |
| 5 | | | 1 | 62.5 | BG | | | | |
| 10 | | | 2 | 50 | BG | | | | |
| | | | | | | | ML | | |
| 15 | | | 3 | 60 | BG | | | Clayey silt, dark yellow brown, medium stiff, moist.. | |
| | | | | | | | | Clayey silt, moderate yellow with reddish brown, hard. | |
| 20 | | | 4 | 80 | BG | | | | |
| 25 | | | 5 | 80 | BG | | | Clay, silty, trace sand, very fine, moderate reddish brown, stiff. | |
| | | | | | | | | Sand, clayey, silty, finely micaceous, moderate reddish orange to moderate reddish brown. | |
| 30 | | | | | | | | | |
| | | | | | | | SC | | |
| 35 | | | 6 | 110 | BG | | | Sand, very fine to fine, silty, clayey, laminated, small clay casts, pale orange to moderate red. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-96 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 45.0 feet |
| Geologist: Jack Carmichael | Well Screen: 35 to 45 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | SC | Sand, very fine to fine, silty, some clay, dark yellowish orange to grayish orange, wet. | | 10/20 sand |
| 45 | | | 7 | 105 | 86 | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 4. | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |



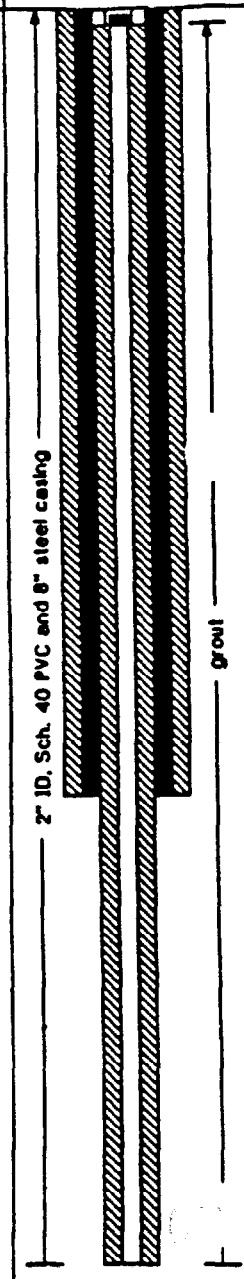
000441

**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-96 | TOC Elevation: feet msl |
| Completed at 0910 on 2-15-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 70.0 feet |
| Geologist: Jack Carmichael | Well Screen: 60 to 70 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown, stiff. | | |
| 5 | | | 1 | 62.5 | BG | | | | | |
| 10 | | | 2 | 50 | BG | | | | | |
| | | | | | | | ML | | | |
| 15 | | | 3 | 60 | BG | | | Clayey silt, dark yellow brown, medium stiff, moist.. | | |
| | | | | | | | | Clayey silt, moderate yellow with reddish brown, hard. | | |
| 20 | | | 4 | 80 | BG | | | | | |
| 25 | | | 5 | 80 | BG | | | Clay, silty, trace sand, very fine, moderate reddish brown, stiff. | | |
| | | | | | | | | Sand, clayey, silty, finely micaceous, moderate reddish orange to moderate reddish brown. | | |
| 30 | | | | | | | | | | |
| | | | | | | | SC | | | |
| 35 | | | 6 | 110 | BG | | | Sand, very fine to fine, silty, clayey, laminated, small clay casts, pale orange to moderate red. | | |
| 40 | | | | | | | | | | |






000442

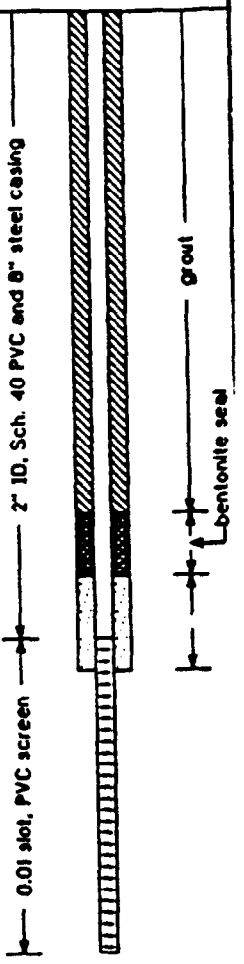
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 70.0 feet |
| Geologist: Jack Carmichael | Well Screen: 60 to 70 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SC | Sand, very fine to fine, silty, some clay, dark yellowish orange to grayish orange, wet. | |
| 45 | | | 7 | 105 | BG | | | Sand, gravelly, clay balls, grayish orange to moderate yellowish brown. | |
| 50 | | | | | | | | | |
| 55 | | | 8 | 100 | BG | | GP | Sand with gravel, fine to coarse, grayish orange to moderate yellowish brown, wet. | |
| 60 | | | | | | | | | |
| 65 | | | 9 | 100 | BG | | | Gravel, sandy, moderate yellowish brown to dark yellowish orange. | |
| 70 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 4. | |
| 75 | | | 10 | 100 | BG | | | | |
| 80 | | | | | | | | | |

WELL DIAGRAM



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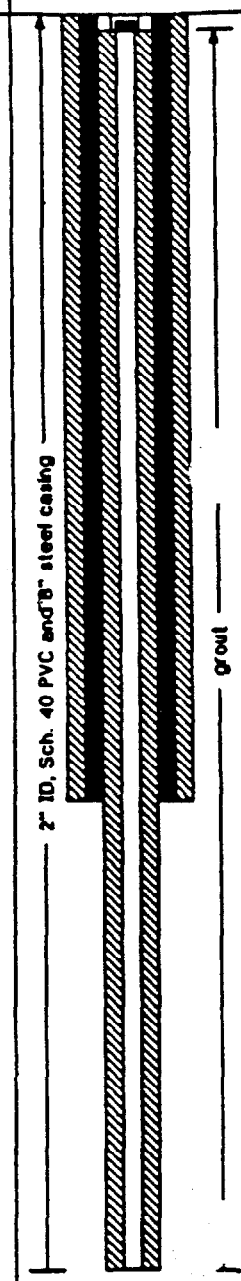
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-96 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 145.0 feet |
| Geologist: Jack Carmichael | Well Screen: 128 to 138 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | BG | | | Clayey silt, moderate brown, stiff. | |
| | | | 2 | | BG | | | | |
| 5 | | | 3 | 62.5 | BG | | | | |
| | | | 4 | | BG | | | | |
| | | | 5 | | BG | | | | |
| 10 | | | 6 | 50 | BG | | | | |
| | | | 7 | | BG | | | | |
| | | | 8 | | BG | | ML | | |
| 15 | | | 9 | 60 | BG | | | Clayey silt, dark yellow brown, medium stiff, moist. | |
| | | | 10 | | BG | | | Clayey silt, moderate yellow with reddish brown, hard. | |
| 20 | | | 11 | 80 | BG | | | | |
| | | | 12 | | BG | | | | |
| 25 | | | 13 | 80 | BG | | | Clay, silty, trace sand, very fine, moderate reddish brown, stiff. | |
| | | | 14 | | BG | | | Sand, clayey, silty, finely micaceous, moderate reddish orange to moderate reddish brown. | |
| | | | 15 | | BG | | | | |
| 30 | | | 16 | | BG | | | | |
| | | | 17 | | BG | | SC | | |
| 35 | | | 18 | 110 | BG | | | Sand, very fine to fine, silty, clayey, laminated, small clay casts, pale orange to moderate red. | |
| | | | 19 | | BG | | | | |
| 40 | | | 20 | | BG | | | | |

WELL DIAGRAM






000444

**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-4MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 145.0 feet |
| Geologist: Jack Carmichael | Well Screen: 128 to 138 feet |

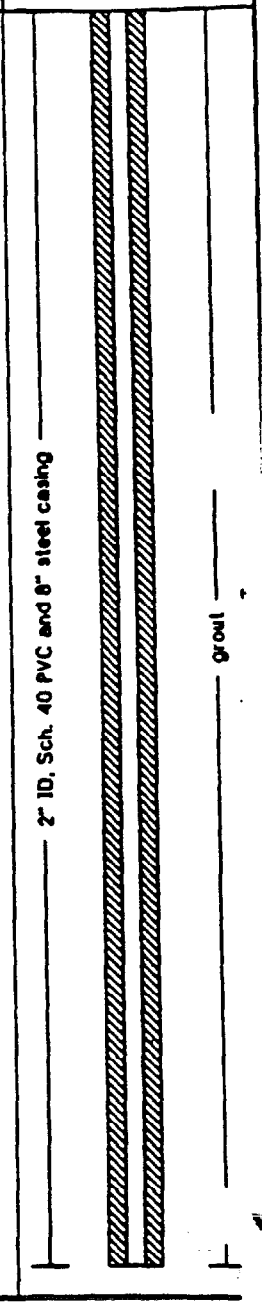
| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21 | | BG | | SC | Sand, very fine to fine, silty, some clay, dark yellowish orange to grayish orange, wet. | | 2" ID, Sch. 40 PVC and 8" steel casing; grout |
| | | | 22 | | BG | | | | | |
| 45 | | | 23 | 105 | BG | | GP | Sand, gravelly, clay balls, grayish orange to moderate yellowish brown. | | |
| | | | 24 | | BG | | | | | |
| | | | 25 | | BG | | | | | |
| 50 | | | 26 | | BG | | | | | |
| | | | 27 | | BG | | | | | |
| 55 | | | 28 | 100 | BG | | | Sand with gravel, fine to coarse, grayish orange to moderate yellowish brown, wet. | | |
| | | | 29 | | BG | | | | | |
| | | | 30 | | BG | | | | | |
| 60 | | | 31 | | BG | | | | | |
| | | | 32 | | BG | | | | | |
| 65 | | | 33 | 100 | BG | | | Gravel, sandy, moderate yellowish brown to dark yellowish orange. | | |
| | | | 34 | | BG | | | | | |
| | | | 35 | | BG | | | | | |
| 70 | | | 36 | | BG | | SC | Sand, very fine to fine, silty, clayey, laminated, light brownish gray to grayish brown, stiff, micaceous, moist. | | |
| | | | 37 | | BG | | | | | |
| 75 | | | 38 | 100 | BG | | | Sand, very fine to fine with clay streaks, pale orange to yellowish gray stained dark yellowish orange. | | |
| | | | 39 | | BG | | | | | |
| 80 | | | 40 | | BG | | | | | |

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-4MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 145.0 feet |
| Geologist: Jack Carmichael | Well Screen: 128 to 138 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 41 | | BG | | | | | |
| | | | 42 | | BG | | | Sand, very fine to fine, with clay streaks, yellowish gray to very pale orange, stained dark yellowish orange, very wet. | | |
| 85 | | | 43 | 100 | BG | | | | | |
| | | | 44 | | BG | | | Sand, very fine to fine, clayey, laminated, pale brown to moderate brown, wet. | | |
| | | | 45 | | BG | | | Sand, very fine to fine, laminated, medium gray to grayish brown, with occassional lignite chips. | | |
| 90 | | | 46 | | BG | | | | | |
| | | | 47 | | BG | | | | | |
| 95 | | | 48 | 100 | BG | | | | | |
| | | | 49 | | BG | | | | | |
| | | | 50 | | BG | | | | | |
| 100 | | | 51 | | BG | | SC | | | |
| | | | 52 | | BG | | | | | |
| 105 | | | 53 | | BG | | | | | |
| | | | 54 | 109 | BG | | | | | |
| | | | 55 | | BG | | | | | |
| 110 | | | 56 | | BG | | | | | |
| | | | 57 | | BG | | | | | |
| 115 | | | 58 | 100 | BG | | | Sand, very fine to fine, clayey with lignitic chips, light brownish gray to grayish brown, clayey zones are stiff, wet. | | |
| | | | 59 | | BG | | | | | |
| | | | 60 | | BG | | | | | |
| 120 | | | | | | | | | | |






000446

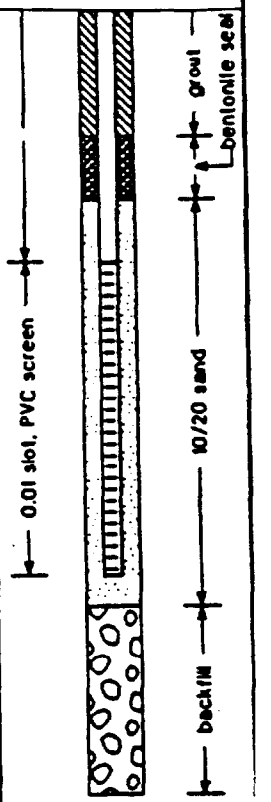
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-4MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 1-09-95 | TOC Elevation: feet msl |
| Completed at 0910 on 2-16-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 145.0 feet |
| Geologist: Jack Carmichael | Well Screen: 128 to 138 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | | BG | | | | |
| | | | 62 | | BG | | | | |
| 125 | | | 63 | 100 | BG | | | | |
| | | | 64 | | BG | | | | |
| | | | 65 | | BG | | | | |
| 130 | | | 66 | | BG | | SC | | |
| | | | 67 | | BG | | | | |
| 135 | | | 68 | 120 | BG | | | Sand, very fine to fine, lignitic, light brownish gray to grayish brown, cohesive in clayey zones, wet. | |
| | | | 69 | | BG | | | | |
| | | | 70 | | BG | | | Lignitic, dusky brown, hard. | |
| 140 | | | 71 | | BG | | CL | Clay, silty, traces of sand, laminated dark brownish gray, color changes below 141', stiff. | |
| | | | 72 | | BG | | | | |
| 145 | | | 73 | 100 | BG | | | End of boring at 145'. | |
| 150 | | | | | | | | | |
| 155 | | | | | | | | | |
| 160 | | | | | | | | | |

WELL DIAGRAM






000447

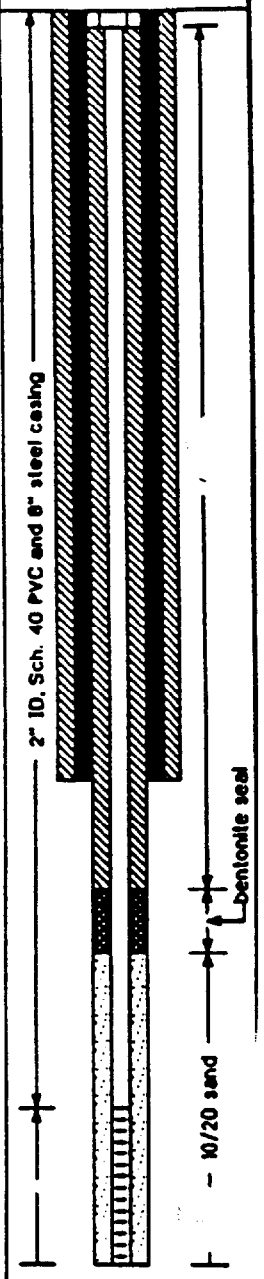
**EnSafe**
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-UF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-28* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *on 1-09-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-21-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *45.0 feet* |
| Geologist: *Jack Carmichael* | Well Screen: *35 to 45 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown to yellowish brown, trace of organics. | |
| 5 | | | 1 | 75 | BG | | | | |
| 10 | | | 2 | 60 | BG | | | | |
| 15 | | | 3 | 100 | BG | | ML | Clayey silt, dark yellowish brown, stiff, hard. | |
| 20 | | | 4 | 90 | BG | | | | |
| 25 | | | | | | | | | |
| 30 | | | 5 | 90 | BG | | | | |
| 35 | | | 6 | 90 | BG | | SC | Sandy clay, fine, medium light brown, soft, wet. Silty sand, medium, light brown, grayish orange to yellow gray. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



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**EnSafe®**
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at on 1-09-95 | TOC Elevation: feet msl |
| Completed at on 2-21-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 45.0 feet |
| Geologist: Jack Carmichael | Well Screen: 35 to 45 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | SC | Silty sand, medium, yellowish orange to light brown. | | 10/20 sand |
| 45 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 5. | | |
| 50 | | | | | | | | | | |
| 55 | | | 7 | 60 | 86 | | | | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

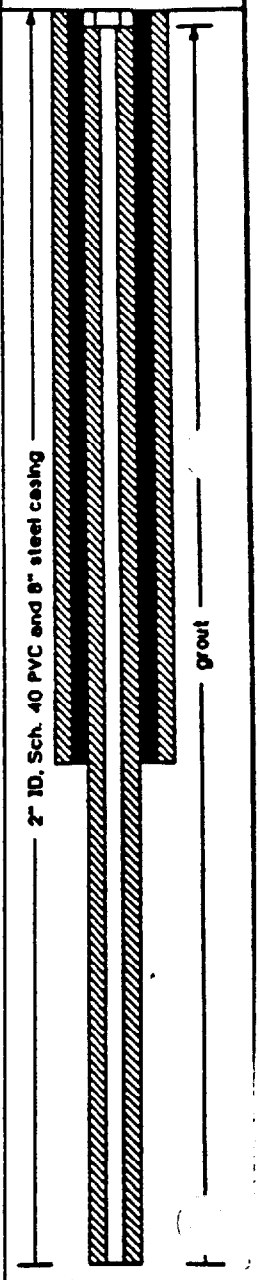
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-5LF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SHMU#7 - Building* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *on 1-09-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-21-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *76.0 feet* |
| Geologist: *Jack Carmichael* | Well Screen: *66 to 76 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown to yellowish brown, trace of organics. | |
| 5 | | | 1 | 75 | BG | | | | |
| 10 | | | 2 | 60 | BG | | | | |
| 15 | | | 3 | 100 | BG | | ML | Clayey silt, dark yellowish brown, stiff, hard. | |
| 20 | | | 4 | 90 | BG | | | | |
| 25 | | | | | | | | | |
| 30 | | | 5 | 90 | BG | | | | |
| 35 | | | 6 | 90 | BG | | SC | Sandy clay, fine, medium light brown, soft, wet. Silty sand, medium, light brown, grayish orange to yellow gray. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



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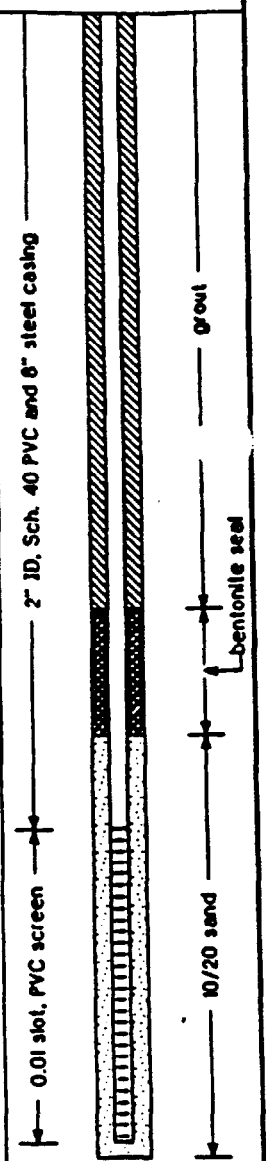
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-5LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at on 1-09-95 | TOC Elevation: feet msl |
| Completed at on 2-21-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 76.0 feet |
| Geologist: Jack Carmichael | Well Screen: 68 to 76 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | SC | Silty sand, medium, yellowish orange to light brown. | |
| 45 | | | | | | | | Sand, medium, micaceous, yellowish orange to light brown. | |
| 50 | | | | | | | | Sand, medium, grayish orange, micaceous. | |
| 55 | | | 7 | 60 | BG | | | | |
| 60 | | | | | | | GP | | |
| 65 | | | | | | | | Gravelly sand, coarse to very coarse, dark yellowish orange. | |
| 70 | | | | | | | | | |
| 75 | | | 8 | 87.5 | BG | | | | |
| | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 Site 5. | |
| 80 | | | | | | | | | |

WELL DIAGRAM



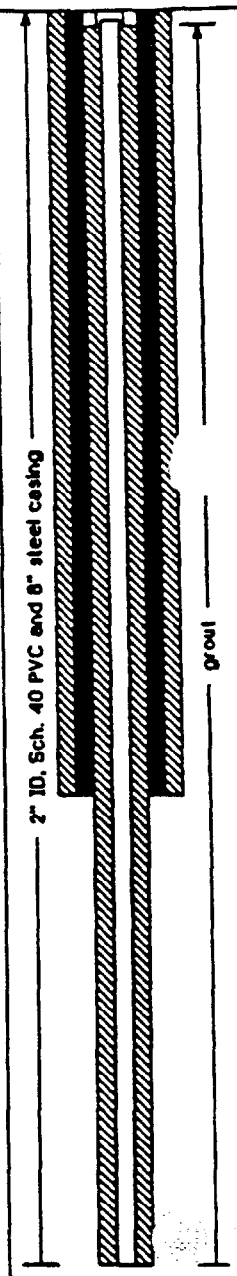
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-5UC

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Memphis, TN* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *on 1-09-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-21-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *135.0 feet* |
| Geologist: *Jack Carmichael* | Well Screen: *122 to 132 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | BG | | | Clayey silt, moderate brown to yellowish brown, trace of organics. | |
| | | | 2 | | BG | | | | |
| 5 | | | 3 | 75 | BG | | | | |
| | | | 4 | | BG | | | | |
| 10 | | | 5 | 60 | BG | | | | |
| | | | 6 | | BG | | | | |
| | | | 7 | | BG | | | | |
| 15 | | | 8 | 100 | BG | | ML | Clayey silt, dark yellowish brown, stiff, hard. | |
| | | | 9 | | BG | | | | |
| 20 | | | 10 | 90 | BG | | | | |
| | | | 11 | | BG | | | | |
| | | | 12 | | BG | | | | |
| 25 | | | 13 | | BG | | | | |
| | | | 14 | | BG | | | | |
| 30 | | | 15 | 90 | BG | | | | |
| | | | 16 | | BG | | | | |
| | | | 17 | | BG | | | Sandy clay, fine, medium light brown, soft, wet. | |
| 35 | | | 18 | 90 | BG | | SC | Silty sand, medium, light brown, grayish orange to yellow gray. | |
| | | | 19 | | BG | | | | |
| 40 | | | 20 | | BG | | | | |

WELL DIAGRAM



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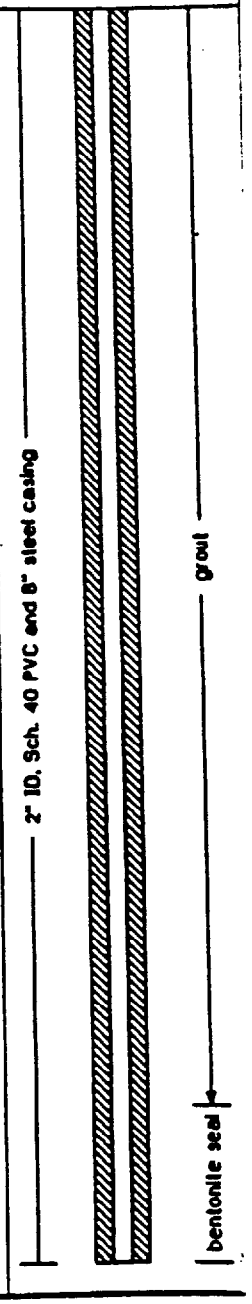
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-5UC

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Memphis, TN* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *on 1-09-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-21-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *135.0 feet* |
| Geologist: *Jack Carmichael* | Well Screen: *122 to 132 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 42 | | BG | | | | |
| | | | 43 | | BG | | | | |
| 85 | | | 44 | | BG | | | | |
| | | | 45 | | BG | | | | |
| 90 | | | 46 | | BG | | | | |
| | | | 47 | | BG | | | | |
| | | | 48 | | BG | | | | |
| 95 | | | | 80 | | | | | |
| | | | 49 | | BG | | | | |
| | | | 50 | | BG | | | | |
| 100 | | | 51 | | BG | | SC | Sand, fine, brownish gray with dark yellow brown clay lenses. | |
| | | | 52 | | BG | | | | |
| | | | 53 | | BG | | | | |
| 105 | | | 54 | | BG | | | | |
| | | | 56 | | BG | | | | |
| 110 | | | 57 | | BG | | | | |
| | | | 58 | | BG | | | | |
| | | | 59 | | BG | | | | |
| 115 | | | | 90 | | | | | |
| | | | 60 | | BG | | | | |
| | | | 61 | | BG | | | | |
| 120 | | | 62 | | BG | | | Clay, dusky brown, waxy, from 119' to 119.5'. Sand, fine, brownish gray with clay lenses described above. | |

WELL DIAGRAM



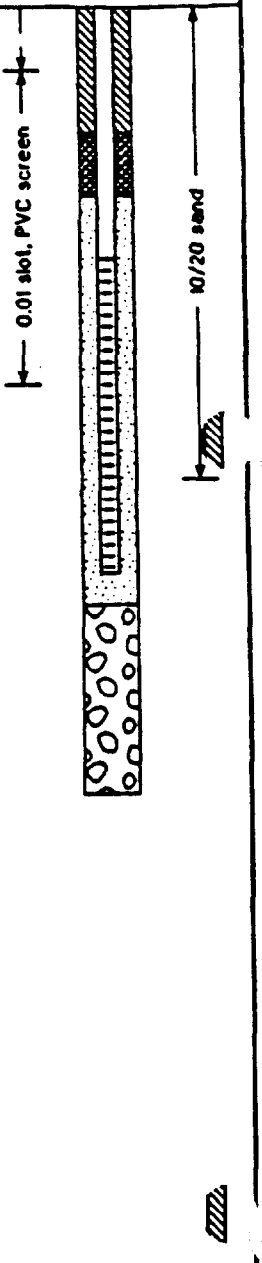
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-5UC

| | |
|---|---|
| Project: NAS Memphis | Location: Memphis, TN |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at on 1-09-95 | TOC Elevation: feet msl |
| Completed at on 2-21-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 135.0 feet |
| Geologist: Jack Carmichael | Well Screen: 122 to 132 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 63 | | BG | | | | |
| | | | 64 | | BG | | SC | | |
| 125 | | | 65 | | BG | | | | |
| | | | 66 | | BG | | | Clay, dusky brown, waxy, mixed with lignitic sand. | |
| 130 | | | 67 | | BG | | | | |
| | | | 68 | | BG | | CL | | |
| | | | 69 | | BG | | | | |
| 135 | | | | 90 | | | | End of boring at 135'. | |
| 140 | | | | | | | | | |
| 145 | | | | | | | | | |
| 150 | | | | | | | | | |
| 155 | | | | | | | | | |
| 160 | | | | | | | | | |

WELL DIAGRAM



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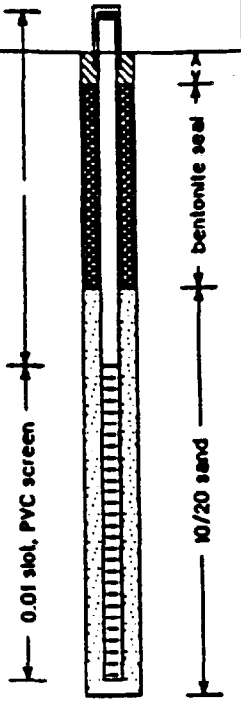
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-6S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.0 feet |
| Geologist: Ben Brantley | Well Screen: 10 to 20 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | | Fill and brick. | |
| | | | 1 | 66 | BG | | | Clayey silt, moderate yellowish brown, mottled with yellow gray. | |
| 5 | | | | | | | | | |
| 10 | | | 2 | 70 | BG | | ML | | |
| 15 | | | 3 | 70 | BG | | | | |
| 20 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 8. | |
| 25 | | | 4 | 60 | BG | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



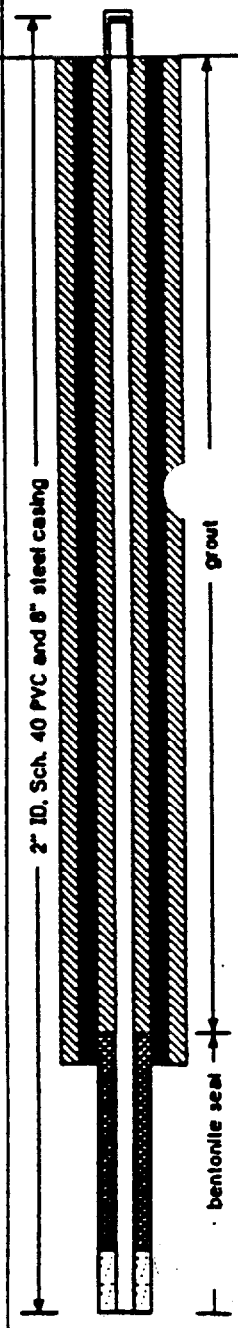
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 55.0 feet |
| Geologist: Ben Brantley | Well Screen: 40 to 50 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Fill and brick. | |
| | | | 1 | 66 | BG | | | Clayey silt, moderate yellowish brown, mottled with yellow gray. | |
| 5 | | | | | | | | | |
| 10 | | | 2 | 70 | BG | | | | |
| 15 | | | 3 | 70 | BG | | | | |
| | | | | | | | ML | | |
| 20 | | | | | | | | | |
| 25 | | | 4 | 60 | BG | | | Clayey silt, olive brown to olive gray, hard, stiff. | |
| 30 | | | | | | | | Clayey silt, light brown to yellowish brown, medium stiff. | |
| | | | 5 | 85 | BG | | | | |
| 35 | | | | | | | SC | Silty clayey sand, fine to very fine, yellowish orange to reddish brown. | |
| 40 | | | | | | | | | |

WELL DIAGRAM






000456

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 55.0 feet |
| Geologist: Ben Brantley | Well Screen: 40 to 50 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| 45 | | | 6 | 54 | BG | | SC | Silty sand, very fine to fine, traces of clay casts, grayish orange to pale yellowish orange. | | 0.01 slot, PVC screen; 10/20 sand |
| 50 | | | | | | | | | | |
| 55 | | | 7 | 100 | BG | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 6. | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

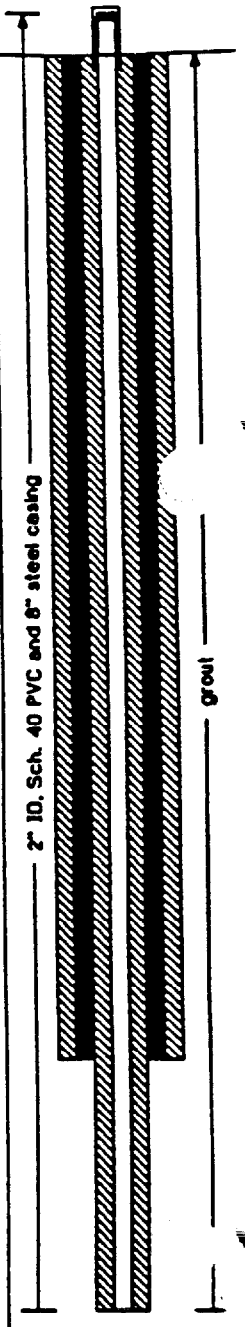
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 78.0 feet |
| Geologist: Ben Brantley | Well Screen: 67 to 77 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | | Fill and brick. | |
| | X | | 1 | 66 | B6 | | | Clayey silt, moderate yellowish brown, mottled with yellow gray. | |
| 5 | X | | | | | | | | |
| 10 | X | | 2 | 70 | B6 | | | | |
| 15 | X | | 3 | 70 | B6 | | ML | | |
| 20 | X | | | | | | | | |
| 25 | X | | 4 | 60 | B6 | | | Clayey silt, olive brown to olive gray, hard, stiff. | |
| 30 | X | | | | | | | Clayey silt, light brown to yellowish brown, medium stiff. | |
| | X | | 5 | 85 | B6 | | | | |
| 35 | X | | | | | | SC | Silty clayey sand, fine to very fine, yellowish orange to reddish brown. | |
| 40 | X | | | | | | | | |

WELL DIAGRAM



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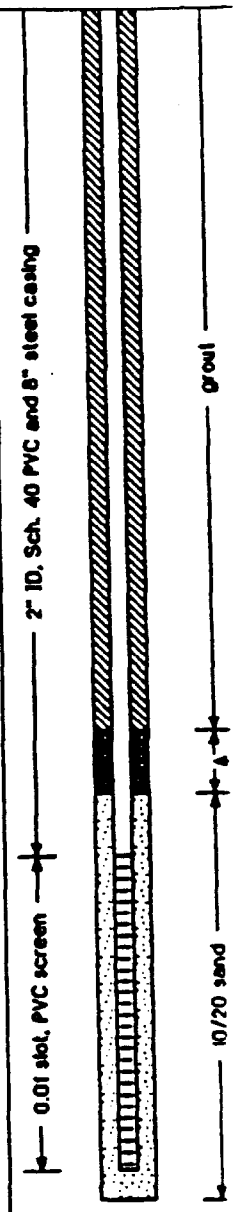
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6LF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN. SWMU#7 - Building N-128* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0820 on 2-10-95* | TOC Elevation: *feet msl* |
| Completed at *1010 on 2-14-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *78.0 feet* |
| Geologist: *Ben Brantley* | Well Screen: *67 to 77 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 45 | | | 6 | 54 | BG | | SC | Silty sand, very fine to fine, traces of clay casts, grayish orange to pale yellowish orange. | |
| 50 | | | | | | | | | |
| 55 | | | 7 | 100 | BG | | GP | Sand, fine to coarse, pale yellowish brown to moderate yellowish brown. | |
| 60 | | | | | | | | | |
| 65 | | | 8 | 70 | BG | | | | |
| 70 | | | | | | | | | |
| 75 | | | 9 | 100 | BG | | | | |
| 80 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 6. | |

WELL DIAGRAM



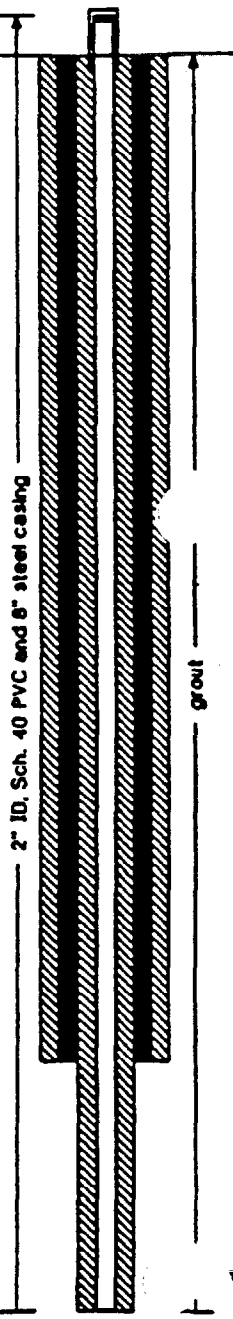
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU17 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 101.0 feet |
| Geologist: Ben Brantley | Well Screen: 84.5 to 94.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 88 | | | | Fill and brick. | |
| | | | | | | | | Clayey silt, moderate yellowish brown, mottled with yellow gray. | |
| 5 | | | 1 | | BG | | | | |
| | | | 2 | | BG | | | | |
| | | | 3 | | BG | | | | |
| 10 | | | | 70 | | | | | |
| | | | 4 | | BG | | | | |
| | | | 5 | | BG | | | | |
| 15 | | | 6 | 70 | BG | | | | |
| | | | 7 | | BG | | ML | | |
| | | | 8 | | BG | | | | |
| 20 | | | 9 | | BG | | | | |
| | | | 10 | | BG | | | | |
| 25 | | | 11 | 60 | BG | | | Clayey silt, olive brown to olive gray, hard, stiff. | |
| | | | 12 | | BG | | | | |
| | | | 13 | | BG | | | Clayey silt, light brown to yellowish brown, medium stiff. | |
| 30 | | | 14 | | BG | | | | |
| | | | 15 | 85 | BG | | | | |
| 35 | | | 16 | | BG | | | Silty clayey sand, fine to very fine, yellowish orange to reddish brown. | |
| | | | 17 | | BG | | SC | | |
| 40 | | | 18 | | BG | | | | |

WELL DIAGRAM





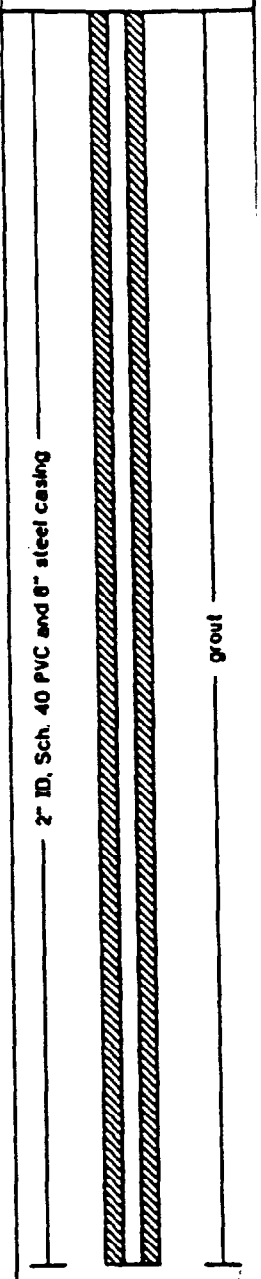

000460

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-6UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU7 - Building N-126 |
| Project No.: N00894 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 101.0 feet |
| Geologist: Ben Brantley | Well Screen: 84.5 to 94.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19 | | BG | | | | | |
| | | | 20 | | BG | | | | | |
| 45 | | | 21 | 54 | BG | | | Silty sand, very fine to fine, traces of clay casts, grayish orange to pale yellowish orange. | | |
| | | | 22 | | BG | | SC | | | |
| | | | 23 | | BG | | | | | |
| 50 | | | 24 | | BG | | | | | |
| | | | 25 | | BG | | | | | |
| 55 | | | 26 | 100 | BG | | | | | |
| | | | 27 | | BG | | | Sand, fine to coarse, pale yellowish brown to moderate yellowish brown. | | |
| | | | 28 | | BG | | | | | |
| 60 | | | 29 | | BG | | | | | |
| | | | 30 | | BG | | | | | |
| 65 | | | 31 | 70 | BG | | | | | |
| | | | 32 | | BG | | GP | | | |
| | | | 33 | | BG | | | | | |
| 70 | | | 34 | | BG | | | | | |
| | | | 35 | | BG | | | | | |
| 75 | | | 36 | 100 | BG | | | | | |
| | | | 37 | | BG | | | Silt clayey, finely laminated, pale yellowish orange to dark yellowish orange. | | |
| | | | 38 | | BG | | SC | | | |
| 80 | | | | | | | | Silty clay with fine sand, light brownish gray to grayish brown, micaceous, soft to stiff, moist. | | |



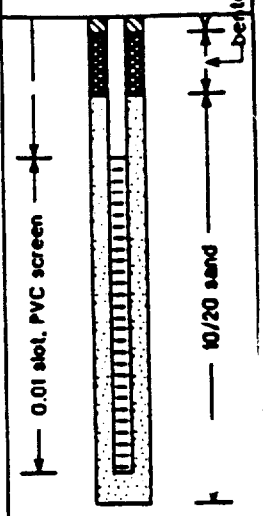
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-6UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU17 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0820 on 2-10-95 | TOC Elevation: feet msl |
| Completed at 1010 on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 101.0 feet |
| Geologist: Ben Brantley | Well Screen: 84.5 to 94.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 39 | | BG | | | | |
| | | | 40 | | BG | | | | |
| 85 | | | 41 | | BG | | | | |
| | | | 42 | 100 | BG | | SC | | |
| | | | 43 | | BG | | | | |
| 90 | | | 44 | | BG | | | | |
| | | | 45 | | BG | | | | |
| 95 | | | 46 | | BG | | | Clay, interbedded very fine sand with silt, becoming more waxy. | |
| | | | 47 | 120 | BG | | CL | | |
| | | | 48 | | BG | | | | |
| 100 | | | 49 | 120 | BG | | | End of boring | |
| 105 | | | | | | | | | |
| 110 | | | | | | | | | |
| 115 | | | | | | | | | |
| 120 | | | | | | | | | |

WELL DIAGRAM






000462

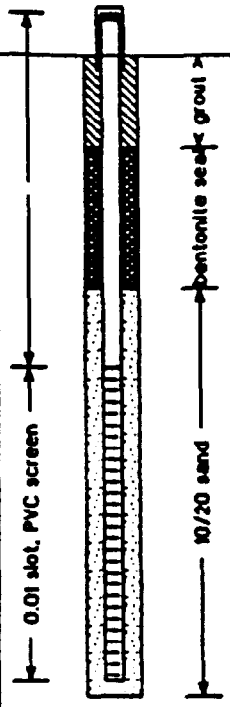
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-7S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.0 feet |
| Geologist: Ben Brantley | Well Screen: 10.0 to 20.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 5 | X | | 1 | 125 | BG | | | Clayey silt, moderate yellowish brown, organics, mottled with yellowish gray silt. | |
| 10 | X | | 2 | 70 | BG | | ML | | |
| 15 | X | | 3 | 80 | BG | | | Clayey silt, light olive gray to olive brown, soft, moist. | |
| 20 | X | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 7. | |
| 25 | | | 4 | 65 | BG | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



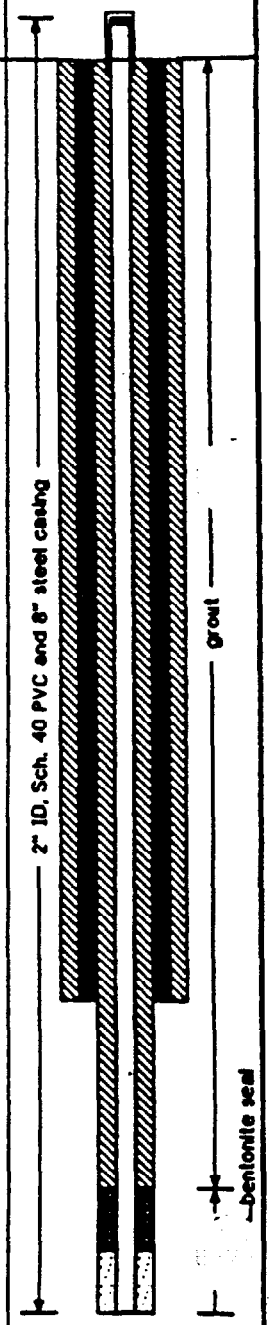
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-7UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-96 | TOC Elevation: feet msl |
| Completed at on 2-14-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 50.0 feet |
| Geologist: Ben Brantley | Well Screen: 40.0 to 50.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate yellowish brown, organics, mottled with yellowish gray silt. | |
| 5 | | | 1 | 125 | BG | | | | |
| 10 | | | 2 | 70 | BG | | | | |
| 15 | | | 3 | 80 | BG | | | Clayey silt, light olive gray to olive brown, soft, moist. | |
| 20 | | | | | | | ML | | |
| 25 | | | 4 | 85 | BG | | | | |
| 30 | | | | | | | | Silty clay, light brown to moderate yellowish brown. | |
| 35 | | | 5 | 90 | BG | | | | |
| | | | | | | | SC | Silty sand, moderate yellowish brown to dark yellowish orange, stained reddish brown. | |
| 40 | | | | | | | GP | Sand, fine to medium, silty, grayish orange to dark yellowish orange, at 39' there is some gray sand. | |

WELL DIAGRAM






000464

Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-7UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 50.0 feet |
| Geologist: Ben Brantley | Well Screen: 40.0 to 50.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| 45 | | | 6 | 110 | BG | | GP | | | 0.01 slot, PVC screen; 10/20 sand |
| 50 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 7. | | |
| 55 | | | 7 | 90 | BG | | | | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

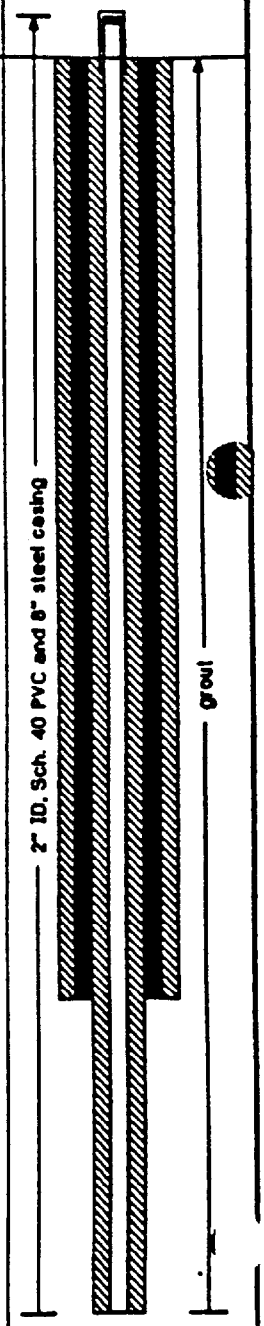
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-7UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SHMUM7 - Building N-28 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 105.0 feet |
| Geologist: Ben Brantley | Well Screen: 92.5 to 102.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | ■ | 1 | | 0.4 | | | Clayey silt, moderate yellowish brown, organics, mottled with yellowish gray silt. | |
| | | | 2 | | BG | | | | |
| 5 | | | | 125 | | | | | |
| | | | 3 | | BG | | | | |
| | | | 4 | | BG | | | | |
| 10 | | ■ | 5 | 70 | BG | | | | |
| | | | 6 | | BG | | | | |
| | | | 7 | | BG | | | | |
| 15 | | | | 80 | | | | Clayey silt, light olive gray to olive brown, soft, moist. | |
| | | | 8 | | BG | | | | |
| | | | 9 | | BG | | ML | | |
| 20 | | | 10 | | BG | | | | |
| | | | 11 | | BG | | | | |
| | | | 12 | | BG | | | | |
| 25 | | | | 85 | | | | | |
| | | | 13 | | BG | | | | |
| | | | 14 | | BG | | | Silty clay, light brown to moderate yellowish brown. | |
| 30 | | ■ | 15 | | BG | | | | |
| | | | 16 | | BG | | | | |
| | | | 17 | | BG | | | | |
| 35 | | | | 90 | | | | | |
| | | | 18 | | BG | | SC | Silty sand, moderate yellowish brown to dark yellowish orange, stained reddish brown. | |
| | | | 19 | | BG | | | | |
| 40 | | | | | | | GP | Sand, fine to medium, silty, grayish orange to dark yellowish orange, at 39' there is some gray sand. | |

WELL DIAGRAM






000466

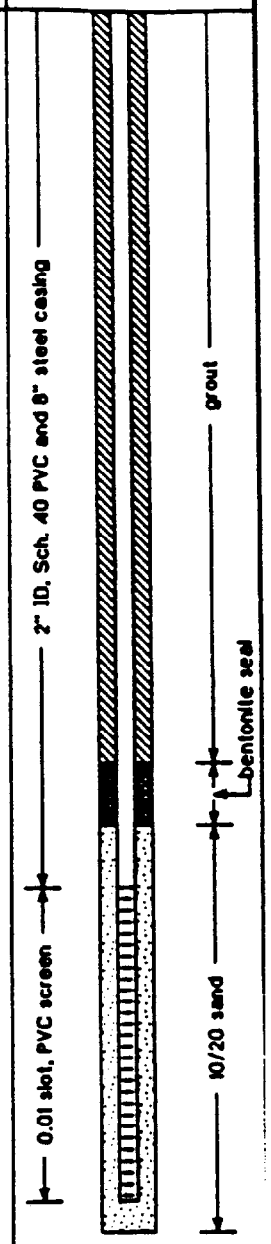
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-7LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 77.0 feet |
| Geologist: Ben Brantley | Well Screen: 68.0 to 78.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 45 | X | | 6 | 110 | BG | | | | |
| 50 | X | | | | | | | | |
| 55 | X | | 7 | 90 | BG | | | | |
| 60 | X | | | | | | GP | Sand and gravel, fine to very coarse grained, grayish orange to dark yellowish orange. | |
| 65 | X | | 8 | 110 | BG | | | | |
| 70 | X | | | | | | | Sand with interdisbursed clay, fine to medium grained. Clay is pinkish gray, moist. | |
| 75 | X | | 9 | 95 | BG | | | | |
| 80 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 7. | |

WELL DIAGRAM






000467

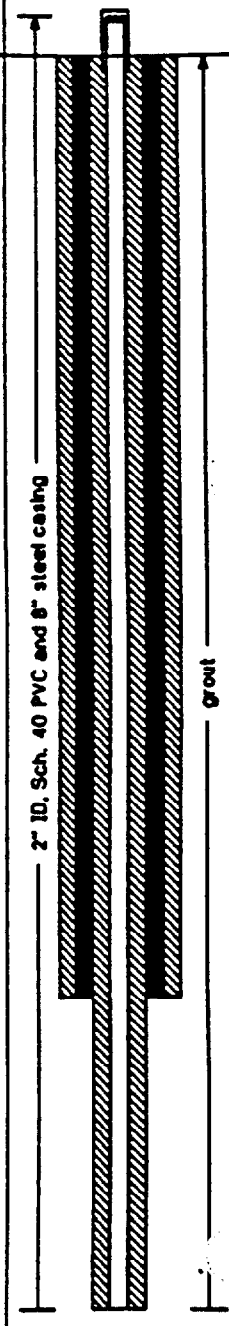
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-7UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 105.0 feet |
| Geologist: Ben Brantley | Well Screen: 92.5 to 102.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | 0.4 | | | Clayey silt, moderate yellowish brown, organics, mottled with yellowish gray silt. | |
| | | | 2 | | BG | | | | |
| 5 | | | 3 | 125 | BG | | | | |
| | | | 4 | | BG | | | | |
| 10 | | | 5 | 70 | BG | | | | |
| | | | 6 | | BG | | | | |
| | | | 7 | | BG | | | | |
| 15 | | | 8 | 80 | BG | | | Clayey silt, light olive gray to olive brown, soft, moist. | |
| | | | 9 | | BG | | ML | | |
| 20 | | | 10 | | BG | | | | |
| | | | 11 | | BG | | | | |
| | | | 12 | | BG | | | | |
| 25 | | | 13 | 65 | BG | | | | |
| | | | 14 | | BG | | | Silty clay, light brown to moderate yellowish brown. | |
| 30 | | | 15 | | BG | | | | |
| | | | 16 | | BG | | | | |
| | | | 17 | | BG | | | | |
| 35 | | | | 90 | | | | | |
| | | | 18 | | BG | | SC | Silty sand, moderate yellowish brown to dark yellowish orange, stained reddish brown. | |
| | | | 19 | | BG | | GP | Sand, fine to medium, silty, grayish orange to dark yellowish orange, at 39' there is some gray sand. | |
| 40 | | | | | | | | | |

