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NSWC WHITE OAK
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Section: 12.10
Site 20903-5640 (White Oak)
Doc. #: 0008
00415

Work Plan
for
RCRA Facility Investigation and Corrective Measures Study

Naval Surface Warfare Center White Oak
Silver Spring, Maryland

Engineering Field Activity Chesapeake
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0298

August 1998

Brown & Root Environmental

A Division of Halliburton NUS Corporation

Section: 12.10
Site 20903-5640 (White Oak)
Doc. #: 0003

019803/P

WORK PLAN
FOR
RCRA FACILITY INVESTIGATION AND CORRECTIVE MEASURES STUDY

NAVAL SURFACE WARFARE CENTER
WHITE OAK
SILVER SPRING, MARYLAND
SITES 2, 3, 4, 7, 8, 9 AND 11

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Chesapeake
Environmental Branch Code 18
Naval Facilities Engineering Command
Washington Navy Yard, Building 212
Washington, D.C. 20374-2121

Submitted by:
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CONTRACT NUMBER N62472-90-D-1298
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AUGUST 1998

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ACRONYMS

AET	Apparent Effects Threshold
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
B&R Environmental	Brown and Root Environmental
BCP	BRAC Cleanup Plan
BCT	BRAC Cleanup Team
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
BRAC II	Defense Base Closure and Realignment Act of 1990
BTAG	Biological Technical Assistance Group
CBC	Chillium-Beltsville-Croom
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act of 1992
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm/s	centimeters per second
COC	Chain of Custody
COMAR	Code of Maryland Regulations
CRAVE	Carcinogenic Risk Assessment Verification Endeavor
CSM	Conceptual Site Model
CSP	Cancer Slope Factor
CTE	Central Tendency Exposure
CTO	Contract Task Order
CWA	Clean Water Act
DMP	Data Management Plan
DOD	Department of Defense
DNR	Department of Natural Resources
DPM	Data Project Manager
DQO	Data Quality Objective
DVC	Data Validation Coordinator
DVM	Data Validation Manager
DVSAP	Design Verification Sampling and Analysis Plan

EA	EA Engineering Science and Technology
EBS	Environmental Baseline Survey
EEI	Ecological Effects Index
EEQ	Ecological Effects Quotient
EFACHES	Engineering Field Activity Chesapeake
EM	Electromagnetic
ERA	Ecological Risk Assessment
ER-L	Effects Range - Low
ERT	Environmental Response Team
FOL	Field Operation Leader
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	Geographic Information System
GMC	Gleneig-Manor-Chester
GPR	Ground Penetrating Radar
GSA	General Services Administration
GW	Groundwater
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HREM	High Resolution Electromagnetic
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
ICR	Incremental Cancer Risk
IDW	Investigation Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic
IMSG	Information Management Solutions Group
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LDR	Land Disposal Restriction
LIMS	Laboratory Information Management System
LOAEL	Lowest-Observed-Adverse-Effects-Level
LW	Leaching Well
MOA	Memorandum of Agreement
MCL	Maximum Contaminant Level

MDE	Maryland Department of the Environment
MCLG	Maximum Contaminant Level Goal
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAAQS	National Ambient Air Quality Standard
NAVSEA	Naval Sea Systems Command
NCP	National Contingency Plan
NEC	Nature and Extent of Contamination
NEESA	Naval Energy and Environmental Support Activity
NEPA	National Environmental Policy Act
NOAEL	No-Observed-Adverse-Effects-Level
NOL	Naval Ordnance Laboratory
NPDES	National Pollutant Discharge Elimination System
NPDWS	National Primary Drinking Water Standards
NRMP	National Resources Management Plan
NSWC-White Oak	Naval Surface Warfare Center - White Oak
OME	Ontario Ministry of the Environment
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCOC	Potential Constituent of Concern
PID	Photoionization Detector
PM	Project Manager
POTW	Public Owned Treatment Works
PP	Proposed Plan
PPM	Parts Per Million
PRG	Preliminary Remediation Goals
PVC	Polyvinyl Chloride
PWC	Public Works Center
QAPP	Quality Assurance Project Plan
RA	Remedial Alternative
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund

RBC	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SAP	Sampling and Analysis Plan
SB	Soil Boring
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SED	Sediment Sample
SMC	Sample Management Coordinator
SMCL	Secondary Maximum Contaminant Level
SS	Surface Soil
SSL	Soil Screening Level
SVOC	Semi-Volatile Organic Compound
SU	Standard Unit
SW	Surface Water
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TEF	Toxicity Equivalence Factor
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TOX	Total Organic Halogen
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TS	Total Solids

TSS	Total Suspended Solids
TVS	Total Volatile Solids
UCL	Upper Confidence Limit
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFD	U.S. Food and Drug Administration
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNR	U.S. Naval Reserve
USNRC	U.S. Nuclear Regulatory Commission
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WP	Work Plan
WQS	Water Quality Standards
ZOI	Zone of Influence

1.0 INTRODUCTION

Brown and Root Environmental (B&R Environmental) is submitting this Work Plan (WP) for the RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) at the Naval Surface Warfare Center, Dahlgren Division Detachment, White Oak (NSWC-White Oak). It has been prepared under Contract Task Order (CTO) 0298 for the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62472-90-D-1298. On January 1, 1998, the assets of B&R Environmental were acquired by Tetra Tech NUS (TtNUS). The CLEAN contract has recently been novated, but for clarity the name, B&R Environmental, will remain in this document.

In conjunction with the Master WP for NSWC-White Oak (B&R Environmental, 1998), this site specific WP will serve as a technical base that defines the nature of work associated with all pre Record of Decision (ROD) Documentation for seven sites at the Base. Specifically, this document will define procedures required for data management, field work, and report preparation pertaining to the RFI. Additional information regarding procedures, requirements, or protocols tied to the CMS are summarized accordingly in relative sections of the document. This project is being conducted according to the Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984.

1.1 FACILITY LOCATION AND SITE SUMMARIES

NSWC-White Oak is a former Navy owned and operated laboratory for Naval Surface Warfare research, located approximately 5 miles north of Washington, D.C., off New Hampshire Avenue in Silver Spring, Maryland (see Figure 1-1). NSWC-White Oak covers approximately 712 acres and is located in both Prince George's and Montgomery Counties. Approximately 662 acres were transferred to the General Services Administration (GSA) in the fall of 1997. The remaining area in the southeastern portion of the facility was transferred to the U.S. Army in February, 1998. Of this total area, approximately 617 acres, or 87 percent, is within Montgomery County. NSWC-White Oak is bordered by the Adelphi Laboratory Center and the United States Naval Reserve (USNR) Training Center along with a mixture of residential, park, industrial, and commercial properties. The facility lies in gently rolling terrain. Local drainage patters are dominated by Paint Branch Creek and its tributaries.

The specific sites associated with this study are listed below with a brief summary of each. These sites have been shown to pose a more imminent threat to human health and the environment than other sites present at NSWC-White Oak. This RFI/CMS is the continuation of the original effort to remediate these sites and mitigate risk. Other, less contaminated sites at NSWC-White Oak will be investigated during

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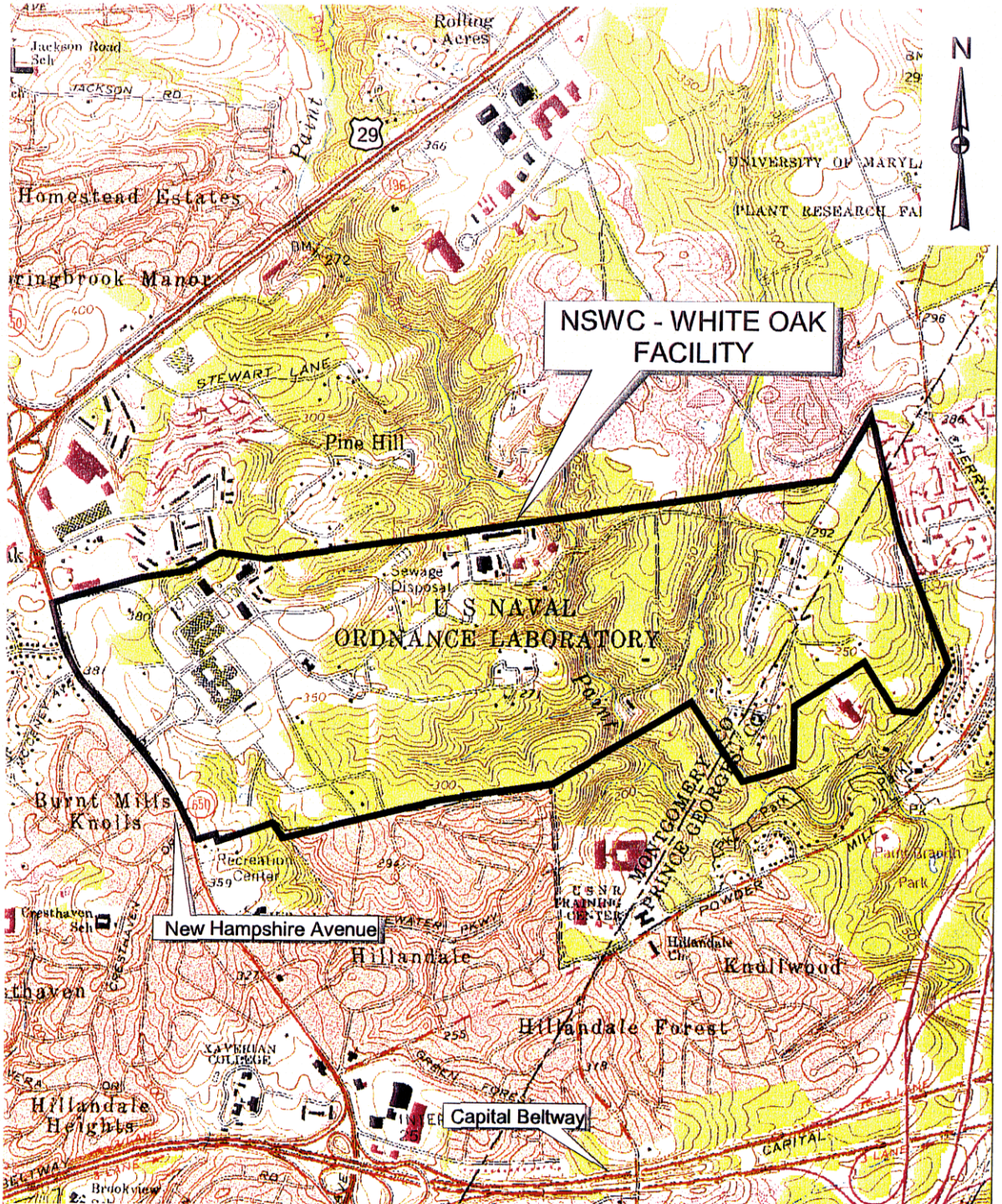

DRAWN BY D. PERRY — DATE 4-FEB-98	Brown & Root Environmental	CONTRACT NUMBER 7687	OWNER No. 0102
CHECKED BY — DATE	SITE VICINITY MAP NSWC - WHITE OAK SILVER SPRING, MARYLAND	APPROVED BY — DATE —	
COST/SCHEDULE-AREA		APPROVED BY — DATE —	
SCALE AS NOTED		DRAWING No. FIGURE 1-1	REV 0

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future studies. Detailed information for each site is presented in Section 3.0. Figure 1-2 shows site locations in relation to the Base boundaries, surface water bodies, and other landmarks. The facility boundaries identified on Figures 1-1 and 1-2 are the boundaries that existed prior to the transfer of the property to the Army.

- **Site 2 - Apple Orchard Landfill**

  The Apple Orchard Landfill is an abandoned landfill located on the south side of Perimeter Road in the northwestern end of the NSWC-White Oak property. The landfill covers approximately 4.3 acres, the majority of which consists of a topographic plateau adjacent to Perimeter Road. The Apple Orchard Landfill was reportedly operated as an open disposal area and landfill from 1948 until 1982. In addition to domestic refuse, wastes reportedly disposed of consisted of oils containing polychlorinated biphenyls (PCBs), solvents, paint residue, acids, and miscellaneous compounds. An estimated 500 gallons of PCB-contaminated oils were deposited at the site prior to 1970. It has been estimated that the landfill contains 75,000 cubic yards of waste/fill.

- **Site 3 - Pistol Range Landfill**

  The Pistol Range Landfill is located directly north of Dahlgren Road, north of the Monroe Loop. An unnamed, southward flowing stream is located adjacent to the western edge of the site. The landfill is approximately 1.1 acres in size. The Pistol Range Landfill was operated as a landfill from the late 1940s until the mid-1970s. Fill materials were pushed into a gully adjacent to the site that was formed by a small perennial tributary to Paint Branch Creek. Wastes reportedly disposed in the landfill include solid wastes, ordnance cases, solvents, oils possibly containing PCBs, sodium nitrate, and miscellaneous metallic objects. An estimated 8,000 gallons of solvents and oils were reportedly disposed of at the site during a 30 year period.

- **Site 4 - Chemical Burial Site**

  The Chemical Burial Site is located south of Perimeter Road and 400 yards northeast of Site 3 (Pistol Range Landfill). The overall area of the site is approximately 1.1 acres. Four discrete locations within the site were reportedly used from the mid-1950s until the early 1970s for disposal of waste chemicals used onsite. Wastes reportedly disposed at this location included acids, explosive compounds, kerosene, chlorinated solvents, and numerous, unidentified laboratory compounds. The total estimated volume of chemicals disposed in the areas was estimated to be 400 cubic feet.

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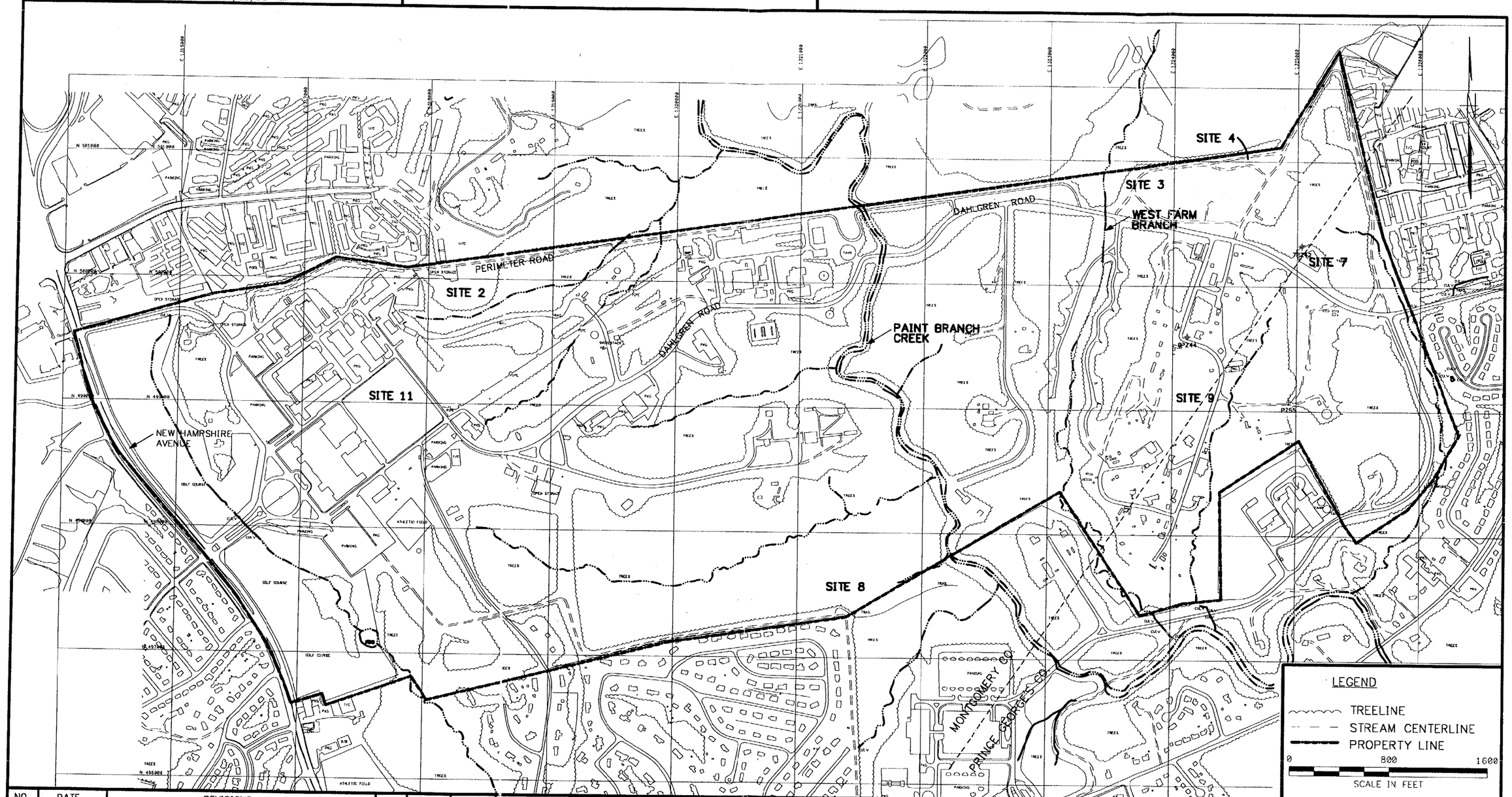

NO.	DATE	REVISIONS	BY	CHKD	APPD

REFERENCES

DRAWN BY MF DATE 2/3/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

Brown & Root Environmental

RI/FS SITE LOCATION MAP
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

CONTRACT NO. 7687
OWNER NO. 0102
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

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- **Site 7 - Ordnance Burn Area**

The Ordnance Burn Area is located north of Dahlgren Road and Buildings 501 and 508, approximately 300 yards southeast of Site 4 (Chemical Burial Area). The site was reportedly used for the thermal destruction of waste ordnance compounds between 1948 and 1968. The site consists of a swale approximately 250 feet long and 20 feet wide. The remainder of the area adjacent to the swale is either cleared or covered by woodland or grass. Waste disposed at this site included various types of explosives, primarily nitroaromatics and nitroaliphatics. It has been reported that approximately 33,000 pounds of explosives were burned at this site over a period of 20 years.

- **Site 8 - Abandoned Chemical Disposal Pit**

The Abandoned Chemical Disposal Pit is located along the southern facility boundary, at the end of Perimeter Road. The site has been described as a pit measuring 10 feet square by 12 feet deep. Site 8 was used from 1951 until 1971 for disposal of miscellaneous waste chemicals from laboratories located throughout NSWC-White Oak facility. Wastes disposed at this site included acids, mercury, solvents, and numerous, unidentified waste chemicals. It has been estimated that approximately 180 pounds of mercury were disposed at this location. Buried waste materials were removed from Site 8 during 1996 to address contaminant sources which may be impacting groundwater.

- **Site 9 - Industrial Wastewater Disposal Area 300**

The Industrial Wastewater Disposal Area 300 is located south of Dahlgren Road along the Montgomery/Prince George's County line and extends southward to the facility boundary. A perennial tributary of Paint Branch Creek is located west and south of the site and an intermittent tributary of the Creek is located to the east. The Industrial Wastewater Disposal Area 300 consists of both leaching wells and leach fields used from the early 1950s until the mid-1970s for dispersion of liquid wastes into the subsurface. Wastewater disposed at the site contained TNT, RDX, and several other explosive related compounds. It is estimated that at least 7,200 pounds of these wastewaters were disposed at this site over a period of approximately 25 years. Two leaching wells were removed from Site 9 during 1996 to address contaminant sources which may be impacting groundwater.

- **Site 11 - Industrial Wastewater Disposal Area 100**

Industrial Wastewater Disposal Area 100 contains thirteen leaching wells in nine areas that were used for wastewater disposal from laboratory activities. The wells are located in an area covering approximately 16 acres. The wells are abandoned while the associated supply lines are believed to be in place. The wells were used for liquid waste disposal into the subsurface until 1976. Original construction consisted of an eight foot diameter brick or concrete well, approximately nine feet in depth. Each well was accessible through a 24 inch diameter manhole cover. One supply line transported wastewater to each well. Wastes that were disposed at Site 11 include metals, acids, chlorinated and non-chlorinated solvents, alcohols, lead, and organic explosive compounds. It has been reported that an estimated 20,000 gallons of wastewater were disposed in these leaching wells. Both listed and characteristic hazardous wastes are believed to have been disposed. Five leaching wells were removed from Site 11 during 1996 to address contaminant sources which may be impacting groundwater.

1.2 SCOPE AND OBJECTIVES

The overall goal of the environmental investigative work at NSWC-White Oak is to sufficiently determine whether the facility and surrounding environmental media is protective of human health and the environment. Initially, this is done through characterization.

The site characterization process is based on standard guidance for conducting an RFI, shown on Figure 1-3. The process includes identification of Data Quality Objectives (DQO), development of an RFI WP, performance of field work, data management, and completion of an RFI and other reports.

The DQO process involves an examination of the data requirements for completing a human health risk assessment (HHRA), ecological risk assessment (ERA), and characterizing nature and extent of contamination (NEC). For each DQO process, goals are established, potential remedies are outlined, assumptions are made, the problems are defined, decisions are made, study boundaries are established, and action items are addressed. A brief discussion of the DQO process and the specific DQOs developed for the HHRA, ERA, and NEC are provided in Appendix A.

Based on the results of the DQO processes, an RFI WP is developed which defines the sampling procedures to be used in the field, how the data will be evaluated, and how the data will be managed. Upon completion of the RFI WP, the required field work shall commence. The field work will include surface water and groundwater sampling, surface and subsurface soil sampling, sediment sampling, and the collection of engineering data such as a topographic survey.

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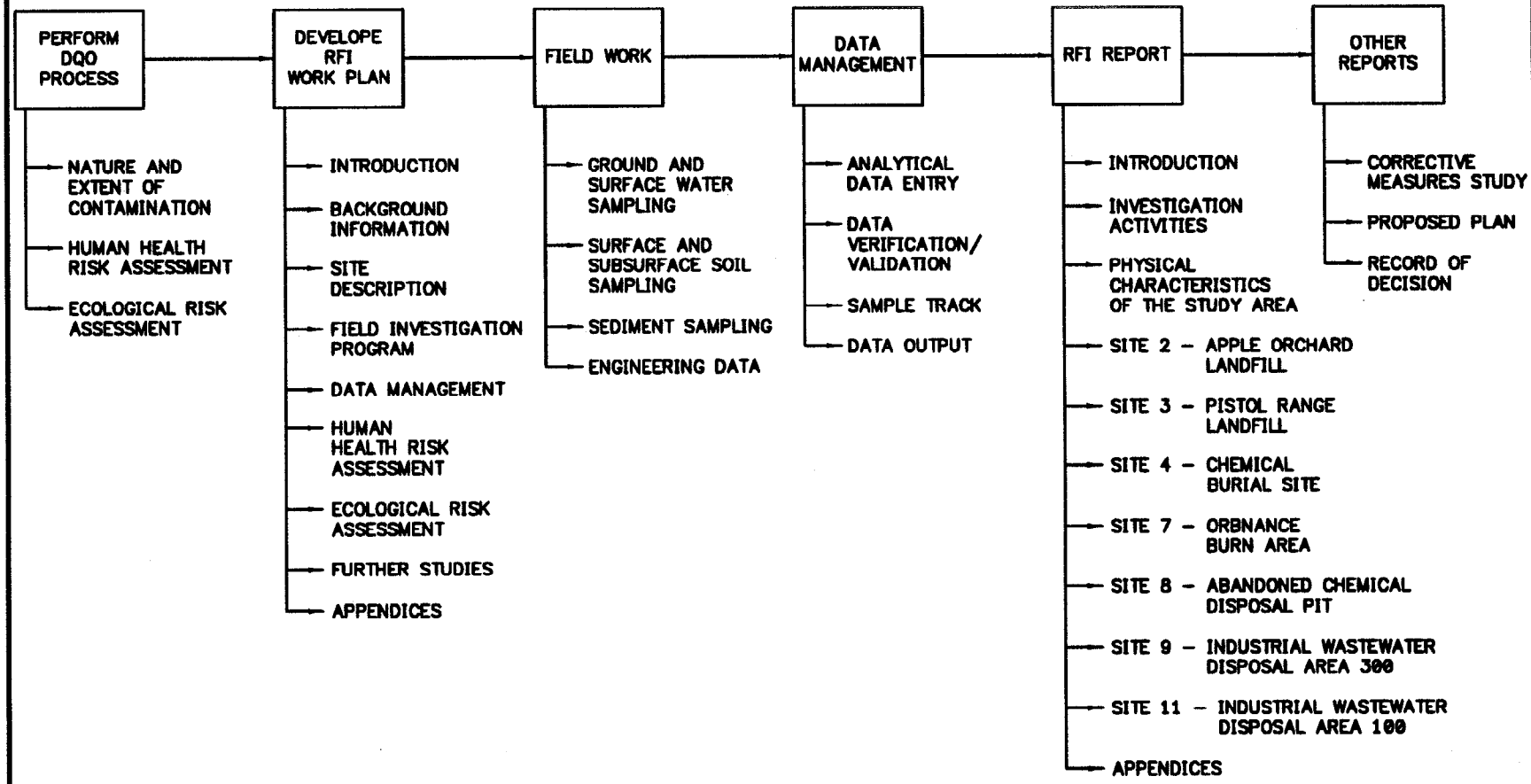

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CHECKED BY DATE	RFI PROCESS DIAGRAM NSWC WHITE OAK SILVER SPRINGS, MARYLAND	APPROVED BY DATE	
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After the field work is completed, the next task is data management which includes sample tracking, sample analysis, data entry, data verification and validation, and data output. An RFI Report shall then be prepared to provide the results of the field study, identify any site contaminants that exceed regulatory standards, and define an unacceptable risk from a human health and ecological perspective. If the RFI Report identifies an unacceptable risk, a CMS will be initiated to evaluate remedial alternatives (RA) for those sites posing an unacceptable risk. The RAs will comply with applicable standards for human health and the environment discussed in the Master WP (B&R Environmental, 1998).

Following release of the CMS, a Proposed Plan (PP) will be issued that outlines the alternatives and makes a recommendation. A public meeting shall be held to provide the community an opportunity to learn more about the site and the proposed action and to provide input before the RA is finalized. After evaluating public comments, a ROD will be issued that specifies the remedial action to be taken.

1.3 REGULATORY OBJECTIVES

Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), required that Federal facility remedial actions be protective of human health and the environment and be relevant and appropriate under the circumstances.

According to U.S. Environmental Protection Agency (USEPA) interim guidance on ARARs (USEPA, 1988a) and proposed revisions to the NCP (USEPA, 1988b) a requirement may be either "applicable" or "relevant and appropriate" to a remedial action, but not both. These terms are defined in the CERCLA Compliance With Other Laws Manual (USEPA, 1988c) as:

- Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the Superfund site.

- Relevant and appropriate requirements, like applicable requirements, are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law. While not technically applicable to a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a Superfund site, relevant and appropriate requirements address problems or situations similar to those encountered at a Superfund site so that their use is well-suited.

ARARs are requirements, criteria, or limitations promulgated under Federal or state law that address a pollutant, action, location, or other circumstance at a site. USEPA guidance offers the following illustrative categories of ARARs:

- Ambient or chemical-specific requirements -- These set health- or risk-based concentration (RBC) limits or ranges for specific substances in various environmental media (e.g., Maximum Contaminant Levels [MCLs] for public drinking water, National Ambient Air Quality Standards [NAAQS] for air quality). If a given chemical has more than one such requirement, the more stringent ARAR should be complied with. Because relatively few chemicals are covered by such pre-established requirements, USEPA's ARAR guidance stipulates that it may frequently be necessary to turn to chemical-specific advisory levels, such as a carcinogenic potency factor or reference doses, to establish cleanup standards.

- Performance, design, or other action-specific requirements -- These set controls or restrictions on particular kinds of activities related to the management of hazardous substances (e.g., Clean Water Act [CWA] pretreatment standards for discharges to publicly owned treatment works [POTW], Resource Conservation and Recovery Act [RCRA] standards for design and operation of hazardous waste management facilities).

  These requirements are not chemical-specific, but rather are specific to given remedial actions. However, they may specify levels for residual or discharged chemical concentrations (or methods for establishing those levels).

- Location requirements -- These set restrictions on activities, depending on characteristics of the site or its immediate environs (e.g., Federal and State siting laws, 100-year floodplain ordinances).

Onsite CERCLA remedial actions are required to comply with the substantive aspects of ARARs, not with administrative aspects, such as obtaining onsite permits. The RFI/CMS, PP, ROD, and design documents for a site should demonstrate full compliance with all substantive ARARs.

1.3.1 Nature and Extent of Contamination

Contaminant concentrations in NSWC-White Oak surface water, sediment, and surface soil will be compared to EPA Region III Biological Technical Assistance Group (BTAG) criteria as presented in Table 3-1 of the Master WP (B&R Environmental, 1998). Groundwater contaminant concentrations will be compared to the Federal Ambient Water Quality Criteria (AWQC) also presented in Table 3-1 of the

Master WP (B&R Environmental, 1998). If the screening criteria is not exceeded, then the limits of the study area will not extend any further. However, if the criteria is exceeded, then the study area will be expanded until the extent of contamination is fully delineated.

1.3.2 Human Health Risk Assessment

Residential USEPA Region III RBCs (USEPA, 1998) and site-specific generic Soil Screening Levels (SSL) (USEPA, 1996a) will be used as guidelines for comparison to contaminant concentrations in NSWC-White Oak media. If the maximum detected concentrations of contaminants in the various media exceed their respective screening levels, they will be retained as potential constituents of concern (PCOCs). A prevalence of these PCOCs and a comparison to their background concentrations will also be considered to determine if these contaminants should be evaluated in the HHRA. Risks associated with exposure to these PCOCs will be evaluated in accordance with USEPA's Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989a) and associated supplemental guidance. USEPA's target risk range of 10^{-4} to 10^{-6} (depending on specific use scenarios) and a hazard index of one are used as benchmarks to determine if risk management alternatives should be evaluated.

1.3.3 Ecological Risk Assessment

USEPA Region III BTAG screening levels (USEPA, 1995a) will be used as guidelines for comparison to contaminant concentrations in NSWC-White Oak surface water, sediment, and surface soil for the ERA. Groundwater contaminant concentrations will be compared to AWQCs. If the maximum detected concentrations of contaminants in these media exceed Region III BTAG screening levels, they will be retained as PCOCs. PCOCs will be included in foodchain models where their calculated intake doses for representative ecological receptors will be compared to published toxicity data, including no-observed-adverse-effects-levels (NOAELs) and lowest-observed-adverse-effects-level (LOAELs). Contaminants whose doses exceed NOAELs using maximum input concentrations will be evaluated using risk management considerations, including frequency of detection, number of exceedances, location of exceedances, magnitude of exceedances, comparison to background, comparison to alternate guidelines, and presumptive remedial alternatives.

1.3.4 Additional Regulatory Drivers

Several preliminary remedial actions have been identified for NSWC-White Oak. Certain ARARs may set controls or restrictions on particular activities included in these remedial actions. The more relevant ones under the current investigation include the following.

Excavation/Offsite Disposal of Soils

- RCRA landfill standards (COMAR 26.13.05.14, Maryland Code 9-209 et seq.)
- Hazardous waste transport requirements (Maryland Code 7-253, and 49 CFR Part 107 and § 171.1-172.558)
- Soil, debris, and sludge deposit requirements
- RCRA manifest requirements (COMAR 26.13)
- CERCLA offsite policy
- Toxic Substances Control Act (TSCA) requirements for PCB disposal
- RCRA standards for tanks and/or containers (COMAR 26.13)
- Radiation protection criteria for cleanup of land and facilities contaminated with residual radioactive materials; in development
- RCRA Land Disposal Restrictions (LDR) (40 CFR Part 268)
- Occupational Safety and Health Administration (OSHA) standards for remedial activities
- Maryland Regulations for the Control and Abatement of Air Pollution (COMAR 26.11)
- Maryland Solid Waste Management Regulations (COMAR 26.04.07)
- Maryland Sediment and Erosion Control Regulations (COMAR 26.17)

Incineration of Soils/Sediment

- RCRA LDRs (40 CFR Part 268)
- RCRA incinerator standards (COMAR 26.11.08, 26.13.05, and 26.13.07)
- RCRA landfill standards (disposal of ash)
- OSHA standards of remedial activities
- Maryland Regulations for the Control and Abatement of Air Pollution (COMAR 26.11)

Capping of Soils

- RCRA closure/post closure standards for Treatment, Storage, and Disposal Facilities (TSDFs) (COMAR 26.13.05)
- RCRA groundwater monitoring (COMAR 26.13.05.06)
- OSHA standards of remedial activities

Excavation/Onsite Treatment of Soils and/or Sediment

- RCRA standards of containers/tanks (COMAR 26.13.05.10)
- OSHA standards for remedial activities

- RCRA landfill standards (for disposal of residues) (COMAR 26.13.05.14; Maryland Code 9-209 et seq.)
- RCRA LDRs (for disposal of residues) (40 CFR Part 268)
- TSCA requirements for PCBs
- Dredge and fill regulations
- Radiation protection criteria for cleanup
- Soil, debris, and sludge deposit requirements
- Maryland Water Protection Permit Regulations (COMAR 26.08.04)
- Maryland Regulations for the Control and Abatement of Air Pollution (COMAR 26.11)

Groundwater Collection and Treatment

- RCRA standards for tanks (COMAR 26.13.05.10)
- RCRA standards for disposal (treatment residue)
- National Pollutant Discharge Elimination System (NPDES) discharge requirements (if discharged directly)
- Maryland General Discharge Permit Program discharge requirements (COMAR 26.08.04.08)
- Pretreatment standards (if discharged to POTW)
- OSHA standards of remedial activities
- RCRA LDRs (treatment residue) (40 CFR Part 268)
- Maryland Water Protection Permit Regulations (COMAR 26.08.04) (Note: Remedial actions need to comply with only the substantive aspects of ARARs and not the administrative aspects. No actual permits are required.)

In addition to the ARARs identified above, any activity associated with the selected remedial action that constitutes land disturbance will be performed in accordance with the Maryland Stormwater Management Regulations (COMAR 26.09.02). The local stormwater management and sediment erosion control programs administered by the Prince George's County Department of Planning and Code Compliance should also be consulted.

1.3.5 Waivers from ARARs

An ARAR may be waived under certain conditions, provided that human health and the environment are protected. CERCLA Section 121 provides that a remedial action that does not attain a level of control at least equivalent to an ARAR can still be selected if:

- It is only part of a total remedial action that will attain such level or standard of control when completed.
- Compliance with the ARAR at the given site will result in greater risk to human health and the environment than alternative options.
- Compliance with such requirements is technically impracticable from an engineering perspective.
- The remedial action will attain a standard of performance equivalent to that required by the ARAR through use of another method or approach.
- The ARAR in question is a state standard, and the state has not consistently applied (or demonstrated the intention to consistently apply) the ARAR in similar circumstances at other sites.
- In meeting the ARAR, the selected remedial action will not provide a balance between the need for protection of public health and welfare and the environment at the site and the availability of Superfund monies to respond to other sites, "taking into consideration the relative immediacy of such threats" (Public Law 99-499, Section 12(d)).

1.4 PROJECT ORGANIZATION

The project organization will conform with the layout illustrated in Figure 1-4. The Project Manager will be Ronald Kotun and he will oversee all tasks from start to completion. Scott Nesbit acts as the Project Coordinator for all work performed by B&R Environmental at NSWC-White Oak and he shall assist the Project Manager on all technical issues. Paul Frank will provide project technical support to the Project Coordinator as well as the HHRA, ERA, site characterization and field work, and data management. Ronald Kotun will be responsible for completing the HHRA. The HHRA will consist of HHRA screening, exposure assessment, toxicity assessment, uncertainty analysis, and human health risk characterization. The ERA will be completed by Kent Cubbage and include ERA screening, exposure assessment, problem formulation, measurement endpoints, study design, and risk characterization. Terry Rojahn will oversee

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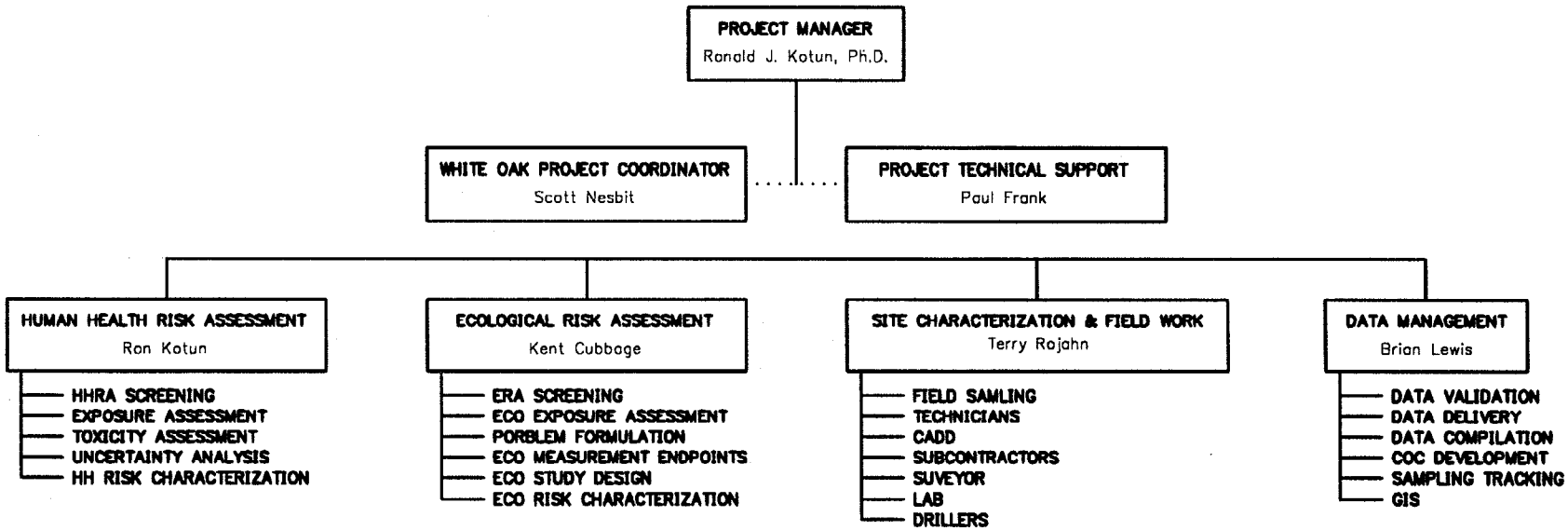

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the site characterization and field work. These tasks include all field sampling and coordinating with technicians, CADD, and subcontractors such as the surveyor, laboratories, and drillers. Brian Lewis will provide the lead on data management. These tasks include data validation, data delivery, data compilation, Chain of Custody (COC) development, sample tracking, and Geographic Information System (GIS) updating.

1.5 PROJECT SCHEDULE

The proposed schedule for CTO 298 NSWC-White Oak is illustrated in Figure 1-5. The proposed schedule is preliminary and subject to change. Based on the schedule, the investigation and characterization of the seven sites at NSWC-White Oak began in November of 1997 with WP development and will be completed in November of 1999. It should be noted that durations shown on this schedule are working days.

Upon completion and approval of the WP, field work activities will commence and last for approximately 50 days. These activities include surface water/sediment sampling, surface/subsurface soil sampling, monitoring well installation, groundwater sampling, water level measurements, azimuthal resistivity survey, EM31 survey, and radiological sampling. Preparation of the RFI Report is anticipated to last approximately five months. The CMS and PP will be completed concurrently with a proposed duration of five months. The ROD is expected to be completed within six months following completion of the PP.

1.6 WORK PLAN REPORT ORGANIZATION

Section 1.0 of the Work Plan contains this brief introduction and a discussion of the project scope and regulatory objectives. Section 2.0 presents information relating to the NSWC-White Oak facility setting and physical characteristics. Section 3.0 provides detailed information for the seven sites to be investigated under this RFI, including a summary of previous investigations and findings. Section 4.0 outlines the field investigation program. Section 5.0 presents the data management plan for this project. Sections 6.0 and 7.0 present the procedures to be followed for the HHRA and ERA, respectively. Section 8.0 outlines additional RFI/CMS objectives. The Master WP, Master Field Sampling Plan (FSP), and Master Quality Assurance Project Plan (QAPP) developed for NSWC-White Oak will be utilized to the maximum extent possible in the performance of this work (B&R Environmental, 1998).

In support of the information presented in this report, the following appendices are provided. Appendix A provides a discussion of the DQO process and identifies the specific DQOs for the HHRA, ERA, and NEC. Appendix B provides DQO statistics. Appendix C provides the Health and Safety Plan (HASP) for the

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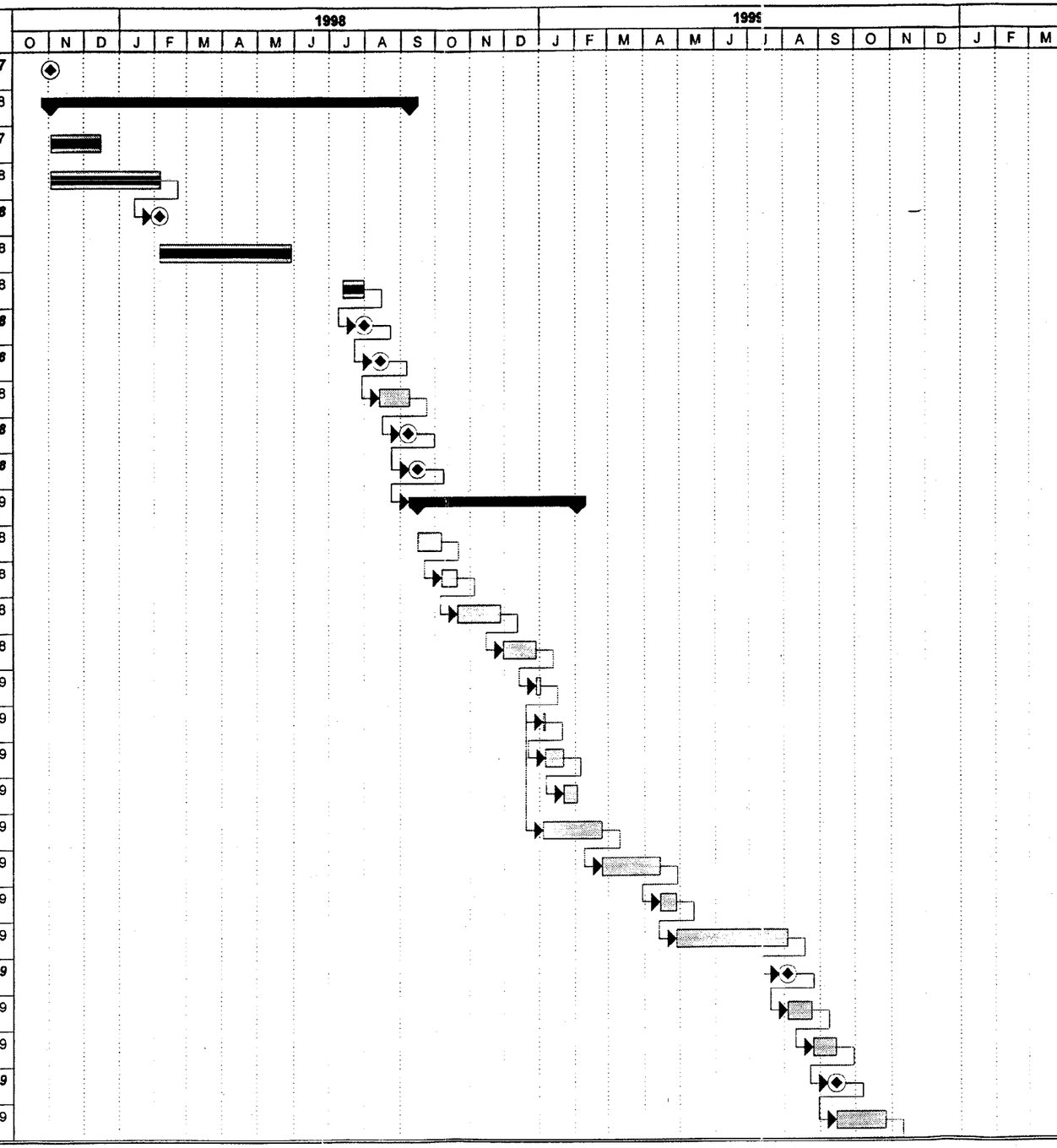
FIGURE 1.5
CTO 298 PROPOSED SCHEDULE
NSWC - WHITE OAK, SILVER SPRING, MD

Task Name	Start	Finish
Authorization to Proceed	***11/3/97***	***11/3/97***
RI/FS Work Plans	11/3/97	9/8/98
Review Existing Data	11/3/97	12/15/97
Prepare Draft Work Plan	11/3/97	2/6/98
Submit Draft Work Plan	***2/6/98***	***2/6/98***
Government Review	2/6/98	5/29/98
Prepare Response to Comments	7/13/98	7/31/98
Submit Response to Comments	***7/31/98***	***7/31/98***
Approval of Response to Comments	***8/14/98***	***8/14/98***
Prepare Final Work Plan	8/14/98	9/8/98
Submit Final Work Plan	***9/8/98***	***9/8/98***
Authorization to Proceed with Fieldwork	***9/15/98***	***9/15/98***
Fieldwork	9/16/98	2/2/99
Mobilization	9/16/98	10/6/98
Soil Sampling	10/7/98	10/20/98
Well Installation	10/21/98	11/27/98
GW Sampling	11/30/98	12/28/98
SW/Sediment Sampling	12/29/98	1/1/99
Ecological Sampling	1/4/99	1/5/99
Misc. Hydrogeology	1/6/99	1/21/99
Demobilization	1/22/99	2/2/99
Laboratory Analysis	1/4/99	2/23/99
Data Validation	2/24/99	4/13/99
Statistical Analysis	4/14/99	4/27/99
Prepare Draft RFI Report	4/28/99	8/3/99
Submit Draft RFI Report	***8/3/99***	***8/3/99***
Navy Review Draft RFI Report	8/4/99	8/24/99
Prepare Pre-Final RFI Report	8/26/99	9/14/99
ubmit Pre-Final RFI Report	***9/14/99***	***9/14/99***
Government Review Pre-Final RFI Report	9/15/99	10/26/99



Project Manager: R. KOTUN
Date: 8/25/98

Task | Progress | Milestone | Summary

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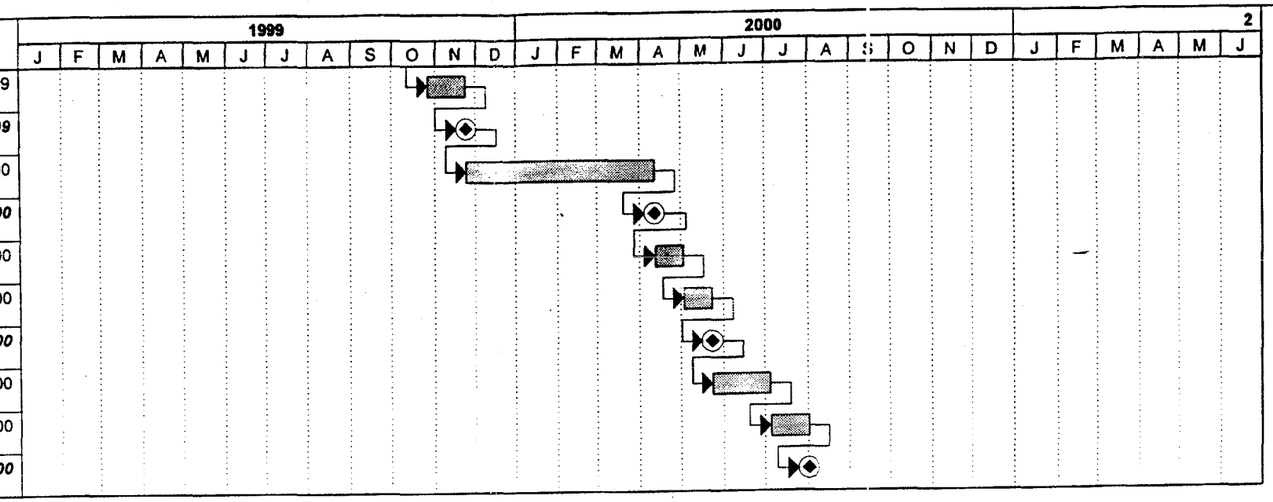
FIGURE 1.5
CTO 298 PROPOSED SCHEDULE
NSWC - WHITE OAK, SILVER SPRING, MD

Task Name	Start	Finish
Prepare Final RFI Report	10/27/99	11/23/99
Submit Final RFI Report	***11/23/99***	***11/23/99***
Prepare Draft CMS Report	11/24/99	4/11/00
Submit Draft CMS Report	***4/11/00***	***4/11/00***
Navy Review CMS Report	4/12/00	5/2/00
Prepare Pre-Final CMS Report	5/3/00	5/23/00
Submit Pre-Final CMS Report	***5/23/00***	***5/23/00***
Government Review Pre-Final CMS Report	5/24/00	7/4/00
Prepare Final CMS Report	7/5/00	8/1/00
Submit Final CMS Report	***8/1/00***	***8/1/00***



Project Manager: R. KOTUN
Date: 8/25/98

Task | Progress | Milestone | Summary

project. Appendices D through K provide data for studies associated with sites 2, 3, 4, 7, 8, 9, 11, and background, respectively. Appendix L provides a preliminary Table of Contents for the RFI report.

2.0 FACILITY SETTING AND PHYSICAL CHARACTERISTICS

2.1 BASE HISTORY

NSWC-White Oak was originally established in 1944 as the Naval Ordnance Laboratory (NOL), with a mission to carry out research on military guns and explosives. Throughout the years, the mission was expanded to include research involving torpedoes, mines, and projectiles. In September 1974, NOL combined with the Naval Weapons Laboratory, Dahlgren, Virginia, to become the Naval Surface Weapons Center, which was renamed the Naval Surface Warfare Center, Dahlgren Division, in 1988. Since that time, it has functioned as the principal Navy Research, Development, Test, and Evaluation Center for surface warfare weapon systems, ordnance technology, strategic systems, and underwater weapons systems.

NSWC-White Oak was identified as a Base Realignment and Closure (BRAC) facility and was closed in 1997, with the property transferred to the General Services Administration (GSA) and to the U.S. Army. GSA and the local redevelopment authority are currently investigating plans for the reuse and development of the NSWC-White Oak property.

2.2 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Several investigations have been completed at NSWC-White Oak over the last 14 years. The work related to previous studies and investigations is outlined below in chronological order.

2.2.1 Initial Assessment Study

Site investigation activities related to areas of potential environmental concern have been undertaken at the facility since approximately 1983. Preliminary work included an Initial Assessment Study (IAS) conducted by the Naval Energy and Environmental Support Activity (NEESA, 1984). Through the study, 14 Installation Restoration Program (IRP) sites at which hazardous materials were reportedly disposed or spilled were investigated to determine if a potential threat to human health and the environment was present and warranted any further examination. The study evaluated historic documentation and site operational data in the development of a score (quantifiable ranking of site hazards) for each site. From this study, the following seven sites were recommended for additional study:

Site 2 - Apply Orchard Landfill
Site 3 - Pistol Range Landfill

Site 4 - Chemical Burial Site

Site 7 - Ordnance Burn Area

Site 8 - Abandoned Chemical Disposal Pit

Site 9 - Industrial Wastewater Disposal from "300" Area

Site 11 - Industrial Wastewater Disposal from "100" Area

2.2.2 Confirmation Study

The Confirmation Study, Verification Phase for the NSWC, White Oak was conducted in September 1985 by Malcolm-Pirnie (Malcolm-Pirnie, 1987). The study was conducted to confirm the findings of the IAS and to obtain additional information in characterizing site hazards. The study involved the placement of 36 groundwater monitoring wells adjacent to sites being investigated (ranging in depth from 20 to 70 feet), placement of 54 soil borings in areas of suspected soil contamination (ranging in depth from surface to 5 feet), a geophysical survey at Site 8 in an attempt to locate the former waste disposal area, and the collection of soil, surface water, groundwater, and sediment samples to characterize site contaminants. Site contamination was found in surface and subsurface soil, stream sediments, and groundwater. The study concluded that sufficient contamination existed to warrant additional study.

2.2.3 RCRA Facility Assessment

In accordance with the Code of Maryland Regulations, COMAR Title 26, hazardous waste generators that store hazardous waste for longer than 90 days are required to obtain a permit as a Treatment, Storage, and Disposal Facility (TSDF). Additionally, under the provisions of the Hazardous and Solid Waste Amendments (HSWA) to RCRA, TSDFs seeking final permits are required to initiate corrective actions for releases of hazardous wastes or constituents from Solid Waste Management Units (SWMUs). NSWC-White Oak operates under an interim status for onsite storage of hazardous waste. An application for a final (Part B) permit was first submitted in 1985, with subsequent resubmissions and modifications. The most recent permit application was submitted in 1992.

Following the submission of the revised RCRA Part B permit application in 1988, a RCRA Facility Assessment (RFA) was conducted by a contractor for the USEPA in November 1990 (Kearney/Centaur Division, 1990). The RFA identified 97 SWMUs and 19 Areas of Concern (AOCs) at NSWC-White Oak. All 14 of the IRP sites identified in the IAS were also identified as SWMUs or AOCs. In the RFA report, 40 SWMUs were recommended for a RCRA Facility Investigation (RFI), which would assess the presence and migration PCOCs. Fifteen SWMUs and AOCs were recommended for verification sampling, which would provide information on whether the SWMUs or AOCs required no further action or an RFI. Eight SWMUs and AOCs were recommended for integrity assessment with results of this assessment leading to

a recommendation of no further action or an RFI. SWMUs 1 (IRP Site 2), 2 (IRP Site 3), 4 (IRP Site 4), 5 (IRP Site 8), 10 through 19 (IRP Site 11), 23 through 28 (IRP Site 9), and 31 (IRP Site 7) are being investigated and, as necessary, remediated under the IRP. Of the SWMUs and AOCs not being investigated under the IRP, the RFA indicated that the following would be of greatest concern:

- SWMU 3 (IRP Site 1) - Parking Lot Landfill
- SWMUs 8, 9, 20 through 22 (IRP Site 12), 29, 30, 35, and 45 - former leaching wells and drain fields
- SWMU 87 - scrap pile within 50 ft of Paint Branch Creek
- SWMUs 50, 51, and 76 - liquid storage with no secondary containment
- SWMUs 58, 72, and 76 - stained concrete or asphalt

In September 1992, Malcolm-Pirnie completed an RFA review for the Navy, which evaluated the applicability of the general recommendations of the RFA to the individual SWMUs. Generally, for those SWMUs which were being investigated under the IRP, it was concluded that the planned level of effort was sufficient to address potential impacts from those SWMUs. It was also concluded that some level of sampling would probably be required for most of the SWMUs and AOCs which were recommended for a RFI or verification sampling.

Investigations at several of the SWMUs and AOCs have been initiated. The BRAC Cleanup Team (BCT) is reviewing the SWMU and AOC list to assess the recommendations of the RFA. As indicated in a memorandum from the USEPA dated 11 March 1996, corrective action for the non-regulated units is being deferred to the BRAC program, which USEPA manages under CERCLA. Closure of RCRA-regulated units will be accomplished under Maryland Department of the Environment (MDE) requirements. Further investigation of these areas, and remediation as necessary, may be required in conjunction with the transfer of the Base property.

2.2.4 Remedial Investigation/Feasibility Study

A RFI was conducted in two phases at the site between January 1989 and March 1992 (Malcolm-Pirnie, 1992). The RFI was conducted to further characterize hazards associated with the previously identified sites and to aid in the development of remedial actions plans for each. The RFI involved the placement of additional groundwater monitoring wells at all sites, collection of surface and subsurface soil, sediment, surface water, and groundwater samples throughout the areas of investigation, collection of ecological data at all sites, performance of ground penetrating radar surveys at Sites 4 and 8, completion of soil gas surveys at Sites 2, 3, 9, and 11, and completion of slug tests and aquifer pumping tests at Site 11.

The results of the RFI confirmed the presence of contamination at all sites. The analytical data was then used in the calculation of risk, based on relevant groundwater use for all seven sites. The calculated risks were determined to be high enough to support the development of a CMS for the sites as described below.