WELL DIAGRAM





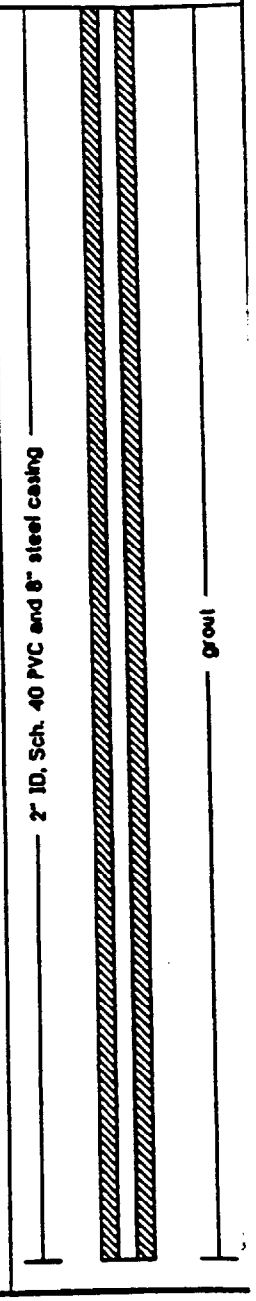

000468

**EnSafe** ®
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-7UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 105.0 feet |
| Geologist: Ben Brantley | Well Screen: 92.5 to 102.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | | BG | | | | | |
| | | | 21 | | BG | | | | | |
| 45 | | | 22 | 110 | BG | | | | | |
| | | | 23 | | BG | | | | | |
| | | | 24 | | BG | | | | | |
| 50 | | | 25 | | BG | | | | | |
| | | | 26 | | BG | | | | | |
| 55 | | | 27 | 90 | BG | | | | | |
| | | | 28 | | BG | | | | | |
| | | | 29 | | BG | | GP | | | |
| 60 | | | 30 | | BG | | | Sand and gravel, fine to very coarse grained, grayish orange to dark yellowish orange. | | |
| | | | 31 | | BG | | | | | |
| 65 | | | 32 | 110 | BG | | | | | |
| | | | 33 | | BG | | | | | |
| | | | 34 | | BG | | | | | |
| 70 | | | 35 | | BG | | | Sand with interdisbursed clay, fine to medium grained. Clay is pinkish gray, moist. | | |
| | | | 36 | | BG | | | | | |
| 75 | | | 37 | 95 | BG | | | | | |
| | | | 38 | | BG | | | | | |
| | | | 39 | | BG | | SC | Sand, interbedded with clay, grayish orange, then becomes silty sand, very fine grained, clay is dark yellowish orange. | | |
| 80 | | | | | | | | | | |



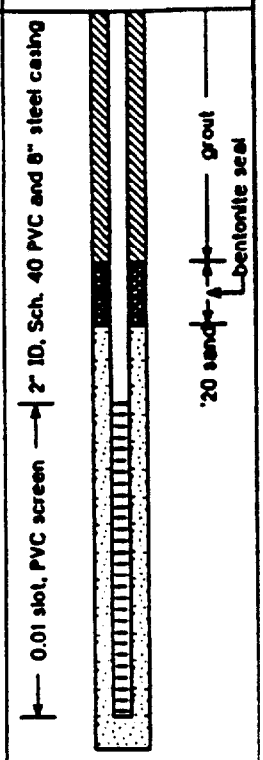
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-7UC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1750 on 2-10-95 | TOC Elevation: feet msl |
| Completed at on 2-14-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 105.0 feet |
| Geologist: Ben Brantley | Well Screen: 92.5 to 102.5 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 40 | | BG | | | | |
| | | | 41 | | BG | | | | |
| 85 | | | 42 | 100 | BG | | | Silty sand, with interbedded clay, very fine sand, dusky yellowish brown clay to moderate brown, mottled with light olive to olive gray sand. | |
| | | | 43 | | BG | | | | |
| | | | 44 | | BG | | | | |
| 90 | | | 45 | | BG | | SC | | |
| | | | 46 | | BG | | | | |
| 95 | | | 47 | 120 | BG | | | | |
| | | | 48 | | BG | | | | |
| | | | 49 | | BG | | | | |
| 100 | | | 50 | | BG | | | | |
| | | | 51 | | BG | | CL | Clay, laminations of sand, dusky yellowish brown to moderate brown clay, light olive to olive gray sand, waxy. | |
| 105 | | | 52 | 115 | BG | | | End of boring at 105'. | |
| 110 | | | | | | | | | |
| 115 | | | | | | | | | |
| 120 | | | | | | | | | |

WELL DIAGRAM






000470

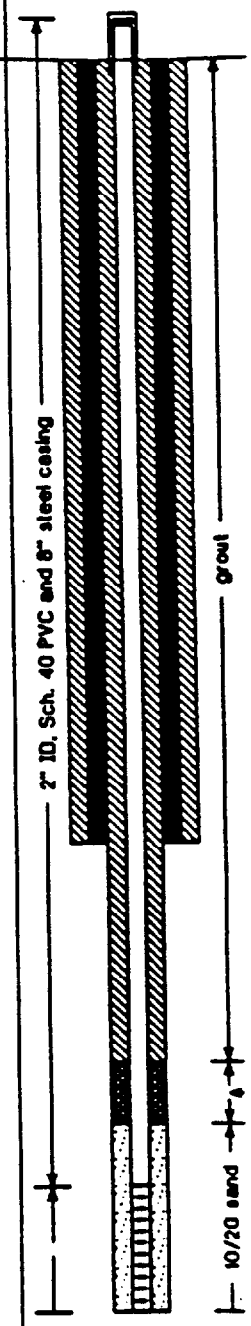
**EnSafe** Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-8UF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0900 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *1210 on 2-24-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *45 feet* |
| Geologist: *David Ladd* | Well Screen: *36.0 to 46.0 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, yellowish brown, mottled yellowish gray. | |
| 5 | | | 1 | 140 | BG | | | Clayey silt, moderate brown, moist, soft. | |
| 10 | | | 2 | 98 | BG | | | | |
| 15 | | | 3 | 98 | BG | | ML | Clayey silt, olive gray, medium stiff to soft. | |
| 20 | | | | | | | | Silt, light olive gray with brown mottling. | |
| 25 | | | 4 | 85 | BG | | | Silt, moderate to light brown, hard. | |
| 30 | | | 5 | 80 | BG | | | Sandy silt, moderate yellowish brown. | |
| 35 | | | 6 | 120 | BG | | GP | Sand, fine, dark yellowish orange mottled with grayish orange, silty. Sand, pale yellowish brown. | |
| 40 | | | | | | | | | |

WELL DIAGRAM






000471

Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-8UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 2-11-96 | TOC Elevation: feet msl |
| Completed at 1210 on 2-24-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 45 feet |
| Geologist: David Ladd | Well Screen: 36.0 to 46.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| 45 | X | | 7 | 80 | BG | | GP | Log information taken form the boring for the Cockfield well at SWMU#7 site 8. | | 10/20 sand |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

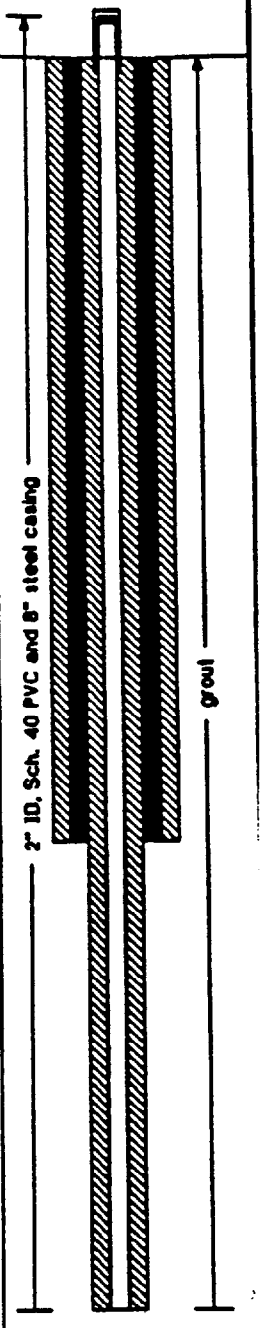
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-8LF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SHMU#7 - Building N-128* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0900 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *1210 on 2-24-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *76 feet* |
| Geologist: *David Ladd* | Well Screen: *68.0 to 78.0 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, yellowish brown, mottled yellowish gray. | |
| 5 | | | 1 | 140 | BG | | | Clayey silt, moderate brown, moist, soft. | |
| 10 | | | 2 | 98 | BG | | | | |
| 15 | | | 3 | 98 | BG | | ML | Clayey silt, olive gray, medium stiff to soft. | |
| 20 | | | | | | | | Silt, light olive gray with brown mottling. | |
| 25 | | | 4 | 85 | BG | | | Silt, moderate to light brown, hard. | |
| 30 | | | 5 | 80 | BG | | | Sandy silt, moderate yellowish brown. | |
| 35 | | | 6 | 120 | BG | | GP | Sand, fine, dark yellowish orange mottled with grayish orange, silty. Sand, pale yellowish brown. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



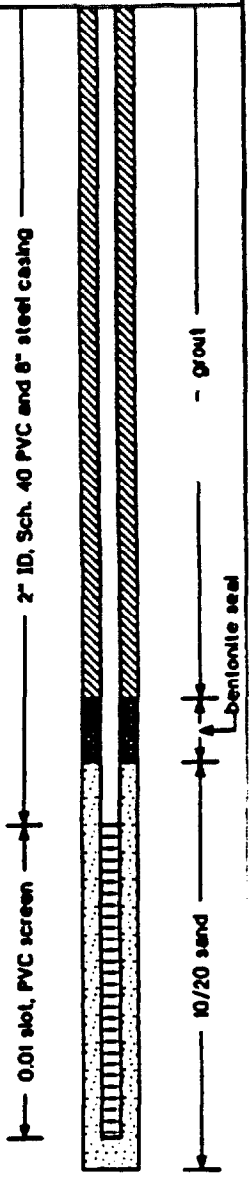
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-8LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 0900 on 2-11-95 | TOC Elevation: feet msl |
| Completed at 1210 on 2-24-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 78 feet |
| Geologist: David Ladd | Well Screen: 68.0 to 78.0 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 45 | X | | 7 | 80 | BG | | | Sand, fine, grayish orange to dark yellowish orange, wet, scattered gravel. | |
| 50 | X | | | | | | | | |
| 55 | X | | 8 | 95 | BG | | GP | | |
| 60 | X | | | | | | | | |
| 65 | X | | 9 | 90 | BG | | | Sand and gravel, fine to very coarse grained, grayish orange to dark yellowish orange, gravel. | |
| 70 | X | | | | | | | | |
| 75 | X | | 10 | 90 | BG | | | | |
| 80 | | | | | | | | Log information taken form the boring for the Cockfield well at SWMU#7 site 8. | |

WELL DIAGRAM



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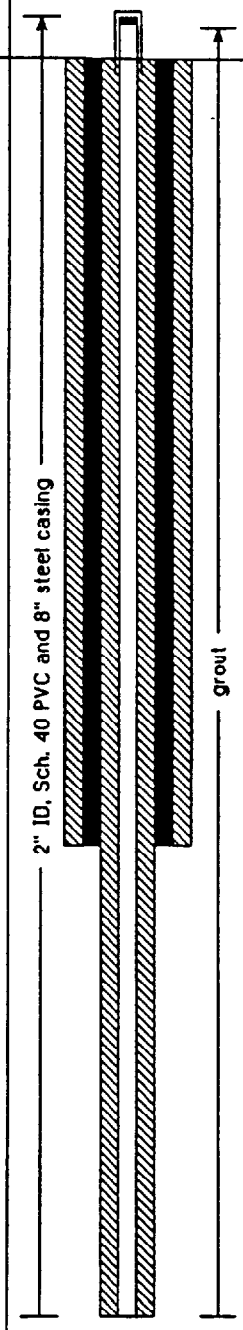
**Environmental & Safety Designs, Inc.**

# Log of Monitoring Well 07-MW-8U

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0900 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *1210 on 2-24-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *125 feet* |
| Geologist: *David Ladd* | Well Screen: *113.5 below grade to 123.5 below grade feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | ■ | 1 | | BG | | | Clayey silt, yellowish brown, mottled yellowish gray. | |
| | | | 2 | | BG | | | | |
| 5 | | | 3 | 140 | BG | | | Clayey silt, moderate brown, moist, soft. | |
| | | | 4 | | BG | | | | |
| 10 | | ■ | 5 | 98 | BG | | | | |
| | | | 6 | | BG | | | | |
| | | | 7 | | BG | | | | |
| 15 | | | 8 | 98 | BG | | ML | | |
| | | | 9 | | BG | | | Clayey silt, olive gray, medium stiff to soft. | |
| 20 | | ■ | 10 | | BG | | | | |
| | | | 11 | | BG | | | Silt, light olive gray with brown mottling. | |
| 25 | | | | 85 | | | | Silt, moderate to light brown, hard. | |
| | | | 13 | | BG | | | | |
| | | | 14 | | BG | | | | |
| 30 | | | 15 | 80 | BG | | | Sandy silt, moderate yellowish brown. | |
| | | | 16 | | BG | | | | |
| 35 | | | 17 | 120 | BG | | | Sand, fine, dark yellowish orange mottled with grayish orange, silty. | |
| | | | 18 | | BG | | GP | Sand, pale yellowish brown. | |
| 40 | | | 19 | | BG | | | | |

WELL DIAGRAM



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**EnSafe** Environmental & Safety Designs, Inc.

# Log of Monitoring Well 07-MW-8U

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0900 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *1210 on 2-24-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *125 feet* |
| Geologist: *David Ladd* | Well Screen: *113.5 below grade to 123.5 below grade feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | | BG | | | | | |
| | | | 21 | | BG | | | | | |
| 45 | | | 22 | 80 | BG | | | Sand, fine, grayish orange to dark yellowish orange, wet, scattered gravel. | | |
| | | | 23 | | BG | | | | | |
| | | | 24 | | BG | | | | | |
| 50 | | | 25 | | BG | | | | | |
| | | | 26 | | BG | | | | | |
| 55 | | | 27 | 95 | BG | | | | | |
| | | | 28 | | BG | | | | | |
| | | | 29 | | BG | | GP | | | |
| 60 | | | 30 | | BG | | | | | |
| | | | 31 | | BG | | | | | |
| 65 | | | 32 | 90 | BG | | | Sand and gravel, fine to very coarse grained, grayish orange to dark yellowish orange, gravel. | | |
| | | | 33 | | BG | | | | | |
| | | | 34 | | BG | | | | | |
| 70 | | | 35 | | BG | | | | | |
| | | | 36 | | BG | | | | | |
| 75 | | | 37 | 90 | BG | | | | | |
| | | | 38 | | BG | | SC | Sand, silty, very fine grained, dark yellowish orange mottled with light gray, wet. | | |
| | | | 39 | | BG | | | | | |
| 80 | | | | | | | | | | |

WELL DIAGRAM: 2" ID, Sch. 40 PVC and 8" steel casing; grout



000476

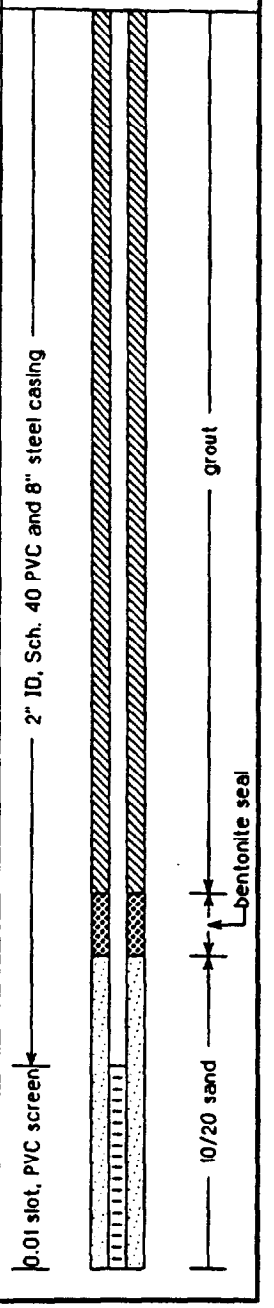
**EnSafe** Environmental & Safety Designs, Inc.

# Log of Monitoring Well 07-MW-8U

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-126* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *0900 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *1210 on 2-24-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *125 feet* |
| Geologist: *David Ladd* | Well Screen: *113.5 below grade to 123.5 below grade feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 40 | | BG | | | | |
| | | | 41 | | BG | | | Sand, silty, very fine grained, dark yellowish orange to very pale orange. | |
| 85 | | | 42 | 85 | BG | | | | |
| | | | 43 | | BG | | | Sand, silty, very fine grained, dark yellowish orange mottled with light gray, interbedded with gray clay, wet from 94'-95'. | |
| | | | 44 | | BG | | | | |
| 90 | | | 45 | | BG | | | | |
| | | | 46 | | BG | | | | |
| 95 | | | 47 | 100 | BG | | | Sand with interbedded clay, very fine, dusky brown to moderate brown, mottled with light olive gray, rare marcasite nodules. | |
| | | | 48 | | BG | | | | |
| | | | 49 | | BG | | | | |
| 100 | | | 50 | | BG | | SC | | |
| | | | 51 | | BG | | | | |
| 105 | | | 52 | 110 | BG | | | | |
| | | | 53 | | BG | | | | |
| | | | 54 | | BG | | | | |
| 110 | | | 55 | | BG | | | | |
| | | | 56 | | BG | | | | |
| 115 | | | 57 | 110 | BG | | | | |
| | | | 58 | | BG | | | | |
| | | | 59 | | BG | | | | |
| 120 | | | | | | | | | |

WELL DIAGRAM



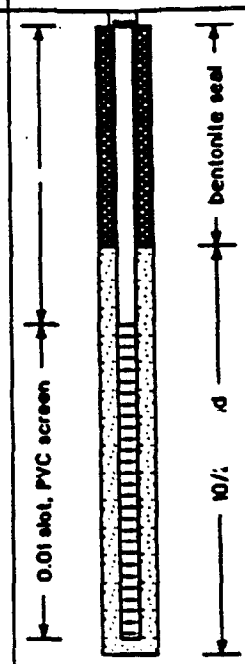
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9S

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 20.5 feet |
| Geologist: Ben Brantley | Well Screen: 10 to 20 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown with yellow gray streaks, moist, soft. | |
| 5 | | | 1 | 100 | BG | | | | |
| 10 | | | 2 | 70 | BG | | ML | | |
| 15 | | | 3 | 100 | BG | | | Silty clay, reddish brown, stiff and plastic. | |
| 20 | | | | | | | | Clayey silt, light brown with clay inclusions. | |
| | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 9. | |
| 25 | | | 4 | 95 | BG | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

WELL DIAGRAM



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**EnSafe**

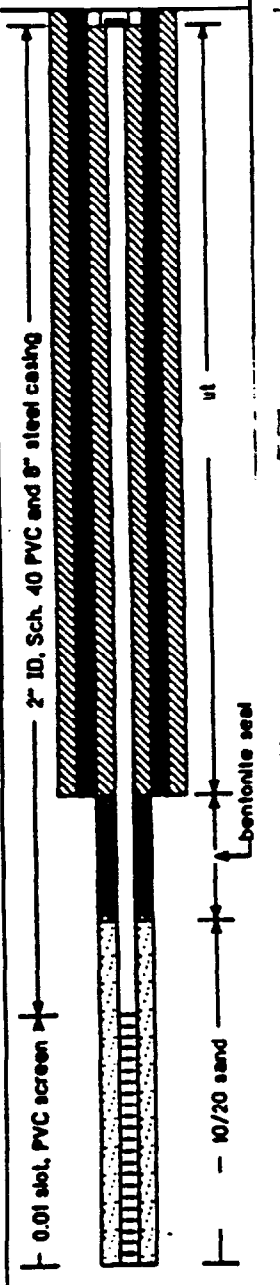
Environmental & Safety Designs, Inc.

# Monitoring Well 07-MW-9UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU17 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 42 feet |
| Geologist: Ben Brantley | Well Screen: 32 to 42 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown with yellow gray streaks, moist, soft. | |
| 5 | | | 1 | 100 | BG | | | | |
| 10 | | | 2 | 70 | BG | | | | |
| 15 | | | 3 | 100 | BG | | | | |
| | | | | | | | ML | Silty clay, reddish brown, stiff and plastic. | |
| 20 | | | | | | | | Clayey silt, light brown with clay inclusions. | |
| | | | | | | | | Silty clay, moderate brown to reddish brown. | |
| 25 | | | 4 | 95 | BG | | | | |
| 30 | | | | | | | | | |
| | | | | | | | | Sand, fine, yellow orange to light brown. | |
| 35 | | | 5 | 80 | BG | | GP | | |
| | | | | | | | | Sand, medium, yellowish gray, micaceous. | |
| 40 | | | | | | | | | |

WELL DIAGRAM



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**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9UF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-96 | TOC Elevation: feet msl |
| Completed at on 2-25-96 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 42 feet |
| Geologist: Ben Brantley | Well Screen: 32 to 42 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | | | | | | GP | | | |
| | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 9. | | |
| 45 | | | 8 | 95 | BG | | | | | |
| 50 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 60 | | | | | | | | | | |
| 65 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| 80 | | | | | | | | | | |

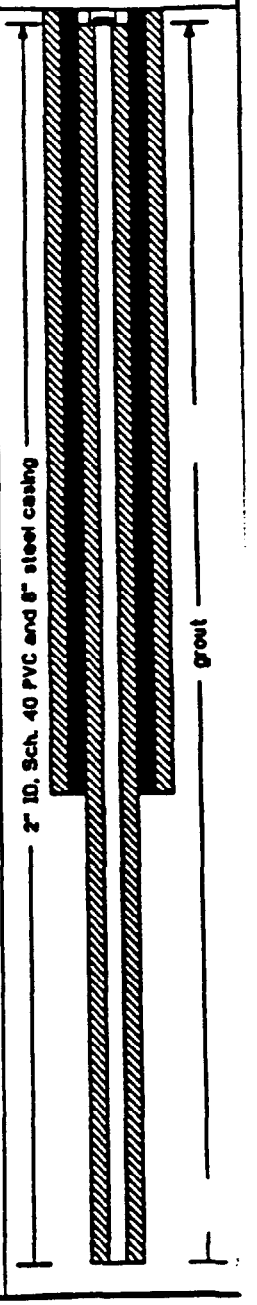
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9LF

| | |
|---|---|
| Project: *NAS Memphis* | Location: *Millington, TN SWMU#7 - Building N-26* |
| Project No.: *N0094* | Surface Elevation: *feet msl* |
| Started at *1550 on 2-11-95* | TOC Elevation: *feet msl* |
| Completed at *on 2-25-95* | Depth to Groundwater: *feet* Measured: |
| Drilling Method: *Rotasonic* | Groundwater Elevation: *feet msl* |
| Drilling Company: *North Star Drilling* | Total Depth: *77 feet* |
| Geologist: *Ben Brantley* | Well Screen: *67 to 77 feet* |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Clayey silt, moderate brown with yellow gray streaks, moist, soft. | |
| 5 | | | 1 | 100 | BG | | | | |
| 10 | | | 2 | 70 | BG | | | | |
| 15 | | | 3 | 100 | BG | | ML | Silty clay, reddish brown, stiff and plastic. | |
| 20 | | | | | | | | Clayey silt, light brown with clay inclusions. | |
| 25 | | | 4 | 95 | BG | | | Silty clay, moderate brown to reddish brown. | |
| 30 | | | | | | | | | |
| 35 | | | 5 | 80 | BG | | GP | Sand, fine, yellow orange to light brown. | |
| 40 | | | | | | | | Sand, medium, yellowish gray, micaceous. | |

WELL DIAGRAM






000431

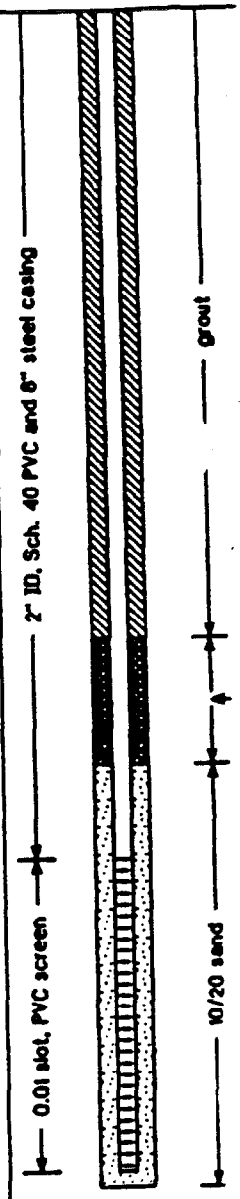
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9LF

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 77 feet |
| Geologist: Ben Brantley | Well Screen: 67 to 77 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| 45 | X | | 6 | 95 | BG | | | | |
| 50 | X | | | | | | | | |
| 55 | X | | | | | | GP | | |
| 60 | X | | | | | | | Sand, Coarse to gravelly, grayish orange to yellowish orange. | |
| 65 | X | | 7 | 90 | BG | | | | |
| 70 | X | | | | | | | | |
| 75 | X | | | | | | SC | Silty sand, very fine, yellowish orange banded with yellowish gray. | |
| 80 | | | | | | | | Log information taken from the boring for the Cockfield well at SWMU#7 site 9. | |

WELL DIAGRAM





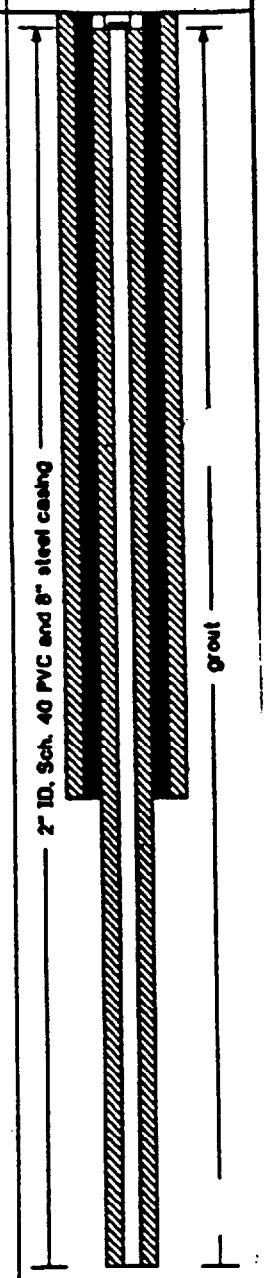

000432

**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 115 feet |
| Geologist: Ben Brantley | Well Screen: 102 to 112 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) | WELL DIAGRAM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | BG | | | Clayey silt, moderate brown with yellow gray streaks, moist, soft. | | |
| 5 | | | 2 | 100 | BG | | | | | |
| | | | 3 | | BG | | | | | |
| | | | 4 | | BG | | | | | |
| 10 | | | | 70 | | | | | | |
| | | | 5 | | BG | | | | | |
| | | | 6 | | BG | | | | | |
| 15 | | | 7 | 100 | BG | | | | | |
| | | | 8 | | BG | | ML | Silty clay, reddish brown, stiff and plastic. | | |
| | | | 9 | | BG | | | Clayey silt, light brown with clay inclusions. | | |
| 20 | | | 10 | | BG | | | | | |
| | | | 11 | | BG | | | Silty clay, moderate brown to reddish brown. | | |
| 25 | | | 12 | 95 | BG | | | | | |
| | | | 13 | | BG | | | | | |
| | | | 14 | | BG | | | | | |
| 30 | | | 15 | | BG | | | | | |
| | | | 16 | | BG | | | Sand, fine, yellow orange to light brown. | | |
| 35 | | | 17 | 80 | BG | | | | | |
| | | | 18 | | BG | | GP | Sand, medium, yellowish gray, micaceous. | | |
| | | | 19 | | BG | | | | | |
| 40 | | | | | | | | | | |






000433

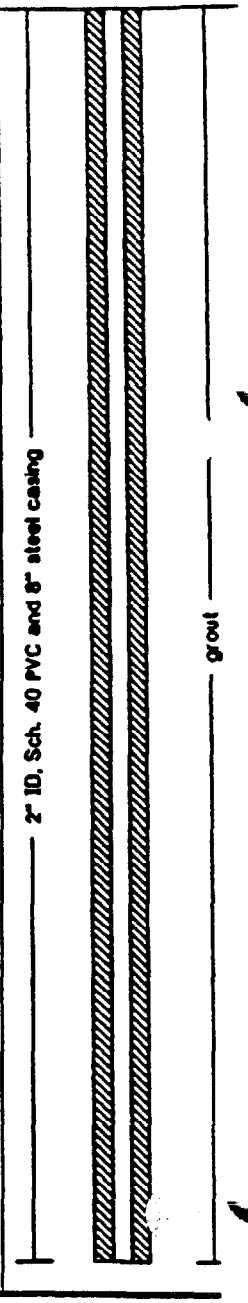
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU7 - Building N-126 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 115 feet |
| Geologist: Ben Brantley | Well Screen: 102 to 112 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft-msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 | | BG | | | | |
| | | | 21 | | BG | | | | |
| 45 | | | 22 | 95 | BG | | | | |
| | | | 23 | | BG | | | | |
| | | | 24 | | BG | | | | |
| 50 | | | 25 | | BG | | | | |
| | | | 26 | | BG | | | | |
| 55 | | | 27 | | BG | | | | |
| | | | 28 | | BG | | GP | | |
| | | | 29 | | BG | | | | |
| 60 | | | 30 | | BG | | | Sand, Coarse to gravelly, grayish orange to yellowish orange. | |
| | | | 31 | | BG | | | | |
| 65 | | | 32 | 90 | BG | | | | |
| | | | 33 | | BG | | | | |
| | | | 34 | | BG | | | | |
| 70 | | | 35 | | BG | | | | |
| | | | 36 | | BG | | | | |
| 75 | | | 37 | | BG | | | Silty sand, very fine, yellowish orange banded with yellowish gray. | |
| | | | 38 | | BG | | SC | | |
| | | | 39 | | BG | | | Clayey silty sand, grayish brown, dusky brown layers of clay with light gray sand. | |
| 80 | | | | | | | | | |

WELL DIAGRAM






000434

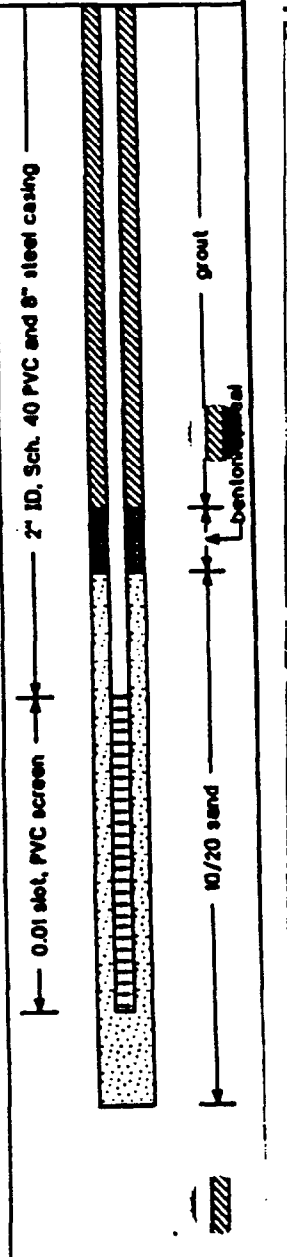
**Environmental & Safety Designs, Inc.**

# Monitoring Well 07-MW-9MC

| | |
|---|---|
| Project: NAS Memphis | Location: Millington, TN SWMU#7 - Building N-128 |
| Project No.: N0094 | Surface Elevation: feet msl |
| Started at 1550 on 2-11-95 | TOC Elevation: feet msl |
| Completed at on 2-25-95 | Depth to Groundwater: feet Measured: |
| Drilling Method: Rotasonic | Groundwater Elevation: feet msl |
| Drilling Company: North Star Drilling | Total Depth: 115 feet |
| Geologist: Ben Brantley | Well Screen: 102 to 112 feet |

| DEPTH IN FEET | LITHOLOGIC SAMPLE | ANALYTICAL SAMPLE | SAMPLE NO. | % RECOVERY | PID (ppm) | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION | ELEV. (ft msl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 40 | | BG | | | | |
| | | | 41 | | BG | | | | |
| 85 | | | 42 | 95 | BG | | | | |
| | | | 43 | | BG | | | | |
| | | | 44 | | BG | | | | |
| 90 | | | 45 | | BG | | | | |
| | | | 46 | | BG | | | | |
| 95 | | | 47 | | BG | | | | |
| | | | 48 | | BG | | SC | | |
| | | | 49 | | BG | | | | |
| 100 | | | 50 | | BG | | | | |
| | | | 51 | | BG | | | | |
| 105 | | | 52 | 90 | BG | | | | |
| | | | 53 | | BG | | | | |
| | | | 54 | | BG | | | | |
| 110 | | | 55 | | BG | | | | |
| | | | 56 | | BG | | CL | Clay, dusky brown, hard and waxy, with medium gray sand lenses. | |
| 115 | | | 57 | 110 | BG | | | End of boring at 115'. | |
| 120 | | | | | | | | | |

WELL DIAGRAM



STATE
TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/17/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 007S000177

Soil Description: Yellow & light Gray Silt with fine sand

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 118.6 | 120.8 |
| Dry Density (Lbs/ft$^3$) | 101.0 | 101.9 |
| Moisture (% Dry Wt) | 17.4 | 18.6 |
| Porosity (n) | .397 | .383 |
| Degree of Saturation (%) | .97 | 1.0 |

### Permeability

Temperature Correction, $R_t$ = 1.048

$K_1 = 6.7 \times 10^{-5}$ cm/sec
$K_2 = 6.4 \times 10^{-5}$ cm/sec
$K_3 = 6.8 \times 10^{-5}$ cm/sec
$K_4 = 6.2 \times 10^{-5}$ cm/sec

Coefficient of Permeability, $K_{20} = 6.8 \times 10^{-5}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0019 Reviewed By: David D. McCray

3750 B ... C... MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/17/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 07S0001112

Soil Description: Dark Brown Clay with Silt & fine sand lenses running horizontal

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density ($Lbs/ft^3$) | 105.6 | 108.0 |
| Dry Density ($Lbs/ft^3$) | 80.2 | 78.6 |
| Moisture (% Dry Wt) | 31.7 | 37.4 |
| Porosity (n) | .506 | .516 |
| Degree of Saturation (%) | .96 | 1.0 |

**Permeability**

Temperature Correction, $R_t = 1.043$

$K_1 = 3.7 \times 10^{-8}$ cm/sec
$K_2 = 4.2 \times 10^{-8}$ cm/sec
$K_3 = 3.9 \times 10^{-8}$ cm/sec
$K_4 = 3.9 \times 10^{-8}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.1 \times 10^{-8}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0018 Reviewed By: David D. McCray

MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

TRI STATE
TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/13/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 007S0003117

Soil Description: Dark Brown Clay with Silt & fine sand lenses running horizontal

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 98.0 | 103.2 |
| Dry Density (Lbs/ft$^3$) | 75.3 | 73.8 |
| Moisture (% Dry Wt) | 30.1 | 39.9 |
| Porosity (n) | .544 | .554 |
| Degree of Saturation (%) | .67 | .95 |

**Permeability**

Temperature Correction, $R_t$ = 1.086

$K_1 = 1.4 \times 10^{-8}$ cm/sec
$K_2 = 1.4 \times 10^{-8}$ cm/sec
$K_3 = 1.7 \times 10^{-8}$ cm/sec
$K_4 = 1.3 \times 10^{-8}$ cm/sec

Coefficient of Permeability, $K_{20} = 1.6 \times 10^{-8}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0014 Reviewed By: David D. McCray

6755 B [illegible] Cove MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/17/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 07S0008127

Soil Description: Dark Brown Clay with Silt & fine sand lenses

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 104.9 | 109.7 |
| Dry Density (Lbs/ft$^3$) | 81.1 | 82.0 |
| Moisture (% Dry Wt) | 29.3 | 33.7 |
| Porosity (n) | .497 | .504 |
| Degree of Saturation (%) | .91 | 1.0 |

**Permeability**

Temperature Correction, $R_t$ = 1.053

$K_1 = 8.7 \times 10^{-7}$ cm/sec
$K_2 = 7.6 \times 10^{-7}$ cm/sec
$K_3 = 8.4 \times 10^{-7}$ cm/sec
$K_4 = 8.5 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 8.7 \times 10^{-7}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0017 Reviewed By: David D. McCray

675 [illegible] Cove MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

TRI STATE TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/13/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 007S000922

Soil Description: Brown Silty Clay

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 119.9 | 121.1 |
| Dry Density (Lbs/ft$^3$) | 94.0 | 95.4 |
| Moisture (% Dry Wt) | 27.5 | 26.9 |
| Porosity (n) | .430 | .420 |
| Degree of Saturation (%) | .963 | .980 |

### Permeability

Temperature Correction, $R_t$ = 1.056

$K_1 = 6.9 \times 10^{-7}$ cm/sec
$K_2 = 1.0 \times 10^{-6}$ cm/sec
$K_3 = 9.7 \times 10^{-7}$ cm/sec
$K_4 = 9.2 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 9.5 \times 10^{-7}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0016 Reviewed By: David D. McCray

6756 Shelby Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614

TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/13/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 008MW025

Soil Description: Dark Brown Silty Clay

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 126.0 | 128.4 |
| Dry Density (Lbs/ft$^3$) | 100.1 | 101.8 |
| Moisture (% Dry Wt) | 25.9 | 26.1 |
| Porosity (n) | .396 | .384 |
| Degree of Saturation (%) | 1.0 | 1.0 |

**Permeability**

Temperature Correction, $R_t$ = 1.086

$K_1 = 5.9 \times 10^{-7}$ cm/sec
$K_2 = 1.6 \times 10^{-7}$ cm/sec
$K_3 = 1.6 \times 10^{-7}$ cm/sec
$K_4 = 2.0 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 3.0 \times 10^{-8}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0015 Reviewed By: David Q. McCray

MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

TRI STATE
TESTING SERVICES, INC.

## Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/27/95 Project No.: E-2-837

Project Name: NAS Memphis, Tennessee

Sample I.D.: 0600S0003022

Soil Description: Gray Silty Clay

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 127.1 | 124.6 |
| Dry Density (Lbs/ft$^3$) | 104.9 | 100.6 |
| Moisture (% Dry Wt) | 21.2 | 23.8 |
| Porosity (n) | .366 | .361 |
| Degree of Saturation (%) | .97 | .99 |

### Permeability

Temperature Correction, $R_t$ = 1.043

$K_1 = 2.2 \times 10^{-7}$ cm/sec
$K_2 = 1.0 \times 10^{-7}$ cm/sec
$K_3 = 1.7 \times 10^{-7}$ cm/sec
$K_4 = 1.6 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 1.7 \times 10^{-7}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. P-95-0011 Reviewed By: David D. McCray

MEMPHIS TN 38133 901-385-1199 FAX 901-386-6614

TRI-STATE
TESTING SERVICES, INC.

## Report of Laboratory Analysis

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134

Project No.: E-2-837
Date: 13 March '95
Sheet 1 of 1

Project: NAVY CLEAN Memphis, Tennessee

| Sample Identification | 007S0003117 | 008MW025 | 007S000922 |
|---|---|---|---|
| Percent Moisture (as received) | 30.1% | 25.9% | 27.5% |
| Bulk Density Wet (as received) LBS/ft$^3$ | 98.0 | 126.0 | 119.9 |
| Bulk Density Dry (as received) LBS/ft$^3$ | 75.3 | 100.1 | 94.0 |
| Specific Gravity | 2.65 | 2.64 | 2.64 |

Reviewed by: David D. McCray

6755 R[illegible] C[illegible] MEMPHIS, TN 38133 901-385-1199 FAX 901-386-6614

STATE TESTING SERVICES, INC.

## Report of Laboratory Analysis

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134

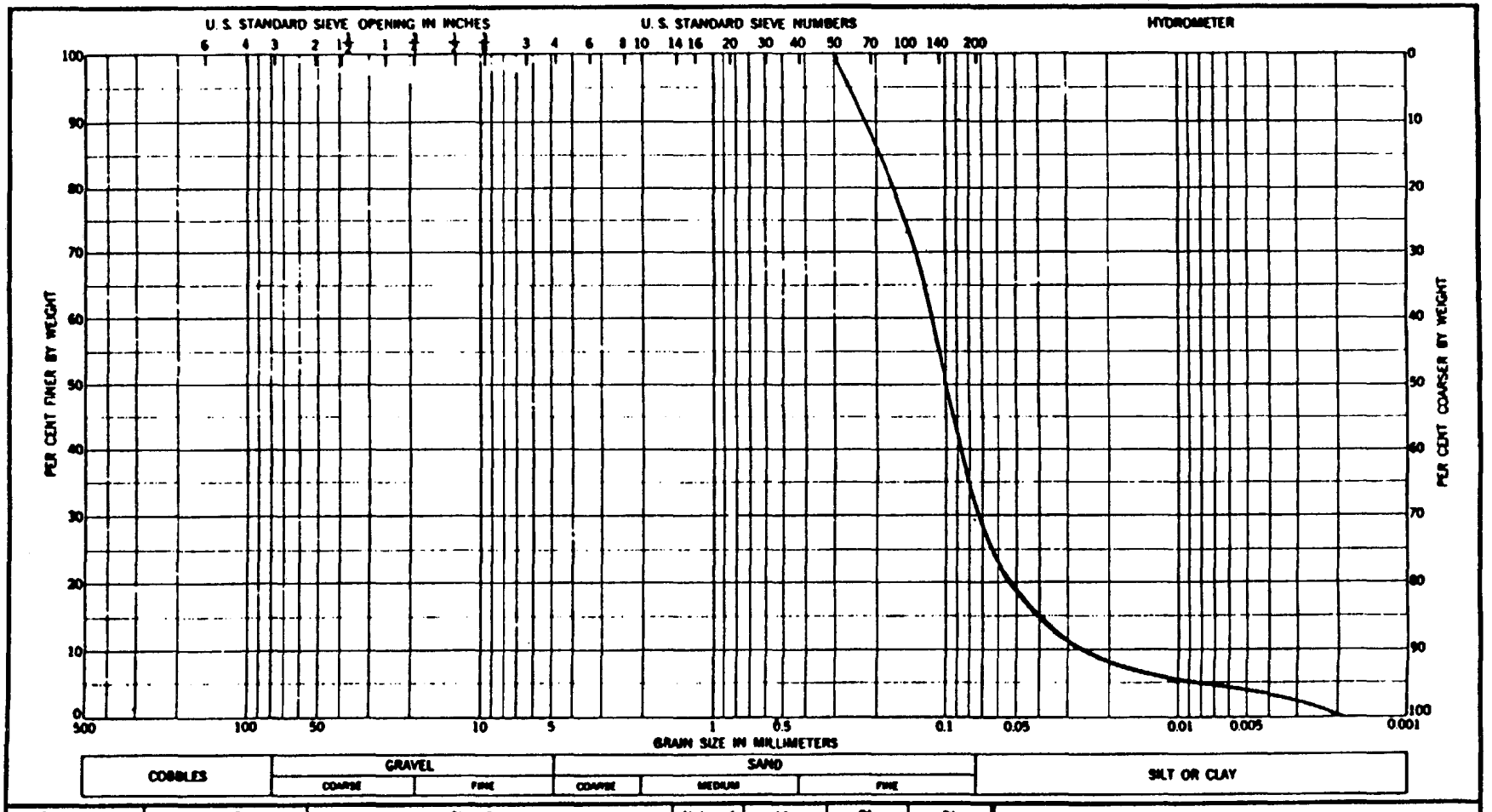
Project No.: E-2-837
Date: 17 March '95
Sheet 1 of 1

Project: NAVY CLEAN Memphis, Tennessee

| Sample Identification | 07S0008127 | 07S0001112 | 007S000177 |
|---|---|---|---|
| Percent Moisture (as received) | 29.3% | 31.7% | 17.4% |
| Bulk Density Wet (as received) LBS/ft$^3$ | 104.9 | 105.6 | 118.6 |
| Bulk Density Dry (as received) LBS/ft$^3$ | 81.1 | 80.2 | 101.0 |
| Specific Gravity | 2.65 | 2.65 | 2.63 |

Reviewed by: David D. McCray

675 B [illegible] Memphis, TN 38133 901-385-1199 FAX 901-386-6614




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project Naval Air Station
Memphis, Tennessee

Area

Boring No. Sample ID 007S000177

Date 03/14/95

## GRADATION CURVES

TRI-STATE TESTING SERVI , INC.

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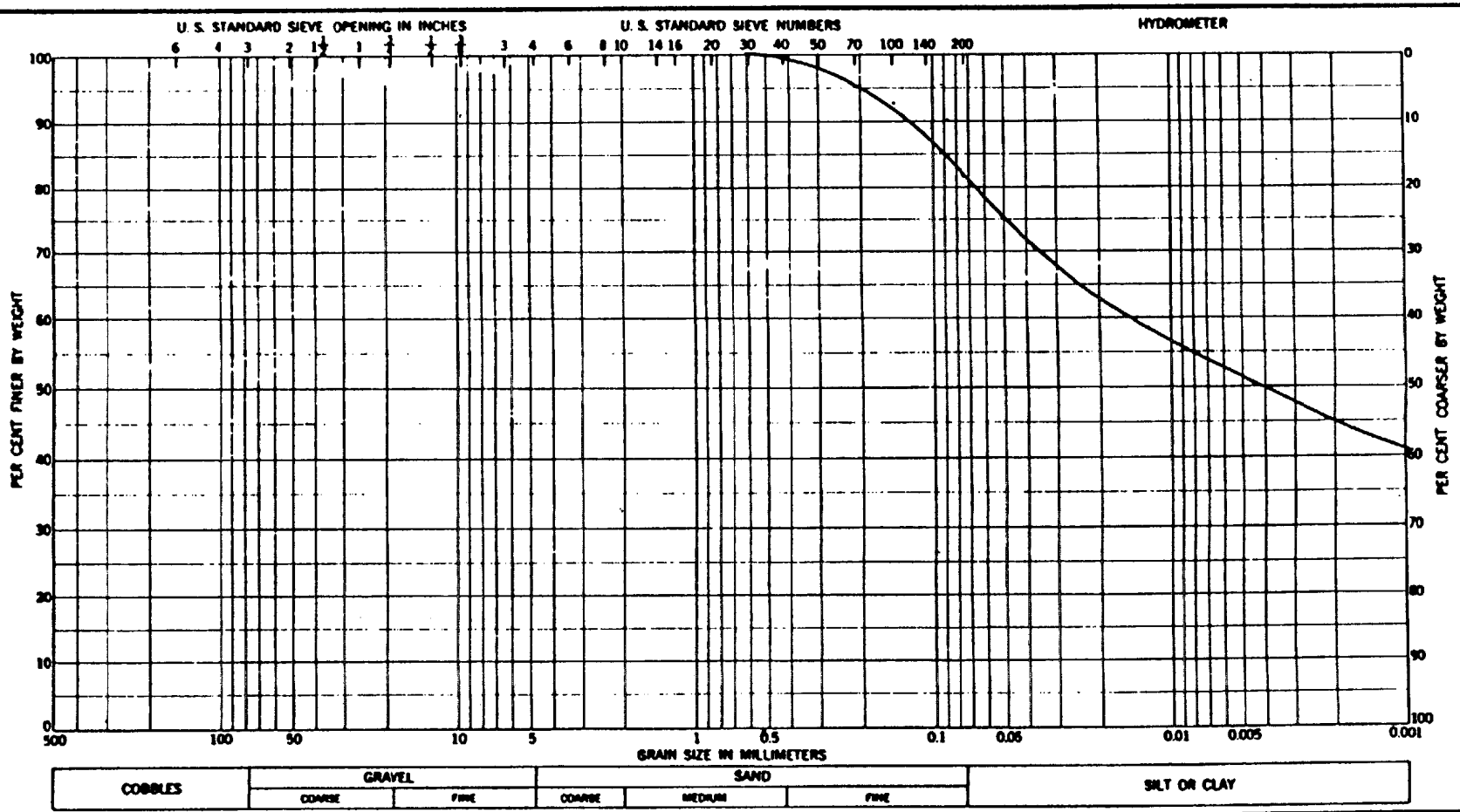



| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Project Naval Air Station
Memphis, Tennessee

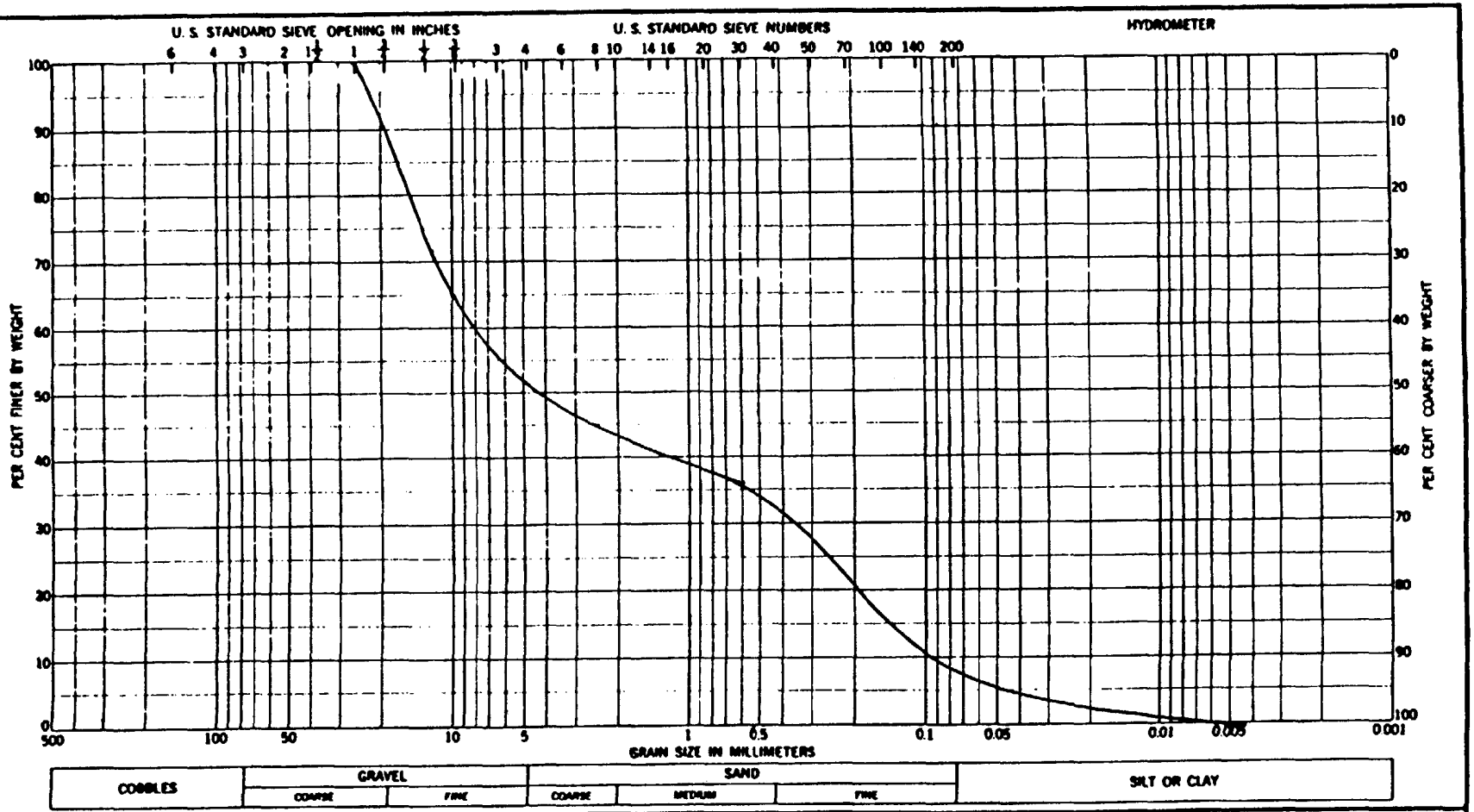
Area

Boring No. Sample ID 0750001112

Date 03/14/95

## GRADATION CURVES

TRI-STATE TESTING SER' .S, INC.