A draft CMS was completed by Malcolm-Pirnie in March 1993 (Malcolm-Pirnie, 1993) and outlined the proposed remedial strategies for the facility. The CMS evaluated the previous site characterization data to determine the most effective means to reduce environmental hazards at NSWC-White Oak.

2.2.5 Design Verification Study

The Design Verification Sampling and Analysis Plan (DVSAP) was submitted in January 1995 (B&R Environmental, 1995a). B&R Environmental was retained by Engineering Field Activity Chesapeake (EFACHES) to prepare remedial designs for Sites 2, 3, 4, 8, 9, and 11. After performing a review of previous documentation, field visits, and discussions with personnel from NSWC-White Oak, EFACHES, and the United States Geological Survey (USGS), B&R Environmental determined that while the available data may have been sufficient for the purposes of the RFI/CMS, it was insufficient for design purposes for several reasons. Of particular concern was the uncertainty that existed with respect to quantities requiring remediation. It appeared that the extent of contamination was not completely characterized at some sites, and the depth of contamination was not ascertained. It also appeared that inconsistencies existed in the information prepared to date which would critically impact the costs of remedies, for example, the area used for Site 2 - Apple Orchard Landfill. It was determined that these issues must be addressed to facilitate the preparation of focused, cost-effective remedies. Accordingly, the DVSAP was developed.

Activities associated with the Design Verification Study included record reviews, terrain conductivity surveys, test pit placement, and subsurface soil and sediment sampling. The results of the activities were then used to develop remedial design plans for the six IRP sites. Two reports were issued addressing the various findings of the study a final report for Sites 8, 9, and 11 (B&R Environmental, 1995a), and a draft report for Sites 2, 3, 4, and 9 (B&R Environmental, 1995b).

2.2.6 Environmental Baseline Survey

The Defense Base Closure and Realignment Act of 1990 (BRAC II) directed the Secretary of Defense to close or realign those installations recommended by the BRAC commission. The Community Environmental Response Facilitation Act (CERFA) of 1992 directed Federal agencies with jurisdiction over real property to terminate Federal government operations and to identify "uncontaminated" parcels of the real property. In 1995, NSWC-White Oak was selected for closure on the BRAC IV list. A Phase I

Environmental Baseline Survey (EBS) was conducted by EA Engineering Science and Technology (EA) to assess the existing environmental information related to storage, release, treatment, or disposal of hazardous substances or petroleum products and to document the environmental condition of the property. The EBS also addressed actions required prior to property transfer to ensure compliance with requirements of CERCLA 120(h), applicable State and real estate laws, compliance programs, and the Department of Defense (DOD) policy *Environmental Requirements for Federal Agency-to-Agency Property Transfer at BRAC Installations* (DOD, 1995). The EBS was finalized and submitted in April 1996 (EA, 1996).

As per the EBS requirements, a search was conducted in order to procure one aerial photograph of the Base and vicinity per 10 year interval. The aerial photographs were purchased from Air Photographics, the U.S. Department of Agriculture (USDA), and the National Archives. Aerial photographs with the following dates were reviewed during the completion of EBS:

- 19 January 1993
- September 1987
- May 1986
- 1 September 1970
- 10 October 1963
- July 1957
- 31 May 1937

The aerial photographic review was conducted by EA project staff familiar with aerial photographic interpretation. NSWC-White Oak and properties surrounding the Base were analyzed. The conditions observed in each photograph, including property boundaries, roads, the presence of commercial and residential adjacent properties, and undeveloped land, were noted in each photograph. Environmental conditions such as the presence of landfills, dumps, or large areas of undeveloped, cleared land were also noted and included in the EBS report.

2.2.7 Source Removal Action - Sites 8, 9, and 11

Source removal activities were completed at Sites 8, 9, and 11 during 1996 to address contaminant sources which may be impacting groundwater resources at NSWC-White Oak. The activities included the excavation and offsite disposal of waste and contaminated media from these sites in conjunction with the findings of the Design Verification Study. The activities included the removal of buried waste materials from Site 8, the removal of two leaching wells from Site 9, and the removal of five leaching wells from

Site 11. Subsurface soil sampling was performed following the completion of waste removal activities in an attempt to verify the removal of contaminated soil.

2.2.8 Groundwater and Background Investigation

A facility-wide groundwater investigation was competed in the spring/summer of 1997. The investigation included the sampling of all existing groundwater monitoring wells and piezometers, and the installation and sampling of new temporary and permanent groundwater monitoring wells in areas proposed for reuse. The groundwater quality was similar to that found during previous studies. An investigation to characterize background soil, sediment, groundwater, and surface water quality was performed in the fall of 1997. A final report is being developed and will be used in the future to evaluate data generated during environmental investigations at NSWC-White Oak.

2.2.9 BRAC Cleanup Plan

The BRAC Cleanup Plan (BCP) was finalized in May 1997 (EFACHES, 1997). It contains the status, management plan, response strategy, and action items related to ongoing environmental restoration and compliance programs at NSWC-White Oak. The scope of the BCP considers BRAC policy, National Environmental Policy Act (NEPA), CERCLA; Comprehensive Environmental Response Facilitation Act (CERFA), RCRA, and other applicable environmental laws.

2.2.10 Natural Resources Plan

A Natural Resources Management Plan (NRMP) was prepared for NSWC-White Oak to plan, record, and assist in the management and conservation of natural resources in an integrated manner within he framework of the mission of the facility (EFACHES, 1995).

The plan was prepared in September 1995 and is a ten-year planning document addressing the following programs:

- Land Management
- Forest Management
- Wildlife and Fisheries Management
- Cultural and Historical Management
- Outdoor Recreation Management

2.2.11 Wetlands and Sensitive Habitats

Wetland mapping was compiled by the University of Maryland College Park Coastal Research Lab as part of the National Wetlands Inventory. A National Wetlands Inventory map of NSWC-White Oak is included in the NRMP. The NRMP recommends that environmental personnel work closely with natural resources personnel when determining cleanup options at IRP sites.

No comprehensive survey for endangered animal species has been conducted at NSWC-White Oak, although no endangered species are known to exist at the facility. However, although with available habitat decreasing in the residential communities surrounding the facility, animal species are adapting to the habitats available at NSWC-White Oak. Wildlife found at the facility include frogs, toads, salamanders, a variety of songbirds, shrews, mice, voles, foxes, raccoons, skunks, deer, snakes, turtles, opossum, rabbits, squirrels, and weasels.

Although there are no known threatened or endangered species at the facility, there is a nesting program for the Eastern Bluebird, which was once a threatened species. The program consists of placing nesting boxes, and tracking data on eggs and hatchlings. An average of 70 percent of the boxes are utilized by the birds each year.

In conjunction with the ecological risk assessments planned for the IRP, a habitat evaluation will be conducted at NSWC-White Oak.

During 1995, in conjunction with the Design Verification Study, a wetlands delineation and forest stand inventory were conducted for Sites 2, 3, 4, 7, 8, 9, and 11. The delineation was performed in accordance with the delineation criteria in the 1987 U.S. Army Corps of Engineers (USCOE) Wetlands Delineation Manual (USCOE, 1987). Wetland areas were identified within or adjacent to five of the seven IRP sites investigated.

2.3 GENERAL BASE PHYSICAL CHARACTERISTICS

2.3.1 Physiography

NSWC-White Oak is located approximately four miles northeast of Washington, D.C. on the boundary between the Piedmont and Coastal Plain physiographic provinces. The facility lies in gently rolling terrain. The topographic expression of the area represents the result of a deeply incised, dendritic stream channel pattern. Local drainage patterns are dominated by Paint Branch Creek and its tributaries.

The highest elevation on the site is approximately 398 feet above mean sea level. The lowest elevation is roughly 145 feet above mean low water. The terrain of the western portion of the Base slopes generally eastward toward Paint Branch Creek with about 3.5 percent grade. Similar grades are encountered in the eastern portion of the facility, but slopes are more generally southward or are locally influenced by proximity to Paint Branch Creek and its tributary drainages. Near stream channels, the ground slopes increase to as much as 65 percent.

2.3.2 Climate

Summers at NSWC-White Oak are warm and humid, and winters are mild. Seasonal temperature variation is about 43°F. The warmest weather occurs in July, with daily temperatures ranging from 69°F to 88°F. The coldest weather occurs in late January and early February, with daily temperatures ranging from 28°F to 44°F. The average annual precipitation is approximately 44 inches. Seasonal variation in precipitation is not pronounced, gradually fluctuating between a typical minimum of 3 inches in February to a typical maximum of 5 inches in August. Snowfall accumulations of more than 10 inches are rare, with the greatest snowfalls occurring in January and February.

The mean annual wind speed varies between eight miles per hour in August and 11 miles per hour in March. The prevailing direction is from the south most of the year, except for northwesterly winds that occur during December, January, and March.

2.3.3 Surface Water Hydrology

NSWC-White Oak lies entirely within the drainage basin of Paint Branch, a 12 mile long tributary to the Northeast Branch of the Anacostia River. Like other streams in the region, Paint Branch is a gaining stream, as it is perennially supported by shallow ground water discharge from small springs and seeps along its length. Another perennial stream, West Farm Branch, flows through the eastern portion of the property. It originates approximately one mile to the north and joins Paint Branch just south of the property line.

In addition to perennial streams, the facility is traversed by eight intermittent streams, all of which discharge to Paint Branch either on or nearby the property or nearby. Several of these streams are very small and are not identified on USGS topographic maps.

2.3.4 Geology

NSWC-White Oak lies along the boundary between the Piedmont and Coastal Plain physiographic provinces. The boundary, known as the Fall Line, represents the contact between older Piedmont Plateau rocks to the west and the younger Atlantic Coastal Plain sedimentary units to the east. In the White Oak area the Fall Line extends from the southwest to the northeast and roughly parallels the Montgomery-Prince George's County line boundary. The topography of both provinces in the White Oak area is characterized by rolling hills with steeply eroded stream valleys.

Underlying NSWC-White Oak, unconsolidated sedimentary units of the Coastal Plain Province overlie fractured metamorphic and igneous rocks of the Piedmont Province. The Coastal Plain sediments include, in ascending order, the Potomac Group, the Upland Sand and Gravel, and undifferentiated Quaternary alluvial deposits. The Potomac Group is of Cretaceous age and consists of a sand, gravel, and silt unit and a clay unit. The Upland Sand and Gravel is of Tertiary age and consists of sand, gravel, and silt with clay lenses. The Coastal Plain sediments are less than a few tens of feet thick at the facility. Table 2-1 provides a list of generalized lithology from the Quarternary to Paleozoic periods.

The Piedmont bedrock extending below the Coastal Plain sediments consists of the Wissahickon Formation, a diamictite gneiss of late Precambrian age. The upper 50 to 70 feet of the Wissahickon Formation has weathered to an unconsolidated saprolite. The saprolite is a clayey material retaining the parent material structure. The Wissahickon Formation accounts for approximately 50 percent of the surficial geology at NSWC-White Oak. Bedrock outcrops of the Wissahickon gneiss occur along the Paint Branch Creek and another unnamed tributary in the central portion of the facility, due to the erosion of overlying sediments. The surficial geology of NSWC-White Oak is illustrated in Figure 2-1.

2.3.5 Soils

The facility soils, with the exception of stream-bed soils, tend to be moderately to excessively well drained and moderately to severely eroded. The soils generally fall within one of two major associations present in the vicinity; the Gleneig-Manor-Chester (GMC) Association and the Chillium-Beltsville-Croom (CBC) Association. The GMC Association is developed in materials weathered from Piedmont metamorphic rocks while the CBC Association is derived from Coastal Plain materials. Soils at the facility tend to be moderately acidic with a pH range ranging from 4 to 6 Standard Units (SUs) (USNOL, 1920). This may be due to the presence of hydroxyl, humic, and fulvic acids derived from the decay of organic matter.

TABLE 2-1

GENERALIZED LITHOLOGIC AND HYDROGEOLOGIC UNITS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 2

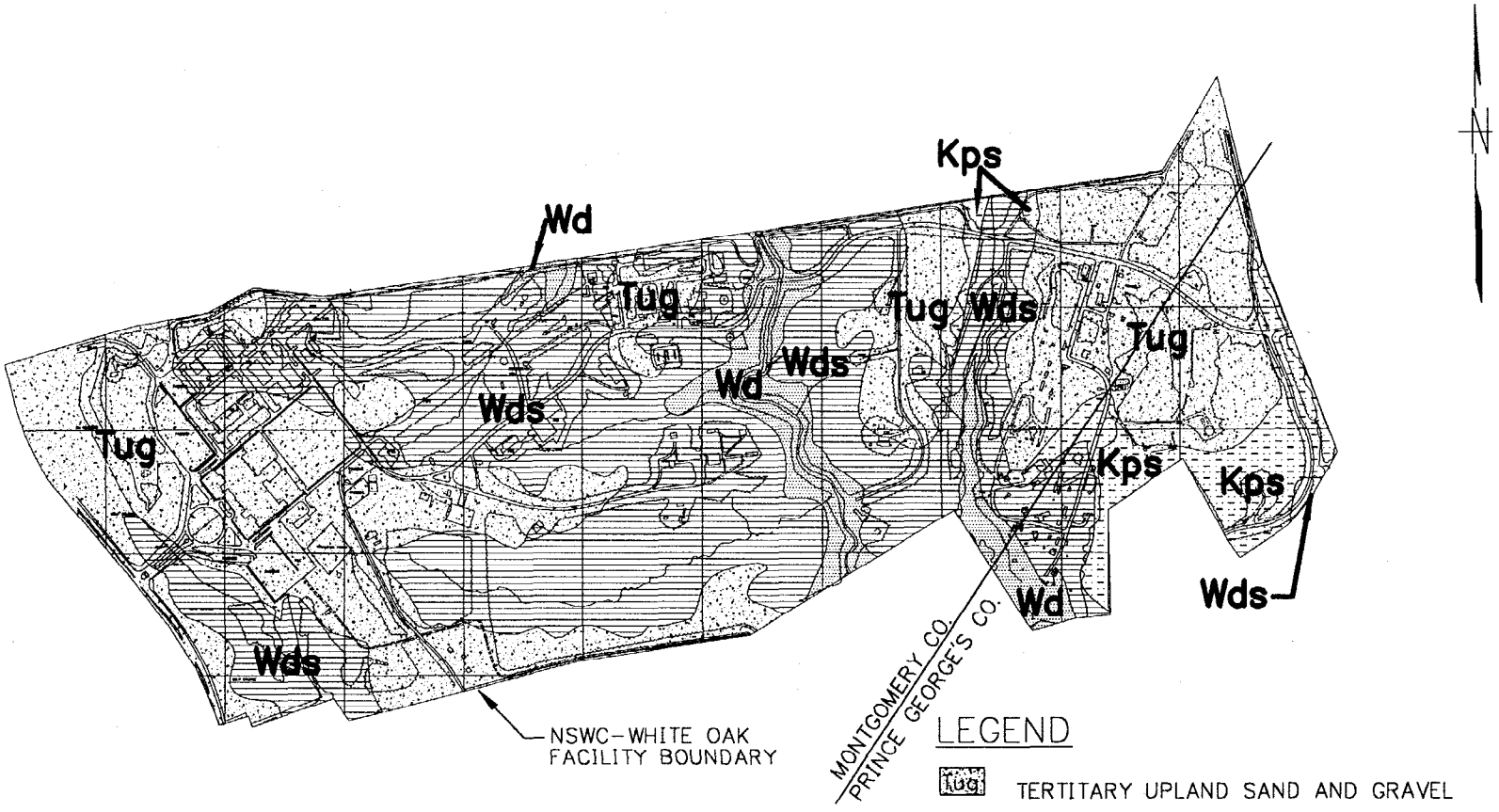
Period	Unit Name (Symbol)	Description
QUATERNARY (Q)	Alluvium (QAL)	Occurs along drainages. Material derived from surrounding rocks. Maximum thickness of 30 ft., average 10 ft. Quartz sand, well-sorted; micaceous, sticky, quartz and mica schist fragments and masses to several tons. USCS: SC-GC
	UNCONFORMITY	
	(Qt)	Occurs as a thin cover. Similar to QAL. USCS: GM, SC-GC, SW
	UNCONFORMITY	
	Upland Terrace Deposits (Qtu)	Caps hills in eastern part of quadrangle. Maximum thickness 30 ft. May be reworked gravels from the underlying Potomac Group. Predominantly sand, with some gravel and clay. Sand, fine to coarse, crossbedded, light-brown, contains quartz, quartzite; sandstone fragments or iron-cemented sand, and widely scattered schist pebbles. Clay, white, in thin beds and lenses. USCS: GM
TERTIARY (T)	Upland Sand and Gravel (Tug)	Formed as alluvial fans. Maximum thickness 60 ft. Possibly equivalent to Brandywine Formation of Pliocene(?) age. Gravel, sand, silt, and clay. Gravel consists of rounded to subangular white and pink quartz; white quartzite and quartzite conglomerate; fine-grained sandstone; rare chert pebbles. Maximum size of boulders is 1.5 ft. in diameter. Sand is subangular fine to medium fine quartz; contains mica flakes. Clay as beds and lenses: kaolinite 40-60%, illite 30-60%, montmorillinite 5-10%. Locally feldspar present in clay; some clay rich in organic matter. USCS: GM-GC, SW
CRETACEOUS (K)	UNCONFORMITY	
	Potomac Group Two components:	(Upper Potomac Group, Kpc, Clay Facies) Approximately 250 ft. thick. Clay, silt, sand, and gravel: Silty and sandy clay, stiff, hard, brick red, becoming drab near surface; kaolinite, 75-90%, remainder illite. Sand as extensive thin beds less than 5 ft. thick scattered through the formation. Lenses of black lignitic clay containing wood fragments, spores, leaf impressions, some pyrite crystals and sulfur bloom; iron as limonite and siderite; lignitic lenses are no more than 7 ft. thick, and 100 ft. long, and are scattered throughout the formation. Incipient east-trending joints in clay approximately 2 ft. apart (Withington, 1964). USCS: ML-CL
	(Kpc) Clay Facies	
	(Kps) Sand Facies	(Lower Potomac Group, Kps, Sand Facies) Maximum thickness 180 ft.; pinches out near Montgomery-Prince George's County line. Deposited unconformably on the metamorphic rocks by a south-flowing river system. Gravel, sand, silt, and clay; Gravel contains quartz and quartzite, as much as 10 ft. thick found at top of the formation. Sand, medium-fine to coarse, generally well sorted, light-brown; locally purple. USCS: GM, SM

TABLE 2-1

GENERALIZED LITHOLOGIC AND HYDROGEOLOGIC UNITS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 2

Period	Unit Name (Symbol)	Description
TRIASSIC (TRD)	UNCONFORMITY	
	Diabase Dikes (Trd)	A single dike approximately 10 ft. thick is in the northern part of the Beltsville Quadrangle.
	UNCONFORMITY	
	Quartz Veins (Q)	Approximately 20 ft. thick. White to clear, massive to shattered.
PRECAMBRIAN AND/OR PALEOZOIC (Ew)	Pegmatite Masses or Dikes (P)	Dikes as thick as 20 ft., in western part of Beltsville quadrangle. Coarse-grained quartz, feldspar, and mica. Maximum crystal size 7 in., scattered mica books as much as 4 in. in diameter.
	WISSAHICKON FORMATION Diamictite Gneiss Facies: Gneiss (Wd) and Saprolite on Gneiss (Wds)	Mica gneiss (Wd) metamorphosed from sedimentary rock. Contains subrounded quartz and rounded schist pebbles. Weathers to saprolite (Wds), a porous, spongy red-brown material that retains the structure of the original rock; grades upward to sticky, micaceous clay. Saprolite averages 15 ft. thick below Coastal Plain sediments, but may be as much as 100 ft. thick on uplands. Clay, gray, montmorillonite - red-brown above water table; some montmorillinite altering to kaolinite in oxidizing environment. Some saprolite and mixed layer clays. USCS: GM, SC, ML-CL, MH
	Pelitic Schist Facies: Schist (Wp) and Saprolite on Schist (Wps)	Quartz-mica schist (Wp), interbedded with metagraywacke and gneiss. Weathering features similar to those of gneiss. Saprolite may be as thick as 150 ft. on interstream uplands. USCS: ML-CL, MH, SC, GM

ACAD: K:\CADD\7687\7687CM07.DWG 01/04/98 MF



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0 1500 3000
SCALE IN FEET

LEGEND

- Tug — TERTITARY UPLAND SAND AND GRAVEL
- Kps — POTOMAC GROUP SAND AND GRAVEL
- Wds — SAPROLITE OF WISSAHICKON DIAMICTITE GNEISS
- Wd — WISSAHICKON DIAMICTITE GNEISS

DRAWN BY HJP DATE 6/23/97	Brown & Root Environmental	CONTRACT NO. 7687	OWNER NO. 0102
CHECKED BY DATE	SURFICIAL GEOLOGY MAP NSWC – WHITE OAK, SILVER SPRING, MARYLAND	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 2-1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

DRAFT
FEBRUARY 1998

2.3.6 Hydrogeology

Groundwater occurs in both unconfined and confined conditions under the facility. Based on the initial work by Malcolm-Pirnie (Malcolm-Pirnie, 1992), the groundwater at NSWC-White Oak occurs within both the Coastal Plain units and the Piedmont bedrock. Within the Coastal Plain units topography influences groundwater flow, which is from upland areas to lower elevations, discharging to streams or other surface water bodies. Generally, groundwater is unconfined within the Coastal Plain units or, in the northeastern part of the facility, may be perched by clay lenses. Within the Piedmont bedrock, fracturing controls groundwater flow. The saprolite acts as an aquifer or aquitard depending on the degree of remnant fracturing of the parent material. Groundwater is unconfined in the shallow bedrock if the saprolite exhibits remnant fracturing and confined if the saprolite does not exhibit remnant fracturing. Groundwater flow occurs under confined conditions at most sites. The Coastal Plain units and the shallow Piedmont bedrock may be hydraulically connected. Monitoring well locations at NSWC-White Oak are shown in Figure 2-2. Well construction information is provided in the previously referenced studies (Malcolm-Pirnie, 1987, 1992, and 1993; B&R Environmental, 1995a).

Based on aquifer tests conducted by Malcom-Pirnie, the estimated hydraulic conductivity of the Coastal Plain units ranges from 9.4×10^{-4} centimeters per second (cm/s) (2.66 feet/day) to 1.67×10^{-3} cm/s (4.73 feet/day). The hydraulic conductivity of the saprolite of the Piedmont bedrock ranges from 6.9×10^{-4} cm/s (1.96 feet/day) to 1.96×10^{-3} cm/s (5.56 feet/day).

2.4 DEMOGRAPHY AND LAND USE

The off-base land use in the vicinity of NSWC-White Oak is shown in Figure 2-3. The Base is located in a residential neighborhood and, as such, is surrounded mainly by residential properties. Commercial properties, including light industry, and another military research facility are also adjacent to NSWC-White Oak. To the north of the facility are commercial retail businesses, an office building, several apartment complexes, and a rock quarry. To the east is a commercial/industrial park and a single-family residential community. To the south is the Powder Mill Community Park, the U.S. Army Adelphi Laboratory Center (formerly known as Harry Diamond Laboratories), residential areas, and the Hillandale Company 12 Fire Department. To the west is New Hampshire Avenue and single-family residential development.

According to the 1990 census, the typical adult resident of White Oak is in his late 20s to 30s, college educated, married, with one child. Median household income exceeds $55,000. The 1991 median price for a single-family home was $200,000. The White Oak population's racial composition is 63 percent

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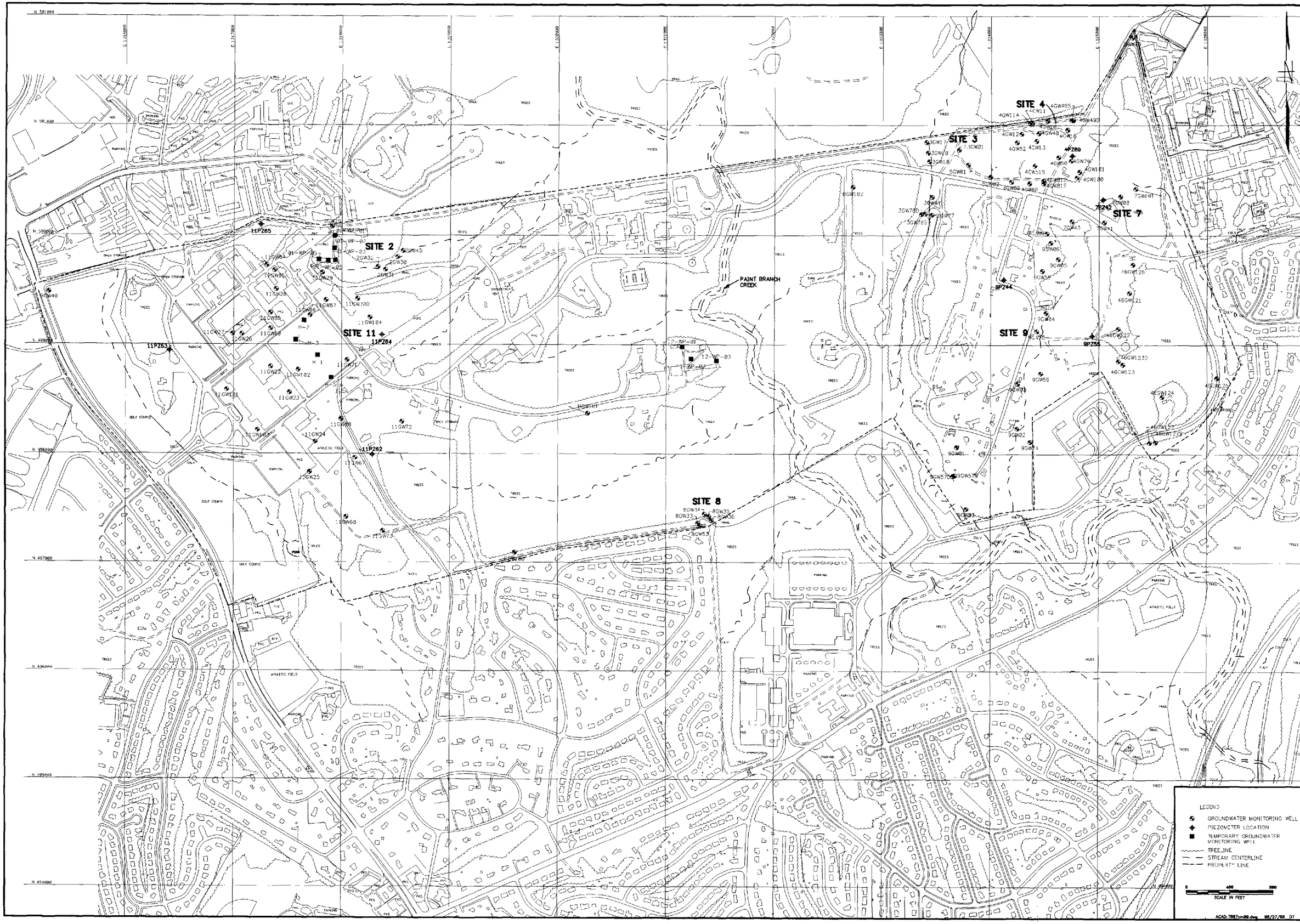


SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

09A	403		
04	404		
	405		
	408		
DATE	DATE	DATE	DATE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC
CHESAPEAKE DIVISION

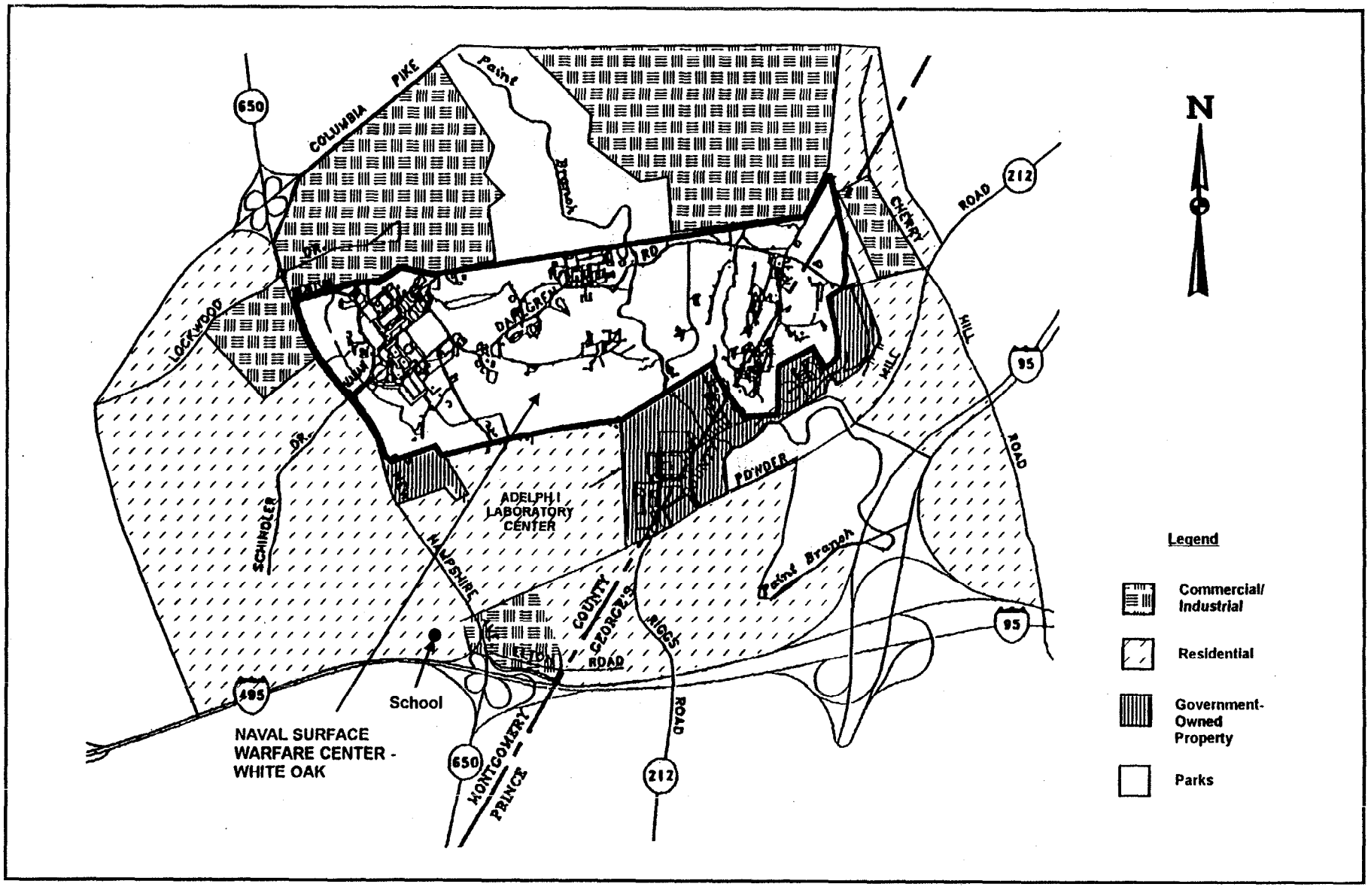
EXISTING GROUNDWATER MONITORING WELLS/ PIEZOMETERS, TEMPORARY MONITORING WELLS NSWC, WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
SPEC.
NAVFAC DRAWING NO.
SHEET OF
FIG. 2-2

SEAL AREA

DES. | DRN. | DATE | TITLE
SUBMITTED BY: | CHAC. | E.I.C. | 401
PROGRAM MANAGER | DATE | 402
APPROVED | DATE | DATE
CTD FOR COMMANDER NAVFAC

FIGURE 2-3
OFF-BASE LAND USE
NSWC-WHITE OAK, SILVER SPRING, MARYLAND



Source: EFACHES, 1997

white, 24 percent black, 10 percent Asian or Pacific Islander, and 3 percent other. People of Hispanic origin, who may be of any race, represent 6 percent of the area's population.