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | - |

Project Naval Air Station
Memphis, Tennessee

Area

Boring No. Sample ID 07S00275

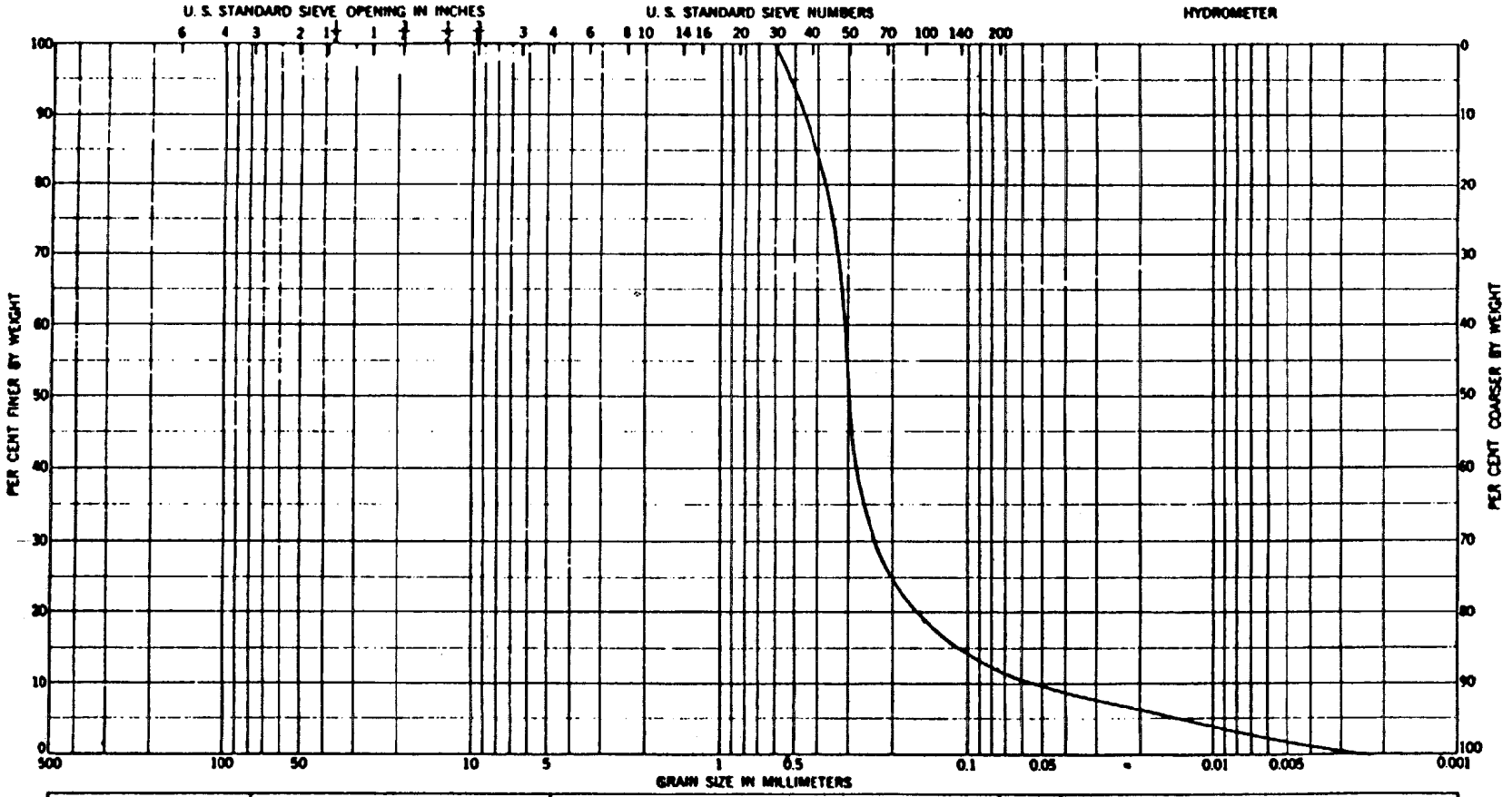
Date 03/06/95

GRADATION CURVES

TRI-STATE TESTING SERV' S, INC.

000437

000438




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project Naval Air Station
Memphis, Tennessee

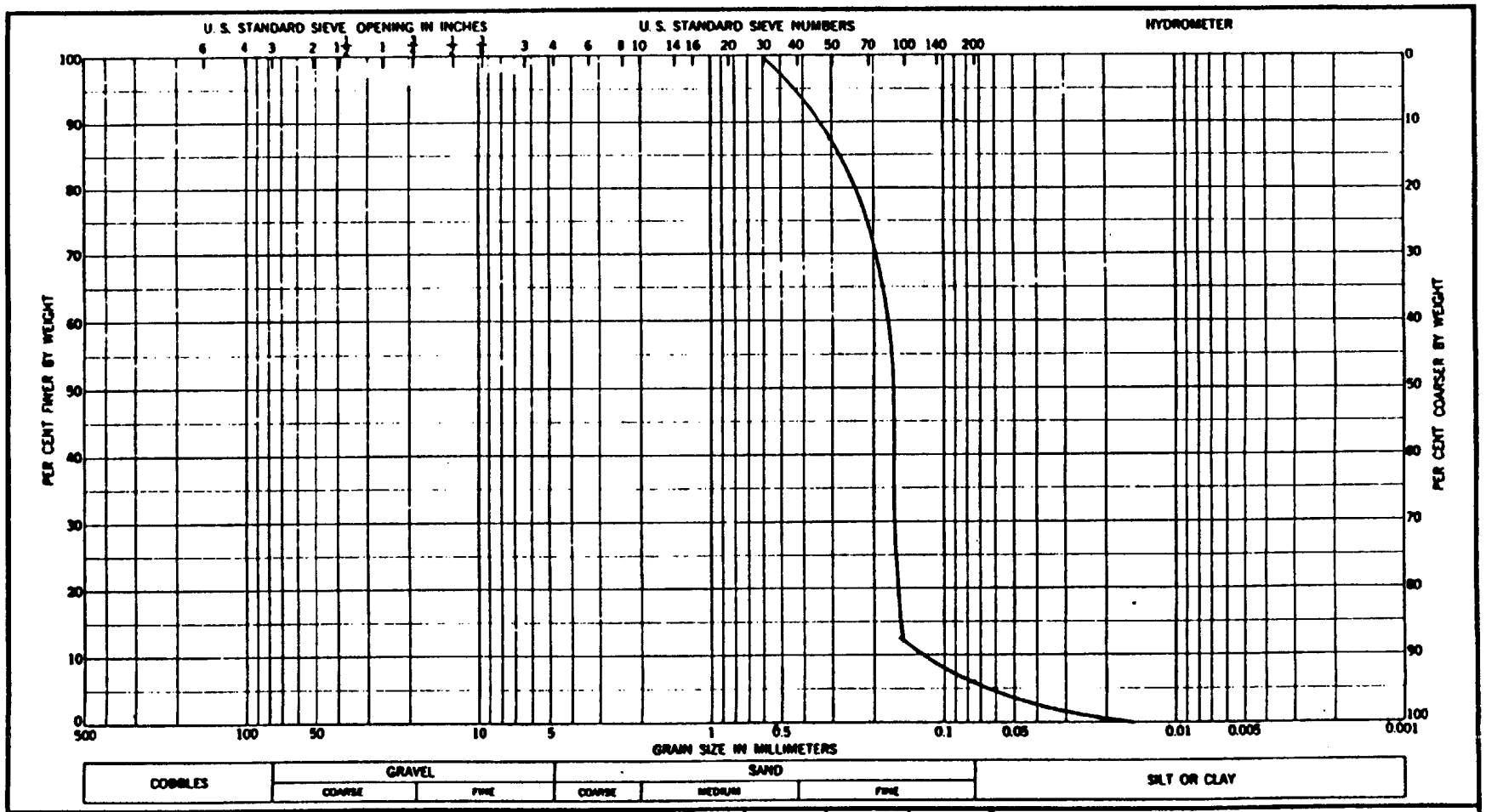
Area

Boring No. Sample ID 07S000341

Date 03/06/95

GRADATION CURVES

TRI-STATE TESTING SERVICES, INC.




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project Naval Air Station
Memphis, Tennessee

Area

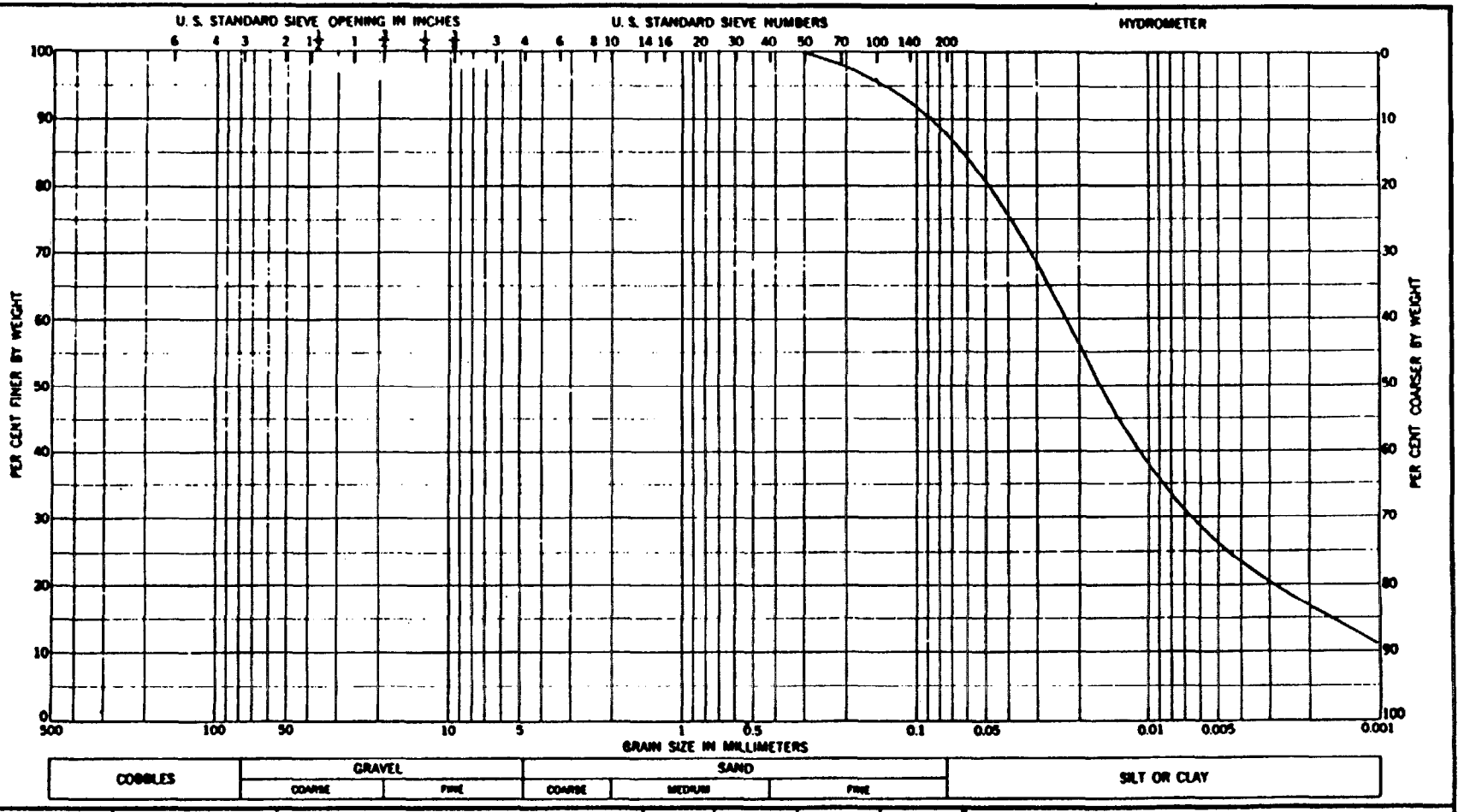
Boring No. Sample ID 07S000346

Date 03/06/95

GRADATION CURVES

TRI-STATE TESTING SERV' 'S, INC.

000439




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project: Naval Air Station Memphis, Tennessee

Area:

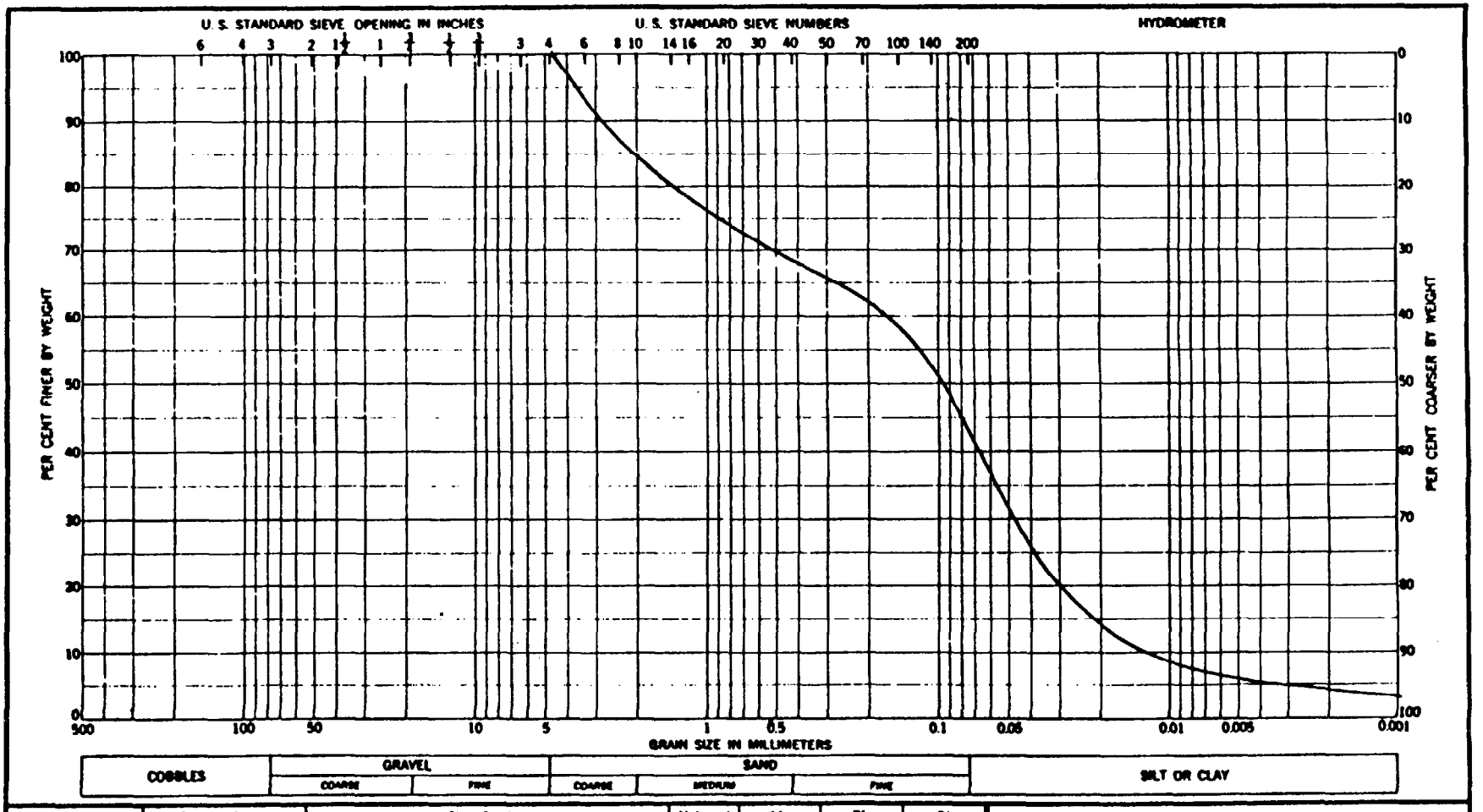
Boring No. Sample ID 00750003117

Date: 03/06/95

GRADATION CURVES

TRI-STATE TESTING SERVICES, INC.

000520




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project Naval Air Station
Memphis, Tennessee

Area

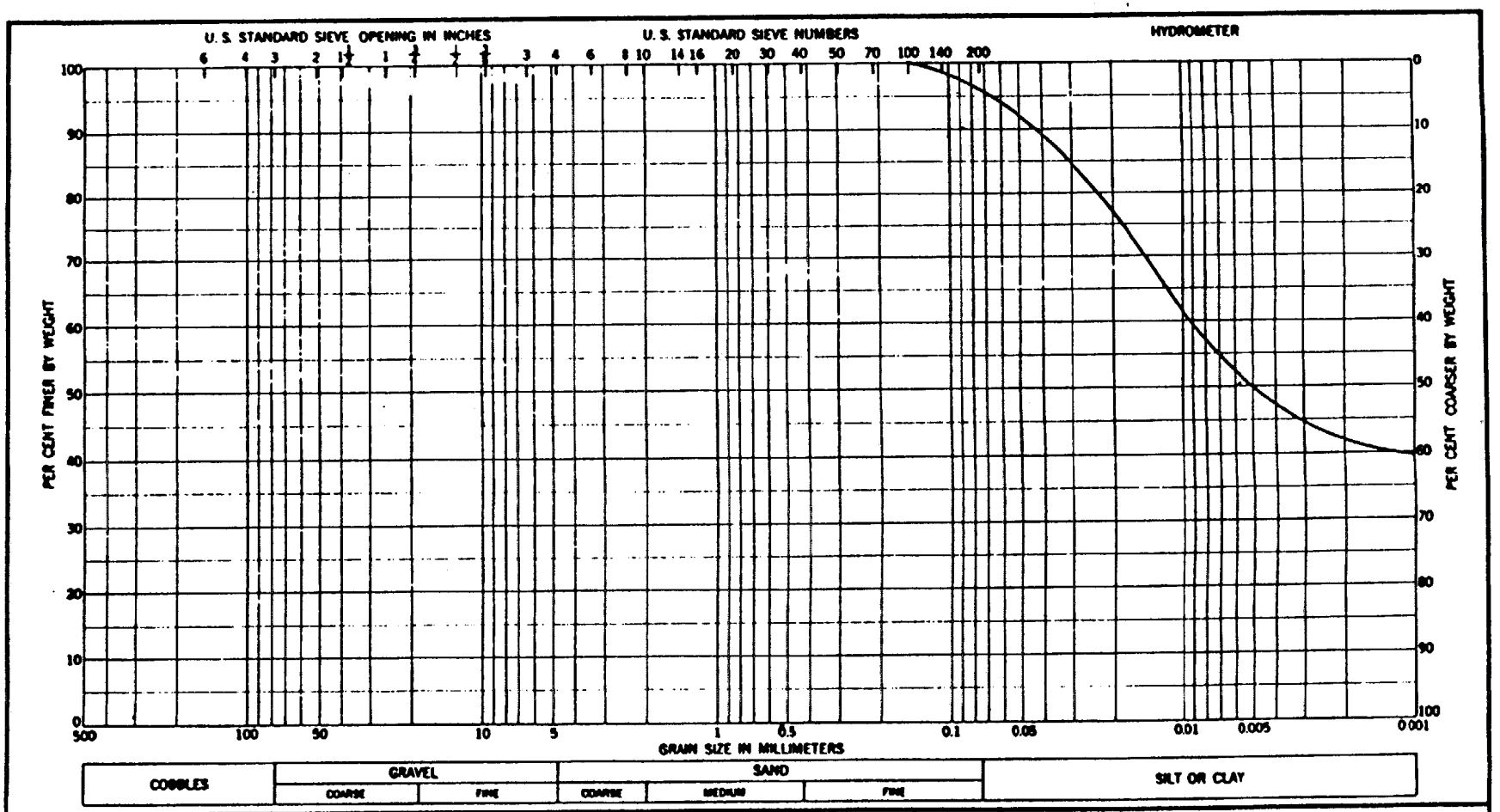
Boring No. Sample ID 07S0008127

Date 03/14/95

## GRADATION CURVES

TRI-STATE TESTING SERVICES, INC.

100501




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| -- | -- | | -- | -- | -- | -- |

Project: Naval Air Station Memphis, Tennessee

Area:

Boring No.: Sample ID 007S000922

Date: 03/06/95

## GRADATION CURVES

TRI-STATE TESTING SERVICES, INC.

# RCRA FACILITY INVESTIGATION DATA VALIDATION REPORT FOR SUPPLEMENTAL SAMPLES ASSEMBLY B NAVAL SUPPORT ACTIVITY MEMPHIS MILLINGTON, TENNESSEE

CTO-094
CONTRACT NO. N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

November 22, 1995

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000504

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Attachment 1 Data Validation Summary Narratives and Data Tables





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## 1.0 INTRODUCTION

This report presents the analytical data collected during the Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) of Naval Support Activity NSA Memphis Assembly B Solid Waste Management Units (SWMU) 4, 6, 31, 38, and 40 and the quality assurance/quality control (QA/QC) evaluation of those data. The purpose of the data evaluation is to verify that the QC requirements of the dataset have been met and to characterize the weakness of any questionable data.

The Assembly B soil, groundwater, and sediment samples were collected at NSA Memphis in May 1995, submitted to National Environmental Testing, Inc. (NET) Laboratory in Bedford, Massachusetts, and reported using U.S. Environmental Protection Agency (USEPA) Level III and Level IV equivalent Data Quality Objectives (DQO). The analytical methods and DQO equivalent laboratory deliverables are summarized in Table 1-1.

**Table 1-1**
**NSA Memphis Analytical Program**

| Analytical Method | Data Quality Level | Method Reference | Site |
|---|---|---|---|
| | | **Full Scan** | |
| Volatile Organic Compounds (VOCs) | IV | SW-846 8240 | All SWMUs |
| Semivolatile Organic Compounds (SVOCs) | IV | SW-846 8270 | All SWMUs |
| Pesticides/Polychlorinated Biphenyls (Pest/PCBs) | IV | SW-846 8080 | All SWMUs |
| Chlorinated Herbicides | IV | SW-846 8150 | All SWMUs |
| Organophosphorus Pesticides (OP Pesticides) | IV | SW-846 8140 | All SWMUs |
| Total Petroleum Hydrocarbons (TPH) | III | USEPA 418.1 | SWMUs 4, 6, 31, & 38 |
| Metals | IV | 40 CFR Part 264 Appendix IX (SW-846 6010/7060/7421/7470/7740/7841) | SWMUs 4, 6, 31, & 38 |
| Cyanide | IV | SW-846 9010 | SWMUs 4, 6, 31, & 38 |
| | | **Waste Characterization** | |
| Gasoline Range Organics (GRO) | III | Modified 8015/TN GRO, 8020 | All SWMUs |
| Diesel Range Organics (DRO) | III | Modified 8015/TN DRO | All SWMUs |



000536

The references for the methods listed in Table 1-1 were obtained from the following sources:

- USEPA Office of Solid Waste and Emergency Response (OSWER), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), Third Edition, revised July 1992.

- USEPA Environmental Monitoring and Support Laboratory, *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020, revised March 1983).

- USEPA *Title 40 Code of Federal Regulations Part 264, Appendix IX* (*52 Federal Register 25947,* July 1987)

- Data validation was performed using the following documents (as appropriate): *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review*, February 1994. OSWER.

NSA Memphis data were validated by either EnSafe/Allen and Hoshall (E/A&H) or E/A&H's subcontractor, Validata Chemical Services of Norcross, Georgia. The data were validated at Level III equivalent DQO. The data validation findings were summarized separately for each sample delivery group (SDG). The individual SDGs usually contain 20 samples of one matrix type, i.e., either solid (soil and/or sediment) or water (groundwater and/or surface water) samples, except for QC samples. The validation summary reports and data summary tables are included in Attachment A to this document.

The following sections discuss the significant data validation findings for individual SWMUs. The following outlines the SWMUs for this project and the analytical parameters associated with each SWMU.



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**Data Validation Summary of the Investigative Samples:**

| | | |
|---|---|---|
| Section 2 | Organic, Metals, Diesel and Gasoline Range Organics (DRO, GRO), and Total Petroleum Hydrocarbons (TPH) Data | SWMU 4 |
| Section 3 | Organic, Metals, DRO, GRO, and TPH Data | SWMU 6 |
| Section 4 | Organic, Metals, DRO, GRO, and TPH Data | SWMU 31 |
| Section 5 | Organic, Metals, DRO, GRO, and TPH Data | SWMU 38 |
| Section 6 | Organic, DRO, and GRO Data | SWMU 40 |

## 1.1 Organic Evaluation Criteria

The USEPA methods described in the following document define QC criteria that the laboratory must meet but the methods do not address data evaluation from a user's perspective: *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and *Methods for Chemical Analysis of Water and Wastes*. Evaluation criteria are available in *USEPA Contract Laboratory National Functional Guidelines for Organic Data Review* (Functional Guidelines), February 1994, which was used throughout the data evaluation process when the analytical methods did not address data usability.

Data evaluation for samples collected at NSA Memphis included the following parameters:

- Holding times
- Gas chromatograph/Mass spectrometry (GC/MS) instrument performance checks
- Surrogate spike recoveries
- Instrument calibration
- Matrix spike and matrix spike duplicates (MS/MSD)

- Blank analysis
- Internal standard performance
- Compound quantitation
- Field duplicate precision

According to Functional Guidelines, when the QC parameters do not fall within the specific method guidelines, the data evaluator annotates or "flags" the corresponding deficient compounds. The data from NSA Memphis were evaluated using this approach. The following flags were used to annotate data with laboratory and/or field deficiencies or problems:

U **Undetected** — The analyte was analyzed for but not detected or was also found in an associated blank, but at a concentration less than 10 times the blank concentration for common laboratory constituents (contaminants) or five times the blank concentration for other constituents; the associated value shown is the quantitation limit. The quantitation limit is described as the minimum level of detection acceptable under the contract Statement of Work.

J **Estimated Value** — At least one QC parameter was outside control limits or the concentration of the analyte was less than the Practical Quantitation Limit (PQL).

UJ **Undetected and Estimated** — The analyte was analyzed for but not detected above the listed estimated quantitation limit; the quantitation limit is estimated because at least one QC parameter was outside control limits.

D **Diluted Result** — The compound was re-analyzed at a secondary dilution factor. If at least one compound was outside the calibration range during an initial analysis, the laboratory flags the analyte "E." When diluted, the sample results will be flagged "D." Generally, values from the initial analysis will be used except where the value exceeded



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the calibration range. Values exceeding the calibration range in the initial analysis will be substituted by the diluted value to ensure the most representative data. The "D" flag will remain on the value to alert the data user that the value from a secondary dilution was used.

**R/UR Unusable Data** — One or more QC parameters grossly exceeded control limits.

These validation flags were applied to data where data deficiencies were noted. Attachment A tabulates all qualified data.

### 1.1.1 Holding Times

Acceptable technical holding times are specified in the analytical methods. The sample holding time depends on the type of analysis and whether the sample was preserved. For water samples, the holding time for preserved volatile organic compounds (VOC) and GRO analysis is 14 days from the collection date. Semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), organophosphorus pesticides, and chlorinated herbicides water samples must be extracted within seven days (14 days for DRO) and analyzed within 40 days after extraction. Holding times for soil matrices are not specified in SW-846. Therefore, the data reviewer has the discretion in applying water sample holding times criterion to soil.

The holding time for TPH (by USEPA Method 418.1) is 28 days from the day of collection for water samples that are preserved and refrigerated. No holding time is cited for soil samples; therefore, the data reviewer can apply the water sample holding time criterion to soil at his discretion.

### 1.1.2 GC/MS Mass Calibration (Instrument Performance Checks)

Tuning and performance criteria are established to ensure that the data produced by the instrument may be correctly interpreted according to the requirements of the method being used.

These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria must be met in all circumstances. Performance standards for VOC (bromofluorobenzene) and SVOC (decafluorotriphenylphosphine) analyses are analyzed to determine if the data produced by the instrument may be correctly interpreted according to the requirements of the method being used. Performance standards must be analyzed within 12 hours of sample analysis, and the results must be within the established criteria.

### 1.1.3 Surrogate Spike Recoveries

Surrogate compounds are added to samples and laboratory blanks before extraction and sample preparation to evaluate the effect of the sample matrix on extraction and measurement procedures. Surrogates are organic compounds which are chemically similar to analytes of interest but not normally found in environmental samples. Three surrogate compounds are added to samples for VOC analysis, eight are added to samples for SVOC analysis, two are added to pesticide/PCB samples, and one is added to both organophosphorus pesticides and chlorinated herbicides. Percent recovery of the surrogates is calculated by comparing the amount of the compound recovered by the analysis to the amount added to the sample.

Surrogate compounds recommended by the SW-846 methods are listed below. Abbreviations for each compound are in parentheses (when applicable).

**VOC Surrogates**
Toluene-d8 (TOL)
Bromofluorobenzene (BFB)
1,2-Dichloroethane-d4 (DCE)

**Pesticide/PCB Surrogates**
Tetrachloro-m-xylene (TCMX)
Decachlorobiphenyl (DCB)

**Herbicide Surrogate**
DCAA

**SVOC Surrogates**
Nitrobenzene-d5 (NBZ)
2-Fluorobiphenyl (FBP)
Terphenyl-d14 (TPH)
2,4,6-Tribromophenol (TBP)

Phenol-d5 (PHL)
2-Chlorophenol-d4 (2CP)
1,2-Dichlorobenzene-d4 (DCB)
2- Fluorophenol (2FP)

**Organophosphorus Pesticide Surrogate**
4-Chloro-3-Nitrobenzotrifluoride (CNBT)



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### 1.1.4 Instrument Calibration

Instruments are initially and continually calibrated with standard solutions to verify that they are capable of producing acceptable quantitative data for the compounds.

*Initial calibration (GC/MS)*: The instrument is initially calibrated at the beginning of the analytical run to check its performance and to establish a linear five-point calibration curve. The initial calibration is verified by calculating the relative response factor (RRF) and the percent relative standard deviation (%RSD) for each compound. An RRF less than 0.05 or a %RSD greater than 30% is outside the QC limits for the initial calibration.

*Continuing calibration (GC/MS)*: Standard solutions are run periodically to check the daily performance of the instrument and to establish the 12-hour RRF on which the sample quantitations are based. The continuing calibration is verified by calculating the RRF and the percent difference (%D) for each compound. An RRF less than 0.05 or a %D greater than 25% is outside the QC limits for the continuing calibration.

*Initial calibration (GC)*: For single-component pesticides, two separate standard mixes are used, five-point calibrations are analyzed, and calibration factors (CF) are established. The CF for single-component pesticides must be less than or equal to 20%.

The multi-component pesticide toxaphene and all PCBs (or aroclors) are analyzed separately. Retention times and CFs are determined for three to five primary peaks. The only review criterion for multi-component compounds is to verify these steps were taken.

A five-point initial calibration is analyzed for herbicides, organophosphorus pesticides, DRO, GRO, and TPH. Two methods for calibration may be used: external or linear regression methods. For the external method, the initial calibration may be verified by calculating the RRF and the %RSD for each compound. An RRF less than 0.05 or a %RSD greater than 20% is

outside the QC limits for the initial calibration. If linear regression is used, the correlation coefficient must meet or exceed 0.995 before analysis of the samples can begin.

*Continuing calibration (GC)*: To confirm the calibration and evaluate instrument performance for single-component pesticides, calibration verification consisting of instrument blank, performance evaluation mixtures, and the midpoint concentration of the two standard mixes are analyzed. The %D between the calculated amount and the true amount must not exceed 15% on the primary column.

Multi-component compounds do not require continuing calibration.

For herbicides and organophosphorus pesticides, the continuing calibration is verified by calculating the RRF and the percent difference (%D) for each compound. An RRF less than 0.05 or a %D greater than 15% is outside the QC limits for the continuing calibration.

### 1.1.5 Matrix Spikes/Matrix Spike Duplicates

An MS is used to determine the accuracy of the analysis for a given matrix. An MS consists of a known quantity of stock solution added to the sample before its preparation and analysis. Evaluating the MS data involves two calculations. First, the percent recovery (%R) is calculated by comparing the amount of the compound recovered by the analysis to the amount added to the sample. In addition, the relative percent difference (RPD) between the MS and the MSD samples is calculated and assessed. No specific requirements have been established for qualifying MS/MSD data. However, guidelines to aid in applying professional judgment are discussed in Functional Guidelines.

### 1.1.6 Laboratory Control Samples (LCS) and Laboratory Duplicates

TPH and GC methods may require that a Laboratory Control Sample (LCS) and laboratory duplicate be performed with each SDG. The LCS monitors the overall performance of each step



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during analysis, including sample preparation. All aqueous LCS %R results must fall within the control limits established by the laboratory. Laboratory duplicate samples are used to demonstrate acceptable method precision at the time of analysis. The RPD between the sample and the duplicate sample is calculated. Although no guidelines are established for organic laboratory duplicates, sample qualification is left up to professional judgment.

### 1.1.7 Blank Analysis

***Laboratory method blanks*** are used to assess the existence and magnitude of potential contamination introduced during analysis. Additionally, *field blanks* may be collected to assess any contamination introduced while collecting samples. When chemicals are found both in samples and laboratory blanks analyzed within the same 12-hour period **and/or** field-derived blanks, the data's usability depends on the reviewer's judgment and the blank's origin. According to Functional Guidelines, a sample result should not be considered positive unless the concentration of the compound in the sample exceeds 10 times the amount in **any** blank for common laboratory contaminants (i.e., methylene chloride, acetone, 2-butanone, and phthalate esters), or five times the amount for other constituents. These amounts are referred to as *action levels* (ALs). Because blank samples may not be prepared using the same weight of sample, volume of sample, or dilution, these factors should be also taken into consideration when using these blank criteria. The specific actions to be taken are as follows:

- If a chemical is found in the blank but not the sample, no action is taken.
- If the sample concentration is less than the quantitation limit and less than the action level, the quantitation limit is reported.
- If the sample concentration is between the quantitation limit and the action level, the concentration is reported as nondetect "U."

- If the sample concentration is greater than the action level, the concentration may be used unqualified.

### *Field-Derived Blanks*

For this project, three types of field-derived blanks were collected: the *field blank*, the *equipment rinsate blank* (also called a *rinsate blank*), and the *trip blank*. The field blank is a sample of the source water used onsite, primarily to decontaminate equipment. The equipment rinsate blank is a sample of runoff water from one or more pieces of the decontaminated equipment used to collect samples. The trip blank is a 40-milliliter volatile organic analysis vial filled at the laboratory with certifiable water used to assess cross-contamination during VOC sample shipment.

The frequencies for collecting these QC samples were defined in Section 4 of the *NAS Memphis Comprehensive RFI Work Plan* (E/A&H, October 1994) as follows:

- *Field blanks* — one per source of water per sampling event.
- *Rinsate blank* — one per week.
- *Trip blank* — one per shipment containing samples for VOAs.

For data validation, each trip blank is associated only with the samples from the same shipment/cooler. The field blanks and the rinsate blanks apply to a larger number of samples because only one is collected per sampling event. Because field-derived blanks are used with method blanks to assess potential cross-contamination of field investigative samples, no action was taken if contamination was detected in the method blanks associated with the field-derived blanks. Most rinsate and field blanks collected for Assembly B were sent to the onsite laboratory during direct push technology (DPT) work.



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### 1.1.8 Internal Standard Performance

GC/MS internal standards (IS) are added to samples to ensure the stability of the instrument's sensitivity and response during each analytical VOC and SVOC run. IS area counts for samples and blanks must not vary more than a factor of two (-50% to +100%) from the associated calibration standard. If an IS area count is outside this window, action should be taken. Listed below are the internal standard compounds recommended by the methods. Abbreviations for each compound are in parentheses.

**VOC IS Compounds**
Bromochloromethane (BCM)
1,4-Difluorobenzene (DFB)
Chlorobenzene-d5 (CBZ)

**SVOC IS Compounds**
1,4-Dichlorobenzene-d4 (DCB)
Naphthalene-d8 (NPT)
Acenaphthene-d10 (ANT)
Phenanthrene-d10 (PHN)
Chrysene-d12 (CRY)
Perylene-d12 (PRY)

### 1.1.9 Field Duplicate Precision

One field duplicate was collected at NSA Memphis for each 10 water and/or soil or sediment samples collected. Field duplicate samples are analyzed to evaluate data precision, which measures the reproducibilty of the analysis.

For the NSA Memphis RFI, RPDs between the samples and duplicates were calculated during the validation processes for sample results above the PQL. If the results for any compounds did not meet RPD criteria of <30% for water and <50% for soil or sediment, the positive results for that compound were flagged as estimated for the sample and duplicate only. If one value was nondetected and the other value was above the PQL, the positive result was flagged as estimated "J", and the nondetected result as estimated "UJ."

## 1.2 Inorganic Evaluation Criteria

The USEPA methods described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* and *Title 40 Code of Federal Regulations Part 264, Appendix IX* define QC criteria that the laboratory must meet, but the methods do not address data evaluation from a user's perspective. Evaluation criteria are available in the Functional Guidelines, which was used throughout the data evaluation process when the analytical methods did not address data usability.

Data evaluation for samples collected at NSA Memphis included the following parameters:

- Holding times
- Instrument calibration
- MS results
- Laboratory duplicates
- Blank analysis
- Inductively Coupled Plasma (ICP) interference check samples
- ICP serial dilutions
- Laboratory control sample results
- Atomic Absorption (AA) duplicate injections and post-digestion spike recoveries
- Field duplicate precision

According to Functional Guidelines, when the QC parameters do not fall within the specific method guidelines, the data evaluator annotates or "flags" the corresponding deficient compounds. The data from NSA Memphis were evaluated using this approach. The following flags were used to annotate data exhibiting laboratory and/or field deficiencies or problems:



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U **Undetected** — The analyte was analyzed for but not detected above the instrument detection limit (IDL) or was also found in an associated blank at a concentration less than 5 times the blank concentration. The IDL is the lowest possible concentration an instrument can detect a particular analyte. The IDL is determined by multiplying by three the standard deviation obtained for the analysis of a standard solution at a concentration of 3X - 5X IDL on three nonconsecutive days with seven consecutive measurements per day.

J **Estimated Value** — One or more QC parameters were outside control limits or the concentration of the analyte was less than the PQL.

UJ **Undetected and Estimated** — The analyte was analyzed for but not detected above the listed estimated IDL; the IDL is estimated because one or more QC parameters was outside control limits.

R/UR **Unusable Data** — One or more QC parameters grossly exceeded control limits.

### 1.2.1 Holding Times

Acceptable technical holding times are specified in the analytical methods. For aqueous samples, the holding time for metals analysis is six months, except for mercury, which is 28 days from the date of collection. For aqueous samples, cyanide analysis has a sample holding time of 14 days from the date of collection. Holding times for soil matrices are not specified in the methods. Therefore, the data reviewer can apply the water sample holding times criteria to soil at his discretion.

### 1.2.2 Instrument Calibration

Initial and continuing calibrations of the instruments with standard solutions are used to check that the instrument is capable of producing acceptable qualitative and quantitative data for the analytes on the Appendix IX list.

An initial calibration is performed to check the performance of the instrument at the beginning of the analytical run and to establish a linear calibration curve. Calibration standard solutions are analyzed periodically to check the performance of the instrument and confirm that the initial calibration curve is still valid. Calibrations are verified by calculating the %R and comparing the amount of the analyte recovered by analysis to the known amount of standard. The %R for metals, except for mercury and cyanide, should fall between 90% and 110%. The %R for mercury and cyanide should fall between 80% and 120% and 85% and 115%, respectively.

### 1.2.3 Blank Analysis

*Laboratory method blanks* are used to assess the existence and magnitude of potential contamination introduced during analysis. Additionally, *field blanks* may be collected to assess the potential contamination introduced during sample collection. When chemicals are found in samples and laboratory blanks, the usability of the data depends on the reviewer's judgment and the blank's origin. According to Functional Guidelines, a sample result should not be considered positive unless the concentration of the compound in the sample exceeds 5 times the amount in any blank. These amounts are referred to as ALs. Because blank samples may not be prepared using the same weight of sample, volume of sample, or dilution, these factors should be also taken into consideration when using these blank criteria. The specific actions to be taken are as follows:

- If a chemical is found in the blank but not the sample, no action is taken.

- If the sample concentration is between the IDL and the action level, the concentration is reported as "U."

- If the sample concentration is greater than the action level, the concentration may be used unqualified.

### 1.2.4 ICP Interference Check Samples

The ICP interference check sample is used to confirm the laboratory instrument's inter-element and background correction factors. Interference samples should be run at the beginning and end of each sample analysis run or at least twice per eight-hour working shift. The percent recoveries for the interference check sample should fall between 80% and 120%.

### 1.2.5 Laboratory Control Samples

LCSs are used to monitor the overall performance of steps in the analysis, including the sample preparation. All aqueous LCS percent recovery results must fall within the control limits of 80% to 120%, except for antimony and silver for which control limits have not been established. Soil LCS standards are generally provided by the USEPA (or state agency or private laboratory). Control limits are established for each soil LCS standard prepared.

### 1.2.6 MS Analysis

Samples are spiked with known quantities of analytes to evaluate the effect of the sample matrix on digestion and measurement procedures. The %R should be within 75% to 125%. However, when the sample concentration exceeds the spike concentration by a factor of four or more, spike recovery criteria are not applicable.

### 1.2.7 Laboratory Duplicates

Laboratory duplicate samples are analyzed to evaluate data precision, a measure of the reproducibilty of the analysis. The RPD between the sample and the duplicate sample is calculated. A control limit of 20 RPD for aqueous samples and 35% for soil or sediment samples should not be exceeded for analyte values greater than the quantitation limit or two times the quantitation limit, respectively.

### 1.2.8 ICP Serial Dilutions

ICP serial dilutions assess the absence or presence of matrix interference. One sample from each set of similar matrix type is chosen for the serial dilution (a five-fold dilution). For an analyte concentration which is at least a factor of 10 times above the instrument detection limit, the measured concentrations of the undiluted sample and of the diluted sample should agree within 10%.

### 1.2.9 AA Duplicate Injections and Post-Digestion Spike Recoveries

During AA analysis, duplicate injections and post digestion spikes are used to assess precision and accuracy of the laboratory analysis. The %RSD of duplicate injections must agree within 20%. Percent recovery of the post-digestion spike sample should fall between 85% and 115%.

### 1.2.10 Field Duplicate Precision

One field duplicate was collected for each 10 water and/or soil samples collected. Field duplicate samples are analyzed to evaluate data precision, which measures the reproducibilty of the analysis.

For the NSA Memphis RFI, RPDs between the samples and duplicates were calculated during the validation processes for sample results above the PQL. If the results for any compounds did not meet RPD criteria of <30% for water and <50% for soil or sediment, the positive results for that compound were flagged as estimated for the sample and duplicate only. If one value was nondetected and the other value was above the PQL, the positive result was flagged as estimated "J," and the nondetected result as estimated "UJ."

## 2.0 DATA VALIDATION RESULTS — SWMU 4

All samples were received by the laboratory intact and with the proper documentation. Table 2-1 summarizes the samples that were included in this solid waste management unit.

**Table 2-1**
**SWMU 4 Sample Analyses**

| Sample ID | VOC | SVOC | Pest/ PCB | Herb | OP Pest | APP IX Metals | Cyanide | DRO | GRO | TPH |
|---|---|---|---|---|---|---|---|---|---|---|
| 004M000101 | X | X | X | X | X | X | X | X | X | X |
| 004M000201 | X | X | X | X | X | X | X | X | X | X |
| 004M000202 | X | X | X | X | X | X | X | X | X | X |

Three investigative samples were analyzed in one SDG for SWMU 4. Full validation reports for each SDG and data tables can be found in Attachment A of this document.

### 2.1 Data Quality

The overall data quality of the analytical work performed at SWMU 4 was considered satisfactory and usable for site remediation and risk assessment. Results that were outside QA/QC requirements were flagged as estimated "J," indicating that the data could be biased either high or low. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

### 2.2 Blanks

Acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin were detected in several method and field blanks associated with these samples. The blanks were examined during the validation process and sample results for acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin believed to be from blank contamination were nullified.



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## 3.0 DATA VALIDATION RESULTS — SWMU 6

All samples were received by the laboratory intact and with the proper documentation. Table 3-1 summarizes the samples that were included in SWMU 6.

**Table 3-1**
**SWMU 6 Sample Analyses**

| Sample ID | VOC | SVOC | Pest/ PCB | Herb | OP Pest | APP IX Metals | Cyanide | DRO | GRO | TPH |
|---|---|---|---|---|---|---|---|---|---|---|
| 006M000101 | X | X | X | X | X | X | X | X | X | X |
| 006M000102 | X | X | X | X | X | X | X | X | X | X |
| 006M000201 | X | X | X | X | X | X | X | X | X | X |
| 006M000301 | X | X | X | X | X | X | X | X | X | X |
| 006M000401 | X | X | X | X | X | X | X | X | X | X |
| 006M000501 | X | X | X | X | X | X | X | X | X | X |
| 006N000501 | X | X | X | X | X | X | X | X | X | X |
| 006M000502 | X | X | X | X | X | X | X | X | X | X |
| 006M000601 | X | X | X | X | X | X | X | X | X | X |
| 006N000601 | X | X | X | X | X | X | X | X | X | X |
| 007T050395 (Trip Blank) | X | | | | | | | | | |
| 007T050495 (Trip Blank) | X | | | | | | | | | |

Ten investigative samples and two field QC samples were analyzed in one SDG for SWMU 6. Full validation reports of each SDG and data tables can be found in Attachment A.

### 3.1 Data Quality

The overall data quality of the analytical work performed at SWMU 6 was considered satisfactory and usable for site remediation and risk assessment. Results outside QA/QC requirements were flagged as estimated "J," indicating that the data could be biased either high or low. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.



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## 3.2 Blanks

Acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin were detected in several method and field blanks. The blanks were examined during the validation process and sample results for acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin believed to be from blank contamination were nullified.



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## 4.0 DATA VALIDATION RESULTS — SWMU 31

All samples were received by the laboratory intact and with the proper documentation. Table 4-1 summarizes the samples that were included in SWMU 31.

**Table 4-1**
**SWMU 31 Sample Analyses**

| Sample ID | VOC | SVOC | Pest/ PCB | Herb | OP Pest | APP IX Metals | Cyanide | DRO | GRO | TPH |
|---|---|---|---|---|---|---|---|---|---|---|
| 031M000101 | X | X | X | X | X | X | X | X | X | X |

One investigative sample was analyzed in one SDG for SWMU 31. Full validation reports for each SDG and data tables can be found in Attachment A.

### 4.1 Data Quality

The overall data quality of the analytical work performed at SWMU 31 was considered to be satisfactory and usable for site remediation and risk assessment. Results that were outside QA/QC requirements were flagged as estimated "J," indicating that the data could be biased either high or low. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

### 4.2 Blanks

Acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin were detected in several method and field blanks. The blanks were examined during the validation process and sample results for acetone, di-n-butylphthalate, zinc, beryllium, cobalt, silver, and tin believed to be from blank contamination were nullified.



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## 5.0 DATA VALIDATION RESULTS — SWMU 38

All samples were received by the laboratory intact and with the proper documentation. Table 5-1 summarizes the samples that were included in SWMU 38.

**Table 5-1**
**SWMU 38 Sample Analyses**

| Sample ID | VOC | SVOC | Pest/ PCB | Herb | OP Pest | APP IX Metals | Cyanide | DRO | GRO | TPH |
|---|---|---|---|---|---|---|---|---|---|---|
| 038M000101 | X | X | X | X | X | X | X | X | X | X |
| 038M000201 | X | X | X | X | X | X | X | X | X | X |
| 038M000301 | X | X | X | X | X | X | X | X | X | X |
| 038M000401 | X | X | X | X | X | X | X | X | X | X |
| 038M000402 | X | X | X | X | X | X | X | X | X | X |
| 038M000501 | X | X | X | X | X | X | X | X | X | X |
| 038N000501 | X | X | X | X | X | X | X | X | X | X |
| 038M000502 | X | X | X | X | X | X | X | X | X | X |
| 038M000601 | X | X | X | X | X | X | X | X | X | X |
| 038M000701 | X | X | X | X | X | X | X | X | X | X |
| 038M000702 | X | X | X | X | X | X | X | X | X | X |
| 038M000801 | X | X | X | X | X | X | X | X | X | X |
| 038M000802 | X | X | X | X | X | X | X | X | X | X |
| 007E050595 (Rinsate Blank) | X | X | X | X | X | X | X | X | X | X |

Thirteen investigative samples and one field QC sample were analyzed in two SDGs for SWMU 38. Full validation reports for each SDG and data tables can be found in Attachment A of this document.