The major claimant for NSWC-White Oak was the Naval Sea Systems Command (NAVSEA). NSWC-White Oak housed four major tenants: NSWC-Dahlgren Division (the host command), NSWC-Indian Head Division, NSWC-Carderock Division, and Public Works Center (PWC) Washington.

There are approximately 300 buildings and facilities at NSWC-White Oak, ranging in area from 16 sq. ft. to greater than 130,000 sq. ft. The types of operations that had historically been located at NSWC-White Oak include: storage facilities (hazardous and non-hazardous materials), pesticide control shops, truck containment dikes (diked concrete pads for truck use when filling underground storage tanks), laboratories (research, photographic, printing, x-ray, plastics, explosives), test facilities (temperature, humidity, vibration, shock, pressure, corrosion, and explosives), drop towers, wind tunnels, transformer stations, boiler houses, wastewater treatment facilities, and offices. Also located at NSWC-White Oak was a small medical clinic, a fire department, residences for military personnel, and buffer areas required to separate Naval facilities and operations from the surrounding community. An NSWC employee organization had developed a nine-hole golf course on the western buffer area, which is now operated by the Montgomery County Parks Department.

Forty-eight acres in the southeastern portion of NSWC-White Oak were transferred to the U.S. Army, and the remaining property (662 acres) were transferred to the GSA in the Fall of 1997 and GSA is currently developing a reuse plan that identifies possible reuse scenarios for the parcels of land at the facility. However, it is planned that the U.S. Food and Drug Administration (USFDA) will use a parcel encompassing Site 11 and surrounding areas. Other government agencies have also expressed interest in using portions of the property. In addition, the GSA has begun discussions with private entities on possible public-private partnership, which could lead to development.

The U.S. Army owns property south of and adjacent to NSWC-White Oak which is used for research and development laboratories. The property that the U.S. Army has acquired will be used as a research and development site for atmospheric profiling, as well as providing a buffer area between the U.S. Army activities and GSA property.

The existing buildings at the facility were specifically designed to support military research and development operations. As future activities at the parcels are planned, structural improvements and/or renovations may be required.

A Memoranda of Agreement (MOA) prepared in 1997 defines the on-going responsibilities of the Navy and the transferees (the GSA and the Army) with regards to the transfer of the property (EFACHES, 1997). Most of these responsibilities are environmental in nature; however, some are not. While a MOA is not required for transfer of property between Federal agencies, the parties involved in the transfer of NSWC-White Oak decided that the document would be beneficial, since the Navy will be present after the Base is transferred to continue its environmental remediation.

2.5 ECOLOGY

2.5.1 Biological Resources

Vegetation communities on the facility have formed as a result of a variety of land uses, soil conditions, and slope. Former land uses such as gravel mining, building construction, landfilling, and logging have influenced the successionally stages and plant species of the site. This, in turn, has affected the animal communities on the facility. The physical environment of the facility is typical of the region. Thus, the vegetation communities and wildlife habitats onsite are representative of regional patterns.

2.5.2 Developed Areas

In developed areas, lawns consist of Kentucky Bluegrass, Red and Tall Fescue, Bermuda Grass, Red Clover, Korean Lespedeza, Annual Ryegrass, Zoysia Grass, and Crown Vetch. Weed species commonly found in these areas include White Clover, Yellow Wood Sorrel, Chickweed, Henbit, Ground Ivy, Wild Strawberry, Purslane, Spotted Spurge, Knotweed, Garlic, Mustard, Dandelion, Plantain, Crabgrass, Goosegrass, Foxtail, Knotweed, and Nut Sedge. Trees in developed areas consist of maples, oaks, elms, poplars, and dogwoods.

Amphibian species associated with developed areas include Chorus Frog and Fowler's Toad. Reptile species include Fence Lizard, Box Turtle, plus a variety of snakes, including Black Racer and Black Rat Snake. Bird species include Mourning Dove, European Starling, House Sparrow, Barn Swallow, Chimney Swift, Purple Martin, American Robin, Catbird, Brown Thrasher, Northern Mocking Bird, and Song Sparrow. Typical mammal species include opossum, Eastern Cottontail, Gray Squirrel, Red Fox, raccoon, and Striped Skunk.

Old field communities are found in abandoned areas. Vegetation found in these areas is determined by the length of time since abandonment. Pioneer species include Crabgrass and Horseweed. Mid-successional species are dominated by Goldenrod, White Aster, and Broomsedge. As succession

continues, pines will invade the area and if left undisturbed, the area will evolve into a pine, or pine-hardwood forested community.

Typical amphibian and reptile species inhabiting this community type include Fowlers and American Toads, Six-lined Racerunner Lizard, plus a variety of snakes, including Black Racer and Black Rat Snake. Bird species include Red-tailed Hawk, Bobwhite Quail, Mourning Dove, Eastern Bluebird, Yellow-breasted Chat, Eastern Meadowlark, Northern Cardinal, Rufous-sided Towhee, Savannah Sparrow, and Grasshopper Sparrow. Mammal species include opossum, Short-tailed Shrew, Least Shrew, Common Mole, Eastern Cottontail, White-footed Mouse, Meadow Mouse, Meadow Vole, Long-tailed Weasel, Striped Skunk, and Red Fox.

2.5.3 Scrub-Shrub Community

The scrub-shrub community represents a successional stage between an old field and forest community and is very diverse because it supports vegetation representative of both communities. Saplings characteristic of this community type include Loblolly Pine, Virginia Pine, Sweetgum, Eastern Red Cedar, and Black Locust. Other characteristic species include Japanese Honeysuckle, Persimmon, brambles, Poison Ivy, Trumpet Creeper, sumac, Virginia Creeper, and grape. The understory includes asters, goldenrods, Wild Onion, Strawberry, and Blackberry.

Typical amphibian species of this community type include Northern Cricket Frog, Northern Spring Pepper, American and Fowlers Toad, and Upland Chorus Frog. Reptiles characteristic of this habitat type include Eastern Mud Turtle, Box Turtle, Eastern Painted Turtle, and a variety of snakes, including Six-lined Racerunner, Northern Water Snake, Northern Black Racer, Black Rat Snake, and Eastern Kingsnake. Birds of this habitat type include Bobwhite Quail, American Robin, European Starling, yellow-rumped Warbler, Northern cardinal, Dark-eyed Junco, Tree Sparrow, White-throated Sparrow, White-eyed Vireo, Eastern Bluebird, Indigo Bunting, and Common Goldfinch. Typical mammal species include Short-tailed Shrew, White-footed Mouse, Meadow Vole, Red Fox, Raccoon, Striped Skunk, and White-tailed Deer.

2.5.4 Pine Forest

Pine Forest in the Atlantic Coastal Plain is successional and indicative of disturbed areas. Primary canopy species are Loblolly and Virginia Pine. Older pine stands have an understory of White and Red Oak, hickory, Blackgum, and Sweetgum. Shrub layer species include Japanese Honeysuckle, Trumpet Creeper, Poison Ivy, Virginia Creeper, Highbush Blueberry, Flowering Spurge, and Spotted Wintergreen.

Typical amphibians of the Pine Forest community include Eastern Spadefoot Toad, Pine-woods Frog, and Green Tree Frogs. Typical reptiles include Eastern Box Turtle, Fence Lizard, Six-lined Racerunner, Ground Skink, Five-lined Skink, Corn Snake, and Black Rate Snake. Raptor species associated with this habitat type include Red-tailed Hawk, Broad-winged Hawk, and Great-horned Owl. Other birds include Bobwhite Quail, Mourning Dove, Common Flicker, Hairy Woodpecker, Yellow-throated Warbler, Pine Warbler, Eastern Meadowlark, and Rufous-sided Towhee. Typical mammal species include Pine Mouse, opossum, Eastern Cottontail, Gray Fox, raccoon, and White-tailed Deer.

2.5.5 Mixed Deciduous Forests

The majority of the forested regions of NSWC-White Oak can be classified as mixed deciduous. The Mixed Deciduous Forest consists of an abundance of broad-leaved trees, including oaks, poplars, hickory, and maples and evergreens including pines, hemlocks, and magnolias. Trees and shrub species, including oaks, poplars, hickory, and maples are generally diverse and support a variety of animals.

The composition of the Mixed Deciduous Forest varies due to selective climatic, soil, topographic, and land use factors. The mixed deciduous understory is populated with dogwoods, Eastern Redbud, American Holly, Striped Maple, Hophornbeam, and members of the magnolia family. The shrub layer consists of Northern Spicebush, Witch Hazel, Pawpaw, Wild Hydrangea, Mountain Pepperbush, and sumac. The forest floor supports numerous flower species including lilies, Ladies Slipper, Bloodroot, Wood poppy, Larkspur, Spring Beauty, Trillium, and various violets and mints.

A variety of food and nesting sites are available to bird species ranging from hawks and owls to warblers and finches. Other birds utilizing this habitat type may include Red-tailed Hawk, Ruffed Grouse, Pileated Woodpecker, Great Crested Flycatcher, Bluejay, Carolina Chickadee, Tufted Titmouse, Hermit Thrush, Veery, Red-eyed Vireo, Scarlet Tanager, and several warbler species. Mammalian species typical of this habitat type includes Gray Squirrel, Eastern Chipmunk, raccoon, foxes, bobcat, and White-tailed Deer.

2.5.6 Oak-Hickory Forest

In undisturbed areas, a climax forest community known as an Oak-Hickory Forest results. The Oak-Hickory Forest is relatively dry and the soil is often sandy. The trees are generally widely spaced, with a low undergrowth of shrubs and vines.

Plants in this forest type include Pitch Pine, Tulip Poplar, Sweetgum, Shagbark Hickory, and Mockernut Hickory. Northern Red, Blackjack, and White and Bur Oak are found in the canopy layer. Shrub species include Eastern Redbud, Flowering Dogwood, Northern Spicebush, American Hazel, Rhododendron, and

Mountain Laurel. Typical understory species include Birdfoot Violet, Goat's Rue, Climbing Bittersweet, Wild Geranium, Big Merrybells, Solomon's Zigzag, Catbrier, and Moccasin Flower.

Animal species associated with this habitat type include opossum, Gray Squirrel, Eastern Chipmunk, Eastern Cottontail, raccoon, Gray Fox, White-tailed Deer, Broad-winged Hawk, Ruffed Grouse, Wild Turkey, Whip-poor-will, Red-bellied Woodpecker, Common Flicker, Blue Jay, Red-eyed Vireo, Scarlet Tanager, Summer Tanager, and Rose-breasted Grosbeak.

2.5.7 White-Tailed Deer

The most conspicuous mammalian species on the facility is the White-tailed Deer. Few deer were sighted during mammalian surveys of individual sites, and tracks, scats, and browse sign were very evident. The most recent population surveys conducted on site indicate a herd of approximately 70 deer (Malcolm-Pirnie, 1992).

At present, there is no hunting allowed on the facility. As a result, the deer on site are diurnal, commonly seen foraging in the mid-morning and mid-afternoon in the vicinity of Dahlgren Road and Keuster Road. Assuming that approximately 635 acres of useable deer habitat exists at the facility (scrub-shrub, old field, pine forest and hardwood forest), and a herd of approximately 70 deer exists on the base, the ratio of cover (in acres) to individuals is approximately nine to one. This is much higher than the optimum ratio of 64 acres per deer, and would indicate that the herd is overpopulated.

2.5.8 Paint Branch Creek

Paint Branch Creek represents the most important surface water body on the facility. The creek is located within the Potomac River Basin and the Washington Metropolitan Area Sub-Basin (Area 02-14-02). Paint Branch Creek and all tributaries north of the Capital Beltway (I-495) are designated as Class III - Natural Trout Waters. This use designation includes waters which have the potential for growth and propagation of trout and are capable of supporting self-sustaining trout populations and their associated food organisms.

Stocking continued in the area irregularly until 1944. It is believed that a naturally reproducing Brown Trout population existed in the Montgomery County portion of the watershed as early as the 1930s. The presence of Brown Trout in Paint Branch Creek was documented by the Maryland Department of Natural Resources (DNR) in 1973, from the extreme headwaters to the upper boundary of NSWC-White Oak (Malcolm-Pirnie, 1987).

Fish surveys conducted during the period 1974-1978 documented a dramatic reduction in the number of trout inhabiting the main stream. The reasons for this are not clear. It is thought that both human-induced and natural factors contributed to the decline (Malcolm-Pirnie, 1992).

Since 1978, the Brown Trout has shown some signs of recovery as a result of several consecutive years of excellent reproduction in the headwaters. In the late 1970s, special fishing regulations were introduced to offer some protection for the trout population without eliminating recreational fishing opportunities. As a result, the Paint Branch Creek watershed, above Fairland Road (approximately 2.5 miles north of the NSWC-White Oak), was designated as a "Special Native Trout Management Area" (effective January 1, 1980). These regulations allow fishermen to catch trout on single hooks or flies, and requires that all fish caught be released. These regulations remain in effect at the present time.

Maryland DNR has conducted numerous surveys since becoming aware of the natural Brown Trout in Paint Branch Creek in 1973. Sampling on the facility was completed by DNR in the summer of 1990. However, the number of fish collected was not sufficient to accurately quantify the population. Sampling in April 1991 again confirmed the presence of Brown Trout in the stream on the facility and showed that the stream supports a marginal trout population. The stream is characterized by sparse trout habitat and variable water levels. Juvenile trout and fry are limited in this portion of the stream because of fluctuating water flow, temperature, and possibly increased sedimentation.

3.0 SITE DESCRIPTIONS

3.1 SITE 2 - APPLE ORCHARD LANDFILL

The Apple Orchard Landfill was reportedly operated as an open disposal area and landfill from 1948 until 1982. The landfill is a single unit that is composed of several disposal areas. In addition to domestic refuse, wastes reportedly disposed of consisted of oils containing PCBs, solvents, paint residue, acids and miscellaneous compounds. An estimated 500 gallons of PCB-contaminated oils were deposited at the site prior to 1970. It has been estimated that the landfill contains 75,000 cubic yards of waste/fill. The major features of Site 2 are shown on Figure 3-1.

3.1.1 Physical Characteristics

The Apple Orchard Landfill is an abandoned landfill located on the south side of Perimeter Road in the northwestern end of the NSWC-White Oak property. The landfill forms a small hill at an elevation of approximately 340 feet mean sea level within the valley of an unnamed stream. The stream is located along the south side of the site and flows north/northeast towards Paint Branch Creek. A drainage swale is present along the western perimeter of the landfill which conveys stormwater flow from adjacent properties.

The landfill covers approximately 4.3 acres, the majority of which consists of plateau adjacent to Perimeter Road. The landfill cover supports old field vegetation with Successional Hardwood Forest on the short but very steep side slopes. The steep slopes range in height from a few feet (along the eastern and western perimeter) to approximately 35 feet along the southern perimeter. The slopes are moderately eroded and exposed waste and fill material are evident throughout. The cover is abutted to the south and west by Mixed Deciduous Forest, to the east by Virginia Pine Forest, and to the north by private lands supporting residential development and Virginia Pine Forest.

Minor erosion is evident on the landfill surface, but the steep slopes along the southern perimeter expose waste and fill material resulting from erosion of the cover materials or lack of placement of initial cover materials.

Surface runoff from the landfill generally flows to the south into the adjacent unnamed stream. This stream like others on the NSWC-White Oak property is a gaining stream as groundwater discharges into the stream channel. Two NDPES permitted outfalls are also located upstream of the landfill and provide a source for the baseline stream flow in the vicinity of the landfill. In addition, surface water within

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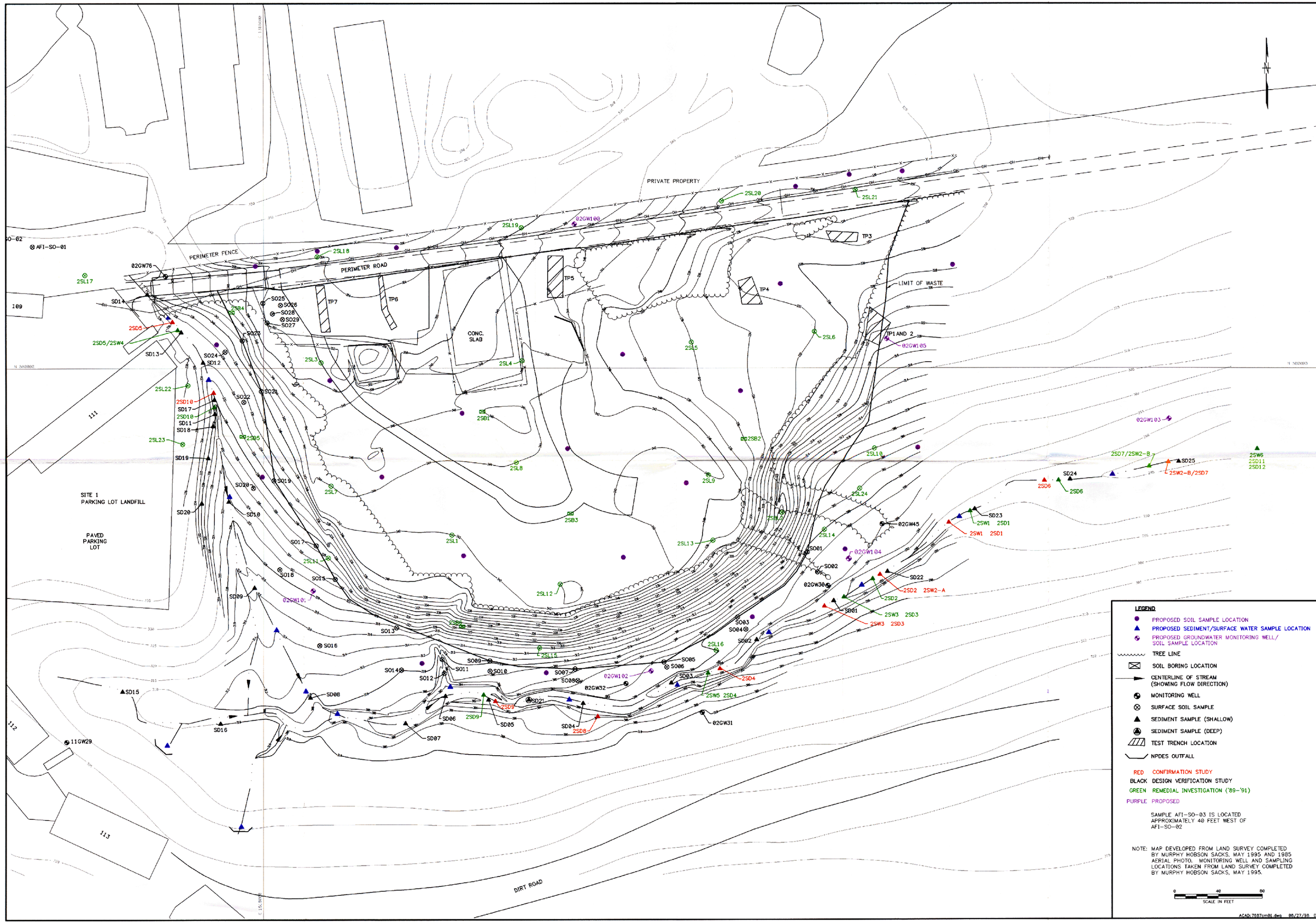

LEGEND

- PROPOSED SOIL SAMPLE LOCATION
- PROPOSED SEDIMENT/SURFACE WATER SAMPLE LOCATION
- PROPOSED GROUNDWATER MONITORING WELL/ SOIL SAMPLE LOCATION
- TREE LINE
- SOIL BORING LOCATION
- CENTERLINE OF STREAM (SHOWING FLOW DIRECTION)
- MONITORING WELL
- SURFACE SOIL SAMPLE
- SEDIMENT SAMPLE (SHALLOW)
- SEDIMENT SAMPLE (DEEP)
- TEST TRENCH LOCATION
- NPDES OUTFALL

RED CONFIRMATION STUDY
BLACK DESIGN VERIFICATION STUDY
GREEN REMEDIAL INVESTIGATION ('89–'91)
PURPLE PROPOSED

SAMPLE AFI-SO-03 IS LOCATED APPROXIMATELY 40 FEET WEST OF AFI-SO-02

NOTE: MAP DEVELOPED FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995 AND 1985 AERIAL PHOTO. MONITORING WELL AND SAMPLING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995.

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SYMBOL	DESCRIPTION	DATE	APPROVED
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PROGRAM MANAGER DATE

APPROVED DATE

EFD FOR COMMANDER NAVFAC

SEAL AREA

DEPARTMENT OF THE NAVY
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON DC

SITE 2–APPLE ORCHARD LANDFILL
EXISTING/PROPOSED SAMPLING LOCATIONS
NSWC–WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
SPEC.
NAVFAC DRAWING NO.
SHEET OF

FIG. 3–1

the northern portion of Area 100 is conveyed through the NSWC-White Oak storm sewers and discharged into this unnamed stream.

Limited information has been gathered specific to the soils in the vicinity of Site 2. The lithology at the site as described in the soil boring logs for the five existing groundwater monitoring wells are provided in prior site reports (Malcolm-Pirnie, 1987 and Malcolm-Pirnie, 1993). In general, the Upland Sand and Gravel unconformably overlies the saprolite of the Wissahickon Formation. The Upland Sand and Gravel ranges in thickness from 4 feet to 10 feet and consists of a brownish-gray silt to a silty sand with a trace of gravel. The saprolite varies in thickness from 20 to 35 feet.

Groundwater at the site is unconfined and present in the saprolite and bedrock and, to a lesser extent, the Upland Sand and Gravel. Depth to the water table at Site 2 ranges from approximately 6 to 20 feet from the toe of the landfill to the perimeter road north of the landfill, respectively. Groundwater flow is to the southeast and discharges to the unnamed stream. Water level observations from the existing groundwater monitoring wells have been used in this determination. Multiple rounds of synoptic groundwater elevations were measured at the existing monitoring wells and used to determine groundwater flow directions in the vicinity of Site 2. Groundwater level measurements are included in Appendix D.

3.1.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or media sampling. Conducted in 1984, the IAS identified wastes which were potentially disposed at Site 2, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 2, Apple Orchard Landfill

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis, site topographic survey

Study Description	Date	Procedure
Wetlands/Forest Stand Delineation	1995	Identification and delineation of wetlands and forest inventory.
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.1.2.1 Confirmation Study/Verification Phase

The Confirmation Study/Verification Phase involved the placement of three groundwater monitoring wells, collection of 10 sediment samples, collection of four surface water samples and the completion of a ground penetrating radar (GPR) survey. Results of the GPR survey were inconclusive. The analytical data suggested that landfill leachate was migrating into the shallow groundwater, which was then discharging into the adjacent stream. Total organic carbon (TOC) and total organic halogen (TOX) levels were elevated in the groundwater downgradient of the landfill, and low levels of PCBs, metals and volatile organic compounds (VOCs) were detected in the stream sediment. A summary of the analytical data collected during the Confirmation Study is provided in Appendix D.

3.1.2.2 Remedial Investigation - Phase I

During the Phase I RFI, samples were collected from six surface water and 10 sediment locations within the small stream that passes to the south of the landfill. PCBs were detected in the sediments. The concentrations indicate a progressive decrease in concentration in the down-stream direction.

In addition, surface soil samples were collected at Site 2. Metals (chromium, copper, lead, and zinc), PCBs, VOCs and semivolatiles were detected in the surface soils. The semivolatiles consisted primarily of anthracene, fluoranthene, naphthalene, phthalate, and pyrene species.

A soil gas survey was also conducted to document volatile organic concentrations and potential contaminant migration through the vadose zone. The results of the soil gas survey indicated the presence of VOCs in the soil vapor near Building 111 and to the east of the landfill near Perimeter Road.

One groundwater monitoring well was placed during the Phase I RFI and sampled along with the three wells installed previously. During the well installation, split-spoon samples were collected to characterize the subsurface lithology. Cadmium, mercury, and TCE were detected in the groundwater.

A summary of the data collected during the RFI is included in Appendix D.

3.1.2.3 Remedial Investigation - Phase II

As with the Phase I RFI, the Phase II RFI included sample collection from six surface water and 10 sediment locations within the small stream that passes to the south of the landfill. The results of this sampling were similar to those obtained during the Phase I investigation.

A 14 point sampling grid was also established to collect surficial soil samples. Additional soil samples were also collected within the grid (three samples), beyond the landfill boundary (nine samples), and from three borings located beyond the landfill boundary (nine samples). These samples were collected to predict contaminant movement through the vadose zone and to quantify chemical contamination in the surface soils. As with the Phase I sampling, PCBs were found in the site soils. Metals (copper, lead, and zinc), PCBs, and VOCs (acetone and methylene chloride) were detected in the subsurface soil at the site.