### 5.1 Data Quality

The overall data quality of the analytical work performed at SWMU 38 was considered satisfactory and usable for site remediation and risk assessment. Results that were outside



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QA/QC requirements were flagged as estimated "J," indicating that the data could be biased either high or low. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

## 5.2 Unusable Data

A few samples were rendered unusable because they grossly exceeded QC parameters. Table 5-2 summarizes the unusable data and explains the qualification.

**Table 5-2**
**SWMU 38 Unusable Data**

| Sample ID | Fraction | Analyte(s) | Reason |
|---|---|---|---|
| 038M000301 | OP Pesticides | naled<br>merphos | Matrix spike/matrix spike duplicate percent recovery |
| 038M000301 | Herbicides | 2,4-DB<br>dalapon<br>dicamba | Matrix spike/matrix spike duplicate percent recovery |

## 5.3 Blanks

Acetone, di-n-butylphthalate, silver, tin, zinc, beryllium, and cobalt were detected in several method and field blanks. The blanks were examined during the validation process and sample results for acetone, di-n-butylphthalate, silver, tin, zinc, beryllium, and cobalt believed to be from blank contamination were nullified.



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## 6.0 DATA VALIDATION RESULTS — SWMU 40

All samples were received by the laboratory intact and with the proper documentation. Table 6-1 summarizes the samples that were included in SWMU 40.

**Table 6-1**
**SWMU 40 Sample Analyses**

| Sample ID | VOC | SVOC | TPH-DRO | TPH-GRO | TPH |
|---|---|---|---|---|---|
| 040S0G0809 | X | X | X | X | |
| 040SG0503D | X | | | | |
| 040SG0703D | X | | | | |
| 040SG0803D | X | | | | |
| 040SG1003D | X | | | | |
| 040GH0512D | X | | | | |
| 040GH0646D | X | | | | |
| 040GH0844D | X | | | | |
| 040GH0951D | X | | | | |
| 040GH1012D | X | | | | |
| 040SS1311D | X | X | X | X | |
| 040SS1503D | X | | | | |
| 040GH1847D | X | | | | |
| 040GH1908D | X | | | | |

Fourteen investigative samples were analyzed in two SDGs for SWMU 40. Full validation reports for each SDG and data tables can be found in Attachment A.

### 6.1 Data Quality

The overall data quality of the analytical work performed at SWMU 40 was considered satisfactory and usable for site remediation and risk assessment. Results that were outside QA/QC requirements were flagged as estimated "J," indicating that the data could be biased

either high or low. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

## 6.2 Unusable Data

A few samples were rendered unusable because they grossly exceeded QC parameters. Table 6-2 summarizes the unusable data and explains the qualification.

**Table 6-2**
**SWMU 40 Unusable Data**

| Sample ID | Fraction | Analyte(s) | Reason |
|---|---|---|---|
| 040S0G0809 | Semivolatiles | base/neutral fraction | Surrogate percent recovery |

## 6.3 Blanks

Acetone, methylene chloride, xylene, 2-butanone, di-n-butylphthalate, arsenic, barium, beryllium, copper, lead, selenium, vanadium, and tin were detected in several method and field blanks. The blanks were examined during the validation process and sample results for acetone, methylene chloride, xylene, 2-butanone, di-n-butylphthalate, arsenic, barium, beryllium, copper, lead, selenium, vanadium, and tin believed to be from blank contamination were nullified.



000531

**Attachment A**

**Data Validation Summary Narratives**

**and**

**Data Tables**

**VALIDATA**
**Chemical Services, Inc.**
P. O. Box 930422 Norcross, Ga. 30093

# DATA VALIDATION SUMMARY REPORT

| | |
|---|---|
| COMPANY: | Ensafe/Allen & Hoshall |
| SITE NAME: | NAS Memphis |
| PROJECT NUMBER: | 8500.024 |
| CONTRACTED LAB: | National Environmental Testing, Inc. |
| QA/QC LEVEL: | Level III |
| EPA SOW/METHOD: | EPA 1990 SOW |
| VALIDATION GUIDELINES: | *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, 1994; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, 1994 |
| SAMPLE MATRICES: | Soil and Water |
| TYPES OF ANALYSES: | Volatile Organics (VOA), Semivolatile Organics (SVOA), Organochlorine Pesticides/PCB's (P/PCB), Total Metals and Cyanide (Me/CN), Herbicides (HERB), Organophosphorus Pesticides (OPPE), Total Petroleum Hydrocarbons (TPH), Diesel Range Organics (DRO), Gasoline Range Organics (GRO) |

SDG NUMBER: 1395

SAMPLES:

| Client Sample #: | Lab Sample #: | Matrix | VOA | SVOA | P/PCB | Me/CN | HERB |
|---|---|---|---|---|---|---|---|
| 004M000101 | 122962151 | Soil | X | X | X | X | X |
| 004M000201 | 122963152 | Soil | X | X | X | X | X |
| 004M000202 | 122964153 | Soil | X | X | X | X | X |
| 006M000101 | 122861155 | Soil | X | X | X | X | X |
| 006M000102 | 122862156 | Soil | X | X | X | X | X |
| 006M000102RE | 122862RE | Soil | X | | | | |
| 006M000201 | 122863157 | Soil | X | X | X | X | X |
| 006M000301 | 122864158 | Soil | X | X | X | X | X |
| 006M000301DL | 122864DL158DL | Soil | | | X | | |
| 006M000401 | 122865159 | Soil | X | X | X | X | X |
| 006M000501 | 122965154 | Soil | X | X | | X | X |
| 006M000501RE | 122954RE* | Soil | | | X | | |
| 006M000501DUP | 122954DUP | Soil | | | | | X |

| Client Sample #: | Lab Sample #: | Matrix | VOA | SVOA | P/PCB | Me/CN | HERB |
|---|---|---|---|---|---|---|---|
| 006N000501 | 122966155 | Soil | X | X | | X | X |
| 006N000501DUP | 122966DUP155DUP | Soil | | | | | X |
| 006N000501RE | 122955RE* | Soil | | | X | | |
| 006M000502 | 122967150 | Soil | X | X | | X | X |
| 006M000502RE | 122956RE* | Soil | | | X | | |
| 006M000502DUP | 122967DUP156DUP | Soil | | | | | X |
| 006M000601 | 122968157 | Soil | X | X | | X | X |
| 006M000601DUP | 122968DUP157DUP | Soil | | | | | X |
| 006M000601RE | 122957RE* | Soil | | | X | | |
| 006N000601 | 122969158 | Soil | X | X | | X | X |
| 006N000601DUP | 122969DUP158DUP | Soil | | | | | X |
| 006N000601RE | 122958RE* | Soil | | | X | | |
| 007T050395 | 122867 | Water | X | | | | |
| 007T050495 | 122973 | Water | X | | | | |
| 031M000101 | 122866160 | Soil | X | X | | X | X |
| 031M000101RE | 122866RE | Soil | X | | | | |
| 038M000101 | 122970159 | Soil | X | X | X | X | X |
| 038M000101DUP | 122970DUP | Soil | | | | | X |
| 038M000201 | 122971160 | Soil | X | X | | X | X |
| 038M000201DUP | 122971DUP160DUP | Soil | | | | | X |
| 038M000201RE | 122960RE* | Soil | | | X | | |
| 038M000301 | 122972161 | Soil | X | X | X | X | X |
| 038M000301DUP | 122972DUP161DUP | Soil | | | | | X |
| 038M000301MS | 122972MS | Soil | | X | | X | X |
| 038M000301MSD | 122972MSD | Soil | | X | | X | X |

| Client Sample #: | Lab Sample #: | Matrix | OPPE | TPH | DRO | GRO |
|---|---|---|---|---|---|---|
| 004M000101 | 122951 | Soil | X | X | X | X |
| 004M000201 | 122952 | Soil | X | X | X | X |
| 004M000202 | 122953 | Soil | X | X | X | X |
| 006M000101 | 122855 | Soil | X | X | X | X |
| 006M000102 | 122856 | Soil | X | X | X | X |
| 006M000201 | 122857 | Soil | X | X | X | X |
| 006M000301 | 122858 | Soil | X | X | X | X |
| 006M000401 | 122859 | Soil | X | X | X | X |
| 006M000501 | 122954 | Soil | X | X | X | X |
| 006N000501 | 122955 | Soil | X | X | X | X |
| 006M000502 | 122956 | Soil | X | X | X | X |
| 006M000601 | 122957 | Soil | X | X | X | X |
| 006N000601 | 122958 | Soil | X | X | X | X |
| 031M000101 | 122860 | Soil | X | X | X | X |
| 038M000101 | 122959 | Soil | X | X | X | X |
| 038M000201 | 122960 | Soil | X | X | X | X |
| 038M000301 | 122961 | Soil | X | X | X | X |
| 038M000301MS | 122961MS | Soil | X | X | X | X |
| 038M000301MSD | 122961MSD | Soil | X | X | X | X |

N = FIELD DUPLICATE, T = TRIP BLANK, DL = DILUTION, RE = REANALYSIS,
DUP = DUPLICATE ANALYSIS, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE
(*) = ONLY THIS ANALYSIS FOR THE SAMPLE WAS SUBMITTED ON THE SPREADSHEET

DATA REVIEWER(S): Amy L. Hogan, Marvin L. Smith

RELEASE SIGNATURE:

## Data Qualifier Definitions:

| | | |
|---|---|---|
| J | - | The associated numerical value is an estimated quantity. |
| R | - | The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification. |
| U | - | The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit. |
| UJ | - | The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity. |

DATA QUALIFICATION SUMMARY

NET, Inc. - 1395 Organics and Inorganics

SAMPLES: 004M000101, 004M000201, 004M000202, 006M000101, 006M000102, 006M000201, 006M000301, 006M000401, 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 007T050395, 007T050495, 031M000101, 038M000101, 038M000201, 038M000301, 038M000301MS, 038M000301MSD, 006M000102RE, 006M000301DL, 006M000501RE, 006M000501DUP, 006N000501DUP, 006N000501RE, 006M000502RE, 006M000502DUP, 006M000601DUP, 006M000601RE, 006N000601DUP, 006N000601RE, 031M000101RE, 038M000101DUP, 038M000201DUP, 038M000201RE, 038M000301DUP

*VOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was necessary.

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/16/95 at 09:31 on instrument HP5970H:

| | |
|---|---|
| acetone | 31.8% |
| 2-butanone | 32.0% |
| 4-methyl-2-pentanone | 26.6% |
| 2-hexanone | 28.1% |

The positive and non-detect results for acetone in associated samples 006M000101, 006M000102, 006M000201, 006M000301 and 031M000101 were flagged as estimated (J) and (UJ). The results for the other compounds, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Difference (%D) of chloromethane (25.6%) exceeded the 25% QC limit for the continuing calibration run on 5/15/95 at 10:48 on instrument HP5970K. The associated sample for this calibration 007T050395 was a trip blank. No action was taken.

The Percent Difference (%D) of chloromethane (29.3%) exceeded the 25% QC limit for the continuing calibration run on 5/17/95 at 10:15 on instrument HP5970K. The associated sample for this calibration 007T050495 was trip blank. No action was taken.

IV.) Blanks:

Method Blanks:

Acetone and bromomethane were detected at 4.0 ug/kg and 1.0, respectively, ug/kg in soil method blank VBLK051695H, ANALYZED AT 13:33. All positive results for acetone in associated samples 006M000101, 006M000102, 006M000201, 006M000301 and 031M000101 less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample. There were no positive results for the other compound in the associated samples. No further action was necessary.

Acetone was detected at 2.0 ug/L in soil method blank VBLK051695H analyzed at 20:53. All positive results for this compound in associated samples 004M000101, 004M000201, 006M000102RE, 006M000501, 006M000502, 006M000601, 006N000501, 006N0000601, 031M000101RE, 038M000201 and 038M000301 less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample.

Trip Blanks:

Methylene chloride was detected at 1.0 ug/L in trip blanks 007T050395 and 007T050495. All positive results for this compound in all samples for this SDG less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample.

TIC's:

There were no TIC's reported in the blanks for this SDG. No action was required.

V.) Surrogate Recoveries:

The Percent Recovery (%R) of toluene-d8 (168%) exceeded the 84-138% QC limits for sample 031M000101RE. All positive results for this sample were flagged as estimated (J).

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

No MS / MSD analyses were performed for this fraction in this SDG. No action was taken.

VII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate sample pairs 006M000501 / 006N000501 and 006M000601 / 006N000601. No action was required.

VIII.) Internal Standards Performance:

The Percent Recoveries (%R's) of 1,4-difluorobenzene (49.7%) and chlorobenzene-d5 (37.5%) were below the 50-200% QC limits for sample 031M000101. All positive and non-detect results for the associated compounds in this sample were flagged as estimated (J) and (UJ).

The Percent Recoveries (%R's) of bromochloromethane (32.5%) and chlorobenzene-d5 (48.5%) were below the 50-200% QC limits for sample 006M000102. All positive and non-detect results for the associated compounds were flagged as estimated (J) and (UJ).

The Percent Recoveries (%R's) of bromochlorobenzene (31.0%), 1,4-difluorobenzene (28.3%) and chlorobenzene-d5 (26.3%) were below the 50-200% QC limits for sample 006M000102RE. All positive and non-detect results for this sample were flagged as estimated (J) and (UJ).

The Percent Recovery (%R) of chlorobenzene-d5 (24.8%) was below the 50-200% QC limits for sample 031M000101RE. All positive and non-detect results for the associated compounds in this sample were flagged as estimated (J) and (UJ).

The Percent Recovery (%R) of chlorobenzene-d5 (45.3%) was below the 50-200% QC limits for sample 038M000301. All positive and non-detect results for the associated compounds were flagged as estimated (J) and (UJ).

IX.) TCL Compound Identification:

All TCL criteria were met, so no action was necessary.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met. No action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

Sample 031M000101RE was analyzed 49 minutes after the 12 hour tuning QC limit. All positive and non-detect results for this sample were flagged as estimated (J) and (UJ). For this reason, the original analysis for 031M000101 is considered by the validator to be of preferrable data quality. Since all of the internal standards failed percent recovery criteria for sample 006M000102RE, the original analysis for this sample is considered by the validator to be of preferrable data quality. All remaining laboratory data were acceptable with qualification.

The method blanks were listed on the speadsheets, but the positive detections of target compounds were not record. Two method blanks were labeled VBLK051695H. The data from the Form 1 of the earlier analysis were entered on the spreadsheet during validation.

*SEMIVOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was necessary.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met, so no action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviations (%RSD's) of hexachlorocyclopentadiene (35.2%) and 2,4-dinitrophenol (32.1%) exceeded the 30% QC limit for the initial calibration run on 4/28/95 on instrument HP5970F. There were no positive results for these compounds in the associated samples. No action was required.

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/11/95 at 11:35 on instrument HP5970F:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 30.2% |
| 2-nitroaniline | 25.8% |

The results for these compounds in associated samples 006M000201, 006M000301, 006M000401, 006M000101, 006M000102 and 031M000101, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/19/95 at 07:50 on instrument HP5970F:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 57.2% |
| n-nitroso-di-n-propylamine | 36.9% |
| 2-nitroaniline | 42.8% |

The only associated sample for this calibration was a method blank. No action was taken.

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/24/95 at 12:57 on instrument HP5970F:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 27.3% |
| n-nitroso-di-n-propylamine | 32.7% |
| 2,4-dinitrophenol | 73.4% |
| 4,6-dinitro-2-methylphenol | 32.7% |
| butylbenzylphthalate | 28.3% |
| di-n-octylphthalate | 52.1% |

All positive and non-detect results for these compounds in associated samples 004M000101, 004M000201, 004M000202, 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 038M000101, 038M000201 and 038M000301 were flagged as estimated (J) and (UJ).

IV.) Blanks:

Method Blanks:

Di-n-butylphthalate was detected at 400 ug/kg in soil method blank SBLK050995F. There were no positive results for this compound in associated samples 006M000101, 006M000102, 006M000201, 006M000301, 006M000401 and 031M000101. No action was required.

Di-n-butylphthalate was detected at 480 ug/kg in soil method blank SBLK051295F. All positive results for this compound in associated samples 004M000101, 004M000201, 004M000202, 006M000502, 006M000501, 006M000601, 006N000501, 006N000601, 038M000101, 038M000201 and 038M000301 less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample. Only samples 004M000101 and 006M000501 required data qualification.

V.) Surrogate Recoveries:

The Percent Recovery (%R) of 2,4,6-tribromophenol exceeded the 19-122% QC limits for the following samples:

| | |
|---|---|
| 006M000101 | 124% |
| 006M000102 | 137% |
| 006M000201 | 131% |
| 006M000301 | 180% |
| 006M000401 | 157% |
| 031M000101 | 149% |

Since only one surrogate recovery failed for each sample, no action was required.

The Percent Recovery (%R) of phenol-d5 exceeded the 24-113% QC limits for the following samples:

| | |
|---|---|
| 006M000502 | 115% |
| 038M000301 | 116% |

Since only one surrogate recovery failed for each sample, no action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

The Relative Percent Difference (RPD) for acenapthene (46%) exceeded the 19% QC limit for spiked samples 038M000301MS and 038M000301MSD. The positive result for this compound in associated sample 038M000301 was previously flagged by the laboratory as estimated (J). No further action was taken.

The RPD for pyrene (114%) exceeded the 36% QC limit for spiked samples 038M000301MS and 038M000301MSD. The positive result for this compound in associated sample 038M000301 was flagged as estimated (J).

The Percent Recovery (%R) for pyrene in spiked sample 038M000301MSD (409%) exceeded the 35-142% QC limits. The positive result for this compound in associated sample 038M000301 was previously flagged as estimated (J). No further action was required.

VII.) Field Duplicates:

The Relative Percent Differences (RPD's) for fluoranthene (84%) and pyrene (71%) exceeded the 60% QC limit for soil field duplicate samples 006M000501 and 006N000501. The positive results for these two compounds in these two field duplicate samples were flagged as estimated (J).

There were no calculable RPD's for field duplicate samples 006M000601 and 006N000601. No action was necessary.

VIII.) Internal Standards Performance:

All Internal Standard Performance criteria were met. No action was required.

IX.) TCL Compound Identification:

All TCL criteria were met, so no action was required.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met, so no action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*PESTICIDES/PCB's*

I.) Holding Times:

The number of days between sample date and extraction date for the following samples exceeded the 14 day QC limit:

| Client Sample # | Days |
|---|---|
| 006M000501RE | 22 |
| 006M000502RE | 22 |
| 006M000601RE | 22 |
| 006N000501RE | 22 |
| 006N000601RE | 22 |
| 038M000201RE | 22 |

All positive and non-detect results for these samples were flagged as estimated (J) and (UJ).

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

All Calibration criteria were met. No action was required.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of surrogates in the following samples exceeded the 30-150% QC limits:

| Client Sample # | TCX %R | DCB %R |
|---|---|---|
| 006M000301 | 184 | 302 |
| 006M000301DL | 192 | 230 |
| 006M000401 | | 176 |
| 031M000101 | | 311 |
| 038M000301 | | 226 |

All positive results for these samples were flagged as estimated (J).

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

Sample 038M000301 was used for the MS / MSD analysis for this SDG. Due to severe matrix effects, no results for these samples were reported. Because of this, all results for this sample were flagged as estimated. Laboratory Control Samples (LCS's) were also analyzed. All recovery criteria for these samples were met. No further action was taken.

VII.) TCL Compound Identification:

Pesticide/PCB Identification Summary (PIS):

All PIS criteria were met. No action was required.

VIII.) Field Duplicates:

The Relative Percent Differences (RPD's) for dieldrin (22%), 4,4'-DDD (53%) and 4,4'-DDT (8.7%) were within the 60% QC limit for field duplicate samples 006M000501RE and 006N000501RE. No action was taken.

The Relative Percent Difference (RPD) for dieldrin (158%) for field duplicate samples 006M000601RE and 006N000601RE exceeded the 60% QC limit. The positive results for this compound in these two samples were previously flagged as estimated (J). No further action was taken.

IX.) Pesticide Cleanup Check:

Florisil Cartridge Check:

All criteria were met, so no action was taken.

Gel Permeation Chromatography (GPC):

All GPC criteria were met, so no action was necessary.

X.) Overall Assessment of Data/General:

The initial laboratory data were not available for the re-extracted sample. No comparision of the two analyses could be made.

All positive and non-detect results for the re-extracted samples in this SDG were flagged as estimated (J) and (UJ) due to holding time exceedances. All laboratory data were acceptable with qualification.

*ORGANOPHOSPHORUS PESTICIDES*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) of merphos (61.2%) exceeded the 20% QC limit for the initial calibration run on 5/12/95. The non-detect results for this compound in associated samples 006M000101, 006M000102, 006M000201, 006M000301, 006M000401 and 031M000101 were flagged as estimated (UJ).

The Percent Relative Standard Deviation (%RSD) of merphos (69.4%) exceeded the 20% QC limit for the initial calibration run on 5/23/95. The non-detect results for this compound in associated samples 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 038M000201, 004M000101, 004M000201, 004M000202, 038M000101 and 038M000301 were flagged as estimated (UJ).

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/14/95 at 01:08:

| Compound | %D |
|---|---|
| naled | 68.3 |
| merphos | 38.1 |
| dichlorvus | 63.2* |
| alpha mevinphos | 54.0* |
| merphos | 61.7* |
| stirophos | 36.7* |
| coumaphos | 2900* |

* The %D's for these compounds were from the secondary column.

The positive and non-detect results for these compounds in associated samples 006M000101, 006M000102, 006M000201, 006M000301, 006M000401 and 031M000101 were flagged as estimated (J) and (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/24/95 at 19:56:

| Compound | %D |
|---|---|
| merphos | 27.7 |
| tokuthion | 115 |
| naled | 27.1* |
| merphos | 38000* |

* The %D's for these compounds were from the secondary column.

The results for these compounds in associated samples 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 038M000201, 004M000101, 004M000201, 004M000202, 038M000101 and 038M000301, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 07:51:

| Compound | %D |
|---|---|
| alpha mevinphos | 26.1 |
| tokuthion | 158 |
| fensolfuthion | 45.0 |
| stirophos | 29.3 |
| sulprofos | 25.9 |
| guthion | 32.1 |
| merphos | 32.4 |
| merphos | 290000* |
| fensolfuthion | 29.6* |
| guthion | 32.5* |
| coumaphos | 25.9* |

* The %D's for these compounds were taken from the secondary column.

The results for these compounds in associated samples 004M000101, 004M000201, 004M000202, 038M000101 and 038M000301, which consisted entirely of non-detects, were flagged as estimated (UJ).

IV.) Blanks:

Method Blanks:

All Method Blank criteria were met. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria for the method was met. No action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

The Relative Percent Differences (RPD's) for the following compounds exceeded the 15% QC limit for spiked samples 038M000301MS and 038M000301MSD:

| | |
|---|---|
| alpha mevinphos | 17% |
| fensolfuthion | 17% |
| guthion | 26% |

The non-detect results for these compounds in associated sample 038M000301 were previously flagged as estimated (UJ). No further action was necessary.

The Percent Recoveries (%R's) of the following compounds were outside the 50-140% QC limits for samples 038M000301MS and 038M000301MSD:

| Client Sample # | MS %R | MSD %R |
|---|---|---|
| naled | 0 | 0 |
| merphos | 0 | 0 |
| tokuthion | 175 | 195 |
| fensolfuthion | | 159 |
| guthion | | 150 |

The non-detect results for naled and merphos in associated sample 038M000301 were rejected (R). There were no positive results for the remaining three compounds in the associated sample. no further action was required.

All MS/MSD results had been flagged on the spreadsheets as undetected (U). During validation, the "U" flags were removed from all compounds except merphos and 0 ug/kg was replaced with the CRQL (110 ug/kg).

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calcuable Relative Percent Differences (RPD's) for field duplicate samples 006M000501 and 006N000501. No action was required.

There were no calcuable RPD's for field duplicate samples 006M000601 and 006N000601. No action was necessary.

IX.) Overall Assessment of Data/General:

Naled and merphos were rejected in sample 038M000301 due to 0% recoveries in the MS / MSD's. All remaining laboratory data were acceptable with qualification.

*HERBICIDES*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) of MCPP (21.6%) exceeded the 20% QC limit for the primary column for the initial calibration run on 5/16/95. Since only one compound exceeded the 20% limit and it was less than 30%, no action was necessary.

The %RSD's for MCPP (58.6%), MCPA (54.5%), 2,4,5-T (21.4%) and 2,4-DB (35.3%) exceeded the 20% QC limit for the secondary column for the initial calibration run on 5/16/95. The results for these compounds in associated samples 006M000101, 006M000102, 006M000201, 006M000301, 006M000401 and 031M000101, which consisted entirely of non-detects, were flagged as estimated (UJ).

Continuing Calibration:

The Percent Difference (%D) of 2,4-DB (68.7%) exceeded the 25% QC limit for the continuing calibration run on 5/17/95 at 10:49 on the secondary column. The results for 2,4-DB were previously qualified in the associated samples based on the initial calibration. No further action was required.

The Percent Difference (%D) of 2,4-DB (83.5%) on the secondary column exceeded the 25% QC limit for the continuing calibration run on 5/17/95 at 16:12. The results for 2,4-DB were previously qualified in the associated samples based on the initial calibration. No further action was required.

The Percent Difference (%D) of dalapon (38.1%) on the primary column exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 19:15. The results for this compound in associated samples 004M000101, 004M000201, 004M000202, 006M000501, 006N000501, 006M000502, 006M000601 and 006N000601, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of dalapon (51.1%) and 2,4-DB (82.8%) on the secondary column exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 19:15. The non-detect results for these compounds in associated sample 004M000101 were flagged as estimated (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/26/95 at 04:10:

| Compound | %D |
|---|---|
| dalapon | 51.3 |
| dalapon | 54.9* |
| 2,4-D | 27.2* |
| silvex | 29.0* |
| 2,4,5-T | 28.6* |
| 2,4-DB | 113* |
| dinoseb | 28.7* |

* The %D's for these compounds were from the secondary column.

The positive and non-detect results for these compounds in associated samples 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 004M000201, 004M000202, 038M000101, 038M000201 and 038M000301 were flagged as estimated (J) and (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/26/95 at 18:58:

| Compound | %D |
|---|---|
| 2,4-D | 25.9* |
| 2,4,5-T | 38.5* |
| 2,4-DB | 96.1* |

* The %D's for these compounds were from the secondary column.

These compounds in the associated samples were previously qualified. No further action was necessary.

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/27/95 at 01:59:

| Compound | %D |
|---|---|
| dalapon | 42.4 |
| dalapon | 33.1* |
| 2,4,5-T | 25.8* |
| 2,4-DB | 112* |

* The %D's for these compounds were from the secondary column.

The results for these compounds in associated samples 006M000501DUP, 006N000501DUP, 006M000502DUP, 006M000601DUP and 006N000601DUP, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/27/95 at 08:35:

| Compound | %D |
|---|---|
| dalapon | 42.4 |
| dalapon | 111* |
| MCPA | 25.6 |
| MCPA | 49.9* |
| dicamba | 32.7* |
| MCPP | 56.5* |
| dichloroprop | 38.5* |
| 2,4-D | 46.3* |
| silvex | 38.2* |
| 2,4,5-T | 48.4* |
| 2,4-DB | 142* |
| dinoseb | 29.8* |

* The %D's for these compounds were from the secondary column.

The positive and non-detect results for these compounds in associated samples 006M000501DUP, 006N000501DUP, 006M000502DUP, 006M000601DUP, 006N000601DUP, 038M000101DUP, 038M000201DUP and 038M000301DUP were flagged as estimated (J) and (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/27/95 at 16:33:

| Compound | %D |
|---|---|
| dalapon | 53.0 |
| dalapon | 67.1* |
| dinoseb | 31.1 |
| dinoseb | 35.9* |
| dicamba | 37.6* |
| dichloroprop | 41.7* |
| 2,4-D | 44.5* |
| silvex | 46.2* |
| 2,4,5-T | 50.0* |
| 2;4-DB | 216* |

* The %D's for these compound were from the confirmatiom column.

The results for these compounds in all associated duplicate samples were previously qualified. No further action was required.

IV.) Blanks:

Method Blanks:

All Method Blank criteria were met. No action was required.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of the surrogate in the following samples exceeded the 30-150% QC limits:

| Client Sample # | %R |
|---|---|
| 006M000501 | 271 |
| 006M000501DUP | 257 |
| 006N000501DUP | 156 |
| 038M000101DUP | 163 |
| 006M000502 | 172 |
| 006M000601 | 227 |
| 006M000502DUP | 159 |
| 006M000601DUP | 200 |

All positive results for these samples were flagged as estimated (J).

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

The Relative Percent Differences (RPD's) for the following compounds exceeded the 20% QC limit for spiked samples 038M000301MS and 038M000301MSD:

| Compound | RPD |
|---|---|
| MCPP | 22 |
| silvex | 89 |
| 2,4,5-T | 99 |
| 2,4-DB | 200 |
| dinoseb | 87 |
| 2,4-D | 110 |

The results for these compounds in associated sample 038M000301, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Recoveries (%R's) of the following compounds were outside the 10-150% QC limits for samples 038M000301MS and 038M000301MSD:

| Compound | MS %R | MSD %R |
|---|---|---|
| dalapon | 0 | 0 |
| dicamba | 0 | 0 |
| MCPP | 500 | 400 |
| MCPA | 300 | 280 |
| 2,4-D | | 360 |
| silvex | 1100 | 420 |
| 2,4,5-T | 500 | 168 |
| 2,4-DB | 0 | 540 |
| dinoseb | 364 | |

There were no positive detections of these compounds in associated sample 038M000301. The non-detect results for dalapon, dicamba and 2,4-DB were rejected (R).

The Relative Percent Differences (RPD's) for the following compounds exceeded the 20% QC limit for samples 038M000301DUPMS and 038M000301DUPMSD:

| Compound | RPD |
|---|---|
| 2,4-D | 122 |
| silvex | 74 |
| dinoseb | 32 |

The results for these compounds in associated sample 038M000301DUP, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Recoveries (%R's) of the following compounds were outside the 10-150% QC limits for samples 038M000301DUPMS and 038M000301DUPMSD:

| Compound | MS %R | MSD %R |
|---|---|---|
| dalapon | 0 | 0 |
| dicamba | 0 | 0 |
| MCPP | 520 | 580 |
| MCPA | 220 | 320 |
| 2,4-D | | 560 |
| silvex | 1260 | 580 |
| 2,4,5-T | 0 | 0 |
| 2,4-DB | 0 | 118 |
| dinoseb | 244 | 176 |

There were no positive detections of these compounds in associated sample 038M000301DUP. The non-detect results for dalapon, dicamba, 2,4-DB and 2,4,5-T in this sample were rejected (R).

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 006M000501DUP and 006N000501DUP. No action was required.

The Relative Percent Difference (RPD) for 2,4-D (113%) exceeded the 60% QC limit for soil field duplicate samples 006M000501 and 006N000501. The positive results for this compound in these two samples were previously flagged as estimated (J). No further action was necessary.

The Relative Percent Difference (RPD) for MCPA (17%) was within the 60% QC limit for soil field duplicate samples 006M000601 and 006N000601. No action was necessary.

The Relative Percent Difference (RPD) for MCPA (57%) was within the 60% QC limit for soil field duplicate samples 006M000601DUP and 006N000601DUP. No action was necessary.

IX.) Overall Assessment of Data/General:

Samples 006M000501, 006N000501, 006M000502, 006M000601, 006N000601, 038M000101, 038M000201 and 038M000301 were analyzed twice due to decreased CCV responses after their first run. The second set of analyses (denoted by the DUP suffix) incurred the same problem also. The original analyses are considered by the validator to be of preferrable data quality since both sets of analyses resulted in the same problem.

The extraction and analysis dates for some of the samples were incorrect on the spreadsheet. The correct dates were provided by the validator as they were listed correctly on the Form I's.

The non-detect results for 2,4-DB, dalapon and dicamba in sample 038M000301 and 2,-DB, 2,4,5-T, dalapon and dicamba in sample 038000301DUP were rejected due to 0% recoveries in their respective MS / MSD's. All other laboratory data were acceptable with qualification.

*TOTAL METALS and CYANIDE*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

III.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

| Blank Type/ID# | Analyte | Max. Conc. | Action Level mg/kg |
|---|---|---|---|
| PBS | beryllium | 0.36 mg/kg | 1.80 |
| PBS | cobalt | 0.60 mg/kg | 3.00 |
| CCB4 | silver | 6.40 ug/L | 6.40 |
| PBS | tin | 3.23 mg/kg | 16.2 |

PBS = Preparation Blank (Soil), CCB = Continuing Calibration Blank

All results greater than the IDL but less than 5X the blank amount (Action Level, mg/kg for soil samples) for which the contaminated blank was an associated calibration or laboratory preparation blank were flagged as undetected (U).

The following analytes had negative results with absolute values greater than the IDL's

| Blank Type/ID# | Analyte | Neg. Conc. | 5X Conc. (mg/kg) |
|---|---|---|---|
| CCB3 | cadmium | -3.20 ug/L | 3.20 |
| CCB3 | lead | -2.30 ug/L | 2.30 |
| CCB1 | thallium | -3.40 ug/L | 3.40 |
| CCB1 | zinc | -20.4 ug/L | 20.4 |

CCB = Continuing Calibration Blank

All associated positive sample results less than 5X the absolute value of the negative blank result were flagged as estimated (J) and all associated non-detects were flagged as estimated (UJ).

IV.) ICP Interference Check Sample Results:

All Interference Check Sample criteria were met. No action was required.

V.) ICP Serial Dilution Analysis:

All Serial Dilution criteria were met, so no action was necessary.

VI.) Laboratory Control Samples (LCS):

All Laboratory Control Sample criteria were met. No action was required.

VII.) Duplicate Sample Analysis:

The Relative Percent Difference (RPD) for lead (86.1%) exceeded the 35% QC limit for soil sample 038M000301MD. The positive and non-detect results for this analyte in all associated samples in this SDG were flagged as estimated (J) and (UJ).

VIII.) Matrix Spike Recoveries:

The Percent Recoveries (%R's) of the following compounds were below the 75-125% QC limits for spiked sample 038M000301MS:

| | |
|---|---|
| antimony | 41.1% |
| selenium | 73.4% |
| silver | 30.3% |

The positive and non-detect results for these analytes in all samples in this SDG were flagged as estimated (J) and (UJ).

IX.) Field Duplicates:

The Relative Percent Differences (RPD's) for the following analytes were calculated for field duplicate samples 006M000501 and 006N000501:

| | |
|---|---|
| arsenic | 55% |
| barium | 11% |
| beryllium | 16% |
| chromium | 10% |
| cobalt | 27% |
| copper | 1.1% |
| lead | 9.7% |
| nickel | 15% |
| tin | 33% |

All RPD's were within the 60% QC limit for soil samples. No action was necessary.

The Relative Percent Differences (RPD's) for the following analytes were calculated for field duplicate samples 006M000601 and 006N000601:

| | |
|---|---|
| arsenic | 62% |
| barium | 76% |
| beryllium | 50% |
| cadmium | 69% |
| chromium | 15% |
| cobalt | 28% |
| copper | 38% |
| lead | 82% |
| nickel | 39% |
| vanadium | 48% |
| zinc | 17% |

The results for arsenic, barium, cadmium and lead were flagged as estimated (J) in the two samples 006M000601 and 006N000601. All other RPD's were within the 60% QC limit, so no further action was required.

X) Furnace Atomic Absorption QC:

Method of Standard Addition:

The coefficient of correlation for arsenic in samples 006M000101 (0.873) and 006M000501 (0.984) were below the 0.995 QC limit. The positive results for this analyte in these samples were flagged as estimated (J).

Post Digestion Spike Recovery:

The Percent Recoveries (%R's) of thallium in the following samples were below the 85-115% QC limits:

| | |
|---|---|
| 006M000102 | 81% |
| 006M000201 | 81% |
| 006M000401 | 81% |
| 031M000101 | 65% |
| 004M000201 | 83% |
| 004M000202 | 78% |
| 006N000501 | 73% |
| 006N000601 | 81% |

All results for this analyte in these samples, which consisted entirely of non-detects, were previously flagged as estimated (J) and (UJ). No further action was taken.

The Perent Recoveries (%R's) of lead in samples 006N000501 (76%) and 006M000401 (83%) were below the 85-115% QC limits. The positive results for this analyte in these two samples were previously flagged as estimated (J). No further action was necessary.

The Percent Recoveries (%R's) for selenium in samples 031M000101 (125%), 004M000101 (117%) and 006M000101 (117%) exceeded the 85-115% QC limits. Since there were no positive detections of selenium in these samples, no action was necessary.

XI.) Sample Result, Calculation/Transcription Verification:

All criteria were met, so no action was taken.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met, so no action was taken.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*TOTAL PETROLEUM HYDROCARBONS*

I.) Holding Times:

All samples were extracted and analyzed within the required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Laboratory Control Samples (LCS):

All LCS Recovery criteria were met. No action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicates associated with this SDG.

IX.) Overall Assessment of Data/General:

All data were acceptable without qualification.

*DIESEL RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within the required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Surrogate Recoveries:

The surrogate Percent Recovery (%R) in sample 031M000301 was zero percent (0%) due to sample dilution. No action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

The Relative Percent Difference was zero percent (0%) for field duplicate samples 006M000501 and 006N000501, which was within the 60% QC limit. No action was necessary.

There were no calculable RPD's for field duplicate samples 006M000601 and 006N000601. No action was required.

IX.) Overall Assessment of Data/General:

All data were acceptable without qualification.

*GASOLINE RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within the required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Surrogate Recoveries:

The Surrogate Percent Recoveries (%R's) in samples 031M000101 (37%) and 004M000202 (49%) were below the 50-150% QC limits. The results for these samples, which consisted entirely of non-detects, were flagged as estimated (UJ).

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 006M000501 and 006N000501. No action was necessary.

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 006M000601 and 006N000601. No action was necessary.

IX.) Overall Assessment of Data/General:

All data were acceptable with qualification.

DATALCP2
10/02/95

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 8015 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 004-M-0001-01 | 004-M-0002-01 | 004-M-0002-02 | 006-M-0001-01 | 006-M-0001-02 | 006-M-0002-01 |
| ORIGINAL ID -----> | 004M000101 | 004M000201 | 004M000202 | 006M000101 | 006M000102 | 006M000201 |
| LAB SAMPLE ID ---> | 122951 | 122952 | 122953 | 122855 | 122856 | 122857 |
| SAMPLE DATE -----> | 05/04/95 | 05/04/95 | 05/04/95 | 05/03/95 | 05/03/95 | 05/03/95 |
| DATE ANALYZED ---> | 05/16/95 | 05/16/95 | 05/16/95 | 05/16/95 | 05/16/95 | 05/16/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 71. U | 71. U | 67. UJ | 58. U | 51. U | 70. U |

000560

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



1395
8015 Mod

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-M-0003-01 | 006-M-0004-01 | 006-M-0005-01 | 006-M-0005-01 | 006-M-0005-02 | 006-M-0006-01 |
| ORIGINAL ID -----> | 006M000301 | 006M000401 | 006M000501 | 006M000501 | 006M000502 | 006M000601 |
| LAB SAMPLE ID ---> | 122858 | 122859 | 122954 | 122955 | 122956 | 122957 |
| SAMPLE DATE -----> | 05/03/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | 05/04/95 |
| DATE ANALYZED ---> | 05/16/95 | 05/16/95 | 05/17/95 | 05/17/95 | 05/16/95 | 05/16/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 52. U | 130. | 74. U | 72. U | 67. U | 68. U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 8015 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-N-0006-01 | 031-M-0001-01 | 038-M-0001-01 | 038-M-0002-01 | 038-M-0003-01 | |
| ORIGINAL ID -----> | 006N000601 | 031M000101 | 038M000101 | 038M000201 | 038M000301 | |
| LAB SAMPLE ID ---> | 122958 | 122860 | 122959 | 122960 | 122961 | |
| SAMPLE DATE -----> | 05/04/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | |
| DATE ANALYZED ---> | 05/17/95 | 05/16/95 | 05/17/95 | 05/17/95 | 05/17/95 | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 71. U | 68. UJ | 77. U | 67. U | 67. U | |

000562

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



1395
8100 Mod

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 004-M-0001-01 | 004-M-0002-01 | 004-M-0002-02 | 006-M-0001-01 | 006-M-0001-02 | 006-M-0002-01 |
| ORIGINAL ID -----> | 004M000101 | 004M000201 | 004M000202 | 006M000101 | 006M000102 | 006M000201 |
| LAB SAMPLE ID ---> | 122951 | 122952 | 122953 | 122855 | 122856 | 122857 |
| SAMPLE DATE -----> | 05/04/95 | 05/04/95 | 05/04/95 | 05/03/95 | 05/03/95 | 05/03/95 |
| DATE EXTRACTED --> | 05/18/95 | 05/18/95 | 05/18/95 | 05/10/95 | 05/10/95 | 05/10/95 |
| DATE ANALYZED ---> | 05/19/95 | 05/19/95 | 05/19/95 | 05/12/95 | 05/12/95 | 05/13/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-6 TPH - Diesel Range Organics | 11000. | 41000. | 29000. | 11000. | 4500. U | 4700. U |

*** Validation Complete ***

000563

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 8100 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-M-0003-01 | 006-M-0004-01 | 006-M-0005-01 | 006-N-0005-01 | 006-M-0005-02 | 006-M-0006-01 |
| ORIGINAL ID -----> | 006M000301 | 006M000401 | 006M000501 | 006N000501 | 006M000502 | 006M000601 |
| LAB SAMPLE ID ---> | 122858 | 122859 | 122954 | 122955 | 122956 | 122957 |
| SAMPLE DATE -----> | 05/03/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | 05/04/95 |
| DATE EXTRACTED --> | 05/10/95 | 05/18/95 | 05/18/95 | 05/18/95 | 05/18/95 | 05/18/95 |
| DATE ANALYZED ---> | 05/13/95 | 05/19/95 | 05/19/95 | 05/20/95 | 05/20/95 | 05/20/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-6 TPH - Diesel Range Organics | 77000. | 360000. | 10000. [1] | 10000. | 5300. U | 5500. U |



*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 8100 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-N-0006-01 | 031-M-0001-01 | 038-M-0001-01 | 038-M-0002-01 | 038-M-0003-01 | |
| ORIGINAL ID -----> | 006N000601 | 031M000101 | 038M000101 | 038M000201 | 038M000301 | |
| LAB SAMPLE ID ---> | 122958 | 122860 | 122959 | 122960 | 122961 | |
| SAMPLE DATE -----> | 05/04/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | |
| DATE EXTRACTED --> | 05/18/95 | 05/10/95 | 05/18/95 | 05/18/95 | 05/18/95 | |
| DATE ANALYZED ---> | 05/20/95 | 05/13/95 | 05/20/95 | 05/20/95 | 05/20/95 | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | |
| CAS # Parameter | | | | | | |
| 9999900-02-6 TPH - Diesel Range Organics | 5700. U | 360000. | 82000. | 11000. | 23000. | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 HERB | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 122951 | | 122952 | | 122953 | | 122855 | | 122856 | | 122857 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/16/95 | | 05/16/95 | | 05/16/95 | |
| | DATE ANALYZED ---> | 05/25/95 | | 05/26/95 | | 05/26/95 | | 05/31/95 | | 05/31/95 | | 05/31/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | U | 9.4 | UJ | 36. | J | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-82-6 | 2,4-DB | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ |
| 88-85-7 | Dinoseb | 4.7 | U | 4.7 | UJ | 4.7 | UJ | 4.7 | U | 4.7 | U | 4.7 | U |
| 93-76-5 | 2,4,5-T | 5.8 | | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | U |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | U | 0.95 | UJ | 0.95 | UJ | 0.95 | U | 0.95 | U | 0.95 | UJ |
| 75-99-0 | Dalapon | 23. | UJ | 23. | UJ | 23. | UJ | 23. | U | 23. | U | 23. | U |
| 1918-00-9 | Dicamba | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U |
| 120-36-5 | Dichlorprop | 9.4 | U | 9.4 | U | 23. | | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-74-6 | MCPA | 940. | U | 5300. | | 1100. | | 940. | UJ | 940. | UJ | 940. | UJ |
| 93-65-2 | MCPP | 940. | U | 940. | U | 940. | U | 940. | UJ | 940. | UJ | 940. | UJ |

000566

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 HERB | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 122858 | | 122859 | | 122954 | | 122955 | | 122956 | | 122957 | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/16/95 | | 05/16/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | |
| | DATE ANALYZED ---> | 05/31/95 | | 05/31/95 | | 05/26/95 | | 05/26/95 | | 05/27/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | U | 9.4 | U | 22. | J | 49. | J | 130. | J | 9.4 | UJ |
| 94-82-6 | 2,4-DB | 9.5 | UJ | 9.5 | UJ | 33. | J | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ |
| 88-85-7 | Dinoseb | 4.7 | U | 4.7 | U | 4.7 | UJ | 15. | J | 4.7 | UJ | 4.7 | UJ |
| 93-76-5 | 2,4,5-T | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | U | 0.95 | U | 2.5 | J | 0.95 | UJ | 0.95 | UJ | 12. | J |
| 75-99-0 | Dalapon | 23. | U | 23. | U | 23. | UJ | 23. | UJ | 23. | UJ | 23. | UJ |
| 1918-00-9 | Dicamba | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U |
| 120-36-5 | Dichlorprop | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-74-6 | MCPA | 940. | UJ | 940. | UJ | 940. | U | 940. | U | 940. | U | 11000. | J |
| 93-65-2 | MCPP | 940. | UJ | 940. | UJ | 940. | U | 940. | U | 940. | U | 940. | U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 HERB | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | |
| | ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | |
| | LAB SAMPLE ID ---> | 122958 | | 122860 | | 122959 | | 122960 | | 122961 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/16/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/31/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | UJ | 22. | | 9.4 | UJ | 9.4 | UJ | 9.4 | UJ |
| 94-82-6 | 2,4-DB | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UR |
| 88-85-7 | Dinoseb | 4.7 | UJ | 24. | | 4.7 | UJ | 4.7 | UJ | 4.7 | UJ |
| 93-76-5 | 2,4,5-T | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | UJ | 0.95 | U | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ |
| 75-99-0 | Dalapon | 23. | UJ | 23. | U | 23. | UJ | 23. | UJ | 23. | UR |
| 1918-00-9 | Dicamba | 0.94 | U | 7.2 | | 0.94 | U | 0.94 | U | 0.94 | UR |
| 120-36-5 | Dichlorprop | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-74-6 | MCPA | 13000. | | 940. | UJ | 940. | U | 940. | U | 940. | U |
| 93-65-2 | MCPP | 940. | U | 940. | UJ | 940. | U | 940. | U | 940. | UJ |

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*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



1395
METAL

| | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 5-122962S | | 5-122963S | | 5-122964S | | 0-122861S | | 0-122862S | | 0-122863S | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| SB | Antimony | 14. | UJ | 16.3 | UJ | 13.5 | UJ | 12.2 | UJ | 13.4 | UJ | 13.5 | UJ |
| AS | Arsenic | 9.3 | | 9.9 | | 2.9 | | 7. | J | 8.2 | | 16.6 | |
| BA | Barium | 294. | | 221. | | 178. | | 159. | | 137. | | 361. | |
| BE | Beryllium | 0.96 | U | 0.73 | U | 0.6 | U | 0.37 | U | 0.47 | U | 0.94 | U |
| CD | Cadmium | 0.84 | UJ | 0.98 | UJ | 0.81 | UJ | 0.73 | UJ | 0.81 | UJ | 0.97 | J |
| CR | Chromium | 14.4 | | 26. | | 14.1 | | 39.2 | | 10.7 | | 12.7 | |
| CO | Cobalt | 14.9 | | 9.3 | J | 4.9 | J | 8. | J | 10.2 | J | 32.4 | |
| CU | Copper | 17.4 | | 25.8 | | 15.3 | | 8.1 | | 13.8 | | 19.8 | |
| PB | Lead | 18.2 | J | 43.8 | J | 16.3 | J | 346. | J | 41.8 | J | 29.4 | J |
| HG | Mercury | 0.14 | U | 0.16 | U | 0.15 | | 0.12 | U | 0.13 | U | 0.14 | U |
| NI | Nickel | 27.6 | | 18.9 | | 15.8 | | 8.8 | J | 16.9 | | 31.4 | |
| SE | Selenium | 0.56 | UJ | 0.65 | UJ | 0.54 | UJ | 0.49 | UJ | 0.54 | UJ | 0.54 | UJ |
| AG | Silver | 0.84 | UJ | 0.98 | UJ | 1.2 | UJ | 0.74 | UJ | 1.3 | UJ | 1. | UJ |
| TL | Thallium | 0.56 | UJ | 0.65 | UJ | 0.54 | UJ | 0.49 | UJ | 0.54 | UJ | 0.54 | UJ |
| V | Vanadium | 33.8 | | 20.8 | | 13.4 | J | 14.1 | | 19.1 | | 40. | |
| ZN | Zinc | 69. | | 78.4 | | 56. | | 20.2 | J | 44.4 | | 49.1 | |
| SN | Tin | 4.2 | U | 4.9 | U | 5.1 | U | 3.7 | U | 7.4 | U | 4.6 | U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 METAL | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 0-122864S | | 0-122865S | | 5-122965S | | 5-122966S | | 5-122967S | | 5-122968S | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| SB | Antimony | 14.1 | UJ | 15.1 | UJ | 15.5 | UJ | 14.9 | UJ | 13.2 | UJ | 13.6 | UJ |
| AS | Arsenic | 11. | | 5.4 | | 5.4 | J | 9.5 | | 8. | | 41.8 | J |
| BA | Barium | 176. | | 233. | | 215. | | 192. | | 137. | | 638. | J |
| BE | Beryllium | 0.54 | U | 0.66 | U | 0.74 | U | 0.63 | U | 0.44 | U | 2. | |
| CD | Cadmium | 10.3 | | 0.91 | UJ | 0.93 | UJ | 0.89 | UJ | 0.79 | UJ | 1.9 | J |
| CR | Chromium | 57.8 | | 13.9 | | 13.4 | | 12.1 | | 9.3 | | 22.5 | |
| CO | Cobalt | 9.8 | J | 11.9 | J | 17.9 | | 13.6 | J | 7.4 | J | 46.5 | |
| CU | Copper | 24.9 | | 12.3 | | 18.2 | | 18. | | 17.5 | | 33.7 | |
| PB | Lead | 122. | J | 13. | J | 21.5 | J | 23.7 | J | 11. | J | 94. | J |
| HG | Mercury | 0.14 | U | 0.15 | U | 0.15 | U | 0.15 | U | 0.13 | U | 0.14 | U |
| NI | Nickel | 14.1 | | 15.6 | | 26.9 | | 23. | | 19.8 | | 58.2 | |
| SE | Selenium | 0.56 | UJ | 0.61 | UJ | 0.62 | UJ | 0.6 | UJ | 0.53 | UJ | 0.71 | J |
| AG | Silver | 1.1 | UJ | 0.91 | UJ | 0.93 | UJ | 0.89 | UJ | 1.6 | UJ | 0.99 | UJ |
| TL | Thallium | 0.56 | UJ | 0.61 | UJ | 0.62 | UJ | 0.6 | UJ | 0.53 | UJ | 0.54 | UJ |
| V | Vanadium | 18.4 | | 20.6 | | 30. | | 26.2 | | 18.3 | | 83.2 | |
| ZN | Zinc | 184. | | 32.6 | | 47.5 | | 53.7 | | 43.6 | | 77.9 | |
| SN | Tin | 4.2 | U | 4.5 | U | 7.8 | U | 5.6 | U | 5.7 | U | 8.7 | U |