During Phase II of the RFI, a fifth groundwater monitoring well was installed and all five wells present at the site were sampled. During the well installation, split-spoon samples were collected to characterize the subsurface lithology. Elevated levels of metals, mercury, and TCE were found in the groundwater.

Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation, mammal, fish, and benthic invertebrate surveys.

A summary of the data collected during the RFI is included in Appendix D.

3.1.2.4 Feasibility Study

The RFI concluded that a significant threat to human health and the environment existed through potential ingestive and dermal exposure to PCB contaminants and recommended remedial action. In response to the recommendations of the RFI Report, a CMS was prepared. The remedial objectives outlined included the removal and/or containment of any remaining contamination sources (i.e., stream sediment and surface soils) and the impedance of further migration of the contaminant into the soil and stream sediments. The recommended RA for Site 2 consisted of the excavation and thermal treatment of contaminated sediment (estimated 167 cubic yards) and construction of a synthetic/soil cap (estimated 57,000 square feet) for surface soils and landfill.

3.1.2.5 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for remediation of the PCB contamination within the adjacent stream and the capping/closure of the landfill. In order to further

characterize the site and prepare remediation plans, a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to site closure.

Field activities at Site 2 included an electromagnetic (EM) survey using a Geonics EM-31 Terrain Conductivity Meter, test pit placement, soil/sediment sampling, and of a topographic survey. The EM survey and test pits were used to define the limits of waste along the northern and eastern boundary of the landfill. Results of the EM survey did not clearly delineate the boundary of the landfill in the northern portion of the site along Perimeter Road. However, the lack of a measurable response appears to indicate landfill contents do not extend past Perimeter Road.

Following completion of the EM survey, seven test trenches were placed along the northern and eastern perimeter. The test trenches were placed with a backhoe at the locations identified on Figure 3-1. Test trenches were excavated to a depth of approximately five feet. A test pit log was developed for each excavation and included a description of soil lithology, soil moisture, soil color, and PID readings. Copies of these logs are provided in the Design Verification Study (B&R Environmental, 1995). Fill and disturbed earth were discovered along the Perimeter Road to the north and along the tree line to the east. A small, undisturbed wooded area was located south of Perimeter Road.

In addition visual observations based on topographic expression along the western and southern perimeter were used to delineate the limits of the landfill. From these observations, the landfill was estimated to consist of 4.3 acres of disposal area. The estimated limits of the landfill are provided on Figure 3-1.

Sediment and soil sampling was also conducted at Site 2 in order to further define the extent of PCB contamination. PCB contaminated sediment was detected approximately 350 feet downstream from the eastern limits of the landfill, with the highest concentration of sediment contamination present within the drainage swale west of the landfill. Elevated PCB concentrations were also present along the western face of the landfill. Offsite sources of PCB contamination were investigated; however, no sources were identified.

To determine the extent of PCB contamination in surface soil between the unnamed tributary and the landfill base, 24 surface soil samples (02-SO-01 through 02-SO-24) were collected. B&R Environmental set up sampling transects spaced approximately 80 feet apart along the base of the landfill. At each sample transect, two surface samples were taken between the edge of the landfill and the stream bed. One sample was collected immediately below the break in slope, at the interface of fill and natural material. The second sample was collected half way between the first sample and the stream bed. In addition,

five surface soil samples (02-SO-25 through 02-SO-29) were collected in the vicinity of the former waste oil storage tank in the northwest corner of the landfill. The locations of surface soil samples are shown in Figure 3-1.

Surface soil samples were collected from the top three inches of soil and consisted of a composite of five points within a two foot radius. Samples were tested for PCBs (Aroclor 1260) using Ensys RISC® Soil field screening kits. In addition to field screening tests, two duplicate surface soil samples (02-SO-21 and 02-SO-28) were sent to a fixed based laboratory for analysis of target compound list (TCL) PCBs to confirm field screening results.

To determine the extent of PCB contamination within the streambed which exceeds anticipated action levels, 25 sediment samples (02-SD-01 through 02-SD-25) were collected from the stream. Sampling transects were established approximately 80 feet apart along the stream and the base of the landfill. Sampling of the stream bed sediments continued approximately every 80 feet along the stream, or as required to collect sufficient sample volume. Sampling locations included drainage ditches which originate near the maintenance buildings west of the landfill (see Figure 3-1).

Sediment samples were collected from the top of the sediment layer (0.0 to 0.5 feet). Due to the shallow depth of the sediment layer, only one sample, 02-SD-21, was collected at depth in the sediment layer (1.5 to 2.0 feet). This sample was collected between sampling transects four and five. Sediment samples were tested for PCBs (Aroclor 1260) using Ensys RISC® Soil field screening kits. In addition to field screening tests, seven duplicate sediment samples (02-SD-02, 02-SD-05, 02-SD-06, 02-SD-07, 02-SD-11, 02-SD-19, and 02-SD-23) were sent to a fixed-based laboratory for analysis of TCL PCBs to confirm field screening results. To calculate the average carbon content for use in determining PCB action levels, four sediment samples (02-SD-05, 02-SD-10, 02-SD-15, and 02-SD-20) were analyzed for TOC. In addition, these samples were analyzed for total volatile solids (TVS) and total solids (TS) to aid in the evaluation of treatment technologies for sediment remediation, if necessary.

In an attempt to identify the presence of offsite sources for PCB contamination, three (3) surface soil samples were collected on the property to the north of the Apple Orchard Landfill. The samples were collected in the vicinity of a stormwater retention pond located on the property. An apartment complex has been constructed on this property, and site drainage patterns appear to have been altered compared with previous conditions identified on aerial photographs. The sampling locations are shown on Figure 3-1. The samples were collected and analyzed for pesticides/PCBs at a fixed-based laboratory.

The results of the soil and sediment sampling and analysis efforts are provided in Appendix D.

Detailed topographic mapping of the Apple Orchard Landfill and its surroundings were also performed at this time. The topographic survey included the area west of the landfill and extended approximately 15 feet beyond the adjacent unnamed stream south of the landfill. The topographic survey identified significant details including wooded areas, roadways, and fence lines. The results of the topographic survey are provided in Figure 3-1.

3.1.2.6 Wetland/Forest Stand Delineation

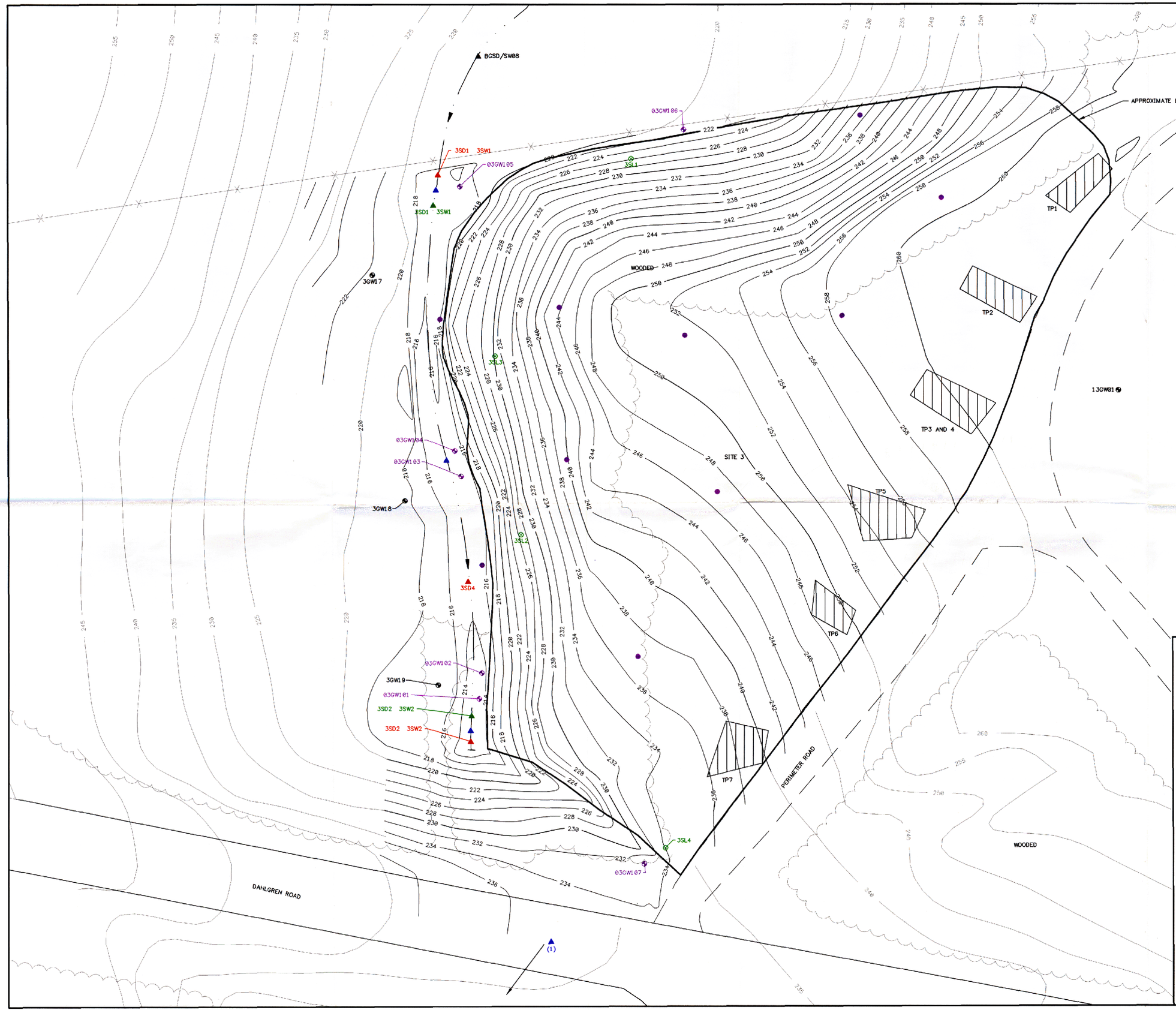
A wetlands delineation and forest inventory were conducted at Site 2 during 1995. Five wetlands have been identified at Site 2 as defined in 33 CFR 328 or delineation criteria in the 1987 Corps of Engineers Wetlands Delineation Manual (USCOE, 1987). These wetlands comprise a system of intermittent and upper perennial headwater streams that converge in the wooded valley south of the landfill. These wetlands form a small stream which flows in an easterly direction, ultimately exiting the northern installation boundary and flowing into Paint Branch Creek. The disposal area at Site 2 does not contain wetlands.

3.1.2.7 Groundwater Characterization Study

During June 1997 the existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and semi-VOCs (SVOCs) as well as target analyte list (TAL) metals plus cyanide, TCL pesticide/PCBs, and Method 8330 explosives. Elevated concentrations of organic and inorganic contaminants were identified at several monitoring wells during this investigation. The results of the groundwater sampling and analysis efforts are provided in Appendix D.

3.2 SITE 3 - PISTOL RANGE LANDFILL

The Pistol Range Landfill is located on the eastern half of the NSWC-White Oak property, directly north of Dahlgren Road and the Monroe Loop. Figure 3-2 shows the major features of Site 3. The Pistol Range Landfill was operated as a landfill from the late 1940s until the mid-1970s. Fill materials were pushed into the West Farm Branch Valley from Perimeter Road forming the site. Wastes reportedly disposed in the landfill include solid wastes, ordnance cases, solvents, oils possibly containing PCBs, sodium nitrate, and miscellaneous metallic objects. An estimated 8,000 gallons of solvents and oils were reportedly disposed of at the site during a 30 year period. It has been estimated that the landfill contains 20,000 cubic yards of waste/fill.



LEGEND

- PROPOSED SOIL SAMPLE LOCATION
- PROPOSED SEDIMENT/SURFACE WATER SAMPLE LOCATION
- PROPOSED GROUNDWATER MONITORING WELL/ SOIL SAMPLE LOCATION
- FENCE LINE
- TREE LINE
- CENTERLINE OF STREAM (SHOWING FLOW DIRECTION)
- MONITORING WELL
- SURFACE SOIL SAMPLE
- SEDIMENT SAMPLE (SHALLOW)
- TEST TRENCH LOCATION

RED CONFIRMATION STUDY
BLACK DESIGN VERIFICATION STUDY
GREEN REMEDIAL INVESTIGATION ('89-'91)
PURPLE PROPOSED

NOTE: (1) 2 ADDITIONAL SEDIMENT/SURFACE WATER SAMPLES PROPOSED SOUTH OF DAHLGREN ROAD ALONG WEST FARM BRANCH.
(2) GROUNDWATER MONITORING WELLS 03GW47, 03GW77,03GW78S,AND 03GW78D LOCATED SOUTH OF DAHLGREN ROAD.
(3) MAP DEVELOPED FROM LAND SURVEY COMPLETED. BY MURPHY HOBSON SACKS, MAY 1995 AND 1985 AERIAL PHOTO. MONITORING WELL AND SAMPLING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995.

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PROGRAM MANAGER		DATE
APPROVED		DATE

EFD / FOR COMMANDER NAVFAC

SEAL AREA

DEPARTMENT OF THE NAVY — **CHESAPEAKE DIVISION** NAVAL FACILITIES ENGINEERING COMMAND — WASHINGTON, DC

SITE 3—PISTOL RANGE LANDFILL
EXISTING/PROPOSED SAMPLING LOCATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO.	80091
DRAWING SIZE:	D
CONST. CONT. NO.	
SPEC.	
NAVFAC DRAWING NO.	
SHEET	OF

FIG. 3-2

3.2.1 Physical Characteristics

A southward flowing stream, West Farm Branch, is located adjacent to the western edge of the site, and some areas of exposed waste/fill are present within the stream. The landfill is estimated to be 1.1 acres in size. The landfill cover supports old field vegetation with narrow strips of Successional Hardwood Forest on the short but very steep berm slopes and on the steep western slope. The stream valley at the bottom of the western side slope supports old field vegetation intermixed with small clumps of hardwood saplings, primarily tulip popular. Areas of Oak-Hickory Forest separating the landfill cover from Dahlgren Road (to the south) have been delineated. The area approximately 50 feet west of the stream, has been delineated as Deciduous Forest.

The site slopes from east to west towards West Farm Branch. Limited information is available related to subsurface conditions at or in proximity to the landfill wastes. Information related to subsurface conditions is provided in the soil boring logs for the groundwater monitoring wells placed on the opposite stream bank and further downstream of the landfill (Malcolm-Pirnie, 1992).

At the Pistol Range Landfill, the sand facies of the Potomac Group extends from the surface to a depth of approximately eight feet below ground surface. It consists of a brown to light-brown silty sand with quartz pebbles and cobbles. Underlying the Potomac Group is the saprolite and the fractured gneiss of the Wissahickon Formation. The saprolite ranges in thickness from four to seven feet across the site. The bedrock is slightly to moderately fractured with fractures filled with clay. A water-bearing zone fracture within the bedrock was encountered at approximately 65 feet below ground surface.

Groundwater flow at the Pistol Range Landfill is generally to the west towards West Farm Branch along the perimeter of the landfill. Based on 1991 water-level data, the saturated thickness of the water table aquifer within the saprolite unit is approximately 20 feet.

Groundwater in the fractured bedrock is confined. The piezometric surface of the bedrock groundwater is comparable to the elevation of the adjacent perennial stream, and groundwater flow from fractured bedrock probably recharges to the stream.

Additional detail related to the physical characteristics of the site are provided in Section 4.0.

3.2.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or media sampling. Conducted in 1984, the ISA identified wastes which were potentially disposed at Site 3, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 3, Pistol Range Landfill

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis, topographic survey
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory.
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.2.2.1 Confirmation Study/Verification Phase

During the Verification Phase of the Confirmation Study, three groundwater monitoring wells, three surface water, and six stream sediment locations were sampled. The analytical data gathered during this investigation suggested that leachate from the landfill was migrating from the landfill to the shallow groundwater. However, the results of this sampling did not conclusively indicate that leachate from the landfill was discharging into the stream. Slight VOC and metals contamination was found in the shallow groundwater. Sampling of groundwater and surface water indicated low levels of TOX and TOC were present.

3.2.2.2 Remedial Investigation - Phase I

During the Phase I RFI, surface water and stream sediment were sampled at four locations from the stream that passes to the west of the landfill. Minor impact on the stream quality was observed through

the surface water and sediment sampling. Low levels of metals were found in the stream both upgradient and downgradient of the landfill.

A vadose zone investigation was conducted which included the collection of two surficial soil samples and a soil gas survey adjacent to the landfill. A soil gas survey sampling grid was also established west and south of the landfill to measure the release of volatile organic contamination through the soil. The results of the soil gas survey indicated the presence of VOCs in the soils with the highest concentrations along the landfill side of the stream and in the area south of Dahlgren Road. The results of the surficial soil sampling confirmed the presence of metals contamination along the face of the landfill. SVOCs were identified in the surface soil during the Phase I investigation.

During Phase I, one groundwater monitoring well was installed and the four wells at the site were sampled. During the well installation, split-spoon samples were collected to characterize the subsurface lithology. The groundwater analytical results confirmed the presence of VOCs and metals. Summary analytical data is provided in Appendix E.

3.2.2.3 Remedial Investigation - Phase II

During Phase II of the RFI, sediment samples were collected from the same locations as during Phase I, however no surface water samples were collected. Two additional surface soil samples were also collected. The semivolatile contamination found during the Phase I investigation was not detected during Phase II.

During Phase II, three additional wells were installed and samples were collected from all seven wells at the site. During the well installation, split-spoon samples were collected to characterize the subsurface lithology. Methylene chloride, 1,2-dichloroethene, TCA, and chlorobenzene were found in the groundwater above the MCL during Phase II. The metals found in unfiltered samples above the MCLs during Phase II included cadmium, chromium, and lead. Summary analytical data is provided in Appendix E.

Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation, mammal, fish, and benthic invertebrate surveys.

3.2.2.4 Feasibility Study

The RFI concluded that a significant threat to human health and the environment exists through potential exposure to volatile organic contaminants via groundwater. In response to the recommendations of the

RFI Report, a CMS was prepared. The remedial objectives outlined included limiting the generation of leachate caused by the percolation of rainwater through the landfill contents and limiting further migration of the contaminant plume in the groundwater outside the landfill. The recommended RA for Site 3 consisted of the construction of a synthetic/soil cap (estimated 40,000 square feet) for surface soils and the landfill and installation of a groundwater extraction and treatment system.

3.2.2.5 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for the capping/closure of the landfill. In order to further characterize the site and prepare remediation plans a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to site closure.

Field activities at Site 3 included an EM survey, test pit placement, and a topographic survey. The EM survey and test pits were used to define the limits of waste along the eastern boundary of the landfill and to determine if waste extended beyond Perimeter Road.

Results of the survey indicated that EM anomalies were present in several locations along the western boundary of the EM survey grid. These anomalies appear to indicate that the edge of the fill material does not extend past Perimeter Road. The remainder of the site showed no significant EM anomalies which would be indicative of buried landfill contents. Appendix E includes field data collected during the EM Survey of Site 3.

Following completion of the EM survey at Site 3, seven test trenches were placed along the Perimeter Road to the and east of the landfill in an attempt to define the limits of waste placement. The test trenches were placed with a backhoe at the locations identified on Figure 3-2.

During the prior site reconnaissance, potential unexploded (UXO) hazards were observed in the face and along the toe of the landfill. Accordingly, a B&R Environmental UXO specialist was utilized to screen all locations prior to and during intrusive work to avoid contact with potential UXO hazards. The UXO specialist surveyed the trenching locations with a magnetometer at two foot depth intervals to limit contact with UXO which may have been disposed at the site.

During trench excavation, several fuses were unearthed which were not detectable by the magnetometer. Following this discovery, Navy Exploded Ordnance Division (EOD) staff were notified, and the fuses were removed from the site.

Test trenches were excavated to a depth of approximately five feet. A test pit log was developed for each excavation and included a description of soil lithology, soil moisture, soil color, and any PID readings. The test pit logs are included in Appendix E. The test trenches were successful in determining the limits of waste placement at the landfill. A well defined waste/natural soil interface was evident in the test trenches placed at the site.

In order to identify the depth to the virgin soil/waste interface along the western face of the landfill, several hand excavations and auger borings were attempted. The purposes of this activity was to address the theory that waste placement at the site consisted of a thin veneer along the stream bank. Due to the high volume of waste material and debris along the face of the landfill, only one excavation and boring could be advanced to a depth of 2 feet. The material encountered during excavation was fill material with large amounts of construction/demolition debris. The depth to the virgin soil/waste interface could not be determined.

Detailed topographic mapping of the Pistol Range Landfill and its surroundings was also completed. The topographic survey includes the area of the landfill enclosed by the perimeter fence line (north), Perimeter Road (east), and Dahlgren Road (south) and extended approximately 50 feet beyond the stream along the western portion of the landfill. The results of this survey are illustrated on Figure 3-2.

3.2.2.6 Wetland/Forest Stand Delineation

A wetlands delineation and forest inventory were conducted at Site 3. One wetland was identified at Site 3 as defined in 33 CFR 328 or delineation criteria in the 1987 Corps of Engineers Wetlands Delineation Manual (USCOE, 1987). This wetland comprises the perennial stream, West Farm Branch, flowing through the stream valley west of the landfill. There are no wetlands within the disposal area of Site 3.

3.2.2.7 Groundwater Characterization Study

During June 1997 the existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL inorganics, cyanide, TCL pesticide/PCBs, and Method 8330 explosives. Low concentrations of organic and inorganic contaminants were identified at monitoring well 03GW17 during the investigation.

3.3 SITE 4 - CHEMICAL BURIAL SITE

The Chemical Burial Site is located south of Perimeter Road and 400 yards northeast of the Pistol Range Landfill. The overall area of the site is approximately 1.1 acres (Figure 3-3). The site was reportedly used from the mid-1950s until the early 1970s for chemical disposal in four discrete locations within the site. Past investigations have identified two disposal areas within the northern most disposal site shown on Figure 3-3. Two distinct disposal sites may be present within the large suspected disposal trench area; however, only one large trench was suggested from the review of an aerial photograph of the site taken in 1985. Wastes reportedly disposed at this location included acids, explosive compounds, kerosene, chlorinated solvents, and numerous, unidentified laboratory compounds. The total volume of chemicals disposed in the areas was estimated to be 400 cubic feet.

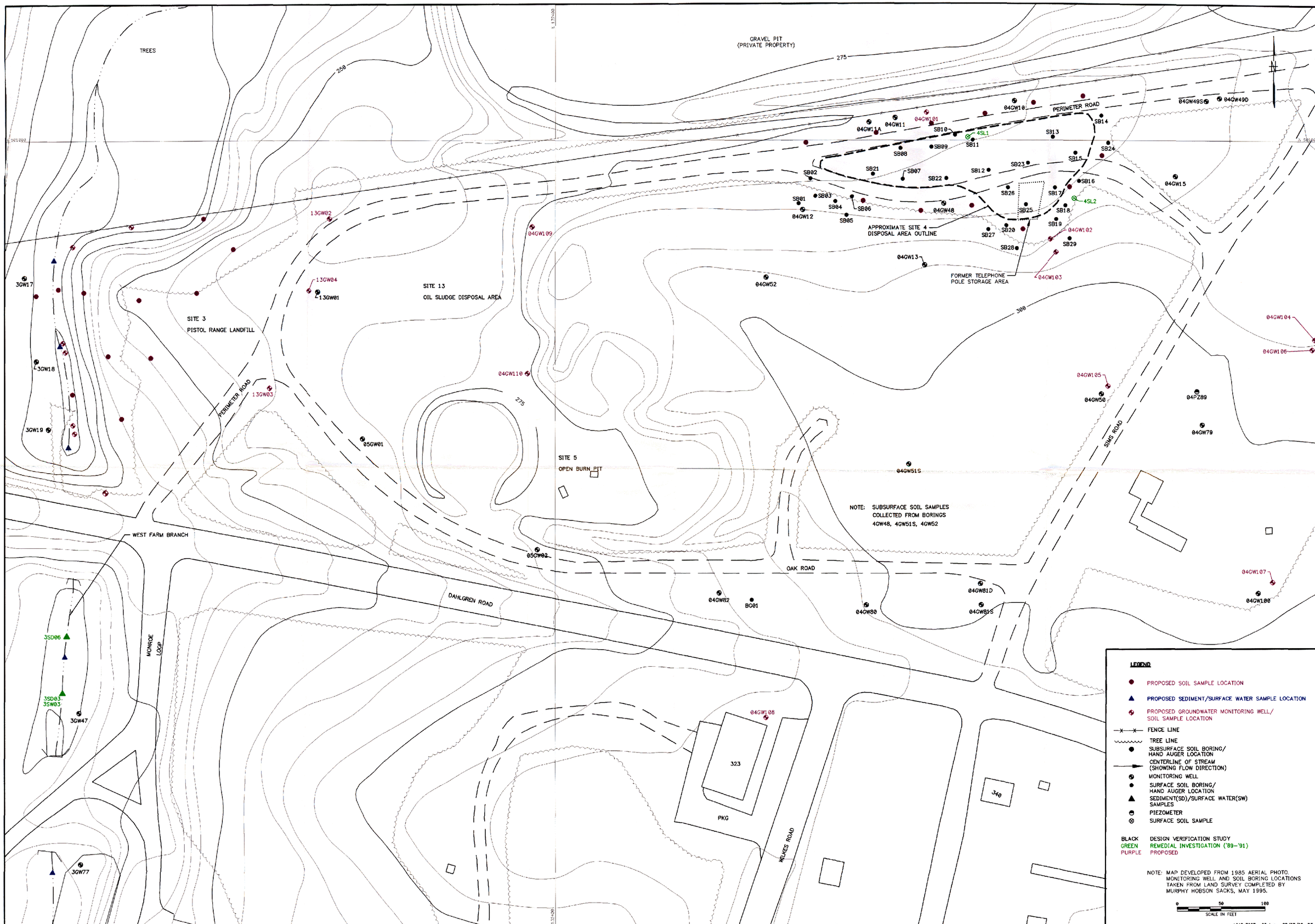
3.3.1 Physical Characteristics

The site is relatively flat with no surface water features within proximity to the site. Surface water would be expected to infiltrate the soils overlying the disposal pits and migrate into the subsurface soils. Information related to subsurface conditions is provided within the previous environmental study reports. Site 4 supports old field vegetation but is bordered to the south, east, and west by Oak-Hickory Forest. Lands to the north of the site are presently used as a quarry.

The Upland Sand and Gravel, the Potomac Group, and the saprolite of the Wissahickon Formation underlie Site 4. The unconsolidated Upland Sand and Gravel occurs at the surface and is underlain by the Potomac Group. Due to the similarity in lithology and sedimentary features, the contact between these two units is not well defined. The thickness of unconsolidated sediments ranges from 45 to 65 feet. Thin (1.0 to 1.75 feet) tan to buff clayey silt to silty clay members of the Potomac Group exist at the site within the unconsolidated sediments. The silty clay seams are laterally continuous to the east and dip to the south, grading into very thin (0.1 to 0.4 feet) silty seams.

The saprolite member of the Wissahickon Formation underlies the unconsolidated sediments at Site 4. Weathered gneiss bedrock was encountered in one boring in the southern portion of the site at a depth of 65 feet. The saprolite and the bedrock surface dip steeply to the east in this area.

Groundwater at Site 4 is unconfined in the unconsolidated sediment units and within the uppermost portion of the saprolite. The saprolite in this area may act as an aquitard, restricting groundwater movement from the water table aquifer downward to the underlying competent bedrock. Depth to the water table ranges from approximately 28 feet in the northern portion of the site to 58 feet in the southern portion. The average saturated thickness of the water table aquifer is approximately 21 feet.



SYMBOL	DESCRIPTION	DATE	APPROVED
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DES. | DR. H.P. | CHK.
SUBMITTED BY: | TITLE | DATE
PROGRAM MANAGER | DATE
APPROVED | DATE
EFD FOR COMMANDER NAVFAC

SEAL AREA

NAVAL FACILITIES ENGINEERING COMMAND
CHESAPEAKE DIVISION
WASHINGTON, DC
DEPARTMENT OF THE NAVY

SITE 4–CHEMICAL BURN AREA
EXISTING/PROPOSED SAMPLING LOCATIONS
NSWC–WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
NAVFAC DRAWING NO.