000570

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

1395
METAL

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | | | |
| | ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | | | |
| | LAB SAMPLE ID ---> | 5-122969S | | 0-122866S | | 5-122970S | | 5-122971S | | 5-122972S | | | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | | |
| CAS # | Parameter | | | | | | | | | | | | |
| SB | Antimony | 14.3 | UJ | 13.9 | UJ | 14.1 | UJ | 13.6 | UJ | 13.7 | UJ | | |
| AS | Arsenic | 22.1 | J | 4.8 | | 8.9 | | 6.8 | | 10.1 | | | |
| BA | Barium | 285. | J | 96.4 | | 109. | | 102. | | 116. | | | |
| BE | Beryllium | 1.2 | U | 0.29 | U | 0.55 | U | 0.45 | U | 0.56 | U | | |
| CD | Cadmium | 0.93 | J | 13.8 | | 1.1 | J | 0.81 | UJ | 0.83 | J | | |
| CR | Chromium | 19.3 | | 75.7 | | 19.9 | | 11.9 | | 14.9 | | | |
| CO | Cobalt | 35. | | 7.7 | J | 9.4 | J | 6. | J | 10.1 | J | | |
| CU | Copper | 23. | | 52.1 | | 22.4 | | 14.5 | | 16.6 | | | |
| PB | Lead | 39.1 | J | 1040. | J | 73. | J | 22.2 | J | 43. | J | | |
| HG | Mercury | 0.14 | U | 0.18 | | 0.2 | | 0.14 | U | 0.16 | | | |
| NI | Nickel | 39.3 | | 22.9 | | 22.9 | | 14.1 | | 16.3 | | | |
| SE | Selenium | 0.57 | UJ | 0.56 | UJ | 0.56 | UJ | 0.54 | UJ | 0.55 | UJ | | |
| AG | Silver | 0.86 | UJ | 1.8 | UJ | 1.2 | UJ | 1.1 | UJ | 1.1 | UJ | | |
| TL | Thallium | 0.57 | UJ | 0.56 | UJ | 0.56 | UJ | 0.57 | J | 0.55 | UJ | | |
| V | Vanadium | 50.8 | | 13.8 | J | 25.8 | | 19.2 | | 21.2 | | | |
| ZN | Zinc | 65.8 | | 856. | | 85.4 | | 47.8 | | 58.9 | | | |
| SN | Tin | 4.3 | U | 10.5 | U | 4.2 | U | 4.1 | U | 4.1 | U | | |

*** Validation Complete ***

| 1395 METAL-CN | | | | | | | |
|---|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 004-M-0001-01 | 004-M-0002-01 | 004-M-0002-02 | 006-M-0001-01 | 006-M-0001-02 | 006-M-0002-01 |
| ORIGINAL ID -----> | 004M000101 | 004M000201 | 004M000202 | 006M000101 | 006M000102 | 006M000201 |
| LAB SAMPLE ID ---> | 122951 | 122952 | 122953 | 122855 | 122856 | 122857 |
| SAMPLE DATE -----> | 05/04/95 | 05/04/95 | 05/04/95 | 05/03/95 | 05/03/95 | 05/03/95 |
| DATE EXTRACTED --> | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 |
| DATE ANALYZED ---> | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| CN Cyanide | 0.88 U | 0.68 U | 0.62 U | 0.5 U | 0.89 U | 0.6 U |

000572

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

1395
METAL-CN

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-M-0003-01 | 006-M-0004-01 | 006-M-0005-01 | 006-M-0005-01 | 006-M-0005-02 | 006-M-0006-01 |
| ORIGINAL ID -----> | 006M000301 | 006M000401 | 006M000501 | 006N000501 | 006M000502 | 006M000601 |
| LAB SAMPLE ID ---> | 122858 | 122859 | 122954 | 122955 | 122956 | 122957 |
| SAMPLE DATE -----> | 05/03/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | 05/04/95 |
| DATE EXTRACTED --> | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 |
| DATE ANALYZED ---> | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| CN Cyanide | 0.58 U | 0.69 U | 0.98 U | 0.66 U | 0.89 | 0.61 U |

*** Validation Complete ***

000543

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 METAL-CN | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-N-0006-01 | 031-M-0001-01 | 031-M-0001-01 | 038-M-0001-01 | 038-M-0002-01 | 038-M-0003-01 |
| ORIGINAL ID -----> | 006N000601 | 031M000101 | 031M000101 | 038M000101 | 038M000201 | 038M000301 |
| LAB SAMPLE ID ---> | 122958 | 12286 | 122860 | 122959 | 122960 | 122961 |
| SAMPLE DATE -----> | 05/04/95 | 05/03/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 |
| DATE EXTRACTED --> | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 |
| DATE ANALYZED ---> | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| CN Cyanide | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.62 U | 0.62 U |

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples

1395
OP PEST

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
| ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| LAB SAMPLE ID ---> | 122951 | | 122952 | | 122953 | | 122855 | | 122856 | | 122857 | |
| SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| DATE EXTRACTED --> | 05/19/95 | | 05/19/95 | | 05/19/95 | | 05/10/95 | | 05/10/95 | | 05/10/95 | |
| DATE ANALYZED ---> | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/13/95 | | 05/13/95 | | 05/13/95 | |
| MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # Parameter | | | | | | | | | | | | |
| 86-50-0 Guthion | 120. | UJ | 120. | UJ | 110. | UJ | 100. | U | 110. | U | 110. | U |
| 35400-43-2 Sulprofos | 120. | UJ | 120. | UJ | 110. | UJ | 100. | U | 110. | U | 110. | U |
| 2921-88-2 Chloropyrifos | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 56-72-4 Coumaphos | 120. | UJ | 120. | UJ | 110. | UJ | 100. | UJ | 110. | UJ | 110. | UJ |
| 8065-48-3 Demeton,O | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 333-41-5 Diazinon | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 62-73-7 Dichlorvos | 120. | U | 120. | U | 110. | U | 100. | UJ | 110. | UJ | 110. | UJ |
| 298-04-4 Disulfoton | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 13194-48-4 Ethoprop | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 115-90-2 Fensulfothion | 120. | UJ | 120. | UJ | 110. | UJ | 100. | U | 110. | U | 110. | U |
| 55-38-9 Fenthion | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 150-50-5 Merphos | 120. | UJ | 120. | UJ | 110. | UJ | 100. | UJ | 110. | UJ | 110. | UJ |
| 7786-34-7 Mevinphos, Alpha | 120. | UJ | 120. | UJ | 110. | UJ | 100. | UJ | 110. | UJ | 110. | UJ |
| 300-76-5 Naled | 120. | UJ | 120. | UJ | 110. | UJ | 100. | UJ | 110. | UJ | 110. | UJ |
| 298-00-0 Methyl parathion | 120. | UJ | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 298-02-2 Phorate | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 299-84-3 Ronnel | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 22248-79-9 Stirophos (Tetrachlorovinphos) | 120. | UJ | 120. | UJ | 110. | UJ | 100. | UJ | 110. | UJ | 110. | UJ |
| 34643-46-4 Tokuthion | 120. | UJ | 120. | UJ | 110. | UJ | 100. | U | 110. | U | 110. | U |
| 327-98-0 Trichloronate | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |
| 126-75-0 Demeton,S | 120. | U | 120. | U | 110. | U | 100. | U | 110. | U | 110. | U |

*** Validation Complete ***

| 1395 OP PEST | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 122858 | | 122859 | | 122954 | | 122955 | | 122956 | | 122957 | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/10/95 | | 05/10/95 | | 05/19/95 | | 05/19/95 | | 05/19/95 | | 05/19/95 | |
| | DATE ANALYZED ---> | 05/13/95 | | 05/13/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 86-50-0 | Guthion | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 35400-43-2 | Sulprofos | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 2921-88-2 | Chloropyrifos | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 56-72-4 | Coumaphos | 110. | UJ | 110. | UJ | 120. | U | 120. | U | 110. | U | 110. | U |
| 8065-48-3 | Demeton,O | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 333-41-5 | Diazinon | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 62-73-7 | Dichlorvos | 110. | UJ | 110. | UJ | 120. | U | 120. | U | 110. | U | 110. | U |
| 298-04-4 | Disulfoton | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 13194-48-4 | Ethoprop | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 115-90-2 | Fensulfothion | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 55-38-9 | Fenthion | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 150-50-5 | Merphos | 110. | UJ | 110. | UJ | 120. | UJ | 120. | UJ | 110. | UJ | 110. | UJ |
| 7786-34-7 | Mevinphos, Alpha | 110. | UJ | 110. | UJ | 120. | U | 120. | U | 110. | U | 110. | U |
| 300-76-5 | Naled | 110. | UJ | 110. | UJ | 120. | UJ | 120. | UJ | 110. | UJ | 110. | UJ |
| 298-00-0 | Methyl parathion | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 298-02-2 | Phorate | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 299-84-3 | Ronnel | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 22248-79-9 | Stirophos (Tetrachlorovinphos) | 110. | UJ | 110. | UJ | 120. | UJ | 120. | UJ | 110. | UJ | 110. | UJ |
| 34643-46-4 | Tokuthion | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 327-98-0 | Trichloronate | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |
| 126-75-0 | Demeton,S | 110. | U | 110. | U | 120. | U | 120. | U | 110. | U | 110. | U |

000576

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 OP PEST | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | |
| | ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | |
| | LAB SAMPLE ID ---> | 122958 | | 122860 | | 122959 | | 122960 | | 122961 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/19/95 | | 05/10/95 | | 05/19/95 | | 05/19/95 | | 05/19/95 | |
| | DATE ANALYZED ---> | 05/24/95 | | 05/13/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | |
| 86-50-0 | Guthion | 120. | U | 110. | U | 130. | UJ | 110. | U | 110. | UJ |
| 35400-43-2 | Sulprofos | 120. | U | 110. | U | 130. | UJ | 110. | U | 110. | UJ |
| 2921-88-2 | Chloropyrifos | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 56-72-4 | Coumaphos | 120. | U | 110. | UJ | 130. | UJ | 110. | U | 110. | UJ |
| 8065-48-3 | Demeton,O | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 333-41-5 | Diazinon | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 62-73-7 | Dichlorvos | 120. | U | 110. | UJ | 130. | U | 110. | U | 110. | U |
| 298-04-4 | Disulfoton | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 13194-48-4 | Ethoprop | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 115-90-2 | Fensulfothion | 120. | U | 110. | U | 130. | UJ | 110. | U | 110. | UJ |
| 55-38-9 | Fenthion | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 150-50-5 | Merphos | 120. | UJ | 110. | UJ | 130. | UJ | 110. | UJ | 110. | UR |
| 7786-34-7 | Mevinphos, Alpha | 120. | U | 110. | UJ | 130. | UJ | 110. | U | 110. | UJ |
| 300-76-5 | Naled | 120. | UJ | 110. | UJ | 130. | UJ | 110. | UJ | 110. | UR |
| 298-00-0 | Methyl parathion | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 298-02-2 | Phorate | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 299-84-3 | Ronnel | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 22248-79-9 | Stirophos (Tetrachlorovinphos) | 120. | UJ | 270. | J | 130. | UJ | 110. | U | 110. | UJ |
| 34643-46-4 | Tokuthion | 120. | U | 110. | U | 130. | UJ | 110. | UJ | 110. | UJ |
| 327-98-0 | Trichloronate | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |
| 126-75-0 | Demeton,S | 120. | U | 110. | U | 130. | U | 110. | U | 110. | U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 PEST | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 122951 | | 122952 | | 122953 | | 122855 | | 122856 | | 122857 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | DATE EXTRACTED --> | 05/11/95 | | 05/11/95 | | 05/11/95 | | 05/09/95 | | 05/09/95 | | 05/09/95 | |
| | DATE ANALYZED ---> | 06/03/95 | | 06/03/95 | | 06/03/95 | | 05/17/95 | | 05/17/95 | | 05/13/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 319-85-7 | beta-BHC | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 319-86-8 | delta-BHC | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 58-89-9 | gamma-BHC (Lindane) | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 76-44-8 | Heptachlor | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 309-00-2 | Aldrin | 2.4 | U | 10. | | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 1024-57-3 | Heptachlor epoxide | 2.4 | U | 4. | | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 959-98-8 | Endosulfan I | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 60-57-1 | Dieldrin | 13. | | 76. | | 11. | | 34. | | 9.5 | | 4.5 | U |
| 72-55-9 | 4,4'-DDE | 4.7 | U | 24. | | 5.7 | | 4.1 | U | 4.4 | U | 4.5 | U |
| 72-20-8 | Endrin | 4.7 | U | 4.7 | U | 4.4 | U | 4.1 | U | 4.4 | U | 4.5 | U |
| 33213-65-9 | Endosulfan II | 4.7 | U | 4.7 | U | 4.4 | U | 4.1 | U | 4.4 | U | 4.5 | U |
| 72-54-8 | 4,4'-DDD | 9.2 | | 20. | | 4.8 | | 4.1 | U | 4.4 | U | 4.5 | U |
| 1031-07-8 | Endosulfan sulfate | 4.7 | U | 4.7 | U | 4.4 | U | 4.1 | U | 4.4 | U | 4.5 | U |
| 50-29-3 | 4,4'-DDT | 7.3 | | 6. | | 4.4 | U | 9.3 | | 4.4 | U | 4.5 | U |
| 72-43-5 | Methoxychlor | 24. | U | 24. | U | 23. | U | 21. | U | 23. | U | 23. | U |
| 53494-70-5 | Endrin ketone | 4.7 | U | 4.7 | U | 4.4 | U | 4.1 | U | 4.4 | U | 4.5 | U |
| 7421-36-3 | Endrin aldehyde | 4.7 | U | 4.7 | U | 4.4 | U | 4.1 | U | 4.4 | U | 4.5 | U |
| 5103-71-9 | alpha-Chlordane | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 5103-74-2 | gamma-Chlordane | 2.4 | U | 2.4 | U | 2.3 | U | 2.1 | U | 2.3 | U | 2.3 | U |
| 8001-35-2 | Toxaphene | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 12674-11-2 | Aroclor-1016 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 11104-28-2 | Aroclor-1221 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 11141-16-5 | Aroclor-1232 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 53469-21-9 | Aroclor-1242 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 12672-29-6 | Aroclor-1248 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 11097-69-1 | Aroclor-1254 | 47. | U | 47. | U | 44. | U | 41. | U | 44. | U | 45. | U |
| 11096-82-5 | Aroclor-1260 | 47. | U | 180. | | 77. | | 41. | U | 44. | U | 45. | U |

000578

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

1395
PEST

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01RE | | 006-N-0005-01RE | | 006-M-0005-02RE | | 006-M-0006-01RE | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501RE | | 006N000501RE | | 006M000502RE | | 006M000601RE | |
| | LAB SAMPLE ID ---> | 122858_10 | | 122859_10 | | 122954RE | | 122955RE | | 122956RE | | 122957RE | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/09/95 | | 05/09/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | DATE ANALYZED ---> | 05/13/95 | | 05/13/95 | | 06/02/95 | | 06/02/95 | | 06/02/95 | | 06/02/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 319-85-7 | beta-BHC | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 319-86-8 | delta-BHC | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 58-89-9 | gamma-BHC (Lindane) | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 76-44-8 | Heptachlor | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 309-00-2 | Aldrin | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 1024-57-3 | Heptachlor epoxide | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 959-98-8 | Endosulfan I | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 60-57-1 | Dieldrin | 73. | DJ | 170. | DJ | 30. | J | 24. | J | 4.4 | UJ | 14. | J |
| 72-55-9 | 4,4'-DDE | 35. | DJ | 50. | DJ | 6.4 | J | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 72-20-8 | Endrin | 43. | U | 45. | U | 4.9 | UJ | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 33213-65-9 | Endosulfan II | 43. | U | 45. | U | 4.9 | UJ | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 72-54-8 | 4,4'-DDD | 6000. | DJ | 720. | DJ | 12. | J | 7. | J | 4.4 | UJ | 4.5 | UJ |
| 1031-07-8 | Endosulfan sulfate | 43. | U | 45. | U | 4.9 | UJ | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 50-29-3 | 4,4'-DDT | 22. | DJ | 86. | DJ | 12. | J | 11. | J | 4.4 | UJ | 4.5 | UJ |
| 72-43-5 | Methoxychlor | 220. | U | 230. | U | 25. | UJ | 25. | UJ | 23. | UJ | 23. | UJ |
| 53494-70-5 | Endrin ketone | 43. | U | 45. | U | 4.9 | UJ | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 7421-36-3 | Endrin aldehyde | 43. | U | 45. | U | 4.9 | UJ | 4.8 | UJ | 4.4 | UJ | 4.5 | UJ |
| 5103-71-9 | alpha-Chlordane | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 5103-74-2 | gamma-Chlordane | 22. | U | 23. | U | 2.5 | UJ | 2.5 | UJ | 2.3 | UJ | 2.3 | UJ |
| 8001-35-2 | Toxaphene | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 12674-11-2 | Aroclor-1016 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 11104-28-2 | Aroclor-1221 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 11141-16-5 | Aroclor-1232 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 53469-21-9 | Aroclor-1242 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 12672-29-6 | Aroclor-1248 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 11097-69-1 | Aroclor-1254 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |
| 11096-82-5 | Aroclor-1260 | 430. | U | 450. | U | 49. | UJ | 48. | UJ | 44. | UJ | 45. | UJ |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 PEST | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-N-0006-01RE | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01RE | | 038-M-0003-01 | |
| | ORIGINAL ID -----> | 006N000601RE | | 031M000101 | | 038M000101 | | 038M000201RE | | 038M000301 | |
| | LAB SAMPLE ID ---> | 122958RE_10R | | 122860_10 | | 122959_10 | | 122960RE_5RE | | 122961_10 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/26/95 | | 05/09/95 | | 05/11/95 | | 05/26/95 | | 05/11/95 | |
| | DATE ANALYZED ---> | 06/02/95 | | 05/13/95 | | 06/02/95 | | 06/02/95 | | 06/02/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 319-85-7 | beta-BHC | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 319-86-8 | delta-BHC | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 58-89-9 | gamma-BHC (Lindane) | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 76-44-8 | Heptachlor | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 309-00-2 | Aldrin | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 1024-57-3 | Heptachlor epoxide | 24. | UJ | 31. | DJ | 26. | U | 11. | UJ | 26. | UJ |
| 959-98-8 | Endosulfan I | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 60-57-1 | Dieldrin | 120. | DJ | 32. | DJ | 220. | DJ | 44. | DJ | 150. | DJ |
| 72-55-9 | 4,4'-DDE | 47. | UJ | 20. | DJ | 95. | DJ | 72. | DJ | 70. | DJ |
| 72-20-8 | Endrin | 47. | UJ | 45. | U | 51. | U | 22. | UJ | 51. | UJ |
| 33213-65-9 | Endosulfan II | 47. | UJ | 45. | U | 51. | U | 22. | UJ | 51. | UJ |
| 72-54-8 | 4,4'-DDD | 47. | UJ | 12. | DJ | 460. | DJ | 37. | DJ | 130. | DJ |
| 1031-07-8 | Endosulfan sulfate | 47. | UJ | 45. | U | 51. | U | 22. | UJ | 51. | UJ |
| 50-29-3 | 4,4'-DDT | 47. | UJ | 45. | U | 180. | DJ | 47. | DJ | 87. | DJ |
| 72-43-5 | Methoxychlor | 240. | UJ | 230. | U | 260. | U | 110. | UJ | 260. | UJ |
| 53494-70-5 | Endrin ketone | 47. | UJ | 76. | DJ | 51. | U | 22. | UJ | 51. | UJ |
| 7421-36-3 | Endrin aldehyde | 47. | UJ | 45. | U | 51. | U | 22. | UJ | 51. | UJ |
| 5103-71-9 | alpha-Chlordane | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 5103-74-2 | gamma-Chlordane | 24. | UJ | 23. | U | 26. | U | 11. | UJ | 26. | UJ |
| 8001-35-2 | Toxaphene | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 12674-11-2 | Aroclor-1016 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 11104-28-2 | Aroclor-1221 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 11141-16-5 | Aroclor-1232 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 53469-21-9 | Aroclor-1242 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 12672-29-6 | Aroclor-1248 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 11097-69-1 | Aroclor-1254 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |
| 11096-82-5 | Aroclor-1260 | 470. | UJ | 450. | U | 510. | U | 220. | UJ | 510. | UJ |

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*** Validation Complete ***

1395
SVOA

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 122962 | | 122963 | | 122964 | | 122861 | | 122862 | | 122863 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | DATE EXTRACTED --> | 05/12/95 | | 05/12/95 | | 05/12/95 | | 05/09/95 | | 05/09/95 | | 05/09/95 | |
| | DATE ANALYZED ---> | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/11/95 | | 05/11/95 | | 05/11/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 108-95-2 | Phenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 95-57-8 | 2-Chlorophenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 490. | UJ | 500. | UJ | 450. | UJ | 420. | UJ | 400. | UJ | 410. | UJ |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 490. | UJ | 500. | UJ | 450. | UJ | 420. | U | 400. | U | 410. | U |
| 67-72-1 | Hexachloroethane | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 98-95-3 | Nitrobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 78-59-1 | Isophorone | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 88-75-5 | 2-Nitrophenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 105-67-9 | 2,4-Dimethylphenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 120-83-2 | 2,4-Dichlorophenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 91-20-3 | Naphthalene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 106-47-8 | 4-Chloroaniline | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 87-68-3 | Hexachlorobutadiene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 91-57-6 | 2-Methylnaphthalene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 1200. | U | 1200. | U | 1100. | U | 1000. | U | 960. | U | 1000. | U |
| 91-58-7 | 2-Chloronaphthalene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 88-74-4 | 2-Nitroaniline | 1200. | U | 1200. | U | 1100. | U | 1000. | UJ | 960. | UJ | 1000. | UJ |
| 131-11-3 | Dimethylphthalate | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 208-96-8 | Acenaphthylene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 99-09-2 | 3-Nitroaniline | 1200. | U | 1200. | U | 1100. | U | 1000. | U | 960. | U | 1000. | U |
| 83-32-9 | Acenaphthene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 51-28-5 | 2,4-Dinitrophenol | 1200. | UJ | 1200. | UJ | 1100. | UJ | 1000. | U | 960. | U | 1000. | U |
| 100-02-7 | 4-Nitrophenol | 1200. | U | 1200. | U | 1100. | U | 1000. | U | 960. | U | 1000. | U |
| 132-64-9 | Dibenzofuran | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 121-14-2 | 2,4-Dinitrotoluene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |

*** Validation Complete ***

000531

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 SVOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 122962 | | 122963 | | 122964 | | 122861 | | 122862 | | 122863 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | DATE EXTRACTED --> | 05/12/95 | | 05/12/95 | | 05/12/95 | | 05/09/95 | | 05/09/95 | | 05/09/95 | |
| | DATE ANALYZED ---> | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/11/95 | | 05/11/95 | | 05/11/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 84-66-2 | Diethylphthalate | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 86-73-7 | Fluorene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 100-01-6 | 4-Nitroaniline | 1200. | U | 1200. | U | 1100. | U | 1000. | U | 960. | U | 1000. | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 1200. | UJ | 1200. | UJ | 1100. | UJ | 1000. | U | 960. | U | 1000. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 101-55-3 | 4-Bromophenylphenylether | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 118-74-1 | Hexachlorobenzene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 87-86-5 | Pentachlorophenol | 1200. | U | 1200. | U | 1100. | U | 1000. | U | 960. | U | 1000. | U |
| 85-01-8 | Phenanthrene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 120-12-7 | Anthracene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 86-74-8 | Carbazole | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 84-74-2 | Di-n-butylphthalate | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 206-44-0 | Fluoranthene | 490. | U | 79. | J | 450. | U | 420. | U | 41. | J | 410. | U |
| 129-00-0 | Pyrene | 490. | U | 73. | J | 450. | U | 420. | U | 400. | U | 410. | U |
| 85-68-7 | Butylbenzylphthalate | 490. | UJ | 500. | UJ | 450. | UJ | 420. | U | 400. | U | 410. | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 56-55-3 | Benzo(a)anthracene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 218-01-9 | Chrysene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 99. | J | 140. | J | 47. | J | 60. | J | 400. | U | 410. | U |
| 117-84-0 | Di-n-octylphthalate | 490. | UJ | 500. | UJ | 450. | UJ | 420. | U | 400. | U | 410. | U |
| 205-99-2 | Benzo(b)fluoranthene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 207-08-9 | Benzo(k)fluoranthene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 50-32-8 | Benzo(a)pyrene | 490. | U | 500. | U | 450. | U | 46. | J | 400. | U | 410. | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 53-70-3 | Dibenzo(a,h)anthracene | 490. | U | 500. | U | 450. | U | 420. | U | 400. | U | 410. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 490. | U | 500. | U | 450. | U | 42. | J | 400. | U | 410. | U |

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*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1395 SVOA | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 122864 | | 122865 | | 122965 | | 122966 | | 122967 | | 122968 | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/09/95 | | 05/09/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | |
| | DATE ANALYZED ---> | 05/11/95 | | 05/11/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 108-95-2 | Phenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 95-57-8 | 2-Chlorophenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 3900. | UJ | 390. | UJ | 2500. | UJ | 460. | UJ | 440. | UJ | 450. | UJ |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 3900. | U | 390. | U | 2500. | UJ | 460. | UJ | 440. | UJ | 450. | UJ |
| 67-72-1 | Hexachloroethane | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 98-95-3 | Nitrobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 78-59-1 | Isophorone | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 88-75-5 | 2-Nitrophenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 105-67-9 | 2,4-Dimethylphenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 120-83-2 | 2,4-Dichlorophenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 91-20-3 | Naphthalene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 106-47-8 | 4-Chloroaniline | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 87-68-3 | Hexachlorobutadiene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 91-57-6 | 2-Methylnaphthalene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 9500. | U | 950. | U | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 91-58-7 | 2-Chloronaphthalene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 88-74-4 | 2-Nitroaniline | 9500. | UJ | 950. | UJ | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 131-11-3 | Dimethylphthalate | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 208-96-8 | Acenaphthylene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 99-09-2 | 3-Nitroaniline | 9500. | U | 950. | U | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 83-32-9 | Acenaphthene | 3900. | U | 390. | U | 2500. | U | 52. | J | 440. | U | 450. | U |
| 51-28-5 | 2,4-Dinitrophenol | 9500. | U | 950. | U | 6100. | UJ | 1100. | UJ | 1100. | UJ | 1100. | UJ |
| 100-02-7 | 4-Nitrophenol | 9500. | U | 950. | U | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 132-64-9 | Dibenzofuran | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 121-14-2 | 2,4-Dinitrotoluene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |

*** Validation Complete ***

000538

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 SVOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 122864 | | 122865 | | 122965 | | 122966 | | 122967 | | 122968 | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/09/95 | | 05/09/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | |
| | DATE ANALYZED ---> | 05/11/95 | | 05/11/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 84-66-2 | Diethylphthalate | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 86-73-7 | Fluorene | 3900. | U | 390. | U | 2500. | U | 70. | J | 440. | U | 450. | U |
| 100-01-6 | 4-Nitroaniline | 9500. | U | 950. | U | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 9500. | U | 950. | U | 6100. | UJ | 1100. | UJ | 1100. | UJ | 1100. | UJ |
| 86-30-6 | N-Nitrosodiphenylamine | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 101-55-3 | 4-Bromophenylphenylether | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 118-74-1 | Hexachlorobenzene | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 87-86-5 | Pentachlorophenol | 9500. | U | 950. | U | 6100. | U | 1100. | U | 1100. | U | 1100. | U |
| 85-01-8 | Phenanthrene | 460. | J | 390. | U | 2500. | U | 520. | | 440. | U | 450. | U |
| 120-12-7 | Anthracene | 3900. | U | 390. | U | 2500. | U | 120. | J | 440. | U | 450. | U |
| 86-74-8 | Carbazole | 3900. | U | 390. | U | 2500. | U | 85. | J | 440. | U | 450. | U |
| 84-74-2 | Di-n-butylphthalate | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 206-44-0 | Fluoranthene | 2900. | J | 390. | U | 350. | J | 860. | J | 440. | U | 450. | U |
| 129-00-0 | Pyrene | 2400. | J | 38. | J | 310. | J | 650. | J | 440. | U | 450. | U |
| 85-68-7 | Butylbenzylphthalate | 3900. | U | 390. | U | 2500. | UJ | 460. | UJ | 440. | UJ | 450. | UJ |
| 91-94-1 | 3,3'-Dichlorobenzidine | 3900. | U | 390. | U | 2500. | U | 460. | U | 440. | U | 450. | U |
| 56-55-3 | Benzo(a)anthracene | 1800. | J | 390. | U | 2500. | U | 370. | J | 440. | U | 450. | U |
| 218-01-9 | Chrysene | 2300. | J | 390. | U | 2500. | U | 420. | J | 440. | U | 450. | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 1800. | J | 62. | J | 2500. | U | 180. | J | 440. | U | 450. | U |
| 117-84-0 | Di-n-octylphthalate | 3900. | U | 390. | U | 2500. | UJ | 460. | UJ | 440. | UJ | 450. | UJ |
| 205-99-2 | Benzo(b)fluoranthene | 2200. | J | 390. | U | 2500. | U | 330. | J | 440. | U | 450. | U |
| 207-08-9 | Benzo(k)fluoranthene | 1700. | J | 390. | U | 2500. | U | 310. | J | 440. | U | 450. | U |
| 50-32-8 | Benzo(a)pyrene | 2000. | J | 390. | U | 2500. | U | 340. | J | 440. | U | 450. | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 1200. | J | 390. | U | 2500. | U | 190. | J | 440. | U | 450. | U |
| 53-70-3 | Dibenzo(a,h)anthracene | 3900. | U | 390. | U | 2500. | U | 82. | J | 440. | U | 450. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 1300. | J | 390. | U | 2500. | U | 210. | J | 440. | U | 450. | U |

*** Validation Complete ***

000534

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



1395
SVOA

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | | |
| ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | | |
| LAB SAMPLE ID ---> | 122969 | | 122866 | | 122970 | | 122971 | | 122972 | | |
| SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | |
| DATE EXTRACTED --> | 05/12/95 | | 05/09/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | | |
| DATE ANALYZED ---> | 05/24/95 | | 05/11/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | |
| MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | |
| UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | |
| CAS # Parameter | | | | | | | | | | | |
| 108-95-2 Phenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 111-44-4 bis(2-Chloroethyl)ether | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 95-57-8 2-Chlorophenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 541-73-1 1,3-Dichlorobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 106-46-7 1,4-Dichlorobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 95-50-1 1,2-Dichlorobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 95-48-7 2-Methylphenol (o-Cresol) | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 108-60-1 2,2'-oxybis(1-Chloropropane) | 470. | UJ | 3900. | UJ | 460. | UJ | 2300. | UJ | 2300. | UJ | |
| 106-44-5 4-Methylphenol (p-Cresol) | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 621-64-7 N-Nitroso-di-n-propylamine | 470. | UJ | 3900. | U | 460. | UJ | 2300. | UJ | 2300. | UJ | |
| 67-72-1 Hexachloroethane | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 98-95-3 Nitrobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 78-59-1 Isophorone | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 88-75-5 2-Nitrophenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 105-67-9 2,4-Dimethylphenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 111-91-1 bis(2-Chloroethoxy)methane | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 120-83-2 2,4-Dichlorophenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 120-82-1 1,2,4-Trichlorobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 91-20-3 Naphthalene | 470. | U | 3900. | U | 60. | J | 2300. | U | 2300. | U | |
| 106-47-8 4-Chloroaniline | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 87-68-3 Hexachlorobutadiene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 59-50-7 4-Chloro-3-methylphenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 91-57-6 2-Methylnaphthalene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 77-47-4 Hexachlorocyclopentadiene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 88-06-2 2,4,6-Trichlorophenol | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 95-95-4 2,4,5-Trichlorophenol | 1100. | U | 9400. | U | 1100. | U | 5500. | U | 5600. | U | |
| 91-58-7 2-Chloronaphthalene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 88-74-4 2-Nitroaniline | 1100. | U | 9400. | UJ | 1100. | U | 5500. | U | 5600. | U | |
| 131-11-3 Dimethylphthalate | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 208-96-8 Acenaphthylene | 470. | U | 1100. | J | 93. | J | 2300. | U | 2300. | U | |
| 606-20-2 2,6-Dinitrotoluene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |
| 99-09-2 3-Nitroaniline | 1100. | U | 9400. | U | 1100. | U | 5500. | U | 5600. | U | |
| 83-32-9 Acenaphthene | 470. | U | 750. | J | 310. | J | 2300. | U | 640. | J | |
| 51-28-5 2,4-Dinitrophenol | 1100. | UJ | 9400. | U | 1100. | UJ | 5500. | UJ | 5600. | UJ | |
| 100-02-7 4-Nitrophenol | 1100. | U | 9400. | U | 1100. | U | 5500. | U | 5600. | U | |
| 132-64-9 Dibenzofuran | 470. | U | 3900. | U | 150. | J | 2300. | U | 270. | J | |
| 121-14-2 2,4-Dinitrotoluene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U | |

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples

| 1395 SVOA | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | |
| | ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | |
| | LAB SAMPLE ID ---> | 122969 | | 122866 | | 122970 | | 122971 | | 122972 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE EXTRACTED --> | 05/12/95 | | 05/09/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | |
| | DATE ANALYZED ---> | 05/24/95 | | 05/11/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | |
| 84-66-2 | Diethylphthalate | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 86-73-7 | Fluorene | 470. | U | 420. | J | 260. | J | 2300. | U | 510. | J |
| 100-01-6 | 4-Nitroaniline | 1100. | U | 9400. | U | 1100. | U | 5500. | U | 5600. | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 1100. | UJ | 9400. | U | 1100. | UJ | 5500. | UJ | 5600. | UJ |
| 86-30-6 | N-Nitrosodiphenylamine | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 101-55-3 | 4-Bromophenylphenylether | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 118-74-1 | Hexachlorobenzene | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 87-86-5 | Pentachlorophenol | 1100. | U | 9400. | U | 1100. | U | 5500. | U | 5600. | U |
| 85-01-8 | Phenanthrene | 470. | U | 1800. | J | 1900. | | 2300. | U | 1800. | J |
| 120-12-7 | Anthracene | 470. | U | 620. | J | 400. | J | 2300. | U | 470. | J |
| 86-74-8 | Carbazole | 470. | U | 430. | J | 340. | J | 2300. | U | 2300. | U |
| 84-74-2 | Di-n-butylphthalate | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 206-44-0 | Fluoranthene | 470. | U | 20000. | | 4700. | | 330. | J | 3800. | |
| 129-00-0 | Pyrene | 470. | U | 19000. | | 4700. | | 260. | J | 3300. | J |
| 85-68-7 | Butylbenzylphthalate | 470. | UJ | 850. | J | 380. | J | 2300. | UJ | 2300. | UJ |
| 91-94-1 | 3,3'-Dichlorobenzidine | 470. | U | 3900. | U | 460. | U | 2300. | U | 2300. | U |
| 56-55-3 | Benzo(a)anthracene | 470. | U | 16000. | | 3200. | | 2300. | U | 1900. | J |
| 218-01-9 | Chrysene | 470. | U | 21000. | | 3600. | | 2300. | U | 2100. | J |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 67. | J | 2300. | J | 410. | J | 2300. | U | 630. | J |
| 117-84-0 | Di-n-octylphthalate | 470. | UJ | 3900. | U | 460. | UJ | 2300. | UJ | 2300. | UJ |
| 205-99-2 | Benzo(b)fluoranthene | 470. | U | 30000. | | 5000. | | 2300. | U | 1900. | J |
| 207-08-9 | Benzo(k)fluoranthene | 470. | U | 24000. | | 2100. | | 2300. | U | 1600. | J |
| 50-32-8 | Benzo(a)pyrene | 470. | U | 26000. | | 3900. | | 2300. | U | 1700. | J |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 470. | U | 14000. | | 1500. | | 2300. | U | 730. | J |
| 53-70-3 | Dibenzo(a,h)anthracene | 470. | U | 5300. | | 630. | | 2300. | U | 350. | J |
| 191-24-2 | Benzo(g,h,i)perylene | 470. | U | 14000. | | 1400. | | 2300. | U | 630. | J |

000536

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 TPH | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 004-M-0001-01 | 004-M-0002-01 | 004-M-0002-02 | 006-M-0001-01 | 006-M-0001-02 | 006-M-0002-01 |
| ORIGINAL ID -----> | 004M000101 | 004M000201 | 004M000202 | 006M000101 | 006M000102 | 006M000201 |
| LAB SAMPLE ID ---> | 122951 | 122952 | 122953 | 122855 | 122856 | 122857 |
| SAMPLE DATE -----> | 05/04/95 | 05/04/95 | 05/04/95 | 05/03/95 | 05/03/95 | 05/03/95 |
| DATE EXTRACTED --> | 05/15/95 | 05/15/95 | 05/15/95 | 05/11/95 | 05/11/95 | 05/22/95 |
| DATE ANALYZED ---> | 05/15/95 | 05/15/95 | 05/15/95 | 05/12/95 | 05/12/95 | 05/22/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-4 Petroleum Hydrocarbons, TPH | 95. U | 94. U | 90. U | 360. | 130. | 81. U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1395 TPH | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-M-0003-01 | 006-M-0004-01 | 006-M-0005-01 | 006-N-0005-01 | 006-M-0005-02 | 006-M-0006-01 |
| ORIGINAL ID -----> | 006M000301 | 006M000401 | 006M000501 | 006N000501 | 006M000502 | 006M000601 |
| LAB SAMPLE ID ---> | 122858 | 122859 | 122954 | 122955 | 122956 | 122957 |
| SAMPLE DATE -----> | 05/03/95 | 05/03/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 |
| DATE EXTRACTED --> | 05/11/95 | 05/11/95 | 05/15/95 | 05/15/95 | 05/15/95 | 05/15/95 |
| DATE ANALYZED ---> | 05/12/95 | 05/12/95 | 05/15/95 | 05/15/95 | 05/15/95 | 05/15/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-4 Petroleum Hydrocarbons, TPH | 3000. | 1100. | 89. U | 160. | 90. U | 93. U |

000588

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples



1395
TPH

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 006-N-0006-01 | 031-M-0001-01 | 038-M-0001-01 | 038-M-0002-01 | 038-M-0003-01 | |
| ORIGINAL ID -----> | 006N000601 | 031M000101 | 038M000101 | 038M000201 | 038M000301 | |
| LAB SAMPLE ID ---> | 122958 | 122860 | 122959 | 122960 | 122961 | |
| SAMPLE DATE -----> | 05/04/95 | 05/03/95 | 05/04/95 | 05/04/95 | 05/04/95 | |
| DATE EXTRACTED --> | 05/15/95 | 05/11/95 | 05/15/95 | 05/15/95 | 05/15/95 | |
| DATE ANALYZED ---> | 05/15/95 | 05/12/95 | 05/15/95 | 05/15/95 | 05/15/95 | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | |
| CAS # Parameter | | | | | | |
| 9999900-02-4 Petroleum Hydrocarbons, TPH | 93. U | 1100. | 420. | 91. U | 360. | |

*** Validation Complete ***

| 1395 VOA | SAMPLE ID -------> | 004-M-0001-01 | | 004-M-0002-01 | | 004-M-0002-02 | | 006-M-0001-01 | | 006-M-0001-02 | | 006-M-0002-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 004M000101 | | 004M000201 | | 004M000202 | | 006M000101 | | 006M000102 | | 006M000201 | |
| | LAB SAMPLE ID ---> | 122962 | | 122963 | | 122964 | | 122861 | | 122862 | | 122863 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/03/95 | | 05/03/95 | | 05/03/95 | |
| | DATE ANALYZED ---> | 05/16/95 | | 05/16/95 | | 05/17/95 | | 05/16/95 | | 05/16/95 | | 05/16/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 74-87-3 | Chloromethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 74-83-9 | Bromomethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 75-01-4 | Vinyl chloride | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 75-00-3 | Chloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 75-09-2 | Methylene chloride | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 67-64-1 | Acetone | 15. | U | 19. | U | 59. | | 12. | UJ | 99. | J | 12. | UJ |
| 75-15-0 | Carbon disulfide | 15. | U | 15. | U | 14. | U | 12. | U | 5. | J | 12. | U |
| 75-35-4 | 1,1-Dichloroethene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 75-34-3 | 1,1-Dichloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 67-66-3 | Chloroform | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 107-06-2 | 1,2-Dichloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 78-93-3 | 2-Butanone (MEK) | 15. | U | 4. | J | 14. | U | 12. | UJ | 12. | UJ | 12. | UJ |
| 71-55-6 | 1,1,1-Trichloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 56-23-5 | Carbon tetrachloride | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 75-27-4 | Bromodichloromethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 78-87-5 | 1,2-Dichloropropane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 79-01-6 | Trichloroethene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 124-48-1 | Dibromochloromethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 71-43-2 | Benzene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 75-25-2 | Bromoform | 15. | U | 15. | U | 14. | U | 12. | U | 12. | U | 12. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 15. | U | 15. | U | 14. | U | 12. | UJ | 12. | UJ | 12. | UJ |
| 591-78-6 | 2-Hexanone | 15. | U | 15. | U | 14. | U | 12. | UJ | 12. | UJ | 12. | UJ |
| 127-18-4 | Tetrachloroethene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 108-88-3 | Toluene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 108-90-7 | Chlorobenzene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 100-41-4 | Ethylbenzene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 100-42-5 | Styrene | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |
| 1330-20-7 | Xylene (Total) | 15. | U | 15. | U | 14. | U | 12. | U | 12. | UJ | 12. | U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

1395
VOA
000531

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 006-M-0003-01 | | 006-M-0004-01 | | 006-M-0005-01 | | 006-N-0005-01 | | 006-M-0005-02 | | 006-M-0006-01 | |
| | ORIGINAL ID -----> | 006M000301 | | 006M000401 | | 006M000501 | | 006N000501 | | 006M000502 | | 006M000601 | |
| | LAB SAMPLE ID ---> | 122864 | | 122865 | | 122965 | | 122966 | | 122967 | | 122968 | |
| | SAMPLE DATE -----> | 05/03/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE ANALYZED ---> | 05/16/95 | | 05/17/95 | | 05/17/95 | | 05/17/95 | | 05/17/95 | | 05/17/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 74-87-3 | Chloromethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 74-83-9 | Bromomethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 2. | J |
| 75-01-4 | Vinyl chloride | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-00-3 | Chloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-09-2 | Methylene chloride | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 67-64-1 | Acetone | 30. | UJ | 4. | J | 15. | U | 14. | U | 16. | U | 14. | U |
| 75-15-0 | Carbon disulfide | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-35-4 | 1,1-Dichloroethene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-34-3 | 1,1-Dichloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 67-66-3 | Chloroform | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 107-06-2 | 1,2-Dichloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 78-93-3 | 2-Butanone (MEK) | 12. | UJ | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 56-23-5 | Carbon tetrachloride | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-27-4 | Bromodichloromethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 78-87-5 | 1,2-Dichloropropane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 79-01-6 | Trichloroethene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 124-48-1 | Dibromochloromethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 71-43-2 | Benzene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 75-25-2 | Bromoform | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 12. | UJ | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 591-78-6 | 2-Hexanone | 12. | UJ | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 127-18-4 | Tetrachloroethene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 108-88-3 | Toluene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 108-90-7 | Chlorobenzene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 100-41-4 | Ethylbenzene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 100-42-5 | Styrene | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |
| 1330-20-7 | Xylene (Total) | 12. | U | 13. | U | 15. | U | 14. | U | 13. | U | 14. | U |

*** Validati[illegible] [illegible]omplete ***

| 1395 VOA | SAMPLE ID -------> | 006-N-0006-01 | | 031-M-0001-01 | | 038-M-0001-01 | | 038-M-0002-01 | | 038-M-0003-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 006N000601 | | 031M000101 | | 038M000101 | | 038M000201 | | 038M000301 | |
| | LAB SAMPLE ID ---> | 122969 | | 122866 | | 122970 | | 122971 | | 122972 | |
| | SAMPLE DATE -----> | 05/04/95 | | 05/03/95 | | 05/04/95 | | 05/04/95 | | 05/04/95 | |
| | DATE ANALYZED ---> | 05/17/95 | | 05/16/95 | | 05/17/95 | | 05/17/95 | | 05/17/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | |
| 74-87-3 | Chloromethane | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 74-83-9 | Bromomethane | 14. | U | 12. | U | 14. | U | 14. | U | 2. | J |
| 75-01-4 | Vinyl chloride | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 75-00-3 | Chloroethane | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 75-09-2 | Methylene chloride | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 67-64-1 | Acetone | 14. | U | 12. | UJ | 8. | J | 14. | U | 14. | U |
| 75-15-0 | Carbon disulfide | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 75-35-4 | 1,1-Dichloroethene | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 75-34-3 | 1,1-Dichloroethane | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 67-66-3 | Chloroform | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 107-06-2 | 1,2-Dichloroethane | 14. | U | 12. | U | 14. | U | 14. | U | 14. | U |
| 78-93-3 | 2-Butanone (MEK) | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 56-23-5 | Carbon tetrachloride | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 75-27-4 | Bromodichloromethane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 78-87-5 | 1,2-Dichloropropane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 79-01-6 | Trichloroethene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 124-48-1 | Dibromochloromethane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 71-43-2 | Benzene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 75-25-2 | Bromoform | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 591-78-6 | 2-Hexanone | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 127-18-4 | Tetrachloroethene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 108-88-3 | Toluene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 108-90-7 | Chlorobenzene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 100-41-4 | Ethylbenzene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 100-42-5 | Styrene | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |
| 1330-20-7 | Xylene (Total) | 14. | U | 12. | UJ | 14. | U | 14. | U | 14. | UJ |

000592

*** Validation Complete ***

# VALIDATA

**Chemical Services, Inc.**

P. O. Box 930422 Norcross, Ga. 30093


## DATA VALIDATION SUMMARY REPORT

| | |
|---|---|
| COMPANY: | Ensafe/Allen & Hoshall |
| SITE NAME: | NAS Memphis |
| PROJECT NUMBER: | 8500.024 |
| CONTRACTED LAB: | National Environmental Testing, Inc. |
| QA/QC LEVEL: | Level III |
| EPA SOW/METHOD: | EPA 1990 SOW |
| VALIDATION GUIDELINES: | *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, 1994; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, 1994 |
| SAMPLE MATRICES: | Soil and Water |
| TYPES OF ANALYSES: | Volatile Organics (VOA), Semivolatile Organics (SVOA), Organochlorine Pesticides/PCB's (P/PCB), Total Metals and Cyanide (Me/CN), Herbicides (HERB), Organophosphorus Pesticides (OPPE), Total Petroleum Hydrocarbons (TPH), Diesel Range Organics (DRO), Gasoline Range Organics (GRO) |

SDG NUMBER: 1398

SAMPLES:

| Client Sample #: | Lab Sample #: | Matrix | VOA | SVOA | P/PCB | Me/CN | HERB |
|---|---|---|---|---|---|---|---|
| 007E050595 | 123019 | Water | X | X | X | X | X |
| 038M000401 | 123020 | Soil | X | X | | X | X |
| 038M000401RE | 123009RE | Soil | | | X | | |
| 038M000402 | 123021 | Soil | X | X | | X | X |
| 038M000402RE | 123010RE | Soil | | | X | | |
| 038M000501 | 123022 | Soil | X | X | | X | X |
| 038M000501RE | 123011RE | Soil | | | X | | |
| 038N000501 | 123023 | Soil | X | X | | X | X |
| 038N000501RE | 123012RE | Soil | | | X | | |
| 038M000502 | 123024 | Soil | X | X | | X | X |
| 038M000502RE | 123013RE | Soil | | | X | | |
| 038M000601 | 123025 | Soil | X | X | | X | X |
| 038M000601RE | 123014RE | Soil | | | X | | |

| Client Sample #: | Lab Sample #: | Matrix | VOA | SVOA | P/PCB | Me/CN | HERB |
|---|---|---|---|---|---|---|---|
| 038M000701 | 123026 | Soil | X | X | | X | X |
| 038M000701RE | 123015RE | Soil | | | X | | |
| 038M000702 | 123027 | Soil | X | X | | X | X |
| 038M000702RE | 123016RE | Soil | | | X | | |
| 038M000801 | 123028 | Soil | X | X | | X | X |
| 038M000801RE | 123017RE | Soil | | | X | | |
| 038M000802 | 123029 | Soil | X | X | | X | X |
| 038M000802RE | 123018RE | Soil | | | X | | |
| 038M000701MS | 123026MS | Soil | X | X | | X | X |
| 038M000701REMS | 123015REMS | Soil | | | X | | |
| 038M000701MSD | 123026MSD | Soil | X | X | | | X |
| 038M000701RD | 123015RFMSD | Soil | | | X | | |
| 038M000701MD | 123026MD | Soil | | | | X | |
| TRIP BLANK | 123115 | Water | X | | | | |

N = FIELD DUPLICATE, E = EQUIPMENT BLANK, RE = REEXTRACTION,
MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE, MD = MATRIX DUPLICATE
RD = REEXTRACTION MATRIX SPIKE DUPLICATE

| Client Sample #: | Lab Sample #: | Matrix | OPPE | TPH | DRO | GRO |
|---|---|---|---|---|---|---|
| 007E050595 | 123007 | Water | X | X | X | X |
| 038M000401 | 123009 | Soil | X | X | X | X |
| 038M000402 | 123010 | Soil | X | X | X | X |
| 038M000501 | 123011 | Soil | X | X | X | X |
| 038N000501 | 123012 | Soil | X | X | X | X |
| 038M000502 | 123013 | Soil | X | X | X | X |
| 038M000601 | 123014 | Soil | X | X | X | X |
| 038M000701 | 123015 | Soil | X | X | X | X |
| 038M000702 | 123016 | Soil | X | X | X | X |
| 038M000801 | 123017 | Soil | X | X | X | X |
| 038M000802 | 123018 | Soil | X | X | X | X |
| 038M000701MS | 123015MS | Soil | X | X | X | X |
| 038M000701MSD | 123015MSD | Soil | X | X | X | X |

E = EQUIPMENT BLANK, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

DATA REVIEWER(S): Amy L. Hogan, Marvin L. Smith

RELEASE SIGNATURE: Kevin C. Hannon

## Data Qualifier Definitions:

| | | |
|---|---|---|
| J | - | The associated numerical value is an estimated quantity. |
| R | - | The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification. |
| U | - | The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit. |
| UJ | - | The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity. |

DATA QUALIFICATION SUMMARY

NET, Inc. - 1398 Organics and Inorganics

SAMPLES: 007E050595, 038M000401, 038M000402, 038M000501, 038N000501, 038M000502, 038M000601, 038M000701, 038M000701MS, 038M000701MSD, 038M000702, 038M000801, 038M000802, TRIP BLANK, 038M000401RE, 038000402RE, 038M000501RE, 038N000501RE, 038M000801RE, 038M000802RE, 038M000701REMS, 038M000701RD

*VOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC/MS Tuning:

All Tuning criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was necessary.

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/18/95 at 09:07 on instrument HP5970H:

| | |
|---|---|
| chloromethane | 27.0% |
| vinyl chloride | 28.8% |

The results for these compounds in associated samples 038M000401, 038N000501, 038M000701, 038M000702 and 038M000801, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Difference (%D) of chloromethane (37.2%) exceeded the 25% QC limit for the continuing calibration run on 5/19/95 at 09:59 on instrument HP5970K. The non-detect result for this compound in associated sample 038M000802 was flagged as estimated (UJ).

The Percent Difference (%D) of bromoform (37.1%) exceeded the 25% QC limit for the continuing calibration run on 5/20/95 at 07:11 on instrument HP5970L. The non-detect result for this compound in associated sample 038M000601 was flagged as estimated (UJ).

IV.) Blanks:

Method Blanks:

Acetone was detected at 3.0 ug/kg in soil method blank VBLK051895H. All positive results for acetone in associated samples 038M000401, 038M000701, 038M000702, 038M000801 and 038N000501 less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample.

4-Methyl-2-pentanone and 2-hexanone were detected at 1.0 mg/kg and 3.0 mg/kg, respectively, in soil method blank VBLK052095L. There were no positive results for these compounds in the associated samples. No action was required.

Trip Blanks:

Methylene chloride was detected at 1.0 ug/L in the associated trip blank for this SDG. There were no positive results for this compound in the samples in this SDG. No action was necessary.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was necessary.

TIC's:

There were no TIC's reported in the blanks for this SDG.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was required.

VII.) Field Duplicates:

There were no calculable Relative Percent Differences for field duplicate samples 038M000501 and 038N000501. No action was required.

VIII.) Internal Standards Performance:

All Internal Standards Performance criteria were met. No action was necessary.

IX.) TCL Compound Identification:

All TCL criteria were met, so no action was necessary.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

The CRQL's and analytical results for method blanks VBLK051695K, VBLK051795H and VBLK051895H were incorrect on the spreadsheets. The Form I values for these 3 blanks were entered on the speadsheets during validation.

All other CRQL criteria were met. No further action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*SEMIVOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was necessary.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met, so no action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviations (%RSD's) of hexachlorocyclopentadiene (35.2%) and 2,4-dinitrophenol (32.1%) exceeded the 30% QC limit for the initial calibration run on 4/28/95 on instrument HP5970F. There were no positive results for these compounds in the associated samples. No action was required.

Continuing Calibration:

The Percent Difference (%D) of 2,2'-oxybis(1-chloropropane) were 26.8% which exceeded the 25% QC limit for the continuing calibration run on 5/23/95 at 13:55 on instrument HP5970F. Since the only associated samples for this calibration were method blanks, no action was required.

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/26/95 at 09:39 on instrument HP5970F:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 26.6% |
| 2,4-dinitrophenol | 28.7% |
| butylbenzylphthalate | 26.2% |
| 3,3-dichlorobenzidine | 43.8% |

The positive and non-detect results for these compounds in associated samples 038M000401, 038M000402, 038M000501, 038N000501, 038M000502, 038M000601, 038M000701, 038M000702, 038M000801 and 038M000802 were flagged as estimated (J) and (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/17/95 at 11:57 on instrument HP5970J:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 140% |
| n-nitroso-di-n-propylamine | 25.4% |
| 4,6-dinitro-2-methylphenol | 34.8% |
| benzo(g,h,i)perylene | 26.3% |

The associated sample for this calibration was a method blank. No action was taken.

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 6/01/95 at 10:48 on instrument HP5970J:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 60.8% |
| 4-nitrophenol | 43.7% |
| carbazole | 25.1% |
| butylbenzylphthalate | 25.0% |
| 3,3-dichlorobenzidine | 26.0% |
| bis(2-ehtylhexyl)phthalate | 32.3% |
| di-n-octyl phthalate | 38.5% |

The associated sample for this calibration was an equipment blank (007E050595). No action was required.

IV.) Blanks:

Method Blanks:

Di-n-butylphthalate was detected at 490 ug/kg in soil method blank SBLK051895F. There were no positive results for this compound in the associated samples. No action was required.

Equipment Blank:

There were no positive results for equipment blank 007E050595. No action was necessary.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for soil field duplicate samples 038M000501 and 038N000501, since all positive detections were below the CRQL.

VIII.) Internal Standards Performance:

All Internal Standard Performance criteria were met. No action was required.

IX) TCL Compound Identification:

All TCL criteria were met, so no action was required.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met, so no action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*PESTICIDES/PCB's*

I.) Holding Times:

The holding time from sample date to extraction date for the following samples exceeded the 14 day QC limit:

| Client Sample # | Days |
|---|---|
| 038M000401RE | 25 |
| 038M000402RE | 25 |
| 038M000501RE | 25 |
| 038N000501RE | 25 |
| 038M000502RE | 25 |
| 038M000601RE | 25 |
| 038M000701RE | 25 |
| 038M000702RE | 25 |
| 038M000801RE | 25 |
| 038M000802RE | 25 |

All positive and non-detect results for these samples were flagged as estimated (J) and (UJ).

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was required.

III.) Calibration:

The Percent Difference (%D) for 4,4'-DDD (27.5%) exceeded the 25% QC limit for the continuing calibration run on 6/06/95 at 12:40. The results for this compound in the associated samples were previously flagged based on holding times. No further action was required.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was necessary.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

The Relative Percent Difference (RPD) for 4,4'-DDT (28%) exceeded the 27% QC limit for samples 038M000701REMS and 038M000701REMSD. The result for this compound in associated sample 038M000701RE was previously flagged as estimated based on the holding time. No further action was required.

VII.) TCL Compound Identification:

Pesticide/PCB Identification Summary (PIS):

The Column Percent Difference (%D) for sample 038M000501RE (78.6%) exceeded the 70% QC limit. The result for this compound in this sample was previously flagged as estimated based on holding time criteria. No further action was required.

VIII.) Field Duplicates:

The Relative Percent Differences (RPD's) for dieldrin (48%), 4,4'-DDD (49%) and 4,4'-DDT (2.3%) were within the 60% QC limit for field duplicate samples 038M000501RE and 038N000501RE. No action was taken.

IX.) Pesticide Cleanup Check:

Florisil Cartridge Check:

All criteria were met, so no action was taken.

Gel Permeation Chromatography (GPC):

All GPC criteria were met, so no action was necessary.

X.) Overall Assessment of Data/General:

The initial analytical data were not submitted for validation. All sample data were from the reanalyses.

All laboratory data were acceptable with qualification.

*ORGANOPHOSPHORUS PESTICIDES*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) of merphos (69.4%) exceeded the 20% QC limit for the initial calibration run on 5/24/95. This %RSD was from the secondary column. The results for merphos in all samples of this SDG, which consisted entirely of non-detects, were flagged as estimated (UJ).

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 17:59:

| Compound | %D |
|---|---|
| dichlorvos | 28.8 |
| naled | 50.8 |
| naled | 45.6* |
| merphos | 78.0 |
| merphos | 463000* |
| fensolfothion | 32.2 |

* The %D's for these compounds were taken from the secondary column.

The results for these compounds in associated samples 038M000401, 038M000402, 038M000501, 038N000501, 038M000502, 038M000601, 038M000701, 038M000702, 038M000801 and 038M000802, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/26/95 at 16:30:

| Compound | %D |
|---|---|
| merphos | 34.4 |
| merphos | 277000* |
| naled | 46.3* |

* The %D's for these compounds were taken from the secondary column.

The results for merphos in the associated samples were previously flagged as estimated (UJ). No further action was necessary.

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 6/01/95 at 17:02:

| Compound | %D |
|---|---|
| dichlorvos | 30.9 |
| naled | 26.5 |
| merphos | 360000 |

| Compound | %D |
|---|---|
| dichlorvos | 42.1* |
| merphos | 37.4* |
| alpha mevinphos | 60.3* |
| o,demeton | 33.6* |
| ethoprop | 28.7* |
| phorate | 31.4* |
| s,demeton | 27.2* |
| diazinon | 33.4* |
| disulfton | 43.9* |
| ronnel | 36.5* |
| fenthion | 25.9* |
| chlorpyrifos | 57.9* |
| tokuthion | 26.9* |
| fensolfothion | 73.4* |
| sulprofos | 25.4* |
| guthion | 36.6* |
| coumophos | 48.7* |

* The %D's for these compounds were taken from the secondary column.

The only associated sample for this calibration was equipment blank 007E050595. No action was taken.

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 6/01/95 at 23:40:

| Compound | %D |
|---|---|
| naled | 27.7 |
| naled | 27.1* |
| merphos | 319000 |
| dichlorvos | 66.2* |
| alpha mevinphos | 68.0* |
| o,demeton | 42.3* |
| ethoprop | 30.0* |
| phorate | 33.9* |
| s,demeton | 35.5* |
| diazinon | 28.8* |
| disulfoton | 25.6* |
| methyl parathion | 37.5* |
| ronnel | 40.9* |
| fenthion | 26.3* |
| chlorpyrifos | 26.7* |
| stirophos | 50.5* |
| sulprofos | 27.1* |
| coumophos | 48.7* |

* The %D's for these compounds were taken from the secondary column.



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The only associated sample for this calibration was an equipment blank 007E050595. No action was taken.

IV.) Blanks:

Method Blanks:

All Method Blank criteria were met. No action was required.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was requried.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

The Relative Percent Differences (RPD's) for the following compounds exceeded the 15% QC limit for spiked samples 038M000701MS and 038M000701MSD:

| | |
|---|---|
| naled | 18% |
| dichlorvos | 18% |
| merphos | 76% |

The non-detect results for these compounds in associated sample 038M000701 were previously flagged as estimated (UJ) based on the continuing calibration. No further action was necessary.

The Percent Recoveries (%R's) of the following compounds were outside the 50-140% QC limits for samples 038M000701MS and 038M000701MSD:

| Compound | MS %R |
|---|---|
| naled | 45 |

The result for this compound in associated sample 038M000701 was previously flagged as estimated (UJ) based on the continuing calibration. No further action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*HERBICIDES*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviation (%RSD) of MCPP (21.6%) on the primary column exceeded the 20% QC limit for the initial calibration run on 5/16/95. Since only one compound exceeded the 20% limit and was less than 30%, no action was necessary.

The %RSD's for MCPP (58.6%), MCPA (54.5%), 2,4,5-T (21.4%) and 2,4-DB (35.3%) exceeded the 20% QC limit for the secondary column for the initial calibration run on 5/16/95. All positive and non-detect results for these compounds in all samples in this SDG were flagged as estimated (J) and (UJ).

Continuing Calibration:

The Percent Difference (%D) of 2,4-DB (33.2%) on the secondary column exceeded the 25% QC limit for the continuing calibration run on 5/23/95 at 20:28. Since the results for this compound in the associated samples were qualified based on the initial calibration, no further action was required.

The Percent Differences (%D's) of dalapon (32.6%) on the primary column and 2,4-DB (66.1%) on the secondary column exceeded the 25% QC limit for the continuing calibration run on 5/24/95 at 04:19. The only associated sample for this calibration was equipment blank 007E050595. No action was taken.

The Percent Difference (%D) of dalapon (49.5%) on the primary column exceeded the 25% QC limit for the continuing calibration run on 5/24/95 at 17:05. The results for this compound in associated samples 038M000401, 038M000402, 038M000501, 038N000501, 038M000502 and 038M000601, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/24/95 at 17:05:

| Compound | %D |
|---|---|
| dalapon | 38.1* |
| silvex | 33.3* |
| MCPA | 48.8* |
| 2,4-DB | 73.8* |

* The %D's for these compounds were taken from the secondary column.

The non-detect results for these compounds in associated samples 038M000401, 038M000402, 038M000501, 038N000501, 038M000502 and 038M000601 were flagged as estimated (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 01:04:

| Compound | %D |
|---|---|
| dalapon | 39.4* |
| 2,4-D | 90.9* |

* The %D's for these compounds were from the secondary column.

The non-detect results for these compounds in associated samples 038M000701, 038M000702, 038M000801 and 038M000802 were flagged as estimated (UJ).

The Percent Differences (%D's) for the following compounds exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 08:26:

| Compound | %D |
|---|---|
| dalapon | 47.6* |
| silvex | 25.6* |
| 2,4,5-T | 41.3* |
| 2,4-DB | 113* |

* The %D's for these compounds were from the secondary column.

The positive and non-detect results for these compounds in associated samples 038M000701, 038M000702, 038M000801 and 038M000802 were flagged as estimated (J) and (UJ).

IV.) Blanks:

Method Blanks:

All Method Blank criteria were met. No action was required.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

The Relative Percent Differences (RPD's) for the following compounds exceeded the 20% QC limit for samples 038M000701MS and 038M000701MSD:

| Compound | RPD |
|---|---|
| MCPA | 27 |
| dicamba | 29 |
| 2,4-DB | 52 |
| dinoseb | 40 |

The results for these compounds in associated sample 038M000701, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Recoveries (%R's) of the following compounds were outside the 10-150% QC limits for samples 038M000701MS and 038M000701MSD:

| Compound | MS %R | MSD %R |
|---|---|---|
| dalapon | 0 | 0 |

The non-detect result for dalapon in associated sample 038M000701 was previously flagged as estimated (UJ). No further action was required.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 038M000501 and 038N000501. No action was required.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*TOTAL METALS and CYANIDE*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Calibration:

All Calibration criteria were met. No action was required.

II.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

| Blank Type/ID# | Analyte | Max. Conc. | Action Level mg/kg |
|---|---|---|---|
| CCB6 | arsenic | 2.20 ug/L | 2.20 |
| PBW | barium | 4.62 ug/L | 4.62 |
| PBS | beryllium | 0.33 mg/kg | 1.65 |
| PBW | copper | 5.65 ug/L | 5.65 |
| PBS | lead | 0.48 mg/kg | 2.40 |
| CCB1 | selenium | 2.10 ug/L | 2.10 |
| PBW | vanadium | 5.92 ug/L | 5.92 |
| CCB4 | tin | 23.8 ug/L | 23.8 |

PBS = Preparation Blank (Soil), PBW = Preparation Blank (Water),
CCB = Continuing Calibration Blank

All results greater than the IDL but less than 5X the blank amount (Action Level, mg/kg for soil samples) for which the contaminated blank was an associated calibration or laboratory preparation blank were flagged as undetected (U).

The following analyte had a negative result with an absolute value greater than the IDL:

| Blank Type/ID# | Analyte | Neg. Conc. | 5X Conc. (mg/kg) |
|---|---|---|---|
| CCB2 | cobalt | -3.90 ug/L | 3.90 |

CCB = Continuing Calibration Blank

All associated positive sample results less than 5X the absolute value of the negative blank result were flagged as estimated (J) and all non-detects were flagged as estimated (UJ).

Equipment Blank:

Arsenic was detected at 2.40 ug/L in equipment blank 07E050595. All results for this analyte were previously qualified using the calibration blanks. No further action was required.

IV.) ICP Interference Check Sample Results:

All Interference Check Sample criteria were met. No action was required.

V.) ICP Serial Dilution Analysis:

All Serial Dilution criteria were met, so no action was necessary.

VI.) Laboratory Control Samples (LCS):

The Percent Recoveries (%R's) of antimony (269%), arsenic (68.7%), mercury (51.9%) and vanadium (77.8%) were outside the 80-120% QC limits for the soil LCS. The positive result for antimony in sample 038M000801 was flagged as estimated (J). The positive and non-detect results for the other analytes in all soil samples in this SDG were flagged as estimated (J) and (UJ).

VII.) Duplicate Sample Analysis:

The Relative Percent Differences (RPD's) for chromium (84.5%), vanadium (66.8%) and zinc (63.8%) exceeded the 35% QC limit for soil sample 038M000701MD. The positive and non-detect results for these analytes in the samples in this SDG were flagged as estimated (J) and (UJ).

VIII.) Matrix Spike Recoveries:

The Percent Recoveries (%R's) of the following compounds were below the 75-125% QC limits for sample 038M000701MS:

| | |
|---|---|
| antimony | 62.5% |
| lead | 63.5% |
| silver | 0.00% |

The positive results for silver in all samples in this SDG were flagged as estimated and the non-detect results for this analyte were rejected (R). The positive and non-detect results for antimony and lead in all samples in this SDG were flagged as estimated (J) and (UJ).

IX.) Field Duplicates:

The Relative Percent Differences (RPD's) for the following analytes were calculated for field duplicate samples 038M000501 and 038N000501:

| | |
|---|---|
| arsenic | 13% |
| barium | 75% |
| beryllium | 15% |
| cadmium | 5.4% |
| chromium | 66% |
| cobalt | 63% |
| copper | 20% |
| lead | 38% |
| nickel | 50% |
| vanadium | 9.5% |
| zinc | 5.5% |
| tin | 36% |

The results for barium, chromium and cobalt were flagged as estimated (J) in the two associated samples, 038M000501 and 038N000501 since the RPD's exceeded the 60% QC limit.

X.) Furnace Atomic Absorption QC:

Method of Standard Addition (MSA):

All MSA criteria were met. No action was required.

Post Digestion Spike Recovery:

The Percent Recoveries (%R's) of thallium in the following samples were below the 85-115% QC limits:

| | |
|---|---|
| 038M000501 | 84.8% |
| 038M000502 | 82.0% |
| 038M000801 | 78.5% |

All positive and non-detect results for thallium in these samples were flagged as estimated (J) and (UJ).

The Percent Recoveries (%R's) for selenium in the following samples exceeded the 85-115% QC limits:

| | |
|---|---|
| 038M000401 | 159% |
| 038M000502 | 132% |
| 038M000601 | 120% |

The results for this compound in these samples consisted entirely of non-detects, so no action was taken.

XI.) Sample Result, Calculation/Transcription Verification:

All criteria were met, so no action was taken.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met, so no action was taken.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*TOTAL PETROLEUM HYDROCARBONS*

I.) Holding Times:

All samples were extracted and analyzed within required the holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Laboratory Control Samples (LCS):

All LCS Recovery criteria were met. No action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicates associated with this SDG. No action was taken.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable without qualification.

*DIESEL RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was necessary.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 038M000501 and 038N000501. No action was necessary.

IX.) Overall Assessment of Data/General:

No calibration was run for the analysis of sample 007E050595. Since the sample was an equipment blank, no action was taken. All laboratory data were acceptable without qualification.

*GASOLINE RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within the required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

Equipment Blank:

There were no positive detections in equipment blank 007E050595. No action was necessary.

V.) Surrogate Recoveries:

The Percent Recovery (%R) in spiked sample 038M000701MS (45%) was below the 50-150% QC limits. Since this sample was a matrix spike, no action was taken.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

The Relative Percent Difference (RPD) was 31%, which exceeded the 20% QC limit for samples 038M000701MS and 038M000701MSD. The positive result in the associated inspiked sample 038M000701 was flagged as estimated (J).

The Percent Recoveries (%R's) in samples 038M00701MS (29%) and 038M000701MSD (40%) were below the 50-100% QC limits. The result in the associated sample was previously flagged as estimated (J). No further action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no calculable Relative Percent Differences (RPD's) for field duplicate samples 038M000501 and 038N000501. No action was necessary.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 8015 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0004-01 | 038-M-0004-02 | 038-M-0005-01 | 038-N-0005-01 | 038-M-0005-02 | 038-M-0006-01 |
| ORIGINAL ID -----> | 038M000401 | 038M000402 | 038M000501 | 038N000501 | 038M000502 | 038M000601 |
| LAB SAMPLE ID ---> | 123009 | 123010 | 123011 | 123012 | 123013 | 123014 |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 |
| DATE ANALYZED ---> | 05/18/95 | 05/18/95 | 05/18/95 | 05/18/95 | 05/18/95 | 06/20/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 67. J | 64. U | 67. U | 70. U | 67. U | 70. U |

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples



1398
8015 Mod

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0007-01 | 038-M-0007-02 | 038-M-0008-01 | 038-M-0008-02 | | |
| ORIGINAL ID -----> | 038M000701 | 038M000702 | 038M000801 | 038M000802 | | |
| LAB SAMPLE ID ---> | 123015 | 123016 | 123017 | 123018 | | |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | | |
| DATE ANALYZED ---> | 05/18/95 | 06/20/95 | 06/20/95 | 06/20/95 | | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | | |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | | |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 73. J | 70. U | 68. U | 71. U | | |

*** Validation Complete ***

000616

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples

| 1398 8100 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0004-01 | 038-M-0004-02 | 038-M-0005-01 | 038-N-0005-01 | 038-M-0005-02 | 038-M-0006-01 |
| ORIGINAL ID -----> | 038M000401 | 038M000402 | 038M000501 | 038N000501 | 038M000502 | 038M000601 |
| LAB SAMPLE ID ---> | 123009 | 123010 | 123011 | 123012 | 123013 | 123014 |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 |
| DATE EXTRACTED --> | 05/30/95 | 05/30/95 | 05/30/95 | 05/30/95 | 05/30/95 | 05/30/95 |
| DATE ANALYZED ---> | 06/08/95 | 06/08/95 | 06/08/95 | 06/08/95 | 06/08/95 | 06/08/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A |
| CAS # Parameter | | | | | | |
| 9999900-02-6 TPH - Diesel Range Organics | 5600. U | 15000. | 5300. U | 5600. U | 5300. U | 5600. U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



1398
8100 Mod

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0007-01 | 038-M-0007-02 | 038-M-0008-01 | 038-M-0008-02 | | |
| ORIGINAL ID -----> | 038M000701 | 038M000702 | 038M000801 | 038M000802 | | |
| LAB SAMPLE ID ---> | 123015 | 123016 | 123017 | 123018 | | |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | | |
| DATE EXTRACTED --> | 05/30/95 | 05/30/95 | 05/30/95 | 05/30/95 | | |
| DATE ANALYZED ---> | 06/08/95 | 06/09/95 | 06/09/95 | 06/09/95 | | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | | |
| UNITS ----------> | ug/Kg A | ug/Kg A | ug/Kg A | ug/Kg A | | |
| CAS # Parameter | | | | | | |
| 9999900-02-6 TPH - Diesel Range Organics | 8000. | 5600. U | 21000. | 27000. | | |

*** Validation Complete ***

000618

| 1398 HERB | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-N-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038N000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 123009 | | 123010 | | 123011 | | 123012 | | 123013 | | 123014 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | |
| | DATE ANALYZED ---> | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | | 05/24/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-82-6 | 2,4-DB | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ |
| 88-85-7 | Dinoseb | 4.7 | U | 4.7 | U | 4.7 | U | 4.7 | U | 4.7 | U | 4.7 | U |
| 93-76-5 | 2,4,5-T | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ |
| 75-99-0 | Dalapon | 23. | UJ | 23. | UJ | 23. | UJ | 23. | UJ | 23. | UJ | 23. | UJ |
| 1918-00-9 | Dicamba | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U | 0.94 | U |
| 120-36-5 | Dichlorprop | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U |
| 94-74-6 | MCPA | 940. | UJ | 940. | UJ | 940. | UJ | 940. | UJ | 940. | UJ | 940. | UJ |
| 93-65-2 | MCPP | 940. | UJ | 940. | UJ | 940. | UJ | 5200. | J | 3600. | J | 940. | UJ |

*** Validation Complete ***

| 1398 HERB | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 038-M-0008-02 | | | |
| | ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 038M000802 | | | |
| | LAB SAMPLE ID ---> | 123015 | | 123016 | | 123017 | | 123018 | | | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | | |
| | DATE ANALYZED ---> | 05/25/95 | | 05/25/95 | | 05/25/95 | | 05/25/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | | |
| CAS # | Parameter | | | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | UJ | 9.4 | UJ | 9.4 | UJ | 9.4 | UJ | | |
| 94-82-6 | 2,4-DB | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | 9.5 | UJ | | |
| 88-85-7 | Dinoseb | 4.7 | UJ | 4.7 | U | 4.7 | U | 4.7 | U | | |
| 93-76-5 | 2,4,5-T | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | 0.95 | UJ | | |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | UJ | 0.95 | UJ | 6. | J | 0.95 | UJ | | |
| 75-99-0 | Dalapon | 23. | UJ | 23. | UJ | 23. | UJ | 23. | UJ | | |
| 1918-00-9 | Dicamba | 0.94 | UJ | 0.94 | U | 7.2 | | 0.94 | U | | |
| 120-36-5 | Dichlorprop | 9.4 | U | 9.4 | U | 9.4 | U | 9.4 | U | | |
| 94-74-6 | MCPA | 940. | UJ | 940. | UJ | 940. | UJ | 940. | UJ | | |
| 93-65-2 | MCPP | 940. | UJ | 940. | UJ | 940. | UJ | 940. | UJ | | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1398 METAL | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-M-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038M000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 1-123020S | | 1-123021S | | 1-123022S | | 1-123023S | | 1-123024S | | 1-123025S | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| SB | Antimony | 14.7 | UJ | 13.9 | UJ | 13.4 | UJ | 13.9 | UJ | 14.4 | UJ | 13.9 | UJ |
| AS | Arsenic | 18.3 | J | 16.2 | J | 11.7 | J | 10.3 | J | 1.3 | UJ | 31.9 | J |
| BA | Barium | 233. | | 196. | | 94.6 | J | 209. | J | 38.4 | J | 550. | |
| BE | Beryllium | 0.73 | U | 0.64 | U | 0.49 | U | 0.57 | U | 0.29 | U | 1.1 | U |
| CD | Cadmium | 1.3 | J | 1.1 | J | 1.9 | | 1.8 | | 0.86 | U | 1.9 | |
| CR | Chromium | 10.3 | J | 10.9 | J | 18. | J | 9.1 | J | 5.8 | J | 6. | J |
| CO | Cobalt | 18.3 | | 9.2 | J | 8.5 | J | 16.4 | J | 4.3 | J | 25.1 | |
| CU | Copper | 18.7 | | 19. | | 15.8 | | 19.4 | | 15.4 | | 18.2 | |
| PB | Lead | 18.7 | J | 16.7 | J | 19.3 | J | 28.5 | J | 10.7 | J | 53.3 | J |
| HG | Mercury | 0.15 | UJ | 0.14 | UJ | 0.13 | UJ | 0.14 | UJ | 0.14 | UJ | 0.24 | J |
| NI | Nickel | 21. | | 13.2 | | 12.9 | | 20.4 | | 7.2 | U | 22.7 | |
| SE | Selenium | 0.59 | U | 0.55 | U | 0.54 | U | 0.56 | U | 0.58 | U | 0.56 | U |
| AG | Silver | 1.5 | UR | 1.4 | UR | 1.3 | UR | 1.4 | UR | 1.4 | UR | 1.4 | UR |
| TL | Thallium | 0.59 | U | 0.55 | U | 0.54 | UJ | 0.56 | U | 0.58 | UJ | 0.56 | U |
| V | Vanadium | 33.8 | J | 21.7 | J | 23. | J | 25.3 | J | 10.3 | J | 36.8 | J |
| ZN | Zinc | 57. | J | 50.9 | J | 46.4 | J | 49. | J | 29.5 | J | 46. | J |
| SN | Tin | 9.5 | U | 6.3 | U | 8.5 | U | 12.2 | U | 15.2 | U | 10.7 | U |

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples

| 1398 METAL | SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 038-M-0008-02 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 038M000802 | | | |
| | LAB SAMPLE ID ---> | 1-123026S | | 1-123027S | | 1-123028S | | 1-23029S L | | | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | | |
| CAS # | Parameter | | | | | | | | | | |
| SB | Antimony | 13.2 | UJ | 13.7 | UJ | 14. | J | 14.9 | UJ | | |
| AS | Arsenic | 4.8 | J | 4.1 | J | 24.7 | J | 22. | J | | |
| BA | Barium | 111. | | 91.4 | | 549. | | 223. | | | |
| BE | Beryllium | 0.33 | U | 0.28 | U | 1.6 | U | 0.89 | U | | |
| CD | Cadmium | 0.79 | U | 0.82 | U | 3.4 | | 1.1 | J | | |
| CR | Chromium | 5.5 | J | 3.7 | J | 21.2 | J | 17.7 | J | | |
| CO | Cobalt | 7.4 | J | 5.1 | J | 33.4 | | 22.7 | | | |
| CU | Copper | 10.6 | | 7. | | 20.4 | | 18.3 | | | |
| PB | Lead | 12.6 | J | 8.1 | J | 54.6 | J | 67.4 | J | | |
| HG | Mercury | 0.13 | UJ | 0.14 | UJ | 0.14 | UJ | 0.15 | UJ | | |
| NI | Nickel | 8.1 | J | 6.8 | U | 28.2 | | 22. | | | |
| SE | Selenium | 0.53 | U | 0.55 | U | 0.56 | U | 0.6 | U | | |
| AG | Silver | 1.3 | UR | 1.4 | UR | 1.4 | UR | 1.5 | UR | | |
| TL | Thallium | 0.53 | U | 0.55 | U | 0.56 | UJ | 0.6 | U | | |
| V | Vanadium | 13.2 | J | 9.2 | J | 51.6 | J | 43. | J | | |
| ZN | Zinc | 21.5 | J | 19.1 | J | 59.8 | J | 57. | J | | |
| SN | Tin | 12.2 | U | 6.9 | U | 15.9 | U | 13.8 | U | | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1398 METAL-CN | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0004-01 | 038-M-0004-02 | 038-M-0005-01 | 038-N-0005-01 | 038-M-0005-02 | 038-M-0006-01 |
| ORIGINAL ID -----> | 038M000401 | 038M000402 | 038M000501 | 038N000501 | 038M000502 | 038M000601 |
| LAB SAMPLE ID ---> | 123009 | 123010 | 123011 | 123012 | 123013 | 123014 |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 |
| DATE EXTRACTED --> | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 |
| DATE ANALYZED ---> | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # Parameter | | | | | | |
| CN Cyanide | 0.56 U | 0.63 U | 0.51 U | 0.64 U | 0.58 U | 0.75 U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1398 METAL-CN | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0007-01 | 038-M-0007-02 | 038-M-0008-01 | 038-M-0008-02 | | |
| ORIGINAL ID -----> | 038M000701 | 038M000702 | 038M000801 | 038M000802 | | |
| LAB SAMPLE ID ---> | 123015 | 123016 | 123017 | 123018 | | |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | | |
| DATE EXTRACTED --> | 05/09/95 | 05/09/95 | 05/09/95 | 05/09/95 | | |
| DATE ANALYZED ---> | 05/10/95 | 05/10/95 | 05/10/95 | 05/10/95 | | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | | |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | | |
| CAS # Parameter | | | | | | |
| CN Cyanide | 0.56 U | 0.5 U | 0.5 U | 0.59 U | | |

*** Validation Complete ***

000624

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 OP PEST | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-N-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038N000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 123009 | | 123010 | | 123011 | | 123012 | | 123013 | | 123014 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 86-50-0 | Guthion | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 35400-43-2 | Sulprofos | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 2921-88-2 | Chloropyrifos | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 56-72-4 | Coumaphos | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 8065-48-3 | Demeton,O | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 333-41-5 | Diazinon | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 62-73-7 | Dichlorvos | 120. | UJ | 110. | UJ | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ |
| 298-04-4 | Disulfoton | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 13194-48-4 | Ethoprop | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 115-90-2 | Fensulfothion | 120. | UJ | 110. | UJ | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ |
| 55-38-9 | Fenthion | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 150-50-5 | Merphos | 120. | UJ | 110. | UJ | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ |
| 7786-34-7 | Mevinphos, Alpha | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 300-76-5 | Naled | 120. | UJ | 110. | UJ | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ |
| 298-00-0 | Methyl parathion | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 298-02-2 | Phorate | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 299-84-3 | Ronnel | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 22248-79-9 | Stirophos (Tetrachlorovinphos) | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 34643-46-4 | Tokuthion | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 327-98-0 | Trichloronate | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |
| 126-75-0 | Demeton,S | 120. | U | 110. | U | 110. | U | 120. | U | 110. | U | 120. | U |

000625

*** Validation Complete ***

| 1398 OP PEST | SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 038-M-0008-02 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 038M000802 | | | |
| | LAB SAMPLE ID ---> | 123015 | | 123016 | | 123017 | | 123018 | | | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | 05/23/95 | | 05/23/95 | | | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | | |
| CAS # | Parameter | | | | | | | | | | |
| 86-50-0 | Guthion | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 35400-43-2 | Sulprofos | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 2921-88-2 | Chloropyrifos | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 56-72-4 | Coumaphos | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 8065-48-3 | Demeton,O | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 333-41-5 | Diazinon | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 62-73-7 | Dichlorvos | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ | | |
| 298-04-4 | Disulfoton | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 13194-48-4 | Ethoprop | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 115-90-2 | Fensulfothion | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ | | |
| 55-38-9 | Fenthion | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 150-50-5 | Merphos | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ | | |
| 7786-34-7 | Mevinphos, Alpha | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 300-76-5 | Naled | 110. | UJ | 120. | UJ | 110. | UJ | 120. | UJ | | |
| 298-00-0 | Methyl parathion | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 298-02-2 | Phorate | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 299-84-3 | Ronnel | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 22248-79-9 | Stirophos (Tetrachlorovinphos) | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 34643-46-4 | Tokuthion | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 327-98-0 | Trichloronate | 110. | U | 120. | U | 110. | U | 120. | U | | |
| 126-75-0 | Demeton,S | 110. | U | 120. | U | 110. | U | 120. | U | | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 PEST | SAMPLE ID -------> | 038-M-0004-01RE | | 038-M-0004-02RE | | 038-M-0005-01RE | | 038-N-0005-01RE | | 038-M-0005-02RE | | 038-M-0006-01RE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000401RE | | 038M000402RE | | 038M000501RE | | 038N000501RE | | 038M000502RE | | 038M000601RE | |
| | LAB SAMPLE ID ---> | 123009RE | | 123010RE | | 123011RE | | 123012RE | | 123013RE | | 123014RE | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/30/95 | | 05/30/95 | | 05/30/95 | | 05/30/95 | | 05/30/95 | | 05/30/95 | |
| | DATE ANALYZED ---> | 06/06/95 | | 06/06/95 | | 06/06/95 | | 06/06/95 | | 06/06/95 | | 06/07/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 319-85-7 | beta-BHC | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 319-86-8 | delta-BHC | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 58-89-9 | gamma-BHC (Lindane) | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 76-44-8 | Heptachlor | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 309-00-2 | Aldrin | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 3.4 | J |
| 1024-57-3 | Heptachlor epoxide | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 959-98-8 | Endosulfan I | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 60-57-1 | Dieldrin | 12. | J | 4.5 | UJ | 26. | J | 16. | J | 4.4 | UJ | 42. | J |
| 72-55-9 | 4,4'-DDE | 4.6 | UJ | 4.5 | UJ | 6.8 | J | 4.6 | UJ | 4.4 | UJ | 10. | J |
| 72-20-8 | Endrin | 4.6 | UJ | 4.5 | UJ | 4.4 | UJ | 4.6 | UJ | 4.4 | UJ | 4.6 | UJ |
| 33213-65-9 | Endosulfan II | 4.6 | UJ | 4.5 | UJ | 4.4 | UJ | 4.6 | UJ | 4.4 | UJ | 4.6 | UJ |
| 72-54-8 | 4,4'-DDD | 11. | J | 4.5 | UJ | 11. | J | 6.7 | J | 4.4 | UJ | 68. | J |
| 1031-07-8 | Endosulfan sulfate | 4.6 | UJ | 4.5 | UJ | 4.4 | UJ | 4.6 | UJ | 4.4 | UJ | 4.6 | UJ |
| 50-29-3 | 4,4'-DDT | 4.6 | UJ | 4.5 | UJ | 8.4 | J | 8.6 | J | 4.4 | UJ | 13. | J |
| 72-43-5 | Methoxychlor | 24. | UJ | 23. | UJ | 23. | UJ | 24. | UJ | 23. | UJ | 24. | UJ |
| 53494-70-5 | Endrin ketone | 4.6 | UJ | 4.5 | UJ | 4.4 | UJ | 4.6 | UJ | 4.4 | UJ | 4.6 | UJ |
| 7421-36-3 | Endrin aldehyde | 4.6 | UJ | 4.5 | UJ | 4.4 | UJ | 4.6 | UJ | 4.4 | UJ | 4.6 | UJ |
| 5103-71-9 | alpha-Chlordane | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 5103-74-2 | gamma-Chlordane | 2.4 | UJ | 2.3 | UJ | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ |
| 8001-35-2 | Toxaphene | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 12674-11-2 | Aroclor-1016 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 11104-28-2 | Aroclor-1221 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 11141-16-5 | Aroclor-1232 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 53469-21-9 | Aroclor-1242 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 12672-29-6 | Aroclor-1248 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 11097-69-1 | Aroclor-1254 | 46. | UJ | 45. | UJ | 44. | UJ | 46. | UJ | 44. | UJ | 46. | UJ |
| 11096-82-5 | Aroclor-1260 | 46. | UJ | 45. | UJ | 110. | J | 46. | UJ | 44. | UJ | 46. | UJ |

000627

*** Validation Complete ***

| 1398 PEST | SAMPLE ID -------> | 038-M-0007-01RE | | 038-M-0007-02RE | | 038-M-0008-01RE | | 038-M-0008-02RE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000701RE | | 038M000702RE | | 038M000801RE | | 038M000802RE | | | |
| | LAB SAMPLE ID ---> | 123015RE | | 123016RE | | 123017RE | | 123018RECRE | | | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | |
| | DATE EXTRACTED --> | 05/30/95 | | 05/30/95 | | 05/30/95 | | 05/30/95 | | | |
| | DATE ANALYZED ---> | 06/06/95 | | 06/06/95 | | 06/06/95 | | 06/07/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | | |
| CAS # | Parameter | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 319-85-7 | beta-BHC | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 319-86-8 | delta-BHC | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 58-89-9 | gamma-BHC (Lindane) | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 76-44-8 | Heptachlor | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 309-00-2 | Aldrin | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 1024-57-3 | Heptachlor epoxide | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 959-98-8 | Endosulfan I | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 60-57-1 | Dieldrin | 4.4 | UJ | 4.6 | UJ | 24. | J | 4.7 | UJ | | |
| 72-55-9 | 4,4'-DDE | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 9.1 | J | | |
| 72-20-8 | Endrin | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 33213-65-9 | Endosulfan II | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 72-54-8 | 4,4'-DDD | 4.4 | UJ | 4.6 | UJ | 9.3 | J | 4.7 | UJ | | |
| 1031-07-8 | Endosulfan sulfate | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 50-29-3 | 4,4'-DDT | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 72-43-5 | Methoxychlor | 23. | UJ | 24. | UJ | 23. | UJ | 24. | UJ | | |
| 53494-70-5 | Endrin ketone | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 7421-36-3 | Endrin aldehyde | 4.4 | UJ | 4.6 | UJ | 4.5 | UJ | 4.7 | UJ | | |
| 5103-71-9 | alpha-Chlordane | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 5103-74-2 | gamma-Chlordane | 2.3 | UJ | 2.4 | UJ | 2.3 | UJ | 2.4 | UJ | | |
| 8001-35-2 | Toxaphene | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 12674-11-2 | Aroclor-1016 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 11104-28-2 | Aroclor-1221 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 11141-16-5 | Aroclor-1232 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 53469-21-9 | Aroclor-1242 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 12672-29-6 | Aroclor-1248 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 11097-69-1 | Aroclor-1254 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |
| 11096-82-5 | Aroclor-1260 | 44. | UJ | 46. | UJ | 45. | UJ | 47. | UJ | | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 SVOA | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-N-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038N000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 123020 | | 123021 | | 123022 | | 123023 | | 123024 | | 123025 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/10/95 | | 05/18/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 108-95-2 | Phenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 95-57-8 | 2-Chlorophenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 470. | UJ | 460. | UJ | 440. | UJ | 440. | UJ | 440. | UJ | 480. | UJ |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 67-72-1 | Hexachloroethane | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 98-95-3 | Nitrobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 78-59-1 | Isophorone | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 88-75-5 | 2-Nitrophenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 105-67-9 | 2,4-Dimethylphenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 120-83-2 | 2,4-Dichlorophenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 91-20-3 | Naphthalene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 106-47-8 | 4-Chloroaniline | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 87-68-3 | Hexachlorobutadiene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 91-57-6 | 2-Methylnaphthalene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 91-58-7 | 2-Chloronaphthalene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 88-74-4 | 2-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 131-11-3 | Dimethylphthalate | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 208-96-8 | Acenaphthylene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 99-09-2 | 3-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 83-32-9 | Acenaphthene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 51-28-5 | 2,4-Dinitrophenol | 1100. | UJ | 1100. | UJ | 1100. | UJ | 1100. | UJ | 1100. | UJ | 1200. | UJ |
| 100-02-7 | 4-Nitrophenol | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 132-64-9 | Dibenzofuran | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 121-14-2 | 2,4-Dinitrotoluene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |

*** Validation Complete ***

000629

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

1398
SVOA

000630

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-N-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038N000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 123020 | | 123021 | | 123022 | | 123023 | | 123024 | | 123025 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/10/95 | | 05/18/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 84-66-2 | Diethylphthalate | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 86-73-7 | Fluorene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 100-01-6 | 4-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 101-55-3 | 4-Bromophenylphenylether | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 118-74-1 | Hexachlorobenzene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 87-86-5 | Pentachlorophenol | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 85-01-8 | Phenanthrene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 83. | J |
| 120-12-7 | Anthracene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 86-74-8 | Carbazole | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 84-74-2 | Di-n-butylphthalate | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 206-44-0 | Fluoranthene | 470. | U | 460. | U | 89. | J | 440. | U | 440. | U | 130. | J |
| 129-00-0 | Pyrene | 470. | U | 460. | U | 78. | J | 440. | U | 440. | U | 91. | J |
| 85-68-7 | Butylbenzylphthalate | 470. | UJ | 460. | UJ | 440. | UJ | 440. | UJ | 440. | UJ | 480. | UJ |
| 91-94-1 | 3,3'-Dichlorobenzidine | 470. | UJ | 460. | UJ | 440. | UJ | 440. | UJ | 440. | UJ | 480. | UJ |
| 56-55-3 | Benzo(a)anthracene | 470. | U | 460. | U | 100. | J | 440. | U | 440. | U | 52. | J |
| 218-01-9 | Chrysene | 470. | U | 460. | U | 130. | J | 440. | U | 440. | U | 56. | J |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 46. | J |
| 117-84-0 | Di-n-octylphthalate | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 205-99-2 | Benzo(b)fluoranthene | 470. | U | 460. | U | 170. | J | 440. | U | 440. | U | 480. | U |
| 207-08-9 | Benzo(k)fluoranthene | 470. | U | 460. | U | 88. | J | 440. | U | 440. | U | 480. | U |
| 50-32-8 | Benzo(a)pyrene | 470. | U | 460. | U | 170. | J | 45. | J | 440. | U | 52. | J |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 470. | U | 460. | U | 110. | J | 440. | U | 440. | U | 480. | U |
| 53-70-3 | Dibenzo(a,h)anthracene | 470. | U | 460. | U | 440. | U | 440. | U | 440. | U | 480. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 470. | U | 460. | U | 140. | J | 440. | U | 440. | U | 480. | U |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1398 SVOA | SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 039-M-0008-02 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 039M000802 | | | |
| | LAB SAMPLE ID ---> | 123026 | | 123027 | | 123028 | | 123029 | | | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | |
| | DATE EXTRACTED --> | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/18/95 | | | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | | | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | | |
| CAS # | Parameter | | | | | | | | | | |
| 108-95-2 | Phenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 111-44-4 | bis(2-Chloroethyl)ether | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 95-57-8 | 2-Chlorophenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 541-73-1 | 1,3-Dichlorobenzene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 106-46-7 | 1,4-Dichlorobenzene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 95-50-1 | 1,2-Dichlorobenzene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 440. | UJ | 460. | UJ | 460. | UJ | 480. | UJ | | |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 621-64-7 | N-Nitroso-di-n-propylamine | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 67-72-1 | Hexachloroethane | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 98-95-3 | Nitrobenzene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 78-59-1 | Isophorone | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 88-75-5 | 2-Nitrophenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 105-67-9 | 2,4-Dimethylphenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 111-91-1 | bis(2-Chloroethoxy)methane | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 120-83-2 | 2,4-Dichlorophenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 91-20-3 | Naphthalene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 106-47-8 | 4-Chloroaniline | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 87-68-3 | Hexachlorobutadiene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 59-50-7 | 4-Chloro-3-methylphenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 91-57-6 | 2-Methylnaphthalene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 77-47-4 | Hexachlorocyclopentadiene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 88-06-2 | 2,4,6-Trichlorophenol | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 95-95-4 | 2,4,5-Trichlorophenol | 1100. | U | 1100. | U | 1100. | U | 1200. | U | | |
| 91-58-7 | 2-Chloronaphthalene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 88-74-4 | 2-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1200. | U | | |
| 131-11-3 | Dimethylphthalate | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 208-96-8 | Acenaphthylene | 440. | U | 460. | U | 84. | J | 480. | U | | |
| 606-20-2 | 2,6-Dinitrotoluene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 99-09-2 | 3-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1200. | U | | |
| 83-32-9 | Acenaphthene | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 51-28-5 | 2,4-Dinitrophenol | 1100. | UJ | 1100. | UJ | 1100. | UJ | 1200. | UJ | | |
| 100-02-7 | 4-Nitrophenol | 1100. | U | 1100. | U | 1100. | U | 1200. | U | | |
| 132-64-9 | Dibenzofuran | 440. | U | 460. | U | 460. | U | 480. | U | | |
| 121-14-2 | 2,4-Dinitrotoluene | 440. | U | 460. | U | 460. | U | 480. | U | | |

*** Validation Complete ***

1398
SVOA

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 039-M-0008-02 | |
| | ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 039M000802 | |
| | LAB SAMPLE ID ---> | 123026 | | 123027 | | 123028 | | 123029 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE EXTRACTED --> | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/18/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/26/95 | | 05/26/95 | | 05/26/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | |
| 84-66-2 | Diethylphthalate | 440. | U | 460. | U | 460. | U | 480. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 440. | U | 460. | U | 460. | U | 480. | U |
| 86-73-7 | Fluorene | 440. | U | 460. | U | 76. | J | 480. | U |
| 100-01-6 | 4-Nitroaniline | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 440. | U | 460. | U | 460. | U | 480. | U |
| 101-55-3 | 4-Bromophenylphenylether | 440. | U | 460. | U | 460. | U | 480. | U |
| 118-74-1 | Hexachlorobenzene | 440. | U | 460. | U | 460. | U | 480. | U |
| 87-86-5 | Pentachlorophenol | 1100. | U | 1100. | U | 1100. | U | 1200. | U |
| 85-01-8 | Phenanthrene | 440. | U | 460. | U | 1200. | | 82. | J |
| 120-12-7 | Anthracene | 440. | U | 460. | U | 250. | J | 480. | U |
| 86-74-8 | Carbazole | 440. | U | 460. | U | 460. | U | 480. | U |
| 84-74-2 | Di-n-butylphthalate | 440. | U | 460. | U | 460. | U | 480. | U |
| 206-44-0 | Fluoranthene | 42. | J | 460. | U | 1800. | | 220. | J |
| 129-00-0 | Pyrene | 440. | U | 460. | U | 1200. | | 160. | J |
| 85-68-7 | Butylbenzylphthalate | 440. | UJ | 460. | UJ | 110. | J | 480. | UJ |
| 91-94-1 | 3,3'-Dichlorobenzidine | 440. | UJ | 460. | UJ | 460. | UJ | 480. | UJ |
| 56-55-3 | Benzo(a)anthracene | 440. | U | 460. | U | 690. | | 110. | J |
| 218-01-9 | Chrysene | 440. | U | 460. | U | 660. | | 110. | J |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 92. | J | 82. | J | 130. | J | 52. | J |
| 117-84-0 | Di-n-octylphthalate | 440. | U | 460. | U | 460. | U | 480. | U |
| 205-99-2 | Benzo(b)fluoranthene | 440. | U | 460. | U | 600. | | 120. | J |
| 207-08-9 | Benzo(k)fluoranthene | 440. | U | 460. | U | 400. | J | 80. | J |
| 50-32-8 | Benzo(a)pyrene | 440. | U | 460. | U | 610. | | 110. | J |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 440. | U | 460. | U | 380. | J | 70. | J |
| 53-70-3 | Dibenzo(a,h)anthracene | 440. | U | 460. | U | 130. | J | 480. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 440. | U | 460. | U | 410. | J | 73. | J |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 TPH | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0004-01 | 038-M-0004-02 | 038-M-0005-01 | 038-N-0005-01 | 038-M-0005-02 | 038-M-0006-01 |
| | ORIGINAL ID -----> | 038M000401 | 038M000402 | 038M000501 | 038N000501 | 038M000502 | 038M000601 |
| | LAB SAMPLE ID ---> | 123009 | 123010 | 123011 | 123012 | 123013 | 123014 |
| | SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 |
| | DATE EXTRACTED --> | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 |
| | DATE ANALYZED ---> | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 |
| | MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt | Sedmnt |
| | UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A |
| CAS # | Parameter | | | | | | |
| 9999900-02-4 | Petroleum Hydrocarbons, TPH | 94. U | 91. U | 170. | 130. | 89. U | 170. |