FIG. 3–3

Based on water-level readings from monitoring wells within the local area, groundwater flow at Site 4 is to the south-southeast. A groundwater divide exists in the western portion of the site diverting groundwater west of the site to an unnamed stream adjacent to Site 3.

Silty clay to clayey silt layers approximately 20 to 25 feet below ground surface form localized perched groundwater zones at Site 4. The clay seams appear to be limited to the northern area of the site.

The average hydraulic conductivity at Site 4 is approximately 9.4×10^{-4} cm/s (2.67 feet/day), based on slug tests. Transmissivity and storativity values range from 1.43×10^{-2} cm^2/s to 1.11×10^{-1} cm^2/s and 3.75×10^{-4} to 2.98×10^{-3} cm/s, respectively, based on two constant pumping tests.

Additional details related to the physical characteristics of the site are provided in Section 4.0.

3.3.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or media sampling. Conducted in 1984, the IAS identified wastes which were potentially disposed at Site 4, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 4, Chemical Burial Area

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.3.2.1 Confirmation Study/Verification Phase

Six groundwater monitoring wells were installed and sampled during the Verification Phase of the Confirmation Study. The results indicated that the buried wastes were leaching organic compounds to the shallow groundwater. This was suggested by the TOC and TOX data for the shallow groundwater samples. Low levels of VOCs, oils and grease, and metals were also found at the site.

3.3.2.2 Remedial Investigation - Phase I

This investigation included the collection of six soil samples and a soil gas survey. No compounds were detected above background levels in the subsurface soils.

The soil gas survey was conducted to document VOC concentrations in the soil and to determine the movement of these compounds in the upper soil and vadose zone. The soil gas survey indicated the presence of VOCs in the site soils.

During Phase I, six groundwater monitoring wells were installed at the site. Two wells were installed as a well cluster, with one deep and one shallow well. Following installation all twelve wells at the site were sampled. During the well installation, split-spoon samples were collected to characterize the subsurface lithology.

A summary of the data collected during the RFI is included in Appendix F.

3.3.2.3 Remedial Investigation - Phase II

A GPR survey was conducted at the site during Phase II of the RFI, to identify the four burial areas at the site. In addition two surface soil samples were collected to measure the concentration of contaminants in the surface soil. The analytical results indicate that elevated concentrations of VOCs and SVOCs were present within the surface soils. VOCs detected included methylene chloride, acetone, TCE, carbon disulfide, 1,1,-trichloroethane, and m- and p-xylene. The only semivolatile identified above background was pyrene.

During Phase II, an additional six well groundwater monitoring wells were installed. Two wells were installed as a cluster, with one deep well and one shallow well. Groundwater samples from seventeen wells were then collected (one well installed for a constant rate pumping test was not sampled). Seven slug tests and two constant rate pumping tests were also conducted. During the well installation, split-spoon samples were collected to characterize the subsurface lithology.

Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation and mammal surveys.

A summary of the data collected during the RFI is included in Appendix F.

3.3.2.4 Feasibility Study

The RFI, concluded that a significant threat to human health and the environment exists through potential contaminant exposure via groundwater and recommended remedial action. In response to the recommendations of the RFI Report, a CMS was prepared in 1993. The remedial objectives outlined include the removal or containment of any remaining contamination sources and the reduction of the health risks associated with exposure to contaminated groundwater. The CMS evaluated alternatives for achieving the remedial objectives. The recommended RA for Site 4 consisted of the excavation and thermal treatment of contaminated soils (estimated 5,200 cubic yards), offsite disposal of excavated waste materials, and the installation of a groundwater extraction and treatment system.

3.3.2.5 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for remediation of the waste and subsurface soil contamination. In order to further characterize the site and prepare remediation plans a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to site closure.

Field activities at Site 4 included an EM survey and subsurface soil sampling which enabled B&R Environmental to identify areas of significant subsurface contamination. Contamination identified at the site was consistent in nature with contamination identified previously and with the groundwater contamination identified at the site. High concentrations of organic contaminants were identified within the site. Additional sampling performed within the southeastern portion of the site further defined the limits of contamination, and allowed for the development of a source removal action at the site.

An EM survey of Site 4 was completed to define the extent of buried objects which might indicate the location of the chemical burial pits. The survey was conducted across the entire site and extended to the fence line north of Perimeter Road. An area used for telephone pole storage was not included in the survey area during this investigation. The survey grid was approximately 100 feet wide and 400 feet long, with grid spacings of 10 feet. A Geonics EM-31 Terrain Conductivity Meter was used to measure the ground conductivity in the immediate vicinity of the instrument to a depth of approximately 10 feet.

Readings from this instrument were recorded at two positions at each grid point (with the EM-31 pointing north-south and again pointing east-west). Anomalous readings between grid points were noted and investigated further with the EM instrument.

Results of the survey indicated that EM anomalies were present in four locations within Site 4. The most significant EM readings occurred in the central and western portion of the suspected disposal trench area and near the suspected burial pit location along the southeastern edge of the site. Readings consistent with subsurface variability were noted and these locations were staked in the field to be sampled. These locations appear to be consistent with the results of the previous investigations. In addition, slight EM anomalies were present behind the telephone pole storage area, and within the suspected burial pit location in the southwestern corner of the site. Readings consistent with small buried objects were noted and these locations were marked in the field to be sampled. The limited magnitude of the EM deflections in these areas indicates that these burial pits are likely to be small and probably do not contain large metal containers or drums. The remainder of the site showed no significant EM anomalies which would be indicative of buried objects.

To obtain subsurface soil contamination data within the central portion of the suspected pit locations, three hand auger borings (04-SB09, 04-SB11, 04-SB13) and three soil borings (04-SB03, 04-SB04, 04-SB18) were completed. Hand auger borings were mechanically advanced, using a powered hand auger, a minimum of five feet prior to sampling. The depths of fill material and contamination were observed to the extent possible and were recorded in the field log book. Soil borings were advanced to a depth of 16 feet. Continuous split-spoon samples were collected to the base of each boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained by B&R Environmental. The locations of hand auger and soil borings are shown on Figure 3-3.

For purposes of characterizing soil contamination outside of the immediate area of the disposal pits, four hand auger boring (04-SB20, 04-SB08, 04-SB10, and 04-SB14) and 10 soil borings (04-SB01, 04-SB02, 04-SB05, 04-SB06, 04-SB07, 04-SB12, 04-SB15, 04-SB16, 04-SB17, and 04-SB19) were placed at the site. These borings were used to collect soil samples adjacent to the disposal pits in order to better define the extent of contaminant migration into surrounding soils. Hand auger borings were mechanically advanced, using a powered hand auger, a minimum of five) feet prior to sampling. The depths of fill material and contamination were observed to the extent possible and were recorded in the field log book. Soil borings were advanced to a minimum of 16 feet. Continuous split-spoon samples were collected to the base of each boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained. The locations of hand auger and soil borings are shown on Figure 3-3.

After completion and analysis of the initial round of sampling at Site 4, nine additional soil borings were completed. The secondary boring locations were selected in order to better identify the southern boundary of the suspected disposal trench and to more clearly define the extent of subsurface contamination in the vicinity of the telephone pole storage area. Secondary soil borings were advanced to a minimum of 16 feet. Continuous split-spoon samples were collected to the base of each boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained by B&R Environmental. The locations of secondary soil borings are shown on Figure 3-3.

One soil sample was collected from each boring location. The sampling depth was based on obvious indications of contamination, such as stains or chemical odor; elevated PID readings, or the presence of fill material. Samples were collected at various depths within the borings, dependent upon the above observations. The identification of the sample depth is included as part of the sample identification (i.e., soil sample collected from boring 04-SB04 at depth of 10 to 12 feet is identified as 04-SB04-1012). Each soil sample collected during the initial sampling event was analyzed for TCL VOCs, TCL SVOCs, total Kjeldahl nitrogen (TKN), TAL metals and cyanide, pH, and nitroaromatic and nitrosamine compounds. Those samples collected during the secondary sampling event were analyzed for parameters identified during the previous investigation. All samples in the vicinity of the telephone pole storage area (04-SB25-1416, 04-SB26-1416, 04-SB27-1618, 04-SB28-1618, and 04-SB29-1618) were analyzed for trichloroethene. The remaining samples (04-SB21-1618, 04-SB22-1618, 04-SB23-1618, and 04-SB24-1618) were analyzed for TCL SVOCs and TAL metals.

Twelve soil samples (04-SB01-1216, 04-SB03-1214, 04-SB04-1214, 04-SB07-1822, 04-SB08-0809, 04-SB09-0809, 04-SB10-0708, 04-SB11-0809, 04-SB14-0506, 04-SB15-0812, 04-SB18-1012, and 08-SB19-1012) collected from Site 4 were tested for PCBs (Aroclor 1260) using Ensys PCB RISC® Soil test kits. In addition, one duplicate sample (04-SB09-0809) was analyzed for the TAL PCBs at a fixed base laboratory, to verify field test kit performance.

In addition to samples collected for chemical analysis, two subsurface soil samples (04-SB01-0406, 04-SB16-0406) were collected for determination of geotechnical parameters, including soil classification, grain size, and moisture content. These samples consisted of site representative soils collected from auger cuttings at the sampling location.

The analytical results associated with the soil sampling activities are provided in Appendix F.

3.3.2.6 Wetland/Forest Stand Delineation

One wetland area was delineated on Site 4 during previous field investigations. The wetland consisted of a small, isolated pool of water in the woods immediately east of the site. The wetland appears to be of man-made origin and is likely to become dry during drier seasons. The pool is completely shaded by trees growing on the surrounding uplands. It appears to be too small and isolated to be of significant ecological or hydrological value. The cover over the former burial sites lacks wetlands. Site 4 supports old field vegetation but is bordered to the south, east, and west by Oak-Hickory Forest. Lands to the north of the site are presently used as a quarry.

3.3.2.7 High Resolution Electromagnetic Survey

During June 1997, a High Resolution Electromagnetic (HREM) survey was performed at Site 4. The survey was performed to verify the results of the terrain conductivity survey previously performed at the site during the Design Verification Study. The results of the HREM survey are provided in Appendix F.

3.3.2.8 Groundwater Characterization Study

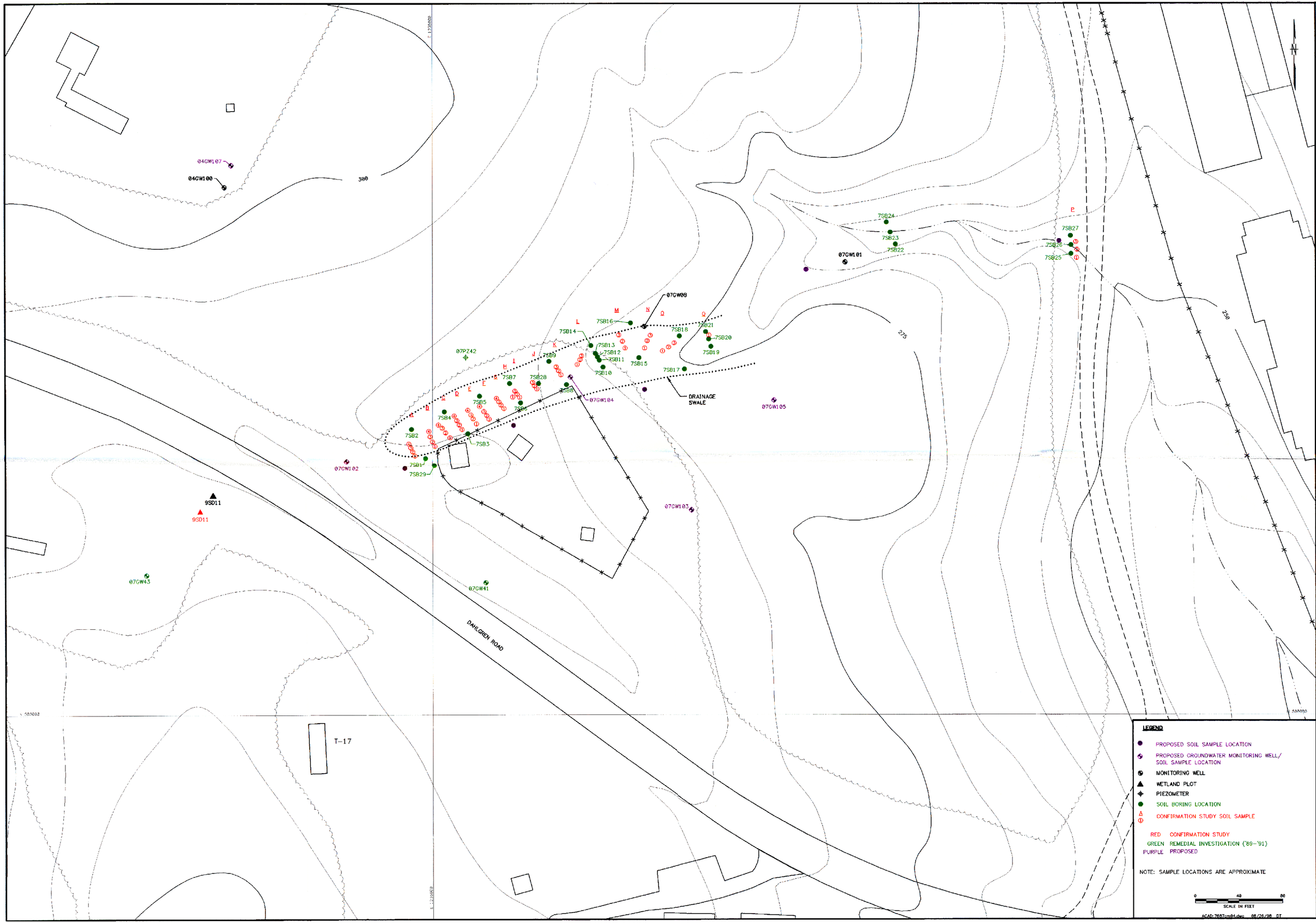
During June 1997 the existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL inorganics, cyanide, TCL pesticide/PCBs, and Method 8330 explosives. TCE was identified in numerous wells at Site 4 during this investigation. The groundwater sampling results are provided in Appendix F.

3.4 SITE 7 - ORDNANCE BURN AREA

Site 7, the Ordnance Burn Area, is located north of Dahlgren Road, approximately 300 yards southeast of Site 4 (the Chemical Burial Area), and north of Buildings 501, 506, and 508. The site was reportedly used for the thermal destruction of waste ordnance compounds between 1948 and 1968. The site consists of a swale approximately 250 feet long and 20 feet wide. Waste disposed at this site included various types of explosives, primarily nitroaromatics and nitroaliphatics. It has been reported that approximately 33,000 pounds of explosives were burned at this site over a period of 20 years. Site details are provided in Figure 3-4.

3.4.1 Physical Characteristics

Site 7 consists of a swale 20 feet wide and approximately 250 feet in length. Buildings 501 and 506, previously used for the storage of hazardous wastes, are located immediately south of Site 7, within a



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401	409		
402	D43	DATE	

REVIEWED BY RAICC

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DES	DR. HLP	CHK.	
SUBMITTED BY:		TITLE	
PROGRAM MANAGER		DATE	
APPROVED		DATE	

DTD FOR COMMANDER NAVFAC

SEAL AREA

DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

CHESAPEAKE DIVISION

WASHINGTON, DC

SITE 7–ORDANANCE BURN AREA

EXISTING/PROPOSED SAMPLING LOCATIONS

NSWC, WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091

DRAWING SIZE: D

CONST. CONT. NO.

SPEC.

NAVFAC DRAWING NO.

SHEET OF

FIG. 3–4

fenced enclosure. The remainder of the area adjacent to the swale is either cleared or covered by woodland or grass.

The site is flat with a gentle slope to the east. The Upland Sand and Gravel and the Potomac Group underlie Site 7. The thickness of unconsolidated sediments ranges from 58 to 68 feet. A thin (1 to 2 feet) pale white to beige clayey silt to silty clay member of the Potomac Group exists at 40-45 feet below ground surface in the northern and western portions of the site. This unit may correlate to the clay unit encountered at Site 4. The depth to the Wissahickon Formation is unknown at Site 4.

Depth to the water table ranges from approximately 34 to 51 feet from east to west across Site 7. The average hydraulic conductivity is estimated to be 1.67×10^{-3} cm/s (4.73 feet/day), based on slug tests by Malcom-Pirnie. Groundwater flow direction has not been accurately defined at Site 7.

Additional detail related to the physical characteristics of the site are provided in Section 4.0.

3.4.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or field sampling. Conducted in 1984, the IAS identified wastes which were potentially disposed at Site 7, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 7, Ordnance Burn Area

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.4.2.1 Confirmation Study/Verification Phase

The Confirmation Study/Verification Phase involved the placement of one groundwater monitoring well (7GW09) and 54 soil borings within swale. Soil samples were collected at the surface and at one foot depths to a total depth of five feet. All soil boring samples were analyzed to the two foot depth, with the analysis of deeper samples performed only when nitroaromatic contamination was identified in the shallower samples. Significant nitroaromatic contamination was identified throughout the subsurface soil within the swale.

Monitoring well 7GW08 was sampled on two occasions during this investigation. Nitroaromatic contamination was identified in the monitoring well during both events. TNT, TDX, HMX, and 2,4-dinitrotoluene were found during the sampling activities.

3.4.2.2 Remedial Investigation - Phase I

During the Phase I RFI, 59 soil samples were collected from 27 hand auger borings. The hand auger borings were advanced to a depth of five feet and were used to characterize the nitroaromatic concentrations in the subsurface soil within the swale. Nitroaromatic contamination was detected in all but three samples collected from the swale during Phase I. Concentrations of HMX and RDX were identified up-to 160,000 micrograms per kilogram (ug/kg) and 1,000 ug/kg, respectively. In addition concentrations of 2,4,6-TNT were also detected during the investigation.

Two groundwater monitoring wells (7GW41 and 7GW42) and one piezometer (7PZ42) were installed during the Phase I investigation. The new and existing wells were sampled during this phase of the investigation. Metals and nitroaromatics were detected in the groundwater during Phase I. Nitroaromatics were only detected in monitoring well 7GW08. Groundwater samples were not analyzed for volatile organic compounds during this sampling round.

A summary of the data collected during RFI is included in Appendix G.

3.4.2.3 Remedial Investigation - Phase II

During the Phase II RFI, two soil borings were advanced to a depth of 15 feet, with samples collected at 5, 10, and 15 feet below the ground surface. The samples were collected to characterize the vertical extent of contamination in the shallow soil within and just beyond the limits of the swale. As with the Phase I RFI, elevated concentrations of RDX, HMX and 2,4,6 TNT were detected in the subsurface soil.

During Phase II, the three existing wells were sampled and slug tests were performed at monitoring wells 7GW41 and 7GW43. Low levels of volatile organics, including cis-1,2-dichloroethene, TCE, and 1,1,2,2-tetrachloroethane were detected in the groundwater during Phase II. Nitroaromatics were also detected in the groundwater at monitoring well 7GW08.

A summary of the data collected during RFI is included in Appendix G.

3.4.2.4 Feasibility Study

The RFI concluded that a significant threat to human health and the environment existed through potential exposure to nitroaromatic and volatile organic contaminants in soil and groundwater. In response to the recommendations of the RFI Report, a draft CMS was prepared. The remedial objectives outlined included the removal of the contaminant source to prevent further contaminant migration into the groundwater and limiting further migration of the contaminants identified in the groundwater. The recommended RA for Site 7 consisted of soil washing within the swale with associated groundwater treatment.

3.4.2.5 Wetland/Forest Stand Delineation

Site 7 does not contain wetlands as defined in 33 CFR 328 or delineation criteria in the 1987 Corps of Engineers Wetlands Delineation Manual (USCOE, 1987). In addition, Site 7 does not contain other areas regulated under Section 404 of the CWA or the Maryland Nontidal Wetlands Protection Act.

The proximity of the drainage swale is surrounded by Pine Forest, while further to the west, north, and east, Oak-Hickory Forest is present.

3.4.2.6 Groundwater Characterization Study

During June 1997 the four existing groundwater monitoring wells and piezometer were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL inorganics, cyanide, TCL pesticide/PCBs, and Method 8330 explosives. Nitroaromatic contamination was identified in monitoring well 7GW08, while TCE contamination was identified in wells 7GW41, 7GW43, and piezometer 7PZ42. A summary of the data is provided in Appendix G.

3.5 SITE 8 - ABANDONED CHEMICAL DISPOSAL PIT

The Abandoned Chemical Disposal Pit is located along the southern facility boundary, at the end of Perimeter Road. The site has been described as a pit 10-feet by 10-feet by 12-feet. The location of the site was identified during the Design Verification Study with the location confirmed through a site geophysical investigation in the Summer of 1996 and the excavation activities conducted in the Fall of 1996. The major features of Site 8 are shown on Figure 3-5.

Site 8 was used from 1951 until 1971 for disposal of miscellaneous waste chemicals from laboratories at the NSWC-White Oak facility. Wastes disposed at this site included acids, mercury, solvents, and numerous, unidentified waste chemicals. The primary wastes of concern include solvents and mercury. It has been estimated that approximately 180 pounds of mercury were disposed at this location.

3.5.1 Physical Characteristics

The site is relatively flat with no surface water features within proximity to the site. Surface water would be expected to infiltrate the soils overlying the site and migrate into the subsurface soils or flow towards the east.

The Upland Sand and Gravel and the saprolite of the Wissahickon Formation are the two geologic units present at Site 8. The Upland Sand and Gravel ranges in thickness from 0 to 10 feet. The saprolite at Site 8 begins approximately 5 to 10 feet below ground surface and ranges thickness from 20 to 39 feet.

Groundwater flow direction at Site 8 is to the north, discharging to an unnamed, intermittent tributary of Paint Branch Creek along the northern boundary of the site. The unnamed, intermittent tributary also receives runoff from Site 11. Depth to groundwater ranges from approximately 31 to 38 feet, with the average saturated aquifer thickness of 20 feet. The estimated hydraulic conductivity of the Upland Sand and Gravel at Site 8 is approximately 2.28×10^{-3} cm/sec(6.46 feet/day).

Additional detail related to the physical characteristics of the site are provided in Section 4.0.

3.5.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or media sampling. Conducted in 1984, the IAS identified wastes which were potentially disposed at Site 8, and the period of time during which the site was active. This information was ascertained through a

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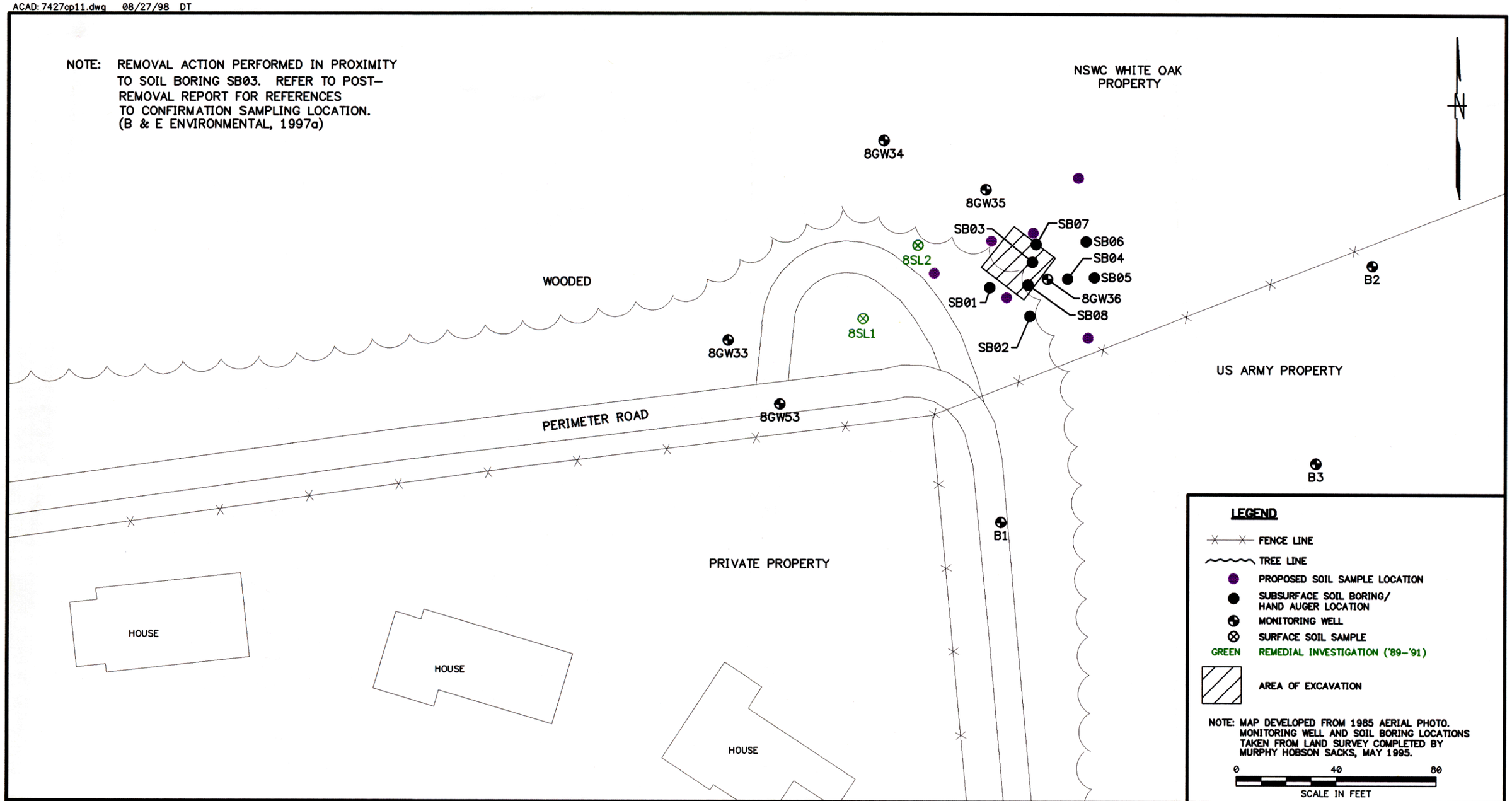
NOTE: REMOVAL ACTION PERFORMED IN PROXIMITY TO SOIL BORING SB03. REFER TO POST-REMOVAL REPORT FOR REFERENCES TO CONFIRMATION SAMPLING LOCATION. (B & E ENVIRONMENTAL, 1997a)



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 3/4/97
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

Tetra Tech NUS, Inc.

SITE 8 – ABANDONED CHEMICAL DISPOSAL PIT
NSWC –WHITE OAK,SILVER SPRING, MARYLAND
PROPOSED/EXISTING SAMPLING LOCATIONS

CONTRACT NO. 7687
OWNER NO. 0298
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3-5
REV. 0

FORM CADD MI SOUTH_BLDG4 - REV 0 - 02/11/97

review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 8, Abandoned Chemical Disposal Pit

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Remedial Investigation (Phase III)	1994	Sampling and analysis of groundwater samples from 5 existing wells
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory
Source Removal Action	1996	Removal of waste and contaminated soil from subsurface disposal area
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.5.2.1 Confirmation Study/Verification Phase

Four groundwater monitoring wells were installed and sampled during this investigation. In addition, a GPR geophysical survey was conducted in an attempt to locate the former underground disposal area, although results were inconclusive. The analytical data collected during this investigation suggested that no mercury contamination in the groundwater existed. Some metal and VOC contamination was detected in the groundwater, but only in significant concentrations in one well. TOC, TOX, and oil and grease results were relatively low.

3.5.2.2 Remedial Investigation - Phase I

During Phase I, two surficial soil samples were collected and a GPR survey was conducted. The GPR survey was conducted to better define the location of the abandoned disposal pit. The sampling was performed in an attempt to measure chemical concentrations in the soil, determine the potential presence of buried drums, and to assist in the prediction of contaminant movement.

The Phase I investigation also included the installation of one additional groundwater monitoring well. This well and the four previously installed wells were sampled during the Phase I RFI. During the well installation, split-spoon samples were collected to characterize the subsurface lithology.

3.5.2.3 Remedial Investigation - Phase II

During Phase II of the RFI, all five monitoring wells were sampled. In addition, single- and multiple-well tests were conducted to characterize the hydraulic characteristics of the water table aquifer. Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation and mammal surveys.