000633

*** Validation Complete ***

# NAS MEMPHIS

## NAS MEMPHIS, RFI, ASSEMBLY B

Primary Samples



1398
TPH
000634

| | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0007-01 | 038-M-0007-02 | 038-M-0008-01 | 038-M-0008-02 | | |
| ORIGINAL ID -----> | 038M000701 | 038M000702 | 038M000801 | 038M000802 | | |
| LAB SAMPLE ID ---> | 123015 | 123016 | 123017 | 123018 | | |
| SAMPLE DATE -----> | 05/05/95 | 05/05/95 | 05/05/95 | 05/05/95 | | |
| DATE EXTRACTED --> | 05/26/95 | 05/26/95 | 05/26/95 | 05/26/95 | | |
| DATE ANALYZED ---> | 05/26/95 | 05/30/95 | 05/30/95 | 05/30/95 | | |
| MATRIX ----------> | Sedmnt | Sedmnt | Sedmnt | Sedmnt | | |
| UNITS ----------> | mg/Kg A | mg/Kg A | mg/Kg A | mg/Kg A | | |
| CAS # Parameter | | | | | | |
| 9999900-02-4 Petroleum Hydrocarbons, TPH | 89. U | 94. U | 190. | 95. U | | |

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1398 VOA | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 038-M-0004-01 | | 038-M-0004-02 | | 038-M-0005-01 | | 038-N-0005-01 | | 038-M-0005-02 | | 038-M-0006-01 | |
| | ORIGINAL ID -----> | 038M000401 | | 038M000402 | | 038M000501 | | 038N000501 | | 038M000502 | | 038M000601 | |
| | LAB SAMPLE ID ---> | 123020 | | 123021 | | 123022 | | 123023 | | 123024 | | 123025 | |
| | SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | |
| | DATE ANALYZED ---> | 05/18/95 | | 05/17/95 | | 05/17/95 | | 05/18/95 | | 05/17/95 | | 05/20/95 | |
| | MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 74-87-3 | Chloromethane | 14. | UJ | 14. | U | 13. | U | 13. | UJ | 13. | U | 14. | U |
| 74-83-9 | Bromomethane | 14. | U | 2. | J | 2. | J | 13. | U | 13. | U | 14. | U |
| 75-01-4 | Vinyl chloride | 14. | UJ | 14. | U | 13. | U | 13. | UJ | 13. | U | 14. | U |
| 75-00-3 | Chloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 75-09-2 | Methylene chloride | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 67-64-1 | Acetone | 49. | | 93. | | 5. | J | 23. | U | 48. | | 33. | |
| 75-15-0 | Carbon disulfide | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 75-35-4 | 1,1-Dichloroethene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 75-34-3 | 1,1-Dichloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 67-66-3 | Chloroform | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 107-06-2 | 1,2-Dichloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 78-93-3 | 2-Butanone (MEK) | 14. | U | 7. | J | 13. | U | 13. | U | 13. | U | 14. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 56-23-5 | Carbon tetrachloride | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 75-27-4 | Bromodichloromethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 78-87-5 | 1,2-Dichloropropane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 79-01-6 | Trichloroethene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 124-48-1 | Dibromochloromethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 71-43-2 | Benzene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 75-25-2 | Bromoform | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | UJ |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 591-78-6 | 2-Hexanone | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 127-18-4 | Tetrachloroethene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 108-88-3 | Toluene | 14. | U | 1. | J | 13. | U | 13. | U | 13. | U | 14. | U |
| 108-90-7 | Chlorobenzene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 100-41-4 | Ethylbenzene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 100-42-5 | Styrene | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |
| 1330-20-7 | Xylene (Total) | 14. | U | 14. | U | 13. | U | 13. | U | 13. | U | 14. | U |

000635

*** Validation Complete ***

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

00636

1398
VOA

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 038-M-0007-01 | | 038-M-0007-02 | | 038-M-0008-01 | | 038-M-0008-02 | | | | |
| ORIGINAL ID -----> | 038M000701 | | 038M000702 | | 038M000801 | | 038M000802 | | | | |
| LAB SAMPLE ID ---> | 123026 | | 123027 | | 123028 | | 123029 | | | | |
| SAMPLE DATE -----> | 05/05/95 | | 05/05/95 | | 05/05/95 | | 05/05/95 | | | | |
| DATE ANALYZED ---> | 05/18/95 | | 05/18/95 | | 05/18/95 | | 05/19/95 | | | | |
| MATRIX ----------> | Sedmnt | | Sedmnt | | Sedmnt | | Sedmnt | | | | |
| UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | | | |
| CAS # Parameter | | | | | | | | | | | |
| 74-87-3 Chloromethane | 13. | UJ | 69. | UJ | 14. | UJ | 1800. | UJ | | | |
| 74-83-9 Bromomethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-01-4 Vinyl chloride | 13. | UJ | 69. | UJ | 14. | UJ | 1800. | U | | | |
| 75-00-3 Chloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-09-2 Methylene chloride | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 67-64-1 Acetone | 13. | U | 1200. | | 14. | U | 7600. | | | | |
| 75-15-0 Carbon disulfide | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-35-4 1,1-Dichloroethene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-34-3 1,1-Dichloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 540-59-0 1,2-Dichloroethene (total) | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 67-66-3 Chloroform | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 107-06-2 1,2-Dichloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 78-93-3 2-Butanone (MEK) | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 71-55-6 1,1,1-Trichloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 56-23-5 Carbon tetrachloride | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-27-4 Bromodichloromethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 78-87-5 1,2-Dichloropropane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 10061-01-5 cis-1,3-Dichloropropene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 79-01-6 Trichloroethene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 124-48-1 Dibromochloromethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 79-00-5 1,1,2-Trichloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 71-43-2 Benzene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 10061-02-6 trans-1,3-Dichloropropene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 75-25-2 Bromoform | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 108-10-1 4-Methyl-2-Pentanone (MIBK) | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 591-78-6 2-Hexanone | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 127-18-4 Tetrachloroethene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 79-34-5 1,1,2,2-Tetrachloroethane | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 108-88-3 Toluene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 108-90-7 Chlorobenzene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 100-41-4 Ethylbenzene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 100-42-5 Styrene | 13. | U | 69. | U | 14. | U | 1800. | U | | | |
| 1330-20-7 Xylene (Total) | 13. | U | 69. | U | 14. | U | 1800. | U | | | |

*** Validation Complete ***

# VALIDATA

**Chemical Services, Inc.**

P. O. Box 930422 Norcross, Ga. 30093


## DATA VALIDATION SUMMARY REPORT

| | |
|---|---|
| COMPANY: | Ensafe/Allen & Hoshall |
| SITE NAME: | NAS Memphis |
| PROJECT NUMBER: | 8500.024 |
| CONTRACTED LAB: | National Environmental Testing, Inc. |
| QA/QC LEVEL: | Level III |
| EPA SOW/METHOD: | EPA 1990 SOW |
| VALIDATION GUIDELINES: | *USEPA Contract LaboratoryProgram National Functional Guidelines for Organic Data Review,* 1994; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* 1994 |
| SAMPLE MATRIX: | Soil, Water |
| TYPES OF ANALYSES: | Volatile Organics (VOA), Semivolatile Organics (SVOA), Diesel Range Organics (DRO), Gasoline Range Organices (GRO) |

SDG NUMBER: 1403

SAMPLES:

| Client Sample #: | Lab Sample #: | Matrix | VOA | SVOA | DRO | GRO |
|---|---|---|---|---|---|---|
| 040E000200 | 123579 | Water | X | | | |
| 040S0G0809 | 123573 | Soil | X | X | X | X |
| 040S0G0809DL | 123573DL | Soil | X | X | | |
| 040SG0503D | 123571 | Soil | X | | | |
| 040SG0703D | 123570 | Soil | X | | | |
| 040SG0803D | 123572 | Soil | X | | | |
| 040SG1003D | 123569 | Soil | X | | | |
| 040GH0512D | 123578 | Soil | X | | | |
| 040GH0646D | 123575 | Soil | X | | | |
| 040GH0844D | 123577 | Soil | X | | | |
| 040GH0951D | 123576 | Soil | X | | | |
| 040GH1012D | 123574 | Soil | X | | | |
| 040SS1311D | 123580 | Soil | X | X | X | X |
| 040SS1311DDL | 123580DL | Soil | X | | | |
| 040SS1503D | 123568 | Soil | X | | | |

E = EQUIPMENT BLANK, DL = DILUTION

DATA REVIEWER(S): Amy L. Hogan, Marvin L. Smith

RELEASE SIGNATURE: Kevin C. Haumon

## Data Qualifier Definitions:

| | | |
|---|---|---|
| J | - | The associated numerical value is an estimated quantity. |
| R | - | The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification. |
| U | - | The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit. |
| UJ | - | The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity. |

DATA QUALIFICATION SUMMARY

NET, Inc. - 1403 Organics

SAMPLES: 040E000200, 040S0G0809, 040S0G0809DL, 040SG0503D, 040SG0703D, 040SG0803D, 040SG1003D, 040GH0512D, 040GH0646D, 040GH0844D, 040GH0951D, 040GH1012D, 040SS1311D, 040SS1311DDL, 040SS1503D

*VOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC/MS Tuning:

All Tuning criteria were met. No action was necessary.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met. No action was necessary.

Continuing Calibration:

The Percent Difference (%D) of chloromethane (39.8%) exceeded the 25% QC limit for the continuing calibration run on 5/25/95 at 10:00 on instrument HP5970H. The results for this compound in associated samples 040SG0803D, 040SS1311D, 040SS1503D, 040SG0703D and 040SG0503D, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of acetone (27.2%) and 2-hexanone (26.9%) exceeded the 25% QC limit for the continuing calibration run on 5/26/95 at 09:59 on instrument HP5970H. The results for these compounds in associated samples 040SG1003D and 040S0G0809, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Difference (%D) of chloromethane (31.2%) exceeded the 25% QC limit for the continuing calibration run on 5/22/95 at 15:51 on instrument HP5970K. The results for this compound in associated samples 040GH1012D and 040GH0646D, which consisted entirely of non-detects, were flagged as estimated (UJ).

IV.) Blanks:

Method Blanks:

Methylene chloride and acetone were detected at 1 ug/kg and 3 ug/kg, respectively, in soil method blank VBLK052695H. The results for these compounds in associated samples 040S0G0809 and 040SG1003D were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample.

Xylene was detected at 17 ug/L in water method blank VBLK052395K. The result for this compound in associated samples 040GH0512D, 040GH0844D and 040GH951D were flagged as undetected, with the CRQL replacing the analytical result in sample 040GH0844D.

Equipment Blanks:

Acetone, 2-butanone and xylene were detected at 13.0 ug/L, 11.0 ug/L and 3.0 ug/L, respectively, in equipment blank 040E000200. All positive results for acetone in associated samples 040SS1503D, 040SS1311D, 040GH1012D, 040GH0646D and 040S0G0809 less than 10X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample. The results for 2-butanone and xylene in the associated samples less than 5X the blank amount were flagged as undetected (U) with the detection limit being raised to the level of contamination in each sample.

TIC's:

There were no TIC's reported in the blanks for this SDG. No data qualification was required.

V.) Surrogate Recoveries:

The Percent Recovery (%R) of bromofluorobenzene (115%) in sample 040SS1311DDL exceeded the 59-113% QC limits. All positive results in this sample were flagged as estimated (J).

VI.) Matrix Spike/Matrix Spike Duplicate (MS / MSD):

No MS / MSD analyses were performed for this fraction. No action was required.

VII.) Field Duplicates:

There were no field duplicate samples associated with this SDG. No action was required.

VIII.) Internal Standards Performance:

All Internal Standards Performance criteria were met. No action was required.

IX.) TCL Compound Identification:

All TCL criteria were met, so no action was necessary.

Incorrect laboratory results and CRQL's were reported in the spreadsheets for water method blanks VBLK052295K and VBLK052395K and for soil method blank VBLK052695H. The Form I data for these method blanks were entered on the spreadsheets during validation.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All other CRQL criteria were met. No further action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

*SEMIVOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met. No action was necessary.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met, so no action was necessary.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviations (%RSD's) of hexachlorocyclopentadiene (35.2%) and 2,4-dinitrophenol (32.1%) exceeded the 30% QC limit for the initial calibration run on 4/28/95 on instrument HP5970F. There were no positive results for these compounds in the associated samples. No action was required.

Continuing Calibration:

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 6/06/95 at 11:28 on instrument HP5970F:

| | |
|---|---|
| hexachlorobutadiene | 28.2% |
| hexachlorocyclopentadiene | 26.2% |
| 3-nitroaniline | 42.5% |

| | |
|---|---|
| 2,4-dinitrophenol | 51.8% |
| 4-nitrophenol | 32.4% |
| 4-nitroaniline | 45.9% |
| hexachlorobenzene | 30.0% |
| carbazole | 41.8% |
| butylbenzylphthalate | 43.4% |
| 3,3-dichlorobenzidine | 57.4% |
| bis(2-ethylhexyl)phthalate | 30.8% |
| di-n-octylphthalate | 34.1% |

The positive result for bis(2-ethylhexyl)phthalate in associated samples 040S0G0809 and 040SS1311D were flagged as estimated (J). The results for the other compounds in these samples, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) of the following compounds exceeded the 25% QC limit for the continuing calibration run on 6/07/95 at 10:51 on instrument HP5970F:

| | |
|---|---|
| 2,2'-oxybis(1-chloropropane) | 38.0% |
| 2,4-dinitrophenol | 26.6% |

The results for these compounds in associated sample 040S0G0809DL, which consisted entirely of non-detects, were flagged as estimated (UJ).

IV.) Blanks:

Method Blanks:

Di-n-butylphthalate was detected at 430 ug/kg in soil method blank SBLK052395F. There were no positive results for this compound in the associated samples. No action was necessary.

V.) Surrogate Recoveries:

The Percent Recovery (%R) of 1,2-dichlorobenzene-d4 (0%) was below the 20-130% QC limits for sample 040S0G0809. All results for the base/neutral fraction of this sample were rejected (R) since the %R was less than 10%.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

No MS / MSD analyses were performed for this fraction. No action was necessary.

VII.) Field Duplicates:

There were no field duplicate samples associated with this SDG. No action was required.

VIII.) Internal Standards Performance:

All Internal Standard Performance criteria were met. No action was required.

IX.) TCL Compound Identification:

All TCL criteria were met, so no action was required.

X.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met, so no action was required.

XI.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was taken.

XII.) System Performance:

All criteria were met, so no action was necessary.

XIII.) Overall Assessment of Data/General:

The results for the base/neutral compounds in sample 040S0G0809 were rejected (R) due to low a low surrogate Percent Recovery (0%). All other laboratory data were acceptable with qualification.

*DIESEL RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within the required the holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.



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VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

No MS / MSD analyses were performed for this fraction. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicate samples associated with this SDG. No action was necessary.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable without qualification.

*GASOLINE RANGE ORGANICS*

I.) Holding Times:

All samples were extracted and analyzed within the required holding times. No action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met. No action was necessary.

III.) Calibration:

All Calibration criteria were met. No action was necessary.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no data qualification was necessary.

V.) Surrogate Recoveries:

The Surrogate Percent Recovery (%R) in sample 040S0G0809 (0%), which was below the 60-120% QC limits, was due to a dilution of the sample. The positive result for this sample was flagged as estimated (J).

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

No MS / MSD analyses were performed for this fraction in this SDG. No action was necessary.

VII.) TCL Compound Identification:

All Compound Identification criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicate samples associated with this SDG. No action was necessary.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualification.

# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples

| 1403 8015 Mod | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLE ID -------> | 040-S-0G08-09 | 040-S-S131-1D | | | | |
| ORIGINAL ID -----> | 40SG0809 | 40SS1311D | | | | |
| LAB SAMPLE ID ---> | 123582 | 123581 | | | | |
| SAMPLE DATE -----> | 05/12/95 | 05/12/95 | | | | |
| DATE ANALYZED ---> | 05/20/95 | 05/20/95 | | | | |
| MATRIX ----------> | Soil | Soil | | | | |
| UNITS ----------> | ug/Kg A | ug/Kg A | | | | |
| CAS # Parameter | | | | | | |
| 9999900-02-5 TPH - Gasoline Range Organics | 770000. J | 17000. | | | | |

*** Validation Complete ***

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# NAS MEMPHIS
## NAS MEMPHIS, RFI, ASSEMBLY B
Primary Samples



| 1403 8100 Mod | | | | | | |
|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-S-0G08-09 | 040-S-S131-10 | | | |
| | ORIGINAL ID -----> | 40SG0809 | 40SS1311D | | | |
| | LAB SAMPLE ID ---> | 123573 | 123580 | | | |
| | SAMPLE DATE -----> | 05/12/95 | 05/12/95 | | | |
| | DATE EXTRACTED --> | 06/02/95 | 06/02/95 | | | |
| | DATE ANALYZED ---> | 06/12/95 | 06/12/95 | | | |
| | MATRIX ----------> | Soil | Soil | | | |
| | UNITS ----------> | ug/Kg A | ug/Kg A | | | |
| CAS # | Parameter | | | | | |
| 9999900-02-6 | TPH - Diesel Range Organics | 600000. | 80000. | | | |

*** Validation Complete ***

| 1403 SVOA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-S-0G08-09 | | 040-S-S131-1D | | | | | |
| | ORIGINAL ID -----> | 40SG0809 | | 40SS1311D | | | | | |
| | LAB SAMPLE ID ---> | 123573 | | 123580 | | | | | |
| | SAMPLE DATE -----> | 05/12/95 | | 05/12/95 | | | | | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | | | | |
| | DATE ANALYZED ---> | 06/06/95 | | 06/06/95 | | | | | |
| | MATRIX ----------> | Soil | | Soil | | | | | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | | | | |
| CAS # | Parameter | | | | | | | | |
| 108-95-2 | Phenol | 420. | U | 2200. | U | | | | |
| 111-44-4 | bis(2-Chloroethyl)ether | 420. | UR | 2200. | U | | | | |
| 95-57-8 | 2-Chlorophenol | 420. | U | 2200. | U | | | | |
| 541-73-1 | 1,3-Dichlorobenzene | 420. | UR | 2200. | U | | | | |
| 106-46-7 | 1,4-Dichlorobenzene | 420. | UR | 2200. | U | | | | |
| 95-50-1 | 1,2-Dichlorobenzene | 420. | UR | 2200. | U | | | | |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 420. | U | 2200. | U | | | | |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 420. | UR | 2200. | U | | | | |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 420. | U | 2200. | U | | | | |
| 621-64-7 | N-Nitroso-di-n-propylamine | 420. | UR | 2200. | U | | | | |
| 67-72-1 | Hexachloroethane | 420. | UR | 2200. | U | | | | |
| 98-95-3 | Nitrobenzene | 420. | UR | 2200. | U | | | | |
| 78-59-1 | Isophorone | 420. | UR | 2200. | U | | | | |
| 88-75-5 | 2-Nitrophenol | 420. | U | 2200. | U | | | | |
| 105-67-9 | 2,4-Dimethylphenol | 420. | U | 2200. | U | | | | |
| 111-91-1 | bis(2-Chloroethoxy)methane | 420. | UR | 2200. | U | | | | |
| 120-83-2 | 2,4-Dichlorophenol | 420. | U | 2200. | U | | | | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 420. | UR | 2200. | U | | | | |
| 91-20-3 | Naphthalene | 15000. | D | 3100. | | | | | |
| 106-47-8 | 4-Chloroaniline | 420. | UR | 2200. | U | | | | |
| 87-68-3 | Hexachlorobutadiene | 420. | UR | 2200. | UJ | | | | |
| 59-50-7 | 4-Chloro-3-methylphenol | 420. | U | 2200. | U | | | | |
| 91-57-6 | 2-Methylnaphthalene | 11000. | D | 1600. | J | | | | |
| 77-47-4 | Hexachlorocyclopentadiene | 420. | UR | 2200. | UJ | | | | |
| 88-06-2 | 2,4,6-Trichlorophenol | 420. | U | 2200. | U | | | | |
| 95-95-4 | 2,4,5-Trichlorophenol | 1000. | U | 5300. | U | | | | |
| 91-58-7 | 2-Chloronaphthalene | 420. | UR | 2200. | U | | | | |
| 88-74-4 | 2-Nitroaniline | 1000. | UR | 5300. | U | | | | |
| 131-11-3 | Dimethylphthalate | 420. | UR | 2200. | U | | | | |
| 208-96-8 | Acenaphthylene | 420. | UR | 2200. | U | | | | |
| 606-20-2 | 2,6-Dinitrotoluene | 420. | UR | 2200. | U | | | | |
| 99-09-2 | 3-Nitroaniline | 1000. | UR | 5300. | UJ | | | | |
| 83-32-9 | Acenaphthene | 420. | UR | 2200. | U | | | | |
| 51-28-5 | 2,4-Dinitrophenol | 1000. | UJ | 5300. | UJ | | | | |
| 100-02-7 | 4-Nitrophenol | 1000. | UJ | 5300. | UJ | | | | |
| 132-64-9 | Dibenzofuran | 420. | UR | 2200. | U | | | | |
| 121-14-2 | 2,4-Dinitrotoluene | 420. | UR | 2200. | U | | | | |

*** Validation Complete ***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1403 | SAMPLE ID -------> | 040-S-0G08-09 | | 040-S-S131-1D | | | |
| SVOA | ORIGINAL ID -----> | 40SG0809 | | 40SS1311D | | | |
| | LAB SAMPLE ID ---> | 123573 | | 123580 | | | |
| | SAMPLE DATE -----> | 05/12/95 | | 05/12/95 | | | |
| | DATE EXTRACTED --> | 05/23/95 | | 05/23/95 | | | |
| | DATE ANALYZED ---> | 06/06/95 | | 06/06/95 | | | |
| | MATRIX ----------> | Soil | | Soil | | | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | | |
| CAS # | Parameter | | | | | | |
| 84-66-2 | Diethylphthalate | 420. | UR | 2200. | U | | |
| 7005-72-3 | 4-Chlorophenylphenylether | 420. | UR | 2200. | U | | |
| 86-73-7 | Fluorene | 45. | J | 2200. | U | | |
| 100-01-6 | 4-Nitroaniline | 1000. | UR | 5300. | UJ | | |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 1000. | U | 5300. | U | | |
| 86-30-6 | N-Nitrosodiphenylamine | 420. | UR | 2200. | U | | |
| 101-55-3 | 4-Bromophenylphenylether | 420. | UR | 2200. | U | | |
| 118-74-1 | Hexachlorobenzene | 420. | UR | 2200. | UJ | | |
| 87-86-5 | Pentachlorophenol | 1000. | U | 5300. | U | | |
| 85-01-8 | Phenanthrene | 48. | J | 2200. | U | | |
| 120-12-7 | Anthracene | 420. | UR | 2200. | U | | |
| 86-74-8 | Carbazole | 420. | UR | 2200. | UJ | | |
| 84-74-2 | Di-n-butylphthalate | 420. | UR | 2200. | U | | |
| 206-44-0 | Fluoranthene | 420. | UR | 2200. | U | | |
| 129-00-0 | Pyrene | 420. | UR | 2200. | U | | |
| 85-68-7 | Butylbenzylphthalate | 420. | UR | 2200. | UJ | | |
| 91-94-1 | 3,3'-Dichlorobenzidine | 420. | UR | 2200. | UJ | | |
| 56-55-3 | Benzo(a)anthracene | 420. | UR | 2200. | U | | |
| 218-01-9 | Chrysene | 420. | UR | 2200. | U | | |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 62. | J | 380. | J | | |
| 117-84-0 | Di-n-octylphthalate | 420. | UR | 2200. | UJ | | |
| 205-99-2 | Benzo(b)fluoranthene | 420. | UR | 2200. | U | | |
| 207-08-9 | Benzo(k)fluoranthene | 420. | UR | 2200. | U | | |
| 50-32-8 | Benzo(a)pyrene | 420. | UR | 2200. | U | | |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 420. | UR | 2200. | U | | |
| 53-70-3 | Dibenzo(a,h)anthracene | 420. | UR | 2200. | U | | |
| 191-24-2 | Benzo(g,h,i)perylene | 420. | UR | 2200. | U | | |

*** Validation Complete ***

00650

| 1403 VOA | SAMPLE ID -------> | 040-S-0G08-09 | | 040-S-G050-3D | | 040-S-G070-3D | | 040-S-G080-3D | | 040-S-G100-3D | | 040-G-H051-2D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ORIGINAL ID -----> | 40SG0809 | | 40SG0503D | | 40SG0703D | | 40SG0803D | | 40SG1003D | | 40GH0512D | |
| | LAB SAMPLE ID ---> | 123573 | | 123571 | | 123570 | | 123572 | | 123569 | | 123578 | |
| | SAMPLE DATE -----> | 05/12/95 | | 05/10/95 | | 05/11/95 | | 05/11/95 | | 05/11/95 | | 05/11/95 | |
| | DATE ANALYZED ---> | 05/26/95 | | 05/25/95 | | 05/25/95 | | 05/25/95 | | 05/26/95 | | 05/23/95 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Water | |
| | UNITS ----------> | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/KG | A | UG/L | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 74-87-3 | Chloromethane | 64. | U | 12. | UJ | 12. | UJ | 13. | UJ | 12. | U | 10. | U |
| 74-83-9 | Bromomethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-01-4 | Vinyl chloride | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-00-3 | Chloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-09-2 | Methylene chloride | 64. | U | 2. | J | 2. | J | 2. | J | 12. | U | 10. | U |
| 67-64-1 | Acetone | 240. | UJ | 10. | J | 5. | J | 38. | | 12. | UJ | 28. | |
| 75-15-0 | Carbon disulfide | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-35-4 | 1,1-Dichloroethene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-34-3 | 1,1-Dichloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 67-66-3 | Chloroform | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 107-06-2 | 1,2-Dichloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 78-93-3 | 2-Butanone (MEK) | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 56-23-5 | Carbon tetrachloride | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-27-4 | Bromodichloromethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 78-87-5 | 1,2-Dichloropropane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 79-01-6 | Trichloroethene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 124-48-1 | Dibromochloromethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 71-43-2 | Benzene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 75-25-2 | Bromoform | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 591-78-6 | 2-Hexanone | 64. | UJ | 12. | U | 12. | U | 13. | U | 12. | UJ | 10. | U |
| 127-18-4 | Tetrachloroethene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 108-88-3 | Toluene | 53. | J | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 108-90-7 | Chlorobenzene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 100-41-4 | Ethylbenzene | 7700. | D | 12. | U | 12. | U | 120. | | 12. | U | 10. | U |
| 100-42-5 | Styrene | 64. | U | 12. | U | 12. | U | 13. | U | 12. | U | 10. | U |
| 1330-20-7 | Xylene (Total) | 33000. | DJ | 12. | U | 12. | U | 210. | | 12. | U | 10. | U |

*** Validation Complete ***

000651

1403
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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-G-H064-6D | | 040-G-H084-4D | | 040-G-H095-1D | | 040-G-H101-2D | | 040-S-S131-1D | | 040-S-S150-3D | |
| | ORIGINAL ID -----> | 40GH0646D | | 40GH0844D | | 40GH951D | | 40GH1012D | | 40SS1311D | | 40SS1503D | |
| | LAB SAMPLE ID ---> | 123575 | | 123577 | | 123576 | | 123574 | | 123580 | | 123568 | |
| | SAMPLE DATE -----> | 05/11/95 | | 05/11/95 | | 05/11/95 | | 05/12/95 | | 05/12/95 | | 05/12/95 | |
| | DATE ANALYZED ---> | 05/22/95 | | 05/23/95 | | 05/23/95 | | 05/22/95 | | 05/25/95 | | 05/25/95 | |
| | MATRIX ----------> | Water | | Water | | Water | | Water | | Soil | | Soil | |
| | UNITS ----------> | UG/L | A | UG/L | A | UG/L | A | UG/L | A | UG/KG | A | UG/KG | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 74-87-3 | Chloromethane | 10. | UJ | 10. | U | 10. | U | 10. | UJ | 13. | UJ | 12. | UJ |
| 74-83-9 | Bromomethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-01-4 | Vinyl chloride | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-00-3 | Chloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-09-2 | Methylene chloride | 10. | U | 10. | U | 10. | U | 10. | U | 4. | J | 1. | J |
| 67-64-1 | Acetone | 10. | U | 6. | J | 3. | J | 23. | U | 110. | U | 24. | U |
| 75-15-0 | Carbon disulfide | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-35-4 | 1,1-Dichloroethene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-34-3 | 1,1-Dichloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 540-59-0 | 1,2-Dichloroethene (total) | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 67-66-3 | Chloroform | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 107-06-2 | 1,2-Dichloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 78-93-3 | 2-Butanone (MEK) | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 71-55-6 | 1,1,1-Trichloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 56-23-5 | Carbon tetrachloride | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-27-4 | Bromodichloromethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 78-87-5 | 1,2-Dichloropropane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 10061-01-5 | cis-1,3-Dichloropropene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 79-01-6 | Trichloroethene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 124-48-1 | Dibromochloromethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 79-00-5 | 1,1,2-Trichloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 71-43-2 | Benzene | 10. | U | 10. | U | 10. | U | 10. | U | 6. | J | 12. | U |
| 10061-02-6 | trans-1,3-Dichloropropene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 75-25-2 | Bromoform | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 591-78-6 | 2-Hexanone | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 127-18-4 | Tetrachloroethene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 108-88-3 | Toluene | 10. | U | 10. | U | 10. | U | 10. | U | 6. | J | 12. | U |
| 108-90-7 | Chlorobenzene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 100-41-4 | Ethylbenzene | 10. | U | 10. | U | 10. | U | 10. | U | 1300. | DJ | 12. | U |
| 100-42-5 | Styrene | 10. | U | 10. | U | 10. | U | 10. | U | 13. | U | 12. | U |
| 1330-20-7 | Xylene (Total) | 10. | U | 10. | U | 10. | U | 10. | U | 260. | DJ | 12. | U |

*** Validation Complete ***

# RCRA FACILITY INVESTIGATION DATA VALIDATION REPORT FOR SUPPLEMENTAL SAMPLES ASSEMBLY B NAVAL SUPPORT ACTIVITY MEMPHIS MILLINGTON, TENNESSEE

CT0-094
CONTRACT NO. N62467-89D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

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October 3, 1996

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## 1.0 INTRODUCTION

This report presents the analytical data collected during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of Naval Support Activity (NSA) Memphis Assembly B Solid Waste Management Units (SWMUs) 38 and 40; and the quality assurance/quality control (QA/QC) evaluation of those data. The purpose of the data evaluation is to verify that the QC requirements of the data set have been met and to characterize the weakness of any questionable data.

The Assembly B soil samples were collected at NSA Memphis on September 25, 1995 while the sediment samples were collected on May 2, 1996. All samples were submitted to National Environmental Testing, Inc. (NET) Laboratory in Bedford, Massachusetts, and were reported using U.S. Environmental Protection Agency (USEPA) Data Quality Objectives (DQO) Level III and Level IV equivalents. The analytical methods and DQO laboratory deliverables are summarized in Table 1-1.

**Table 1-1**
**NSA Memphis Analytical Program**

| Analytical Method | Data Quality Level | Method Reference |
|---|---|---|
| | **Full Scan** | |
| Volatile Organic Compounds | III | SW-846 8240 |
| Semivolatile Organic Compounds | IV | SW-846 8270 |
| Pesticides/Polychlorinated Biphenyls | IV | SW-846 8080 |
| Chlorinated Herbicides | III | SW-846 8150 |
| Organophosphorus Pesticides | III | SW-846 8140 |
| Metals | IV | 40 CFR Part 264 Appendix IX (SW-846 6010/7060/7421/7470/7740) |
| Cyanide | III | SW-846 9010 |
| Gasoline Range Organics | III | Modified 8015/TN GRO, 8020 |
| Diesel Range Organics | III | Modified 8015/TN DRO |

*Notes:*
CFR = Code of Federal Regulations
TN GRO/DRO = Tennessee Method for Gasoline Range Organics and Diesel Range Organics



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The references for the methods listed in Table 1-1 were obtained from the following sources:

- USEPA Office of Solid Waste and Emergency Response (OSWER), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), Third Edition, revised July 1992.

- USEPA Environmental Monitoring and Support Laboratory, *Methods for Chemical Analysis of Water and Wastes,* EPA-600/4-79-020, revised March 1983.

- USEPA *Title 40 Code of Federal Regulations (CFR) Part 264, Appendix IX, 52 Federal Register 25947,* July 1987.

Data were validated using the following documents (as appropriate):

- *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, OWSER, February 1994 (EPA-540/R-94/012). (Organic Functional Guidelines).

- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, OSWER, February 1994 (EPA-540/R-94/013). (Inorganic Functional Guidelines).

The NSA Memphis data were validated by either EnSafe/Allen and Hoshall (E/A&H) or E/A&H's subcontractors, Heartland Environmental Services, Inc., of St. Charles, Missouri, or Validata Chemical Services of Norcross, Georgia. Ninety-five percent of the data were validated at DQO Level III while 5% of the data were validated at DQO Level IV. The data validation findings were summarized separately for each individual sample delivery group (SDG). Each SDG usually contained 20 samples of one matrix type, i.e., either a solid (soil and/or sediment)



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or water (groundwater and/or surface water) samples, except for QC samples. The validation summary reports and data summary tables are included in Attachment A to this appendix. The sections listed below discuss the significant data validation findings for each SWMU. The following outlines the SWMUs for this project and the analytical parameters associated with each.

**Data Validation Summary of the Investigative Samples:**

| | | |
|---|---|---|
| Section 2 | Organic, Metals, and Cyanide Data | SWMU 38 |
| Section 3 | Semivolatile, Pesticide/PCB, and Metals Data | SWMU 40 |

Please refer to Sections 1.1 through 1.2.10 of *Appendix 1 — Data Validation Report* of this document for parameters used for data evaluation, control limits, and qualification definitions.

## 2.0 DATA VALIDATION RESULTS — SWMU 38

All samples were received by the laboratory intact and with the proper documentation. Table 2-1 summarizes the samples that were included in SWMU 38.

**Table 2-1**
**SWMU 38 Sample IDs**

| Sample ID | APX IX Metals | CN | Herb | OP Pest | Pest/PCB | SVOC | VOA | DRO | GRO |
|---|---|---|---|---|---|---|---|---|---|
| NFCM000101 | X | X | X | X | X | X | X | X | X |
| NFCM000102 | X | X | X | X | X | X | X | X | X |

Two investigative samples were analyzed in one SDG for SWMU 38. Full validation reports of each SDG and data tables can be found in Attachment A of this report.

## 2.1 Data Quality

The overall data quality of the analytical work performed for NSA Memphis at SWMU 38 was considered to be satisfactory and usable for site remediation and risk assessment. Results that were outside QA/QC requirements were flagged as estimated "J." The estimated qualification indicates that the data could be biased either high or low. The "J" flag alerts the data user to the possibility of a high or low bias. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

## 2.2 Unusable Data

A few samples were rendered unusable because the samples grossly exceeded QC parameters. Table 2-2 summarizes the unusable data and explains the qualification.

**Table 2-2**
**SWMU 38 Unusable Data**

| Sample ID | Fraction | Analyte(s) | Reason |
|---|---|---|---|
| NFCM000101 | Herbicides | All | Surrogate %Rs less than 10% |
| NFCM000102 | Herbicides | All | Surrogate %Rs less than 10% |

Samples NFCM000101 and NFCM000102 were re-analyzed for herbicides due to low surrogate percent recoveries. The surrogate results remained unchanged in the re-analysis. The re-analysis of these two samples exceeded the 14-day extraction holding time by more than two times the initial holding time. Therefore, all results in the re-analysis of samples NFCM000101 and NFCM000102 were qualified as unusable (R). Because the initial analysis represented the preferable holding time, the results from the first analysis were used for investigative interpretation and appear in the data summary tables.



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## 2.3 Blanks

Cadmium, calcium, selenium, and silver were detected in several method and field blanks. The blanks were examined during the validation process and sample results for cadmium, calcium, selenium, and silver that were believed to be from blank contamination were nullified.

# 3.0 DATA VALIDATION RESULTS — SWMU 40

All samples were received by the laboratory intact and with the proper documentation. Table 3-1 summarizes the samples that were included in SWMU 40.

**Table 3-1**
**SWMU 40 Sample IDs**

| Sample ID | APX IX Metals | Pest/PCB | SVOC |
|---|---|---|---|
| 040S001001 | X | X | X |
| 040S001101 | X | X | X |
| 040S001201 | X | X | X |
| 040S001301 | X | X | X |
| 040S001401 | X | X | X |
| 040C001401 | X | X | X |

Six investigative samples were analyzed in one SDG for SWMU 40. Full validation reports of each SDG and data tables can be found in Attachment A of this report.

## 3.1 Data Quality

The overall data quality of the analytical work performed for NSA Memphis at SWMU 40 was considered to be satisfactory and usable for site remediation and risk assessment. Results that were outside QA/QC requirements were flagged as estimated "J." The estimated qualification indicates that the data could be biased either high or low. The "J" flag alerts the data user to

the possibility of a high or low bias. Although the data are qualified as estimated, they remain dependable for use in risk assessment and site remediation.

## 3.2 Blanks

Di-n-butylphthalate and diethylphthalate were detected in several method and field blanks. The blanks were examined during the validation process and sample results for di-n-butylphthalate and diethylphthalate that were believed to be from blank contamination were nullified.



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**Attachment A**

**Data Validation Summary Narratives**

**and**

**Data Tables**

# SWMU 38

**VALIDATA**
**Chemical Services, Inc.**

*P. O. Box 930422, Norcross, GA 30093*

(770) 923-3890
(770) 923-8769 (Fax)

# DATA VALIDATION SUMMARY REPORT

| | |
|---|---|
| COMPANY: | Ensafe/Allen & Hoshall |
| SITE NAME: | NAS Memphis, Gray Area / SWMU 45 |
| PROJECT NUMBER: | 8500.14 |
| CONTRACTED LAB: | National Environmental Testing, Inc. |
| QA/QC LEVEL: | EPA Level III |
| EPA METHOD: | EPA SOW 3-90, SW-846 |
| VALIDATION GUIDELINES: | *USEPA CLP National Functional Guidelines for Organic Data Review,* 1994; *USEPA CLP National Functional Guidelines for Inorganic Data Review,* 1994 |
| SAMPLE MATRICES: | Water, Sediment and Soil |
| TYPES OF ANALYSES: | Volatile Organics, Semivolatile Organics, Pesticides/PCB's, Organophosphorus Pesticides, Chlorinated Herbicides, Gasoline Range Organics, Diesel Range Organics, Total Metals and Cyanide |
| SDG NUMBER: | 1817 (Level III) |

SAMPLES:

| Client Sample # | Lab Sample # | Matrix | Volatile Organics | Semi-volatiles | Pesticides/ PCB's | Chlorinated Herbicides | Total Metals |
|---|---|---|---|---|---|---|---|
| NFCM000101 | 147367 | Sediment | X | X | X | X | X |
| NFCM000102 | 147368 | Sediment | X | X | X | X | X |
| NFCM000102RE | 147368RE | Sediment | | | | X | |
| NFFS001701 | 147369 | Soil | X | X | X | | X |
| NFFS001701DL | 147369DL | Soil | | | X | | |
| NFFS001801 | 147370 | Soil | X | X | X | | X |
| NFFS001801DL | 147370DL | Soil | | | X | | |
| NFFS001901 | 147371 | Soil | X | X | X | | X |
| NFFS002001 | 147372 | Soil | X | X | X | | X |
| NFFS002101 | 147373 | Soil | X | X | X | | X |
| NFFS002101RE | 147373RE | Soil | X | | | | |
| NFFS002201 | 147374 | Soil | X | X | X | | X |
| NFFS002201RE | 147374RE | Soil | X | | | | |
| NFFS002301 | 147375 | Soil | X | X | X | | X |
| NFFS002301RE | 147375RE | Soil | X | | | | |
| NFFS002401 | 147376 | Soil | X | X | X | | X |

| Client Sample # | Lab Sample # | Matrix | Volatile Organics | Semi-volatiles | Pesticides/ PCB's | Chlorinated Herbicides | Total Metals |
|---|---|---|---|---|---|---|---|
| NFFS002401DL | 147376DL | Soil | | | X | | |
| 000T050296 | 147377 | Water | X | | | | |
| NFFS001701MS | 147369MS | Soil | + | | | | |
| NFFS001701MSD | 147369MSD | Soil | + | | | | |
| NFFS002401S* | 147376S* | Soil | | | | | + |
| NFFS002401D* | 147376D* | Soil | | | | | + |

| Client Sample # | Lab Sample # | Matrix | Organophos. Pesticides | Gasoline Range Organics | Diesel Range Organics | Cyanide |
|---|---|---|---|---|---|---|
| NFCM000101 | 147367 | Sediment | X | X | X | X |
| NFCM000101RE | 147367RE | Sediment | X | | | |
| NFCM000102 | 147368 | Sediment | X | X | X | X |
| NFCM000102RE | 147368RE | Sediment | X | | | |
| NFFS001701 | 147369 | Soil | | X | X | |
| NFFS001701RE | 147369RE | Soil | | | X | |
| NFFS001801 | 147370 | Soil | | X | X | |
| NFFS001901 | 147371 | Soil | | X | X | |
| NFFS002001 | 147372 | Soil | | X | X | |
| NFFS002101 | 147373 | Soil | | X | X | |
| NFFS002101RE | 147373RE | Soil | | | X | |
| NFFS002201 | 147374 | Soil | | X | X | |
| NFFS002201RE | 147374RE | Soil | | | X | |
| NFFS002301 | 147375 | Soil | | X | X | |
| NFFS002401 | 147376 | Soil | | X | X | |

+ = Non-billable Quality Control Sample

D* = LAB DUPLICATE, DL = DILUTION, RE = REEXTRACTION / REANALYSIS, MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE, S* = MATRIX SPIKE, T = TRIP BLANK

DATA REVIEWER(S): Linda H. Liu, Marvin L. Smith, Jean M. Delashmit

RELEASE SIGNATURE: Jean M. Delashmit

Data Qualifier Definitions

| | | |
|---|---|---|
| J | - | The association numerical value is an estimated quantity. |
| R | - | The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification. |
| U | - | The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit. |
| UJ | - | The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity. |

DATA QUALIFICATION SUMMARY

National Environmental Testing, Inc. - 1817 CLP Organics and Inorganics

SAMPLE: NFCM000101, NFCM000101RE, NFCM000102, NFCM000102RE, NFFS001701, NFFS001701DL, NFFS001701RE, NFFS001801, NFFS001801DL, NFFS001901, NFFS002001, NFFS002101, NFFS002101RE, NFFS002201, NFFS002201RE, NFFS002301, NFFS002301RE, NFFS002401, NFFS002401DL, 000T050296, NFFS001701MS, NFFS001701MSD, NFFS002401S*, NFFS002401D*

*VOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met, so no action was taken.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met, so no action was required.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met, so no action was required.

Continuing Calibration:

All Continuing Calibration criteria were met, so no action was required.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks, so no action was taken.

Trip Blank:

Methylene chloride was detected at 4 ug/L in trip blank 000T050296. Since methylene chloride was not detected in the associated samples, no action was taken.

TIC's:

All TIC criteria were met, so no action was required.

V.) Surrogate Recoveries:

The Percent Recovery (%R) of bromofluorobenzene was 123% in sample NFFS002101, which exceeded the 59-113% QC limits. Since there were no positive results in this sample, no action was required.

The Percent Recovery (%R) of toluene-d8 was 82% in sample NFFS002101RE, which was below the 84-138% QC limits. The results for this sample, which consisted entirely of non-detects, were flagged as estimated (UJ).

VI.) Laboratory Control Samples (LCS):

No LCS was analyzed in this SDG. No action was taken.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD Recovery criteria were met. No action was taken.

VIII.) Field Duplicates:

No field duplicate samples were analyzed in this SDG. No action was taken.

IX.) Internal Standards Performance (ISTD):

The internal standard area counts were below the 50-200% QC limits for the following samples:

| Sample | Bromochloromethane | 1,4-Difluorobenzene | Chlorobenzene-d5 |
|---|---|---|---|
| NFFS002101 | - | - | 39.2% |
| NFFS002101RE | - | - | 47.2% |
| NFFS002201 | - | - | 47.6% |
| NFFS002201RE | 29.2% | 28.7% | 22.9% |
| NFFS002301 | - | - | 42.4% |
| NFFS002301RE | - | - | 43.4% |

The positive and non-detect results for compounds quantitated using these ISTD's were flagged as estimated (J) and (UJ).

X.) TCL Compound Identification:

All TCL Compound Identification criteria were met, so no action was taken.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met, so no action was necessary.

XII.) Tentatively Identified Compounds (TIC's):

All TIC Identification criteria were met, so no action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was taken.

XIV.) Overall Assessment of Data/General:

The original analysis of sample NFFS002101 was considered by the validator to be of preferable data quality to the reanalysis because of better surrogate recoveries. The original analysis of sample NFFS002201 was considered by the validator to be of preferable data quality to the reanalysis because of better internal standard area counts. The reanalysis of sample NFFS002301RE was considered by the validator to be of preferable data quality to the original analysis because of improved internal standard area counts. All laboratory data were acceptable with qualifications.

*SEMIVOLATILE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met, so no action was taken.

II.) GC/MS Tuning:

All GC/MS Tuning criteria were met, so no action was taken.

III.) Calibration:

Initial Calibration:

The Percent Relative Standard Deviations (%RSD's) exceeded the 30% QC limit for the standards analyzed on 4/24/96 on instrument HP5970F for the following compounds:

| | |
|---|---|
| hexachlorocyclopentadiene | 52.7% |
| 2,4-dinitrophenol | 32.4% |

Since these compounds were not detected in the associated samples, no action was taken.

Continuing Calibration:

The Percent Difference (%D) of hexachlorocyclopentadiene was 27.5% which exceeded the 25% QC limit for the standards analyzed on 5/24/96 at 09:01 on instrument HP5970F. All results for this compound in associated samples NFCM000101, NFCM000102, NFFS001701, NFFS001801, NFFS001901, NFFS002001 and NFFS002101, which consisted entirely of non-detects, were flagged as estimated (UJ).

The Percent Differences (%D's) exceeded the 25% QC limit for the standard analyzed on 5/28/96 at 10:23 on instrument HP5970F for the following compounds:

| | |
|---|---|
| 2,4-dinitrophenol | 54.4% |
| 4,6-dinitro-2-methylphenol | 35.1% |

All results for these two compounds in associated samples NFFS002201, NFFS002301 and NFFS002401, which consisted entirely of non-detects, were flagged as estimated (UJ).

IV.) Blanks:

Method Blank:

There were no positive results in the method blank. No action was taken.

TIC's:

All TIC criteria were met, so no action was necessary.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met, so no action was required.

VI.) Laboratory Control Samples (LCS):

No LCS was analyzed in this SDG. No action was necessary.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD samples were not analyzed in this SDG, so no action was taken.

VIII.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

IX.) Internal Standards Performance:

All Internal Standards Performance criteria were met, so no action was required.

X.) TCL Compound Identification:

All TCL Compound Identification criteria were met, so no action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met, so no action was necessary.

XII.) Tentatively Identified Compounds (TIC's):

All TIC criteria were met, so no action was necessary.

XIII.) System Performance:

All System Performance criteria were met, so no action was taken.

XIV.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualifications.

*PESTICIDES/PCB's*

I.) Holding Times:

All Holding Time criteria were met, so no action was required.

II.) Instrument Performance:

All Pesticide Instrument Performance criteria were met, so no action was taken.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met, so no action was necessary.

Continuing Calibration:

The Percent Differences (%D's) of 4,4'-DDE were 28.5% and 59.6%, respectively, for the standard analyzed on 05/27/96 at 12:02 on the primary column and secondary column, which exceeded the 25% QC limit. The positive and non-detect results for this compound in associated samples NFCM000101, NFCM000102, NFFS001701, NFFS001801, NFFS001901, NFFS002001, NFFS002101, NFFS002201 and NFFS002301 were flagged as estimated (J) and (UJ).

The Percent Differences (%D's) of 4,4'-DDE were 25.2% and 59.6%, respectively, for the standard analyzed on 05/29/96 at 07:55 on the primary column and secondary column, which exceeded the 25% QC limit. The positive and non-detect results for this compound in associated samples NFFS002401, NFFS002401DL, NFFS001801DL and NFFS001701DL were flagged as estimated (J) and (UJ).

The Percent Difference (%D) of aroclor 1260 was 53.7% for the standard analyzed on 05/29/96 at 08:45 on the secondary column, which exceeded the 25% QC limit. The positive and non-detect results for this compound in associated samples NFFS002401, NFFS002401DL, NFFS001801DL and NFFS001701DL were flagged as estimated (J) and (UJ).

IV.) Blanks:

Method Blank:

There were no positive detections in the method blank. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met, so no action was required.

VI.) Laboratory Control Samples (LCS):

All LCS Recovery criteria were met. No action was taken.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

No MS / MSD samples were analyzed in this SDG. No action was taken.

VIII.) TCL Compound Identification:

Pesticide/PCB Identification Summary (PIS):

The Percent Differences (%D's) between columns 1 and 2 exceeded the 70% QC limit for the following compounds and associated samples:

| Sample | Compound | %D |
|---|---|---|
| NFFS002401 | 4,4-DDT | 128 |
| NFFS002401DL | endrin ketone | 443 |

The associated positive sample result for 4,4'-DDT in sample NFFS002401 was flagged as estimated (J). The positive result for endrin ketone in sample NFFS002401DL was rejected (R) because the %D exceeded 300%.

IX.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

X.) Pesticide Cleanup Check:

Florisil Cartridge Check:

All criteria were met, so no action was taken.

Gel Permeation Chromatography (GPC):

All GPC criteria were met. No action was necessary.

XI.) Overall Assessment of Data/General:

The positive result for endrin ketone in sample NFFS002401DL was rejected (R) because the column percent difference exceeded 300%. Results for dieldrin in samples NFFS001701, NFFS001801 and NFFS002401 were above the instrument's linear calibration range. The undiluted values for these compounds were replaced with the diluted values with appropriate flagging. All other laboratory data were acceptable with qualifications.



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*ORGANOPHOSPHORUS PESTICIDES*

I.) Holding Times:

All Holding Time criteria were met, so no action was required.

II.) Instrument Performance:

All Instrument Performance criteria were met, so no action was taken.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met, so no action was necessary.

Continuing Calibration:

All Continuing Calibration criteria were met, so no action was necessary.

IV.) Blanks:

Method Blank:

There were no positive detections in the method blank. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met, so no action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD samples were not analyzed in this SDG, so no action was taken.

VII.) TCL Compound Identification:

Organophosphorus Pesticide Identification Summary (OPIS):

All OPIS Identification criteria were met. No action was required.

VIII.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable without qualification.



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*CHLORINATED HERBICIDES*

I.) Holding Times:

The holding times from sampling date to reextraction date were 35 days for samples NFCM000101RE and NFCM000102RE, which exceeded the 14 day QC limit. All results in samples NFCM000101RE and NFCM000102RE, which consisted entirely of non-detects, were rejected (R) because holding time were exceeded by more than 2X.

II.) Instrument Performance:

All Herbicides Instrument Performance criteria were met, so no action was taken.

III.) Calibration:

Initial Calibration:

All Initial Calibration criteria were met, so no action was required.

Continuing Calibration:

The Percent Difference (%D) of 2,4-DB was 48.9% for the standard analyzed on 5/30/96 at 17:03 on primary column RTX-35, which exceeded the 25% QC limit. The results for this compound in associated samples NFCM000101 and NFCM000102, which consisted entirely of non-detects, were flagged as estimated (UJ).

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks. No action was taken.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of surrogate 2,4-dichlorophenylacetic acid were below the 31-147% QC limits for the following samples:

| Client Sample ID | %R Column 1 | %R Column 2 |
|---|---|---|
| NFCM000101 | 0 | 24 |
| NFCM000102 | 0 | 19 |

All non-detect results for samples NFCM000101 and NFCM000102 were rejected (R) due to surrogate %R's of less than 10%.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD samples were not analyzed in this SDG, so no action was taken.

VII.) TCL Compound Identification (HIS):

All HIS Identification criteria were met. No action was required.

VIII.) Field Duplicates:

Field duplicate samples were not analyzed in this SDG. No action was taken.

IX.) Overall Assessment of Data/General:

All results for samples NFCM000101 and NFCM000102 were rejected (R) due to surrogate %R's of less than 10%. All results for samples NFCM000101RE and NFCM000102RE were rejected due to holding time exceedances of greater than 2X QC limits. There were no other laboratory data for this fraction. The original analyses were left as the "Report A" primary data.

*GASOLINE RANGE ORGANICS*

I.) Holding Times:

All Holding Time criteria were met, so no action was taken.

II.) Instrument Performance:

All Instrument Performance criteria were met, so no action was necessary.

III.) Calibration:

All Initial and Continuing Calibration criteria were met, so no action was required.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks. No action was necessary.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met, so no action was required.

VI.) Laboratory Control Sample (LCS):

Two LCS's were analyzed for this SDG. All Recovery criteria were met. No action was taken.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD samples were not analyzed in this SDG. No action was taken.



000674

VIII.) TCL Compound Identification:

All criteria were met, so no action was required.

IX.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

IX.) Overall Assessment of Data/General:

All laboratory data were acceptable without qualification.

*DIESEL RANGE ORGANICS*

I.) Holding Times:

The holding times from sampling date to reextraction date were 21 days for samples NFFS001701RE, NFFS002101RE and NFFS002201RE, which exceeded the 14 day QC limit. All positive and non-detect results in these samples were flagged as estimated (J) and (UJ).

II.) Instrument Performance:

All Instrument Performance criteria were met, so no action was necessary.

III.) Calibration:

All Initial and Continuing Calibration criteria were met, so no action was required.

IV.) Blanks:

Method Blanks:

There were no positive detections in the method blanks. No action was necessary.

V.) Surrogate Recoveries:

The Percent Recoveries (%R's) of surrogate o-terphenyl were below the 50-150% QC limits for the following samples:

| Client Sample | %R |
|---|---|
| NFFS001701 | 10 |
| NFFS002101 | 31 |
| NFFS002201 | 31 |

The positive and non-detect results for these samples were flagged as estimated (J) and (UJ).

VI.) Laboratory Control Sample (LCS):

Two LCS's were analyzed for this SDG. All Recovery criteria were met. No action was taken.

VII.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD samples were not analyzed in this SDG. No action was taken.

VIII.) TCL Compound Identification:

All criteria were met, so no action was required.

IX.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

X.) Overall Assessment of Data/General:

Sample NFFS002101 was incorrectly identified on the spreadsheet as "NFCS002101." The sample number was corrected on the spreadsheet by the validator, but not in the electronic data. All other laboratory data were acceptable with qualifications. Samples NFFS001701, NFFS002101 and NFFS002201 were reanalyzed outside holding times due to low surrogate recoveries. The reanalysis results for these samples are considered to be of preferable data quality to the original analyses.

*TOTAL METALS AND CYANIDE*

I.) Holding Times:

All Holding Time criteria were met, so no action was taken.

II.) Calibration:

All Initial and Continuing Calibration criteria were met, so no action was necessary.

III.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

| Blank Type/ID# | Analyte | Max. Conc. | Action Level |
|---|---|---|---|
| ICB1 | cadmium | 3.80 ug/L | 3.80 mg/kg |
| PBS | calcium | 7.30 mg/kg | 36.5 mg/kg |
| ICB3 | selenium | 1.20 ug/L | 1.20 mg/kg |
| PBS | silver | 7.19 mg/kg | 36.0 mg/kg |

CCB = Continuing Calibration Blank, ICB = Initial Calibration Blank, PBS = Preparation Blank (Soil)

All results greater than the IDL but less than 5X the blank amount (Action Level, mg/kg for soil and sediment samples) for which the contaminated blank was an associated calibration or preparation blank were flagged as undetected (U).

The following analytes had negative results with absolute values greater than the IDL:

| Blank Type/ID# | Analyte | Neg. Conc. | 5X Conc. |
|---|---|---|---|
| ICB6 | arsenic | -5.90 ug/L | 5.90 mg/kg |
| CCB11 | lead | -3.00 ug/L | 3.00 mg/kg |
| CCB5 | thallium | -2.00 ug/L | 2.00 mg/kg |
| CCB2 | tin | -57.2 ug/L | 57.2 mg/kg |

CCB = Continuing Calibration Blank, ICB = Initial Calibration Blank.

All associated positive sample results less than 5X the absolute value of the negative blank results and all associated non-detects were flagged as estimated (J) and (UJ).

IV.) ICP Interference Check Sample Results:

The Percent Recoveries (%R's) of aluminum, calcium, iron nor magnesium was reported on the Form IV. No action was taken.

The following analytes were detected in ICS Solution A at concentrations greater than the IDL:

| | |
|---|---|
| barium | 4 ug/L |
| cadmium | 197 ug/L |
| copper | 20 ug/L |
| silver | 8 ug/L |
| zinc | 55 ug/L |
| tin | 1140 ug/L |

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was reported on Form I's for the samples in this SDG, no action was required.

Negative results were observed in ICS Solution A at absolute concentrations greater than the IDL for the following analytes:

| | |
|---|---|
| chromium | -8 ug/L |
| cobalt | -3 ug/L |
| vanadium | -11 ug/L |

Since neither aluminum, calcium, iron nor magnesium was reported on the Form I's for the samples in this SDG, no action was required.

V.) ICP Serial Dilution Analysis:

The Serial Dilution Percent Difference (%D) of barium (17%) in soil sample NFFS002401L exceeded the 10% QC limit. Positive results for this analyte in all associated soil samples were flagged as estimated (J).

VI.) Laboratory Control Samples (LCS):

All LCS Recovery criteria were met. No action was required.

VII.) Duplicate Sample Analysis:

All Duplicate Sample criteria were met, so no action was taken.

VIII.) Matrix Spike Recoveries:

The Percent Recoveries (%R's) of antimony (35.9%) and selenium (73.6%) in spiked sample NFFS002401S* were below the 75-125% QC limits. All results for these two analytes in the associated samples, which consisted entirely of non-detects after blank qualification, were flagged as estimated (UJ).

IX.) Field Duplicates:

Field duplicate samples were not designated in this SDG. No action was taken.

X.) Graphite Furnace Atomic Absorption QC (GFAA):

All GFAA criteria were met. No action was necessary.

XI.) Sample Result, Calculation/Transcription Verification:

Cadmium was misspelled as "cadium" on all forms in this data package. No action was taken.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met, so no action was taken.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualifications.

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



| APX9-METAL | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | | | | | |
| | LAB SAMPLE ID ---> | 147367S | | 147368S | | | | | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | | | | | |
| | UNITS ----------> | MG/KG | | MG/KG | | | | | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | | | | | |
| 7440-36-0 | Antimony (Sb) | 8.5 | UJ | 8.6 | UJ | | | | | | | | |
| 7440-38-2 | Arsenic (As) | 5.4 | J | 6.4 | | | | | | | | | |
| 7440-39-3 | Barium (Ba) | 115. | J | 108. | J | | | | | | | | |
| 7440-41-7 | Beryllium (Be) | 0.38 | J | 0.35 | J | | | | | | | | |
| 7440-43-9 | Cadmium (Cd) | 14.2 | | 12.2 | | | | | | | | | |
| 7440-47-3 | Chromium (Cr) | 8.8 | | 7.4 | | | | | | | | | |
| 7440-48-4 | Cobalt (Co) | 9.1 | J | 7.8 | J | | | | | | | | |
| 7440-50-8 | Copper (Cu) | 11.9 | | 11.4 | | | | | | | | | |
| 7439-92-1 | Lead (Pb) | 14.8 | | 12.7 | | | | | | | | | |
| 7439-97-6 | Mercury (Hg) | 0.14 | U | 0.14 | U | | | | | | | | |
| 7440-02-0 | Nickel (Ni) | 14.3 | | 13.1 | | | | | | | | | |
| 7782-49-2 | Selenium (Se) | 0.34 | UJ | 0.29 | UJ | | | | | | | | |
| 7440-22-4 | Silver (Ag) | 0.85 | U | 0.86 | U | | | | | | | | |
| 7440-28-0 | Thallium (Tl) | 0.57 | UJ | 0.57 | UJ | | | | | | | | |
| 7440-62-2 | Vanadium (V) | 17.6 | | 15.3 | | | | | | | | | |
| 7440-66-6 | Zinc (Zn) | 35.4 | | 32.1 | | | | | | | | | |
| 7440-31-5 | Tin (Sn) | 20.1 | J | 24.6 | J | | | | | | | | |

000679

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



METAL-CN

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | |
| | DATE EXTRACTED --> | 05/08/96 | | 05/08/96 | | | | |
| | DATE ANALYZED ---> | 05/31/96 | | 05/31/96 | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | |
| | UNITS ----------> | MG/KG | | MG/KG | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | |
| 57-12-5 | Cyanide (CN) | 0.5 | U | 0.5 | U | | | |

*** Validation Complete ***

000630

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



SW846-HERB

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | | | | | |
| | DATE EXTRACTED --> | 05/16/96 | | 05/16/96 | | | | | | | | | |
| | DATE ANALYZED ---> | 05/30/96 | | 05/30/96 | | | | | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | | | | | |
| 1918-00-9 | Dicamba | 0.94 | UR | 0.94 | UR | | | | | | | | |
| 94-74-6 | MCPA | 930. | UR | 930. | UR | | | | | | | | |
| 93-65-2 | MCPP | 940. | UR | 940. | UR | | | | | | | | |
| 120-36-5 | Dichlorprop | 9.4 | UR | 9.4 | UR | | | | | | | | |
| 94-75-7 | 2,4-D | 9.4 | UR | 9.4 | UR | | | | | | | | |
| 93-72-1 | 2,4,5-TP (Silvex) | 0.95 | UR | 0.95 | UR | | | | | | | | |
| 94-82-6 | 2,4-DB | 9.5 | UR | 9.5 | UR | | | | | | | | |
| 88-85-7 | Dinoseb | 4.7 | UR | 4.7 | UR | | | | | | | | |
| 93-76-5 | 2,4,5-T | 0.95 | UR | 0.95 | UR | | | | | | | | |
| 75-99-0 | Dalapon | 23. | UR | 23. | UR | | | | | | | | |

000681

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



SW846-OP P

000634

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | | | |
| | DATE EXTRACTED --> | 05/07/96 | | 05/07/96 | | | | | | | |
| | DATE ANALYZED ---> | 05/23/96 | | 05/23/96 | | | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | | | |
| 86-50-0 | Guthion | 110. | U | 100. | U | | | | | | |
| 35400-43-2 | Sulprofos | 110. | U | 100. | U | | | | | | |
| 2921-88-2 | Chloropyrifos | 110. | U | 100. | U | | | | | | |
| 56-72-4 | Coumaphos | 110. | U | 100. | U | | | | | | |
| 8065-48-3 | Demeton,O | 110. | U | 100. | U | | | | | | |
| 333-41-5 | Diazinon | 110. | U | 100. | U | | | | | | |
| 62-73-7 | Dichlorvos | 110. | U | 100. | U | | | | | | |
| 298-04-4 | Disulfoton | 110. | U | 100. | U | | | | | | |
| 13194-48-4 | Ethoprop | 110. | U | 100. | U | | | | | | |
| 115-90-2 | Fensulfothion | 110. | U | 100. | U | | | | | | |
| 55-38-9 | Fenthion | 110. | U | 100. | U | | | | | | |
| 150-50-5 | Merphos | 110. | U | 100. | U | | | | | | |
| 7786-34-7 | Mevinphos, Alpha | 110. | U | 100. | U | | | | | | |
| 300-76-5 | Naled | 230. | U | 210. | U | | | | | | |
| 298-00-0 | Methyl parathion | 110. | U | 100. | U | | | | | | |
| 298-02-2 | Phorate | 110. | U | 100. | U | | | | | | |
| 299-84-3 | Ronnel | 110. | U | 100. | U | | | | | | |
| 22248-79-9 | Stirophos (Tetrachlorovinphos) | 110. | U | 100. | U | | | | | | |
| 34643-46-4 | Tokuthion | 110. | U | 100. | U | | | | | | |
| 327-98-0 | Trichloronate | 110. | U | 100. | U | | | | | | |
| 126-75-0 | Demeton,S | 110. | U | 100. | U | | | | | | |

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



| SW846-PEST | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | | | |
| | DATE EXTRACTED --> | 05/07/96 | | 05/07/96 | | | | | | | |
| | DATE ANALYZED ---> | 05/27/96 | | 05/27/96 | | | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | | | |
| 319-84-6 | alpha-BHC | 2.3 | U | 2.1 | U | | | | | | |
| 319-85-7 | beta-BHC | 2.3 | U | 2.1 | U | | | | | | |
| 319-86-8 | delta-BHC | 2.3 | U | 2.1 | U | | | | | | |
| 58-89-9 | gamma-BHC (Lindane) | 2.3 | U | 2.1 | U | | | | | | |
| 76-44-8 | Heptachlor | 2.3 | U | 2.1 | U | | | | | | |
| 309-00-2 | Aldrin | 2. | J | 2.1 | U | | | | | | |
| 1024-57-3 | Heptachlor epoxide | 2.3 | U | 2.1 | U | | | | | | |
| 959-98-8 | Endosulfan I | 2.3 | U | 2.1 | U | | | | | | |
| 60-57-1 | Dieldrin | 2.5 | J | 4.2 | U | | | | | | |
| 72-55-9 | 4,4'-DDE | 5.2 | J | 3.5 | J | | | | | | |
| 72-20-8 | Endrin | 4.6 | U | 4.2 | U | | | | | | |
| 33213-65-9 | Endosulfan II | 4.6 | U | 4.2 | U | | | | | | |
| 72-54-8 | 4,4'-DDD | 4.6 | U | 4.2 | U | | | | | | |
| 1031-07-8 | Endosulfan sulfate | 4.6 | U | 4.2 | U | | | | | | |
| 50-29-3 | 4,4'-DDT | 4.6 | U | 4.2 | U | | | | | | |
| 72-43-5 | Methoxychlor | 23. | U | 21. | U | | | | | | |
| 53494-70-5 | Endrin ketone | 4.6 | U | 4.2 | U | | | | | | |
| 7421-93-4 | Endrin aldehyde | 4.6 | U | 4.2 | U | | | | | | |
| 5103-71-9 | alpha-Chlordane | 2.3 | U | 2.1 | U | | | | | | |
| 5103-74-2 | gamma-Chlordane | 2.3 | U | 2.1 | U | | | | | | |
| 8001-35-2 | Toxaphene | 46. | U | 42. | U | | | | | | |
| 12674-11-2 | Aroclor-1016 | 46. | U | 42. | U | | | | | | |
| 11104-28-2 | Aroclor-1221 | 46. | U | 42. | U | | | | | | |
| 11141-16-5 | Aroclor-1232 | 46. | U | 42. | U | | | | | | |
| 53469-21-9 | Aroclor-1242 | 46. | U | 42. | U | | | | | | |
| 12672-29-6 | Aroclor-1248 | 46. | U | 42. | U | | | | | | |
| 11097-69-1 | Aroclor-1254 | 46. | U | 42. | U | | | | | | |
| 11096-82-5 | Aroclor-1260 | 46. | U | 42. | U | | | | | | |
| 12789-03-6 | Technical Chlordane | 46. | U | 42. | U | | | | | | |

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*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples

SU846-SVOA

000631

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | |
| | ORIGINAL ID ------> | NFCM000101 | | NFCM000102 | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | |
| | SAMPLE DATE ------> | 05/02/96 | | 05/02/96 | | | | | |
| | DATE EXTRACTED --> | 05/09/96 | | 05/09/96 | | | | | |
| | DATE ANALYZED ---> | 05/24/96 | | 05/24/96 | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | |
| 108-95-2 | Phenol | 460. | U | 420. | U | | | | |
| 111-44-4 | bis(2-Chloroethyl)ether | 460. | U | 420. | U | | | | |
| 95-57-8 | 2-Chlorophenol | 460. | U | 420. | U | | | | |
| 541-73-1 | 1,3-Dichlorobenzene | 460. | U | 420. | U | | | | |
| 106-46-7 | 1,4-Dichlorobenzene | 460. | U | 420. | U | | | | |
| 95-50-1 | 1,2-Dichlorobenzene | 460. | U | 420. | U | | | | |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 460. | U | 420. | U | | | | |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 460. | U | 420. | U | | | | |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 460. | U | 420. | U | | | | |
| 621-64-7 | N-Nitroso-di-n-propylamine | 460. | U | 420. | U | | | | |
| 67-72-1 | Hexachloroethane | 460. | U | 420. | U | | | | |
| 98-95-3 | Nitrobenzene | 460. | U | 420. | U | | | | |
| 78-59-1 | Isophorone | 460. | U | 420. | U | | | | |
| 88-75-5 | 2-Nitrophenol | 460. | U | 420. | U | | | | |
| 105-67-9 | 2,4-Dimethylphenol | 460. | U | 420. | U | | | | |
| 120-83-2 | 2,4-Dichlorophenol | 460. | U | 420. | U | | | | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 460. | U | 420. | U | | | | |
| 91-20-3 | Naphthalene | 460. | U | 420. | U | | | | |
| 106-47-8 | 4-Chloroaniline | 460. | U | 420. | U | | | | |
| 87-68-3 | Hexachlorobutadiene | 460. | U | 420. | U | | | | |
| 111-91-1 | bis(2-Chloroethoxy)methane | 460. | U | 420. | U | | | | |
| 59-50-7 | 4-Chloro-3-methylphenol | 460. | U | 420. | U | | | | |
| 91-57-6 | 2-Methylnaphthalene | 460. | U | 420. | U | | | | |
| 77-47-4 | Hexachlorocyclopentadiene | 460. | UJ | 420. | UJ | | | | |
| 88-06-2 | 2,4,6-Trichlorophenol | 460. | U | 420. | U | | | | |
| 95-95-4 | 2,4,5-Trichlorophenol | 1100. | U | 1000. | U | | | | |
| 91-58-7 | 2-Chloronaphthalene | 460. | U | 420. | U | | | | |
| 88-74-4 | 2-Nitroaniline | 1100. | U | 1000. | U | | | | |
| 131-11-3 | Dimethyl phthalate | 460. | U | 420. | U | | | | |
| 208-96-8 | Acenaphthylene | 460. | U | 420. | U | | | | |
| 606-20-2 | 2,6-Dinitrotoluene | 460. | U | 420. | U | | | | |
| 99-09-2 | 3-Nitroaniline | 1100. | U | 1000. | U | | | | |
| 83-32-9 | Acenaphthene | 460. | U | 420. | U | | | | |
| 51-28-5 | 2,4-Dinitrophenol | 1100. | U | 1000. | U | | | | |
| 100-02-7 | 4-Nitrophenol | 1100. | U | 1000. | U | | | | |
| 132-64-9 | Dibenzofuran | 460. | U | 420. | U | | | | |

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



| SW846-SVOA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | |
| | DATE EXTRACTED --> | 05/09/96 | | 05/09/96 | | | | | |
| | DATE ANALYZED ---> | 05/24/96 | | 05/24/96 | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | |
| 121-14-2 | 2,4-Dinitrotoluene | 460. | U | 420. | U | | | | |
| 84-66-2 | Diethylphthalate | 460. | U | 420. | U | | | | |
| 7005-72-3 | 4-Chlorophenylphenylether | 460. | U | 420. | U | | | | |
| 86-73-7 | Fluorene | 460. | U | 420. | U | | | | |
| 100-01-6 | 4-Nitroaniline | 1100. | U | 1000. | U | | | | |
| 534-52-1 | 2-Methyl-4,6-Dinitrophenol | 1100. | U | 1000. | U | | | | |
| 86-30-6 | N-Nitrosodiphenylamine | 460. | U | 420. | U | | | | |
| 101-55-3 | 4-Bromophenyl-phenylether | 460. | U | 420. | U | | | | |
| 118-74-1 | Hexachlorobenzene | 460. | U | 420. | U | | | | |
| 87-86-5 | Pentachlorophenol | 1100. | U | 1000. | U | | | | |
| 85-01-8 | Phenanthrene | 460. | U | 420. | U | | | | |
| 120-12-7 | Anthracene | 460. | U | 420. | U | | | | |
| 86-74-8 | Carbazole | 460. | U | 420. | U | | | | |
| 84-74-2 | Di-n-butylphthalate | 48. | J | 420. | U | | | | |
| 206-44-0 | Fluoranthene | 460. | U | 420. | U | | | | |
| 129-00-0 | Pyrene | 460. | U | 420. | U | | | | |
| 85-68-7 | Butylbenzylphthalate | 510. | | 420. | U | | | | |
| 91-94-1 | 3,3'-Dichlorobenzidine | 460. | U | 420. | U | | | | |
| 56-55-3 | Benzo(a)anthracene | 460. | U | 420. | U | | | | |
| 218-01-9 | Chrysene | 460. | U | 420. | U | | | | |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 460. | U | 420. | U | | | | |
| 117-84-0 | Di-n-octyl phthalate | 460. | U | 420. | U | | | | |
| 205-99-2 | Benzo(b)fluoranthene | 460. | U | 420. | U | | | | |
| 207-08-9 | Benzo(k)fluoranthene | 460. | U | 420. | U | | | | |
| 50-32-8 | Benzo(a)pyrene | 460. | U | 420. | U | | | | |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 460. | U | 420. | U | | | | |
| 53-70-3 | Dibenz(a,h)anthracene | 460. | U | 420. | U | | | | |
| 191-24-2 | Benzo(g,h,i)perylene | 460. | U | 420. | U | | | | |

*** Validation Complete ***

000685

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples

SW846-VOA

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | | |
| | ORIGINAL ID -----> | NFCM000101 | | NFCM000102 | | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | | |
| | DATE ANALYZED ---> | 05/11/96 | | 05/11/96 | | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | | |
| | UNITS ----------> | ug/Kg | | ug/Kg | | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | | |
| 74-87-3 | Chloromethane | 68. | U | 63. | U | | | | |
| 74-83-9 | Bromomethane | 68. | U | 63. | U | | | | |
| 75-01-4 | Vinyl chloride | 68. | U | 63. | U | | | | |
| 75-00-3 | Chloroethane | 68. | U | 63. | U | | | | |
| 75-09-2 | Methylene chloride | 68. | U | 63. | U | | | | |
| 67-64-1 | Acetone | 1300. | | 860. | | | | | |
| 75-15-0 | Carbon disulfide | 68. | U | 63. | U | | | | |
| 75-35-4 | 1,1-Dichloroethene | 68. | U | 63. | U | | | | |
| 75-34-3 | 1,1-Dichloroethane | 68. | U | 63. | U | | | | |
| 540-59-0 | 1,2-Dichloroethene (total) | 68. | U | 63. | U | | | | |
| 67-66-3 | Chloroform | 68. | U | 63. | U | | | | |
| 107-06-2 | 1,2-Dichloroethane | 68. | U | 63. | U | | | | |
| 78-93-3 | 2-Butanone (MEK) | 68. | U | 63. | U | | | | |
| 71-55-6 | 1,1,1-Trichloroethane | 68. | U | 63. | U | | | | |
| 56-23-5 | Carbon tetrachloride | 68. | U | 63. | U | | | | |
| 75-27-4 | Bromodichloromethane | 68. | U | 63. | U | | | | |
| 78-87-5 | 1,2-Dichloropropane | 68. | U | 63. | U | | | | |
| 10061-01-5 | cis-1,3-Dichloropropene | 68. | U | 63. | U | | | | |
| 79-01-6 | Trichloroethene | 68. | U | 63. | U | | | | |
| 124-48-1 | Dibromochloromethane | 68. | U | 63. | U | | | | |
| 79-00-5 | 1,1,2-Trichloroethane | 68. | U | 63. | U | | | | |
| 71-43-2 | Benzene | 68. | U | 63. | U | | | | |
| 10061-02-6 | trans-1,3-Dichloropropene | 68. | U | 63. | U | | | | |
| 75-25-2 | Bromoform | 68. | U | 63. | U | | | | |
| 108-10-1 | 4-Methyl-2-Pentanone (MIBK) | 68. | U | 63. | U | | | | |
| 591-78-6 | 2-Hexanone | 68. | U | 63. | U | | | | |
| 127-18-4 | Tetrachloroethene | 68. | U | 63. | U | | | | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 68. | U | 63. | U | | | | |
| 108-88-3 | Toluene | 68. | U | 63. | U | | | | |
| 108-90-7 | Chlorobenzene | 68. | U | 63. | U | | | | |
| 100-41-4 | Ethylbenzene | 68. | U | 63. | U | | | | |
| 100-42-5 | Styrene | 68. | U | 63. | U | | | | |
| 1330-20-7 | Xylene (Total) | 68. | U | 63. | U | | | | |

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
## SWMU 38 - Sediment Samples



| TPH-DRO | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | NFC-M-0001-02 | | | | |
| | ORIGINAL ID -----> | NFCM000101 | NFCM000102 | | | | |
| | LAB SAMPLE ID ---> | 147367 | 147368 | | | | |
| | ID FROM REPORT --> | NFCM000101 | NFCM000102 | | | | |
| | SAMPLE DATE -----> | 05/02/96 | 05/02/96 | | | | |
| | DATE EXTRACTED --> | 05/11/96 | 05/11/96 | | | | |
| | DATE ANALYZED ---> | 05/22/96 | 05/22/96 | | | | |
| | MATRIX ----------> | Sediment | Sediment | | | | |
| | UNITS ----------> | UG/KG | UG/KG | | | | |
| CAS # | Parameter | 1817 VAL | 1817 VAL | | | | |
| 9999900-02-6 | TPH - Diesel Range Organics | 22000. | 16000. | | | | |

*** Validation Complete ***

000682

NSA MEMPHIS
NSA MEMPHIS, RFI, ASSEMBLY B
SWMU 38 - Sediment Samples



000638

| TPH-GRO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | NFC-M-0001-01 | | NFC-M-0001-02 | | | | |
| | ORIGINAL ID ------> | NFCM000101 | | NFCM000102 | | | | |
| | LAB SAMPLE ID ---> | 147367 | | 147368 | | | | |
| | ID FROM REPORT --> | NFCM000101 | | NFCM000102 | | | | |
| | SAMPLE DATE -----> | 05/02/96 | | 05/02/96 | | | | |
| | DATE ANALYZED ---> | 05/07/96 | | 05/07/96 | | | | |
| | MATRIX ----------> | Sediment | | Sediment | | | | |
| | UNITS ----------> | UG/KG | | UG/KG | | | | |
| CAS # | Parameter | 1817 | VAL | 1817 | VAL | | | |
| 9999900-02-5 | TPH - Gasoline Range Organics | 69. | U | 63. | U | | | |

*** Validation Complete ***

# SWMU 40

# DATA ASSESSMENT AND NARRATIVE

# SEMIVOLATILE ORGANICS

## General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA CLP, 3/90; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

## SDG # T535

A validation was performed on the Volatile Data from SDG T535. The data was evaluated based on the following parameters.

- * Data Completeness
- * Holding Times
- * GC/MS Tuning
- * Calibrations
- * Internal Standard Performance
- Blanks
- * Surrogate Recoveries
- * Matrix Spike/Matrix Spike Duplicate
- * Field Duplicates
- * Compound Identification /Quantitation

* - All criteria were met for this parameter

## Method Blanks

| Associated blank | Compound | Conc. | Action Level |
|---|---|---|---|
| SBLK100395F | di-n-butylphthalate | 640 | 6400 |
| | diethylphthalate | 140 | 1400 |

**Method Blanks (continued)**

| Samples | Compound | Qualification |
|---|---|---|
| 040S001101 | diethylphthalate | CRQL |
| 040S001201 | | CRQL |
| 040S001301 | | CRQL |
| 040S001401 | | CRQL |
| 060S001401 | | CRQL |
| 060S002001 | | CRQL |
| 040S001001 | di-n-butylphthalate | CRQL |
| 040S001101 | | U |
| 040S001201 | | CRQL |
| 040S001301 | | U |
| 040S001401 | | CRQL |
| 040C001401 | | CRQL |
| 060S001401 | | CRQL |
| 060S002001 | | CRQL |

**System Performance and Overall Assessment**

The overall system performance was fair. The laboratory did not encounter any large problems. The data reviewer estimates that less than 5% of the data is qualified.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

R = Result is rejected and unusable

NJ = Presumptive evidence for the presence of the material at an estimated value

K = Result is biased high

L = Result is biased low

## METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | ANALYTE ID | DL | QL |
|---|---|---|---|
| 040S001101 | diethylphthalate | + | CRQL |
| 040S001201 | | | CRQL |
| 040S001301 | | | CRQL |
| 040S001401 | | | CRQL |
| 060S001401 | | | CRQL |
| 060S002001 | | | CRQL |
| 040S001001 | di-n-butylphthalate | + | CRQL |
| 040S001101 | | | U |
| 040S001201 | | | CRQL |
| 040S001301 | | | U |
| 040S001401 | | | CRQL |
| 040C001401 | | | CRQL |
| 060S001401 | | | CRQL |
| 060S002001 | | | CRQL |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

# DATA ASSESSMENT NARRATIVE

# PESTICIDE/AROCLORS

## General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDG # T535

A validation was performed on the Pesticide/Aroclor Data from SDG T535. The data was evaluated based on the following parameters:

| | | |
|---|---|---|
| * | • | Data Completeness |
| * | • | Holding Times |
| * | • | GC Performance |
| | • | Calibration |
| * | • | Blanks |
| * | • | Surrogate Recoveries |
| * | • | Matrix Spike/Matrix Spike Duplicates |
| * | • | Field Duplicates |
| * | • | Compound Identification |
| | • | Compound Quantitation |

* - All criteria were met for this parameter.

## Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory analyzed a single point curve for the aroclors 1221, 1232, 1242, 1248, and 1254. The data did not require qualification because there were no positive results reported for the aroclors analyzed with a single point calibration. However, the laboratory should follow the methodology.

**Continuing Calibrations**

Several continuing calibration standards associated with the reported samples exhibited %Ds above the QC limits.

**Specific Findings**

The continuing calibration of 10/19/95 (1623/1717) contained compounds with %Ds greater than 15% but less than 50%. For the samples and the non-compliant compounds listed below, the positive results are qualified as estimated, J.

| | |
|---|---|
| 040S001101<br>040S001401DL | 4,4'-DDT (21.8%) |
| 060S001401 | 4,4'-DDD (24.8%)<br>4,4'-DDT (21.8%) |

**Analyte Identification/Quantitation**

Several samples required dilution to accurately quantitate target compounds. Four (4) samples were reanalyzed at a further dilution due to non-compliant CCVs. Several samples exhibited column quantitation %Ds greater than 25%. It is the professional opinion of the data reviewer that the single component pesticides reported in the samples with high concentrations of aroclors should be suspect.

**Specific Findings**

Four (4) samples were reanalyzed at a further dilution due to non-compliant CCVs. However, the non-compliances were slight and therefore the reanalysis was unnecessary. For the following dilution samples, all positive and all non-detect results are rejected, UR, in favor of the results reported from the original diluted analysis.

040S001401DL
040S001401DDLMS
040S001401DLMSD
060S002001DL

**Analyte Identification/Quantitation, Continued**

**Specific Findings, Continued**

For the following samples, the results for the E flagged compounds are replaced with the corresponding results from the dilution analysis. All other results from the dilution are rejected, UR, in favor of the results reported from the undiluted analysis.

040S001101

The following sample was unnecessarily reanalyzed at a 5X dilution. For the dilution sample of 5X, all positive and all non-detect results are rejected, UR, in favor of the results reported from the 10X diluted analysis.

040S001101DL(5X)

The following sample was reanalyzed due to high levels of Dieldrin. The results for Dieldrin are replaced with the corresponding results from the 20X dilution analysis. All other results from the dilution are rejected, UR, in favor of the results reported from the undiluted analysis.

060S001401 Dieldrin

The following sample was reanalyzed at a 20X dilution to achieve acceptable results. For the dilution sample of 5X, all positive and all non-detect results are rejected, UR, in favor of the results reported from the 20X diluted analysis.

060S001401DL(5X)

The positive results reported in all samples which exhibited column quantitations differences greater than 25% are qualified as estimated, J.

**System Performance and Overall Assessment**

Overall performance was acceptable. The data reviewer estimates less than 10% of the data required qualifications.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

**U** = Not detected

**J** = Estimated value

**UJ** = Reported quantitation limit is qualified as estimated

**R** = Result is rejected and unusable

D = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

**CRQL =** The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

**U =** The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

**No Action =** The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| SAMPLE ID | ANALYTE ID | DL | QL |
|---|---|---|---|
| 040S001101<br>040S001401DL | 4,4'-DDT | + | J |
| 060S001401 | 4,4'-DDD<br>4,4'-DDT | + | J |
| 040S001401DL<br>040S001401DDLMS<br>040S001401DLMSD<br>060S002001DL | ALL | +/- | UR |
| 040S001101 | ALL E FLAGGED | + | D |
| 040S001101DL | ALL OTHERS | +/- | UR |
| 040S001101DL(5X) | ALL | +/- | UR |
| 060S001401 | Dieldrin | + | D |
| 060S001401DL | ALL OTHERS | +/- | UR |
| 060S001401DL(5X) | ALL | +/- | UR |
| ALL | ALL P >25% | + | J |

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

# DATA ASSESSMENT NARRATIVE
# METALS, CYANIDE AND TPH

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the CLP ILM03.0 Method; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level IV requirements for all samples. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

## SDG # T535

A validation was performed on the Metals and TPH Data from SDG T535. The data was evaluated based on the following parameters.

| | | |
|---|---|---|
| * | • | Data Completeness |
| * | • | Holding Times |
| * | • | Calibrations |
| | • | Blanks |
| * | • | Interferences |
| | • | Matrix Spike Recovery |
| * | • | Matrix Duplicates |
| * | • | Field Duplicates |
| * | • | Laboratory Control Samples |
| * | • | Serial Dilutions |
| * | • | MSAs |

* - All criteria were met for this parameter.

## Blanks

Specfic Findings

The preparation blank exhibited negative bias for Nickel (-4.52 mg/kg) and Selenium (-0.20 mg/kg). All sample values were qualified as estimated, "J" or "UJ" for samples below 45.2 mg/kg for Nickel and below 2.0 mg/kg for Selenium .

## Matrix Spike Recovery

### Specific Finding

The Matrix Spike recovery for Antimony (36%) was below the lower control limits. All positive and non-detect results for all soil samples are qualified as estimated, "J" or "UJ".

## MSAs

### Specific Findings

Several samples exhibited a high recovery but the sample values were non-detect. T herefore no qualification is required.

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

# GLOSSARY OF DATA QUALIFIERS

## QUALIFICATION CODES

**U** = Not detected

**J** = Estimated value

**UJ** = Reported Quantitation limit is qualified as estimated

**R** = Result is rejected and unusable

**D** = Result value is based on dilution analysis

## METHOD BLANK QUALIFICATION CODES

**CRQL =** The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

**U =** The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

**No Action =** The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

# SUMMARY OF DATA QUALIFICATIONS

| Sample ID | Analyte | DL | QL |
|---|---|---|---|
| All soil samples | Ni and Se. | +/U | J/UJ |
| All soil samples | Sb. | +/U | J/UJ |
| All soil samples | all analytes | B | J |

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
SWMU 040 - Soil Samples



T535
APX9-METAL

| SAMPLE ID -------> | 040-S-0010-01 | | 040-S-0011-01 | | 040-S-0012-01 | | 040-S-0013-01 | | 040-S-0014-01 | | 040-C-0014-01 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ORIGINAL ID -----> | 040S001001 | | 040S001101 | | 040S001201 | | 040S001301 | | 040S001401 | | 040C001401 | |
| LAB SAMPLE ID ---> | 6-135659S | | 6-135660S | | 6-135661S | | 6-135662S | | 6-135663S | | 6-135658S | |
| SAMPLE DATE -----> | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | |
| MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| UNITS ----------> | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A | MG/KG | A |
| CAS # Parameter | | | | | | | | | | | | |
| 7440-36-0 Antimony (Sb) | 10.5 | UJ | 10.9 | UJ | 11.4 | UJ | 11.1 | UJ | 10.2 | UJ | 10.3 | UJ |
| 7440-38-2 Arsenic (As) | 8.8 | | 15. | | 7.4 | | 10.2 | | 7.5 | | 9. | |
| 7440-39-3 Barium (Ba) | 41.4 | J | 97.9 | | 90. | | 105. | | 41. | | 43.3 | |
| 7440-41-7 Beryllium (Be) | 0.38 | J | 0.44 | J | 1.4 | | 0.69 | J | 0.54 | J | 0.32 | J |
| 7440-43-9 Cadmium (Cd) | 2.9 | | 2.6 | | 2.6 | | 2.8 | | 9.3 | | 8.9 | |
| 7440-47-3 Chromium (Cr) | 19.5 | | 11.1 | | 18.1 | | 14.1 | | 11.5 | | 11.1 | |
| 7440-48-4 Cobalt (Co) | 6.2 | J | 7.5 | J | 5.3 | J | 8.5 | J | 4.2 | J | 5.1 | J |
| 7440-50-8 Copper (Cu) | 6.8 | | 13.6 | | 6.8 | | 11.4 | | 6.7 | | 7.4 | |
| 7439-92-1 Lead (Pb) | 24.2 | | 133. | | 12.7 | | 16.5 | | 29.4 | | 45.3 | |
| 7439-97-6 Mercury (Hg) | 0.11 | | 0.14 | | 0.12 | | 0.12 | | 0.13 | | 0.11 | |
| 7440-02-0 Nickel (Ni) | 4.2 | UJ | 8.2 | J | 4.6 | UJ | 5.1 | J | 4.1 | UJ | 4.1 | UJ |
| 7782-49-2 Selenium (Se) | 0.21 | UJ | 0.23 | J | 0.23 | UJ | 0.22 | UJ | 0.2 | UJ | 0.21 | UJ |
| 7440-22-4 Silver (Ag) | 0.63 | U | 0.65 | U | 0.69 | U | 0.67 | U | 0.61 | U | 0.62 | U |
| 7440-28-0 Thallium (Tl) | 0.42 | U | 0.43 | U | 0.46 | U | 0.45 | U | 0.41 | U | 0.41 | U |
| 7440-62-2 Vanadium (V) | 14.2 | | 20.4 | | 22.8 | | 22.7 | | 11.7 | | 12.5 | |
| 7440-66-6 Zinc (Zn) | 45.4 | | 62.5 | | 40.9 | | 38.5 | | 39. | | 38.1 | |
| 7440-31-5 Tin (Sn) | 11.3 | J | 11.3 | J | 13.8 | J | 4.5 | U | 4.1 | U | 12.4 | J |

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
SWMU 040 - Soil Samples



T535
SW846-PEST

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-S-0010-01DL | | 040-S-0011-01 | | 040-S-0012-01DL | | 040-S-0013-01 | | 040-S-0014-01DL | | 040-C-0014-01DL | |
| | ORIGINAL ID -----> | 040S001001DL | | 040S001101 | | 040S001201DL | | 040S001301 | | 040S001401DL | | 040C001401DL | |
| | LAB SAMPLE ID ---> | 135659DL | | 135660 | | 135661DL | | 135662 | | 135663DL | | 135658DL | |
| | SAMPLE DATE -----> | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | |
| | DATE EXTRACTED --> | 09/29/95 | | 09/29/95 | | 09/29/95 | | 09/29/95 | | 09/29/95 | | 09/29/95 | |
| | DATE ANALYZED ---> | 10/12/95 | | 10/19/95 | | 10/12/95 | | 10/12/95 | | 10/19/95 | | 10/21/95 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 319-84-6 | alpha-BHC | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 319-85-7 | beta-BHC | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 319-86-8 | delta-BHC | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 58-89-9 | gamma-BHC (Lindane) | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 76-44-8 | Heptachlor | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 309-00-2 | Aldrin | 18. | U | 1.8 | J | 18. | U | 1.1 | J | 17. | U | 18. | U |
| 1024-57-3 | Heptachlor epoxide | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 959-98-8 | Endosulfan I | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 60-57-1 | Dieldrin | 35. | U | 230. | D | 37. | U | 1.8 | J | 71. | D | 55. | D |
| 72-55-9 | 4,4'-DDE | 35. | U | 5.3 | | 37. | U | 2.7 | J | 21. | DJ | 20. | J |
| 72-20-8 | Endrin | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 33213-65-9 | Endosulfan II | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 72-54-8 | 4,4'-DDD | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 1031-07-8 | Endosulfan sulfate | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 50-29-3 | 4,4'-DDT | 32. | DJ | 12. | J | 37. | U | 5.3 | | 40. | DJ | 36. | D |
| 72-43-5 | Methoxychlor | 180. | U | 18. | U | 180. | U | 18. | U | 170. | U | 180. | U |
| 53494-70-5 | Endrin ketone | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 7421-93-4 | Endrin aldehyde | 35. | U | 3.7 | U | 37. | U | 3.7 | U | 35. | U | 35. | U |
| 5103-71-9 | alpha-Chlordane | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 5103-74-2 | gamma-Chlordane | 18. | U | 1.8 | U | 18. | U | 1.8 | U | 17. | U | 18. | U |
| 8001-35-2 | Toxaphene | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 12674-11-2 | Aroclor-1016 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 11104-28-2 | Aroclor-1221 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 53469-21-9 | Aroclor-1242 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 12672-29-6 | Aroclor-1248 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 11097-69-1 | Aroclor-1254 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 11096-82-5 | Aroclor-1260 | 350. | U | 37. | U | 370. | U | 37. | U | 290. | DJ | 250. | DJ |
| 12789-03-6 | Technical Chlordane | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |
| 11141-16-5 | Aroclor-1232 | 350. | U | 37. | U | 370. | U | 37. | U | 350. | U | 350. | U |

*** Validation Complete ***

# NSA MEMPHIS
## NSA MEMPHIS, RFI, ASSEMBLY B
SWMU 040 - Soil Samples



T535
SW846-SVOA

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-S-0010-01 | | 040-S-0011-01 | | 040-S-0012-01 | | 040-S-0013-01 | | 040-S-0014-01 | | 040-C-0014-01 | |
| | ORIGINAL ID -----> | 040S001001 | | 040S001101 | | 040S001201 | | 040S001301 | | 040S001401 | | 040C001401 | |
| | LAB SAMPLE ID ---> | 135659 | | 135660 | | 135661 | | 135662 | | 135663 | | 135658 | |
| | SAMPLE DATE -----> | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | |
| | DATE EXTRACTED --> | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | |
| | DATE ANALYZED ---> | 10/09/95 | | 10/06/95 | | 10/06/95 | | 10/06/95 | | 10/09/95 | | 10/09/95 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 108-95-2 | Phenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 111-44-4 | bis(2-Chloroethyl)ether | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 95-57-8 | 2-Chlorophenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 541-73-1 | 1,3-Dichlorobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 106-46-7 | 1,4-Dichlorobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 95-50-1 | 1,2-Dichlorobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 95-48-7 | 2-Methylphenol (o-Cresol) | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 106-44-5 | 4-Methylphenol (p-Cresol) | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 67-72-1 | Hexachloroethane | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 98-95-3 | Nitrobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 78-59-1 | Isophorone | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 88-75-5 | 2-Nitrophenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 105-67-9 | 2,4-Dimethylphenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 120-83-2 | 2,4-Dichlorophenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 91-20-3 | Naphthalene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 106-47-8 | 4-Chloroaniline | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 87-68-3 | Hexachlorobutadiene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 111-91-1 | bis(2-Chloroethoxy)methane | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 59-50-7 | 4-Chloro-3-methylphenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 91-57-6 | 2-Methylnaphthalene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 77-47-4 | Hexachlorocyclopentadiene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 88-06-2 | 2,4,6-Trichlorophenol | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 95-95-4 | 2,4,5-Trichlorophenol | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 91-58-7 | 2-Chloronaphthalene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 88-74-4 | 2-Nitroaniline | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 131-11-3 | Dimethyl phthalate | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 208-96-8 | Acenaphthylene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 606-20-2 | 2,6-Dinitrotoluene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 99-09-2 | 3-Nitroaniline | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 83-32-9 | Acenaphthene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 51-28-5 | 2,4-Dinitrophenol | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 100-02-7 | 4-Nitrophenol | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 132-64-9 | Dibenzofuran | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 121-14-2 | 2,4-Dinitrotoluene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |

*** Validation Complete ***

000703

# NSA MEMPHIS

## NSA MEMPHIS, RFI, ASSEMBLY B

SWMU 040 - Soil Samples



T535
SW846-SVOA

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLE ID -------> | 040-S-0010-01 | | 040-S-0011-01 | | 040-S-0012-01 | | 040-S-0013-01 | | 040-S-0014-01 | | 040-C-0014-01 | |
| | ORIGINAL ID -----> | 040S001001 | | 040S001101 | | 040S001201 | | 040S001301 | | 040S001401 | | 040C001401 | |
| | LAB SAMPLE ID ---> | 135659 | | 135660 | | 135661 | | 135662 | | 135663 | | 135658 | |
| | SAMPLE DATE -----> | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | | 09/25/95 | |
| | DATE EXTRACTED --> | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | | 10/03/95 | |
| | DATE ANALYZED ---> | 10/09/95 | | 10/06/95 | | 10/06/95 | | 10/06/95 | | 10/09/95 | | 10/09/95 | |
| | MATRIX ----------> | Soil | | Soil | | Soil | | Soil | | Soil | | Soil | |
| | UNITS ----------> | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A | ug/Kg | A |
| CAS # | Parameter | | | | | | | | | | | | |
| 84-66-2 | Diethylphthalate | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 7005-72-3 | 4-Chlorophenylphenylether | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 86-73-7 | Fluorene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 100-01-6 | 4-Nitroaniline | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 534-52-1 | 2-Methyl-4,6-Dinitrophenol | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 86-30-6 | N-Nitrosodiphenylamine | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 101-55-3 | 4-Bromophenyl-phenylether | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 118-74-1 | Hexachlorobenzene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 87-86-5 | Pentachlorophenol | 8900. | U | 920. | U | 4600. | U | 920. | U | 8700. | U | 8800. | U |
| 85-01-8 | Phenanthrene | 3500. | U | 62. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 120-12-7 | Anthracene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 86-74-8 | Carbazole | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 84-74-2 | Di-n-butylphthalate | 3500. | U | 590. | U | 1800. | U | 620. | U | 3500. | U | 3500. | U |
| 206-44-0 | Fluoranthene | 3500. | U | 130. | J | 1800. | U | 370. | U | 380. | J | 3500. | U |
| 129-00-0 | Pyrene | 3500. | U | 160. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 85-68-7 | Butylbenzylphthalate | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 56-55-3 | Benzo(a)anthracene | 3500. | U | 61. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 218-01-9 | Chrysene | 3500. | U | 97. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate (BEHP) | 410. | J | 370. | U | 1800. | U | 370. | U | 410. | J | 370. | J |
| 117-84-0 | Di-n-octyl phthalate | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 205-99-2 | Benzo(b)fluoranthene | 3500. | U | 70. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 207-08-9 | Benzo(k)fluoranthene | 3500. | U | 73. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 50-32-8 | Benzo(a)pyrene | 3500. | U | 67. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 3500. | U | 35. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 53-70-3 | Dibenz(a,h)anthracene | 3500. | U | 370. | U | 1800. | U | 370. | U | 3500. | U | 3500. | U |
| 191-24-2 | Benzo(g,h,i)perylene | 3500. | U | 36. | J | 1800. | U | 370. | U | 3500. | U | 3500. | U |

*** Validation Complete ***