3.5.2.4 Feasibility Study

The draft RFI concluded that a significant threat to human health and the environment may exist in the future through potential contaminant exposure via groundwater and recommended remedial action. In response to the recommendations of the RFI report, a CMS was prepared in 1993. The remedial objectives outlined include the removal of any remaining contamination sources and the reduction of the health risks associated with exposure to contaminated groundwater. The CMS evaluated alternatives for achieving the remedial objectives. The recommended RA for Site 8 consisted of the excavation and thermal treatment of contaminated soils (estimated volume of 1,600 cubic yards), offsite disposal of excavated waste materials, and the installation of a groundwater extraction and treatment system.

3.5.2.5 Remedial Investigation - Phase III

Phase III of the RFI consisted of sampling of the five existing groundwater monitoring wells in April 1993. These results are provided in Appendix H.

3.5.2.6 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for the identification and removal of buried wastes at the site which may serve as a source of groundwater contamination. In order to further characterize the site and prepare remediation plans a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to removal of buried wastes at the site.

An EM survey of Site 8 was completed to define the extent of buried objects which might indicate the location of the chemical disposal pit. The survey was conducted across the entire site and extended into

the wooded area east of the road. A Geonics EM-31 Terrain Conductivity Meter was used to measure the ground conductivity in the immediate vicinity of the instrument to a depth of approximately 10 feet. Readings from this instrument were recorded at two positions at each grid point (with the EM-31 pointing north-south and again pointing east-west). Anomalous readings between grid points were noted and investigated further with the EM instrument.

Results of the survey indicated that EM anomalies were present between the turn-around and monitoring well 8GW36. Readings consistent with small buried objects were noted and these locations were marked in the field to be sampled with hand augers. The remainder of the site showed no significant EM anomalies which would be indicative of buried objects. Based on the results of the EM survey, the disposal pit is presumed to be located east of the turn-around, between the road and well 8GW36. This location is slightly east of the previously suspected disposal pit location. The limited magnitude of the EM deflections in this area indicates that the disposal pit is likely to be small (less than 10 x 10 feet) and probably does not contain large metal containers or drums. Small containers are thought to be present based on subsequent sampling at the site.

To define the extent of the material deposited in the waste pit, two hand auger borings (08-SB03 and 08-SB04) were advanced a minimum of four feet prior to sampling. The depths of fill material and contamination were observed to the extent possible and were recorded in the field log book. The locations of hand auger borings are shown on Figure 3-5.

During placement of hand auger boring 08-SB03, liquid mercury and broken glass were observed in the auger cuttings at a depth of one to two feet. A sample (08-SB03A-0102) of this material was collected prior to advancing the boring and analyzed for TAL metals to confirm the presence of the mercury contamination. No significant PID readings were observed. Soil boring 08-SB03 was then advanced to a depth of six feet. Visual analysis of the soil at these depths also indicated the presence of mercury. In addition, a white powder was observed at a depth of four to six feet. A sample of the soil contaminated with the white powder was collected and analyzed. Groundwater was observed at a depth of six feet within this boring.

Soil boring 08-SB04 was manually advanced to a depth of twelve feet. No apparent soil contamination was identified within soil boring 08-SB04.

For purposes of characterizing soil contamination outside of the immediate area of the disposal pit, four soil borings were placed at the site (08-SB01, 08-SB02, 08-SB05, and 08-SB06). These borings were used to collect soil samples adjacent to the disposal pit in order to better define the extent of contaminant

migration into surrounding soils. No significant contamination was detected in these borings. Visual observations and PID readings of the site soils did not identify any apparent contamination in the soil surrounding the disposal site.

In addition, two soil borings (08-SB07 and 08-SB08) were completed within a 10 foot radius of hand auger boring 08-SB03 to better define the extent of contamination found at this location. The locations of the soil borings are shown on Figure 3-5. Continuous split-spoon sampling occurred to the bottom of each boring. No contamination was identified within either boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained.

One soil sample was collected from each boring location. The sampling depth was based on obvious indications of contamination, such as stains or chemical odor, elevated PID readings, or the presence of fill material. Samples were collected at various depths within each boring, dependent upon the above observations. The identification of the sample depth is included as part of the sample identification (i.e., soil sample collected from boring 08-SB04 at depth of 10 to 12 feet is identified as 08-SB04-1012). Each soil sample was analyzed for TCL VOCs, TCL SVOCS, TKN, TAL metals and cyanide, pH, and nitroaromatic and nitrosamine compounds. Samples 08-SB07-0810 and 08-SB08-0810 were analyzed only for TCL VOCs and TAL metals. Only these groups of contaminants were identified at the suspected pit location (08-SB03). One additional sample (08-SB03A-0102) was collected from hand auger boring 08-SB03 and analyzed for TAL metals due to obvious liquid mercury contamination.

Three soil samples (08-SB03-0304, 08-SB04-1112, and 08-SB05-1618) collected from Site 8 were tested for PCBs using Ensys PCB RISC® Soil test kits. The results of the PCB field screening indicated the presence of elevated PCB levels (> 4.0 ppm Aroclor 1260) in soil sample 08-SB03-0304. However, screening results of the other samples indicated nondetectable PCB levels for Aroclor 1260 based on a 0.4 ppm detection limit.

In addition to samples collected for chemical analysis, two subsurface soil samples (08-SB02-0608, 08-SB06-0406) were collected for determination of geotechnical parameters, including soil classification, grain size, and moisture content. These samples consisted of site representative soils collected from auger cuttings at the sampling location.

3.5.2.7 Wetland/Forest Stand Delineation

A wetlands delineation and forest inventory were conducted at Site 8. Site 8 does not contain wetlands as defined in 33 CFR 328 or delineation criteria in the 1987 Corps of Engineers Wetlands Delineation Manual

(USCOE, 1987). In addition, Site 8 does not contain other areas regulated under Section 404 of the CWA or the Maryland Nontidal Wetlands Protection Act.

Hardwood forest vegetation at Site 8 was inventoried in accordance with the Maryland Forest Conservation Act. No specimen trees or other outstanding vegetation was noted.

3.5.2.8 High Resolution Electromagnetic Survey

During September 1996, a HREM survey was performed at Site 8. The survey was performed to verify the results of the terrain conductivity survey previously performed at the site during the Design Verification Study prior to completion of a source removal action. The results of the HREM survey are provided in Appendix H.

3.5.2.9 Source Removal Action

In response to the draft CMS recommendations related to soil contamination at the site, a removal action was conducted in October and November of 1996. At that time, 100 tons of nonhazardous solid waste, including soil and debris, were excavated from the site and transported offsite for disposal. Excavated materials included mercury filled vials, a white powder, and a Plexiglass cube filled with saline solution. Soil samples were collected at various stages during the excavation activities to confirm the removal of contaminants.

3.5.2.10 Groundwater Characterization Study

During May 1997 the five existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL inorganics, cyanide, TCL pesticide/PCBs, and Method 8330 explosives.

3.5.2.11 Army Research Laboratory Investigations

In addition to work performed by the Navy at NSWC-White Oak, additional investigations have been performed by the US Army Corps of Engineers in support of the neighboring Army Research Laboratory. Work to date has included the installation of three groundwater monitoring wells in areas believed to be downgradient of Site 8, and the collection of groundwater samples at these wells. The investigations have been conducted on two occasions, during 1994 and again in 1997.

3.6 SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300

The Industrial Wastewater Disposal Area 300 is located south of Dahlgren Road along the Montgomery/Prince George's County line and extends southward to the facility boundary. A perennial tributary of Paint Branch Creek is located west and south of the site and an intermittent tributary of the creek is located to the east. Figure 3-6 identifies the major features of Site 9.

The Industrial Wastewater Disposal Area 300 was used from the early 1950s until the mid-1970s. Several leaching wells and above ground discharges to the soil were used in this area for disposal of liquid wastes containing explosive related compounds. Wastewater disposed at the site contained TNT, RDX, and several other explosive related compounds. It is estimated that at least 7,200 pounds of these wastewaters were disposed at this site over a period of approximately 25 years. It is also reported that solvents were disposed in the same manner as the explosive compounds.

3.6.1 Physical Characteristics

Site 9 comprises a mosaic of remnant forest patches and lawns and parking lots surrounding several small building and other structures. Most of the forest remnants comprise Oak Hickory Forest dominated by upland oaks with a dense understudy of mountain laurel. Forest areas on the east and west sides of Site 9 comprise Mixed Deciduous Forest dominated by tulip popular and upland oaks.

The Upland Sand and Gravel, the Potomac Group, and the saprolite of the Wissahickon Formation underlie Site 9. The uppermost geologic unit is the Upland Sand and Gravel, underlain by the Potomac Group. The saprolite member and fractured gneiss of the Wissahickon Formation underlie the unconsolidated sediments of the Upland Sand and Gravel and the Potomac Group. Some of the unconsolidated units have been eroded by the perennial stream to the west of the site and the intermittent stream to east of the site. Both streams are tributaries to Paint Branch Creek. The northern part of the site has experienced less erosion than the southern part.

Based on borehole data, the northern portion of the site is underlain by approximately 40 to 65 feet of unconsolidated sediments. Several silty clay seams exist within the unconsolidated sediments. These layers are localized and are not laterally continuous. The saprolite member of the Wissahickon Formation occurs at approximately 40 feet below ground surface and is approximately 25 feet thick. Below the saprolite and weathered gneiss, a highly weathered gray-green chlorite schist of the Wissahickon Formation occurs at approximately 65 feet below the ground surface.

NOTE: REMOVAL ACTION PERFORMED AT LEACHING WELLS 1 AND 9. REFER TO POST-REMOVAL ACTION REPORT FOR DETAILS AND CONFIRMATION SAMPLING LOCATIONS.

LEGEND

- PROPOSED SEDIMENT/SURFACE WATER SAMPLE LOCATION
- PROPOSED GROUNDWATER SAMPLE LOCATION
- SEDIMENT SAMPLE
- MONITORING WELL LOCATION
- PIEZOMETER LOCATION
- SUBSURFACE SOIL BORING LOCATION/ LEACHING WELL SAMPLE
- TEMPORARY WELL
- GEOPHYSICAL SURVEY GRID AREA

GREEN REMEDIAL INVESTIGATION ('89-91')
RED CONFIRMATION STUDY
PURPLE PROPOSED

NOTE: MAP DEVELOPED FROM 1985 AERIAL PHOTO. MONITORING WELLS, PIEZOMETER, LEACHING WELL AND SUBSURFACE SOIL BORING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY1995

0 100 200
SCALE IN FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
CHESAPEAKE DIVISION
WASHINGTON, DC
NSWC WHITE OAK
SILVER SPRING, MD

SITE 9
INDUSTRIAL WASTEWATER DISPOSAL 300 AREA
EXISTING/PROPOSED SAMPLING LOCATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
NAVFAC DRAWING NO.
SPEC.
SHEET OF

FIG. 3-6

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

DES. DR. HJP CHK.
SUBMITTED BY: TITLE DATE
PROGRAM MANAGER DATE
APPROVED DATE
EFD FOR COMMANDER NAVFAC

09A	403
04	404
E.I.C.	405
401	408
402	04B

REVIEWED BY ROICC DATE

SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

The southern portion of Site 9 is covered by approximately 5 to 15 feet of interbedded red-gray sands, underlain by the saprolite member of the Wissahickon Formation. The saprolite occurs at approximately 5 to 18 feet below ground surface. This variation in thickness may result from erosion rates of the unconsolidated sediments along stream valleys in the southern portion of Site 9.

Based on previous studies, the groundwater flow direction in the northern part of Site 9 is to the south-southwest toward the perennial stream west of the site. Groundwater flow direction in the southern pat of the site is to the southeast. During periods of high water table elevations, the groundwater discharge in this area is to the intermittent stream east of the site.

The physical characteristics of the water table change across the site from the north to the south. In the northern portion of the site, the water table aquifer occurs in the Upland Sand and Gravel unit and, to a minor extent, in the underlying saprolite. In the southern portion of the site, the water table aquifer occurs in the saprolite. Depths to the water table range from approximately 55 feet in the north to 10 feet in the south. The estimated average saturated thickness of the water table aquifer in the Upland Sand and Gravel is 18 feet in the northern portion of the site and 5 feet in the saprolite unit in the southern portion of the site. Based on slug tests, the average hydraulic conductivity for Site 9 is 1.93 ft/day (6.8×10^{-4} cm/sec).

Additional detail related to the physical characteristics of the site are provided in Section 4.0.

3.6.2 Previous Investigations

The IAS was conducted at Site 9 during 1984 and did not involve any intrusive investigations or media sampling. The IAS identified wastes which were potentially disposed at Site 9, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 9, Industrial Wastewater Disposal 300 Area

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options

Study Description	Date	Procedure
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory
Source Removal Action	1996	Removal of waste and contaminated soil from 2 leaching well locations
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.6.2.1 Confirmation Study/Verification Phase

Seven groundwater monitoring wells were installed and sampled during this investigation. In addition, 15 sediment locations were sampled. Generally, TOC and TOX values were detected at low concentrations throughout the site. Metal concentrations were low at all sampling locations. Nitroaromatic contamination was found in one sediment sample and in one groundwater monitoring well.

3.6.2.2 Remedial Investigation - Phase I

During Phase I of the RFI, three surface water and 10 sediment samples were collected from the small stream east of the site and from the stream west of the site. In addition, two surface soil samples were collected. Six soil gas surveys of the soil near former leaching well fields were conducted to measure the release of gaseous VOCs, predict the contaminant movement through the vadose zone, and measure the chemical contamination in the surface soil.

Three piezometers and six groundwater monitoring wells were installed during Phase I. Two wells were installed as a cluster, one shallow and one deep. Thirteen groundwater monitoring wells were then sampled. During the well and piezometer installation, split-spoon samples were collected to characterize the subsurface lithology.

A summary of the analytical data collected during the RFI is included in Appendix I.

3.6.2.3 Remedial Investigation - Phase II

During the Phase II investigation, three surface water and 10 sediment samples were collected from the small stream east of the site and from the stream west of the site during the Phase II investigation. During Phase II one additional groundwater monitoring well was installed. Groundwater samples were then collected from 13 monitoring wells (one of the previous wells was damaged and not sampled). During the

well installation, split-spoon samples were collected to characterize the subsurface lithology. Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation, fish, benthic invertebrate, and mammal surveys.

A summary of the analytical data collected during the RFI is included in Appendix I.

3.6.2.4 Feasibility Study

The RFI concluded that a significant threat to human health and the environment may exist in the future through potential contaminant exposure via groundwater and recommended remedial action. In response to the recommendations of the RFI Report, a CMS was prepared. The remedial objectives outlined included the removal of any remaining contamination sources (i.e., leaching wells and surrounding soils) and the limitation of further migration of the contaminant plume in the groundwater. The recommended RA for Site 9 consisted of the excavation and thermal treatment of contaminated soils (estimated 1,100 cubic yards), offsite disposal of excavated waste materials, and the installation of a contaminated groundwater extraction and treatment system.

3.6.2.5 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for the removal of potential sources of groundwater contamination. In order to further characterize the site and prepare remediation plans a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to removal of groundwater contaminant sources.

From a review of NSWC-White Oak drawing files, 20 leaching well and leaching field locations were identified within Site 9. Following field investigations of the status of each location (to determine if a leaching well had been removed or remained at the facility), subsurface soil or waste sampling was conducted. The sampling and analysis was then used to characterize the nature of contamination within each leaching well (if intact) and in the soils in the vicinity of both intact and removed leaching wells and leaching fields. Additional sampling and analysis was performed in the vicinity of contaminated areas to define the extent of any contaminant migration. These results were then used to define the source removal action required at Site 9.

An attempt was made to locate all site leaching wells, fields, and associated piping through the review of existing facility drawings and use of geophysical survey equipment. Those leaching wells that were uncovered or exposed were subject to direct sediment sampling within the well. At locations where no well could be identified, a sample of the subsurface soil was collected from a soil boring located at or

immediately downgradient of the suspected leaching well location. Following the analysis of all samples, four additional soil borings were advanced in the vicinity of one representative leaching well which contained significant contamination (Leaching Well 9).

An EM and magnetometer survey of Site 9 was completed to determine the location of leaching wells and associated piping. EM surveys were conducted in all areas where leaching wells were suspected to exist but could not be located. A 20 foot by 20 foot survey grid was centered around the reported location of the leaching wells. An EM-38 was used to measure the ground conductivity in the immediate vicinity of the instrument to a depth of approximately 10 feet. Any locations exhibiting anomalous readings were staked and further investigated by hand augering or excavation. Magnetometers were also used to aid in the location of site leaching wells and piping.

The manhole leading to one intact leaching well (LW-5) was located during the EM survey of Site 9. Several locations (LW-2, LW-10, LW-11, LW-13, LW-14, LW-15, LW-16, LW-17, LW-19) showed significant EM anomalies, but upon further investigation, the readings were determined to be miscellaneous subsurface metallic debris. At locations LW-8, LW-3, LW-12, and LW-4, hand augering and excavation were unsuccessful in locating the sources of the significant anomalies identified nor the existence of a leaching well. The remainder of Site 9 showed no significant EM anomalies. Based on these results, LW-1 and LW-9 appear to be the only remaining intact leaching wells present at the site. However, the field investigation was unable to verify the existence of LW-8, LW-3, LW-12, and LW-4.

Two leaching wells (LW-1 and LW-9) were sampled to determine if the sediments/soils in each well were a source of contamination. See Figure 3-6 for leaching well locations. Leaching well conditions, well fill materials, soil types, and PID readings at each location were noted in the field log book. One sample was collected from each leaching well and analyzed for TCL VOCs, TCL SVOCs, TKN, TAL metals plus cyanide, pH, and nitroaromatic and nitrosamine compounds.

Eighteen soil borings were completed in the vicinity of suspected leaching well locations. The borings were used to collect soil samples from the expected bottom of the leaching well (10-15 feet below ground surface). Continuous split-spoon sampling occurred along the entire boring depth. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained.

One sample was collected from each soil boring. The sampling was based on obvious indications of contamination, such as staining, elevated PID readings, or bottom of borehole. Each sample was analyzed for TCL VOCs, TCL SVOCs, TKN, TAL metals plus cyanide CN, pH, and nitroaromatic and

nitrosamine compounds. In addition, one duplicate sample was taken during the initial round of sampling to verify laboratory performance.

In addition to samples collected for chemical analysis, two subsurface soil samples (09-SB09A-0406, 09-SB09C-0608) were collected for determination of geotechnical parameters which would aid in the selection of a soil remedial technology, if required. The parameters analyzed included soil classification, grain size, and moisture content. These samples consisted of site representative soils collected at sampling locations determined in the field.

In order to determine the depth and lateral extent of contamination which was found to be present in leaching well sediment during the initial round of testing, four secondary soil borings (09-SB09A, B, C, and D) were completed within a 15 foot radius of LW-9. See Figure 3-6 for boring locations. Three subsurface soil samples were collected from each boring, at shallow, intermediate and deep intervals. Samples were collected from depths that exhibited elevated PID readings and/or soil staining. Samples were analyzed for TCL SVOCs, TAL metals plus cyanide CN, and pH. Parameter selection was based upon the results of the initial leaching well sampling at LW-9. Only those parameters measured at significant concentrations within LW-9 were analyzed in the secondary borings. Continuous split-spoon sampling occurred to the end of each boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained.

A summary of the analytical data is included in Appendix I.

3.6.2.6 Wetland/Forest Stand Delineation

A wetlands delineation and forest inventory were conducted at Site 9. Wetlands on Site 9 are limited to a narrow stream originating near the northwest corner of the site and flowing southward down a steep gradient close to the site's eastern boundary. The stream flows into Paint Branch Creek to the south of Site 9, beyond the installation fence. The developed areas within the site occupy a low ridge that lacks wetlands.

Site 9 comprises a mosaic of remnant forest patches, lawns, and parking lots surrounding several small buildings and other structures. Most of the forest remnants comprise Oak Hickory Forest dominated by upland oaks with a dense understudy of mountain laurel. Forest areas on the east and west sides of Site 9 comprise Mixed Deciduous Forest dominated by tulip popular and upland oaks.

3.6.2.7 Source Removal Action

In response to the draft CMS recommendations related to soil contamination at the site, a removal action was conducted in October and November of 1996. Two existing leaching wells (LW-1 and LW-9) were excavated and disposed offsite. Surrounding soils were also excavated and disposed offsite. Soil samples were collected at various stages during the excavation activities to confirm the removal of contaminants.

3.6.2.8 Groundwater Characterization Study

During May 1997 the existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL metals plus cyanide, TCL pesticide/PCBs, and Method 8330 explosives.

3.7 SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100

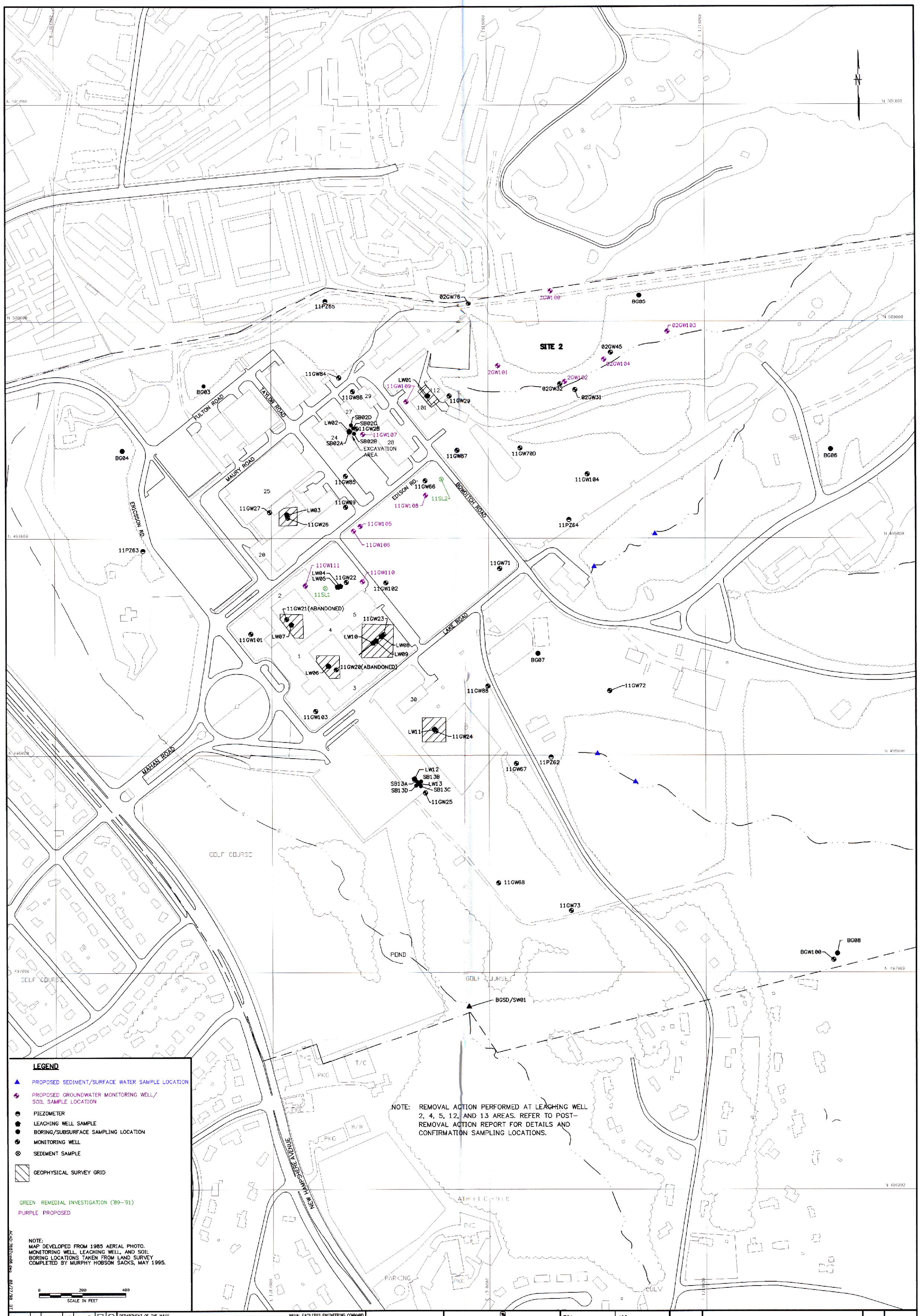
Site 11, Industrial Wastewater Disposal Area 100, contains 13 leaching wells in nine areas that were used for wastewater disposal from laboratory activities. The wells are located in an area covering approximately 16 acres. The wells are abandoned while the associated supply lines are believed to be in place. The wells were used for liquid waste disposal until 1976. Original construction consisted of an eight foot diameter, brick or concrete well, approximately nine feet in depth. Each well was accessible through a 24 inch diameter manhole cover. One supply line transported wastewater to each well. The locations of the leaching wells and the major features of Site 11 have been identified on Figure 3-7.

Wastes that were disposed at Site 11 include metals, acids, chlorinated and non-chlorinated solvents, alcohols, lead, and organic explosive compounds. The IAS reports that an estimated 20,000 gallons of waste were disposed in these leaching wells. Both listed and characteristic hazardous wastes are believed to have been disposed.

3.7.1 Physical Characteristics

Site 11 is entirely urban, lacking natural vegetated areas and forest cover. Information related to subsurface conditions is provided in the soil boring logs contained within previous environmental site investigation reports.

A thin layer of the Upland Sand and Gravel (0 to 20 feet thick) overlies the saprolite of the Wissahickon



LEGEND

- PROPOSED SEDIMENT/SURFACE WATER SAMPLE LOCATION
- PROPOSED GROUNDWATER MONITORING WELL/ SOIL SAMPLE LOCATION
- PIEZOMETER
- LEACHING WELL SAMPLE
- BORING/SUBSURFACE SAMPLING LOCATION
- MONITORING WELL
- SEDIMENT SAMPLE
- GEOPHYSICAL SURVEY GRID

GREEN REMEDIAL INVESTIGATION ('89–'91)
PURPLE PROPOSED

NOTE:
MAP DEVELOPED FROM 1985 AERIAL PHOTO. MONITORING WELL, LEACHING WELL, AND SOIL BORING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995.

0 200 400
SCALE IN FEET

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC

SITE 11
INDUSTRIAL WASTEWATER DISPOSAL AREA 100
EXISTING/PROPOSED SAMPLING LOCATIONS
NSWC–WHITE OAK, SILVER SPRING, MARYLAND

CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
SPEC.
NAVFAC DRAWING NO.
SHEET OF
FIG. 3-7

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

DES. DR. CHK.
SUBMITTED BY: TITLE DATE
PROGRAM MANAGER DATE
APPROVED DATE
EFD FOR COMMANDER NAVFAC

09A	403
04	404
E.I.C.	405
401	408
402	04B

REVIEWED BY ROICC DATE

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

Formation at Site 11. The Upland Sand and Gravel thickens to the east and southeast and consists of brown silt and red-brown fine to medium sand with some gravel. Clayey silt seams less than 1 foot thick and interbedded with fine gravel occur near the base of the unit. The Wissahickon Formation at Site 11 consists of the saprolite member, ranging in thickness from 5 to 55 feet, and a deeper weathered schist member, encountered in only one deep boring.

Groundwater is present in the saprolite and bedrock and, to a lesser extent, the Upland Sand and Gravel. Groundwater within the saprolite and bedrock units is along fracture zones. A shallow groundwater divide transects the site from northwest to southeast, passing approximately through the Main Administration Building. Groundwater flow is from the divide toward streams to the northeast and southwest.

Data from a pumping test at the site indicates that the saprolite layer has a hydraulic conductivity of 0.13 ft/day (4.62 x 10-5 cm/sec). Slug test data indicate a hydraulic conductivity of 2.84 ft/day (1x10-3 cm/sec) for the saprolite.

Additional detail related to the physical characteristics of the site are provided in Section 4.0.

3.7.2 Previous Investigations

The earliest site investigation consisted of the IAS, which did not involve any intrusive investigations or media sampling. Conducted in 1984, the IAS identified wastes which were potentially disposed at Site 11, and the period of time during which the site was active. This information was ascertained through a review of the operational history of the site and other relevant documents, plus interviews with facility personnel. Subsequent studies have included the following onsite investigative work:

Previous Investigation Summary - Site 11, Industrial Wastewater Disposal 100 Area

Study Description	Date	Procedure
Confirmation Study, Verification Phase	1987	Limited groundwater, surface water, sediment, and soil sampling
Remedial Investigation (Phase I/II)	1989/1993	Extensive site characterization and media sampling, risk characterization
Draft Feasibility Study	1993	Analysis of remedial options, risk mitigation options
Design Verification Study	1995	Focused soil sampling, electromagnetic surveys, remedial design analysis
Wetland/Forest Stand Delineation	1995	Identification and delineation of wetlands and a forest inventory

Study Description	Date	Procedure
Source Removal Action	1996	Removal of waste and contaminated soil from 5 leaching well locations
Groundwater Characterization Study	1997	Sampling and analysis of groundwater at all site monitoring wells

3.7.2.1 Confirmation Study/Verification Phase

During the Verification Phase at Site 11, eight monitoring wells were installed and sampled, with samples analyzed for VOCs, TLC metals, TOC, TOX, and oil and grease. Results from the groundwater analysis indicated that numerous site wells contained elevated levels of VOCs and metals. The areas with the highest level of contamination were those downgradient of Buildings 2, 3, and 4, which are located near the former leaching well locations.

3.7.2.2 Remedial Investigation - Phase I

During the RFI, four piezometers and nine groundwater monitoring wells were installed at the site. All site wells were then sampled and analyzed for VOCs, total and soluble metals, TOC, TOX, total dissolved solids (TDS), and total suspended solids (TSS). Results indicated that elevated levels of chromium, lead, and VOCs (including TCE, TCA, DCE, and DCA) were present in the groundwater. Contamination was highest in wells downgradient of Building 2 and 5.

Three surface water and three sediment samples were collected from the stream west of the site. Sediment samples were found to contain elevated levels of SVOCs and metals including chromium and lead. The sediment samples were not analyzed for VOCs. One surface water sample was found to contain an elevated level of lead. All other parameters were within background levels. Two surface soil samples were collected at the site and analyzed for semivolatiles and metals. Sample results indicated that no contaminants were present in surface soils.

Three soil gas surveys were completed at abandoned leaching well locations to determine if VOCs were present in the soil. Results of the soil gas survey were inconclusive.

A summary of the analytical data collected during the RFI is included in Appendix J.

3.7.2.3 Remedial Investigation - Phase II

During Phase II, five additional monitoring wells were installed at Site 11. Groundwater samples were collected and analyzed for metals and VOCs. Analytical results indicated that elevated levels of cadmium, chromium, lead, TCE, TCA, DCE and DCA were present. As in the Phase I investigation, the highest levels of contamination was found downgradient of Buildings 2 and 5. The area of Building 30 was also reported to be contaminated. In addition to groundwater sampling, slug tests and one pumping test were performed. Three monitoring wells were abandoned during this phase of the site investigation.

Three surface water and three sediment samples were collected from the stream west of the site at the same locations as used during the Phase I investigation. The samples were collected in an effort to determine a trend of contamination with time. Samples were analyzed for VOCs, SVOCs, and metals. No significant contaminant concentrations were found in the surface water. Elevated levels of cadmium, chromium, and lead were found in the sediment samples. No SVOCs were detected in these sediment samples.

During both the Phase I and Phase II sediment sampling activities, the largest sediment contaminant concentrations were found at sampling locations nearest the property limits of the facility. These results may indicate that an upgradient source may exist for these contaminants.

A summary of the analytical data collected during the RFI is included in Appendix J.

Ecological investigations were also conducted during Phase II to assess conditions on site. Included in the investigation were terrestrial vegetation, fish, benthic invertebrate, and mammal surveys.

3.7.2.4 Feasibility Study

The RFI concluded that a significant threat to human health and the environment may exist in the future through potential exposure to volatile organic contaminants via groundwater. In response to the recommendations of the RFI Report, a CMS was prepared. The remedial objectives outlined included the removal of any remaining contamination sources (i.e., leaching wells and surrounding soils) and the limitation of further migration of the contaminant plume in the groundwater. The recommended RA for Site 11 consisted of the excavation and thermal treatment of contaminated soils (estimated 500 cubic yards), offsite disposal of excavated waste materials, and the installation of a contaminated groundwater extraction and treatment system.

3.7.2.5 Design Verification Study

Following issuance of the draft CMS, plan preparation was initiated for the removal of potential sources of groundwater contamination In order to further characterize the site and prepare remediation plans, a field investigation was undertaken. The results of this Design Verification Study were used in the preparation of preliminary plans related to removal of groundwater contaminant sources.

From a review of NSWC-White Oak drawing files, 13 leaching well locations were identified within Site 11. Following field investigations of the status of each leaching well (to determine if a leaching well had been removed or remained at the facility), subsurface soil or waste sampling was conducted. The sampling and analysis was then used to characterize the nature of contamination within each leaching well (if intact) and in the soils in the vicinity of both intact and removed leaching wells. Additional sampling and analysis was performed in the vicinity of contaminated areas to define the extent of any contaminant migration. These results were then used to define the source removal action required at Site 11.

An EM survey of Site 11 was completed to determine the location of leaching wells or lines leading to a removed leaching well. EM surveys were conducted in three areas where leaching wells were suspected to exist but could not be located. The three survey grids were centered around the reported location of the leaching wells. EM results were noted at each grid point (at 20-foot spacings) and results were recorded. A Geonics EM-31 Terrain Conductivity Meter was used to measure the ground conductivity in the immediate vicinity of the instrument to a depth of approximately 10 feet. Readings from this instrument were recorded at two positions at each grid point (with the EM-31 pointing north-south and again pointing east-west). Any anomalous readings between grid points were noted and investigated further with the EM instrument.

The manhole leading to one intact leaching well (LW-4) was located during the EM survey of Site 11. This leaching well was subsequently sampled. The remainder of Site 11 showed no significant EM anomalies which may indicate buried objects. No indications of buried lines leading to leaching wells were noted during the surveys. The existing intact leaching wells present at the site (LW-2, LW-4, LW-6, LW-7, LW-12, and LW-13) appear to be the only leaching wells remaining at the site. The other leaching wells appear to have been removed, as no surface or subsurface indications were located during this investigation. EM Survey results are included in Appendix J.

Four individual leaching wells (LW-2, LW-4, LW-12, and LW-13) were sampled to determine if the sediments/soils in and around the well were a source of contamination. Leaching well locations are shown on Figure 3-7. Leaching well conditions, well fill materials, soil types, and PID readings at each location were noted in the field log book. One sample was collected from each leaching well (4 samples total) and

analyzed for TCL VOCs, TCL SVOCs, TKN, TAL metals plus cyanide, pH, and nitroaromatic and nitrosamine compounds.

Three initial hand auger borings (11-LW03, 11-LW06, 11-SB07) were taken at locations of suspected leaching wells that were inaccessible to a drill rig. The locations of these borings were determined based on a review of site drawings. The borings at LW-3 and LW-6 were manually advanced with a stainless steel hand auger assembly to a depth of 10 to 12 feet. This depth was chosen in an attempt to sample soil near the bottom of the suspected leaching wells. The boring at LW- 7 was mechanically advanced, using a powered auger, to a depth of only seven feet. Auger refusal occurred at this depth. Visual observations of the subsurface material were recorded in the field log book. In addition to hand auger borings, six initial soil borings were completed in the vicinity of suspected leaching well locations. The borings were used to collect soil samples from expected depth of the leaching well (10 to 15 feet below ground surface). Continuous split-spoon sampling occurred along the entire boring depth. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained.

One sample was collected from each hand auger and soil boring. The sampling was based on obvious indications of contamination, such as staining, elevated PID readings, or bottom of borehole. Each sample was analyzed for TCL VOCs, TCL SVOCs, TKN, TAL metals plus cyanide, pH, and nitroaromatic and nitrosamine compounds.

In addition to samples collected for chemical analysis, two subsurface soil samples (11-SB02D-0608, 11-SB13D-1012) were collected for determination of geotechnical parameters which would be important to the selection of a potential soil treatment remedial technology. The parameters analyzed included soil classification, grain size, and moisture content. These samples consisted of site representative soils collected at sampling locations determined in the field.

In order to determine the depth and lateral extent of contamination which was found to be present in subsurface soils during the initial round of testing, four secondary soil borings (11-SB13A, B, C, and D) were completed within a 15 foot radius of LW-13 and three secondary soil borings (11-SB02B, C, and D) were completed within a 15 foot radius of LW-2. Three subsurface soil samples were collected from each boring, at shallow, intermediate, and deep intervals. Samples were collected from depths that exhibited highest PID readings and/or soil staining. The locations of secondary soil borings are shown on Figure 3-7. Continuous split-spoon sampling occurred to the end of each boring. A lithologic description was made of each split-spoon sample and a complete log of each boring was maintained. In addition, one hand auger boring (11-SB02A) was completed upgradient of LW-2 as part of the secondary round of sampling. The hand auger boring was conducted due to the inaccessibility of the drilling equipment. This hand

auger boring was manually advanced 10 feet. Visual observations were made to identify the subsurface material and were recorded in the field log book. The location of this boring is shown in Figure 3-7.

Three samples were collected from each secondary hand auger and soil boring (24 samples total) in the vicinity of LW-2 and LW-13. The samples were collected based on obvious indications of contamination, such as staining or elevated PID readings. Samples were analyzed for TCL SVOCs, TAL metals plus cyanide, and pH. Parameter selection was based upon the results of the initial leaching well sampling at LW-2 and LW-13. Only those parameters measured at significant concentrations within LW-2 and LW-13 were analyzed in the secondary borings. In addition, two duplicate samples were taken during the secondary round of sampling to verify laboratory performance.

A summary of the analytical data is included in Appendix J.

3.7.2.6 Wetland/Forest Stand Delineation

A wetland delineation and forest inventory were conducted at Site 11 during the Design Verification Study. Site 11 does not contain wetlands as defined in 33 CFR 328 and meeting delineation criteria in the 1987 Corps of Engineers Wetlands Delineation Manual (USCOE, 1987). In addition, Site 11 does not contain other areas regulated under Section 404 of the CWA or the Maryland Nontidal Wetlands Protection Act. Site 11 is entirely urban, lacking natural vegetated areas that could potentially contain wetlands.

Site 11 lacks forest cover, therefore no forest inventory was completed.

3.7.2.7 Source Removal Action

In response to the draft CMS recommendations related to soil contamination at the site, a removal action was conducted in October and November of 1996. Five existing leaching wells (LW-2, LW-4, LW-5, LW-12, and LW-13) were excavated and disposed offsite. Surrounding soils were also excavated and disposed offsite. Soil samples were collected at various stages during the excavation activities to confirm the removal of contaminants.

3.7.2.8 Groundwater Characterization Study

During May 1997 the existing groundwater monitoring wells were sampled and analyzed for low concentration VOCs and SVOCs as well as TAL inorganics, cyanide, TCL pesticide/PCBs, and Method 8330 explosives. In addition, four new permanent and four temporary wells were installed and sampled. These wells were placed in areas believed to be potential property reuse locations.

3.8 BACKGROUND SAMPLING

Background samples have been collected for all media on and/or in the vicinity of the NSWC-White Oak facility during the previous investigations. It is believed that a sufficient database has been established to characterize regional background conditions. The locations of the previous background sampling locations are provided on Figures 3-8 and 3-9.

3.8.1 Surface Soil

Ten surface soil samples were collected during the background characterization study in the Fall of 1997. The analytical results are provided in Appendix K. The samples were collected from areas believed to not have been impacted by activities on the base.

3.8.2 Subsurface Soil

Three background subsurface soil samples (BG-01-0506, BG-02-0506 and BG-03-0506) were collected in the vicinity of Sites 8, 9, and 11 during the design verification study. Ten additional subsurface soil samples were collected during the background investigation in the Fall of 1997. The samples were collected from areas believed to not have been impacted by activities on the base. The analytical results are provided in Appendix K.

3.8.3 Surface Water/Sediment

Three surface water/sediment samples were collected from Paint Branch Creek during Phase I and Phase II of the RFI. These samples were used to characterize background conditions during the previous RFI work but will excluded from the surface water/sediment database for the purposes of this investigation. Instead, seven surface water/sediment samples (BG-SW/SD-05, 08, 12, 13, 15, and 16) collected during the background characterization study in the Fall of 1997 will be used to characterize background stream characteristics. The samples were collected from streams within the Paint Branch Creek watershed, upstream of the NSWC-White Oak property. The analytical results are provided in Appendix K.

3.8.4 Groundwater

Two background groundwater monitoring wells were installed at NSWC-White Oak during Phase I and II of the RFI (BGW16 and BGW40). These wells have been sampled on four occasions. In addition, three new background groundwater monitoring wells (BGW100, BGW101, and BGW102) have been installed on

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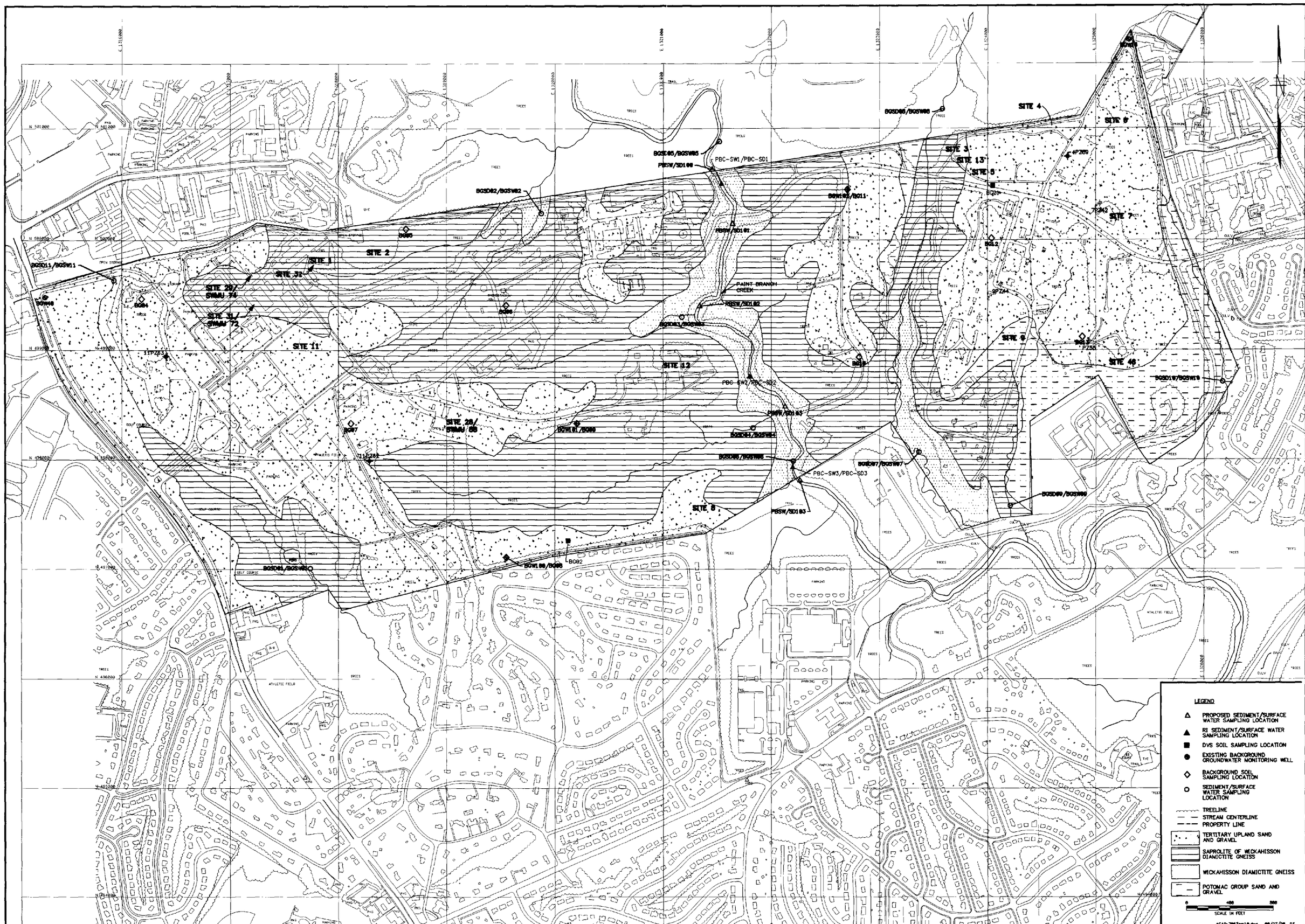
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 11
SITE 12
SITE 13
SITE 32
SITE 28/ SWMU 74
SITE 31/ SWMU 72
SITE 28/ SWMU 69
SITE 40
PAINT BRANCH CREEK
PBC-SW1/PBC-SD1
PBC-SW2/PBC-SD2
PBC-SW3/PBC-SD3
PBSW/SD100
PBSW/SD101
PBSW/SD102
PBSW/SD103
BGSD02/BGSW02
BGSD05/BGSW05
BGSD06/BGSW06
BGSD07/BGSW07
BGSD08/BGSW08
BGSD09/BGSW09
BGSD10/BGSW10
BGSD11/BGSW11
BGSD01/BGSW01
BGW100/BG00
BG02
BG01
BG11
BG12
BG13
BG14
BG15
BG16
BG17
BG18
BG84
BGW40
11PZ63
4PZ69
7PZ42
9PZ44
P258
LEGEND
PROPOSED SEDIMENT/SURFACE WATER SAMPLING LOCATION
RI SEDIMENT/SURFACE WATER SAMPLING LOCATION
DVS SOIL SAMPLING LOCATION
EXISTING BACKGROUND GROUNDWATER MONITORING WELL
BACKGROUND SOIL SAMPLING LOCATION
SEDIMENT/SURFACE WATER SAMPLING LOCATION
TREELINE
STREAM CENTERLINE
PROPERTY LINE
TERTITARY UPLAND SAND AND GRAVEL
SAPROLITE OF WICKAHISSON DIAMICTITE GNEISS
WICKAHISSON DIAMICTITE GNEISS
POTOMAC GROUP SAND AND GRAVEL
SCALE IN FEET
REVISIONS
DESCRIPTION
SYMBOL
DATE
APPROVED
D9A
403
404
405
408
D4B
DATE
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402
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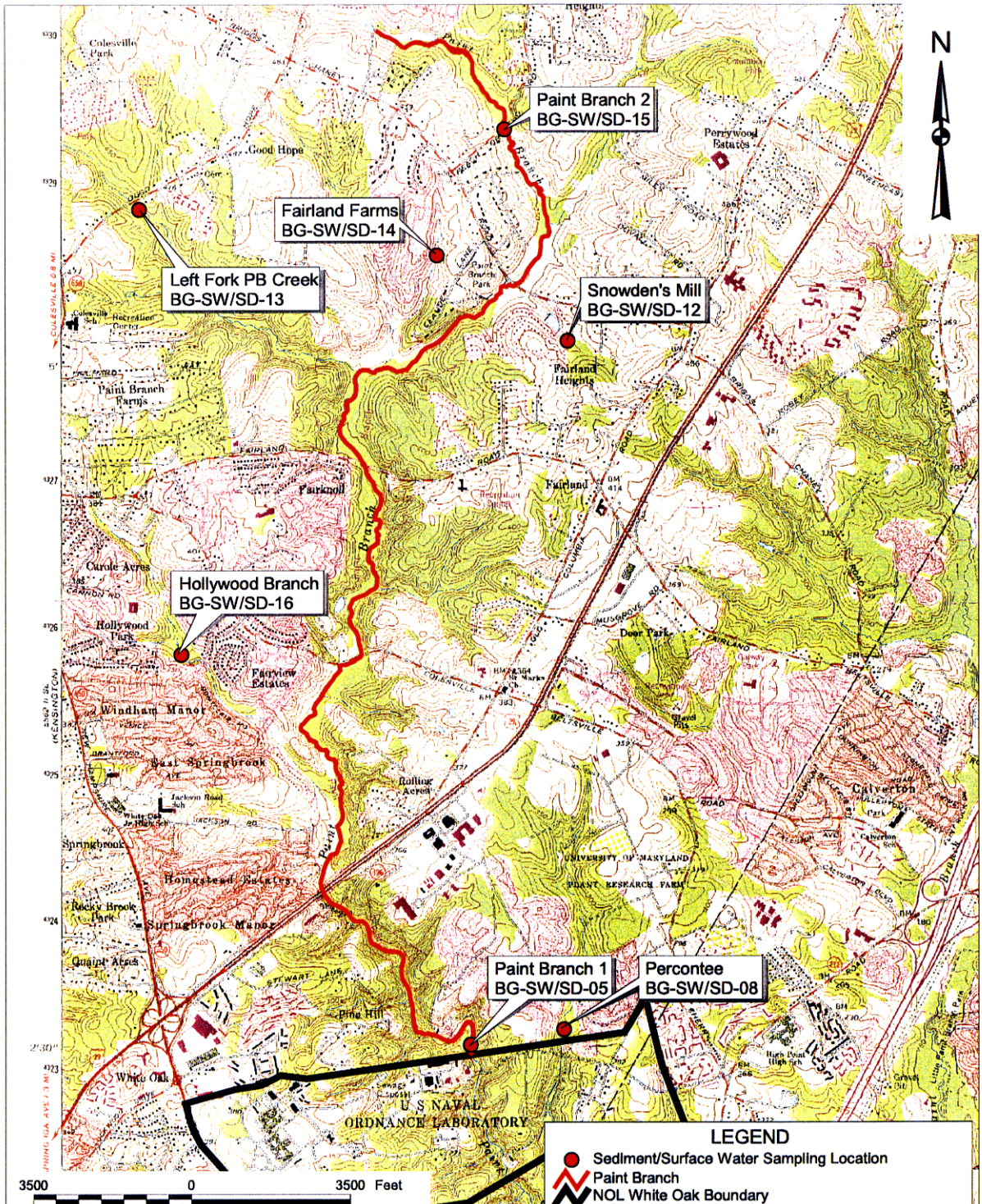
SUBMITTED BY:
PROGRAM MANAGER
APPROVED
EFD, CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC
PAINT BRANCH CREEK
EXISTING/PROPOSED BACKGROUND SAMPLING
NSWC, WHITE OAK, SILVER SPRING, MARYLAND
CODE I.D. NO. 80091
DRAWING SIZE: D
CONST. CONT. NO.
SPEC.
NAVFAC DRAWING NO.
SHEET OF
FIG. 3-8



DRAWN BY D. PERRY	DATE 3-FEB-98	Brown & Root Environmental	CONTRACT NUMBER 7687 / OWNER No. 1000
CHECKED BY	DATE	BACKGROUND SEDIMENT/SURFACE WATER SAMPLE LOCATIONS NSWC - WHITE OAK SILVER SPRING, MARYLAND	APPROVED BY — / DATE —
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING No. FIGURE 3-9 / REV 0

P:\GIS\APR\74271000.APR 3-FEB-98 DNP BACKGROUND LOCATIONS LAYOUT 2

00415F13Y

the NSWC-White Oak property. These new wells were sampled during November 1997. The analytical results obtained from the background groundwater monitoring wells are provided in Appendix K.

4.0 FIELD INVESTIGATION PROGRAM

This section outlines the field investigation program for the RFI at NSWC-White Oak. Section 4.1 summarizes the field investigation activities to be performed for this investigation. Section 4.2 presents the site-specific investigation activities, identifying the types, quantities, locations, and analyses of samples. Section 4.3 describes the methodologies for the field investigation activities, and Section 4.4 presents field sampling methodologies. Section 4.5 discusses the number and types of quality control samples to be collected for this investigation. Section 4.6 provides a schedule for the completion of field investigation activities.

4.1 FIELD INVESTIGATION SUMMARY

The following field investigation activities will be performed for this investigation:

- Fracture trace analysis
- Azimuthal resistivity surveying
- Geologic mapping
- EM geophysical surveying
- Monitoring well installation
- Specific capacity testing
- Water level measurements
- Groundwater sampling
- Surface and subsurface soil sampling
- Surface water sampling
- Sediment sampling
- Radiological and Background radiological sampling

In addition, pumping tests may be performed if significant groundwater contamination which would warrant treatment is found. Pumping test data would then be used for RA evaluations.

Table 4-1 summarizes the number of samples and the number of quality assurance and quality control samples to be collected for this investigation. A total of 64 surface soil samples (0-6"), 46 subsurface soil samples (>6"), 556 groundwater samples, 37 surface water samples, and 37 sediment samples will be collected for this investigation. The groundwater samples will be collected from both shallow and deep wells in order to determine if contaminant migration has resulted in contamination of deeper aquifers.

TABLE 4-1

SAMPLING PROGRAM SUMMARY
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Media	Environmental Samples								Subtotal	QA/QC Samples	Total
	Site							Paint Branch Creek		Duplicate	
	2	3	4	7	8	9	11				
Soil											
Surface (0-6")	26	15	10	7	6	0	0	0	64	7	71
Subsurface (>6")	10	7	10	13	6	0	0	0	46	5	51
Groundwater	44	56	140	32	32	132	120	0	556	56	612
Surface Water	14	5	0	0	0	9	4	5	37	4	43
Sediment	14	5	0	0	0	9	4	5	37	4	43
Background Radiological	0	0	0	0	0	0	0	0	40[1]	4	44

(1) Background radiological samples collected from non-site locations (10/media).

Investigations to date have only examined the surficial aquifer. In addition, 22 radiological samples and 40 background radiological samples will be collected.

4.2 SITE-SPECIFIC FIELD INVESTIGATION

This section describes the site-specific field investigation activities for each site. Methodologies for field investigation activities and field sampling are described in Section 4.3 and 4.4, respectively, and in the Master WP.

4.2.1 Site 2 - Apple Orchard Landfill

Data gaps and investigation rationale for Site 2 are provided in Table 4-2. Sampling locations, sample identification numbers, and analyses for Site 2 are summarized in Table 4-3. Sampling locations are illustrated on Figure 3-1.

Prior to beginning sampling activities at the site, a surface sweep of the site area will be performed to check for elevated levels of radium and uranium-related radionuclides (based on historic information, these radionuclides may have been used in early experiments at the base). The survey will be performed by and in accordance with procedures to be identified by the Navy's Radiological Affairs Support Office (RASO). Where elevated levels of radionuclides are identified during the field surveys, the suite of analyses for soil and groundwater samples will be expanded to include radionuclides.

Twenty-six surface soil and 10 subsurface soil samples will be collected at Site 2. Twenty-four surface soil samples will be collected from hand auger borings on the surface of and along the perimeter of the landfill. Two surface soil samples will be collected from the proposed well borings at the base of the landfill. Surface soil samples will be collected from 0 to 6 inches. Eight subsurface soil samples will be collected from hand auger borings along the perimeter of the landfill. Two subsurface soil samples will be collected from the two proposed well borings at the base of the landfill. Subsurface soil samples will be collected at an interval between 6 inches to 10 feet or at the water table, if shallower than 10 feet. Six surface soil samples (255120-125) will be collected for PCB analyses only, to delineate an area of PCB contamination along Perimeter Road. The remaining soil samples from Site 2 will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

Eleven groundwater samples will be collected at Site 2 during each of four quarterly rounds from five existing monitoring wells (2GW30, 2GW31, 2GW32, 2GW45, and 2GW76) and six proposed monitoring wells (2GW100, 2GW101, 2GW102, 2GW103, 2GW104, and 2GW105) for determination of extent of TCE contamination. The locations of the six proposed monitoring wells are shown on Figure 3-1, and a

TABLE 4-2

INVESTIGATION RATIONALE
SITE 2 - APPLE ORCHARD LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Location	Location/Depth	Analysis
SOIL					
Nature and extent of contamination beyond limit of landfill	Soil sampling	10	2	Along perimeter of landfill/ Surface (0-6") and subsurface (6"-10')	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Human health risk and ecological risk data		10	1	On surface of landfill/Surface (0-6")	
Extent of PCB contamination along Perimeter Road	Soil Sampling	6	1	Surface (0 - 6")	PCBs
GROUNDWATER					
Lateral and vertical extent of TCE contamination Human health risk data	Groundwater sampling	11	4	5 Existing monitoring wells 6 Proposed monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	13	1	5 Existing monitoring wells 5 Proposed monitoring wells 3 Stream gauges	Potentiometric surface contouring
	Slug tests	6	1	New wells	
	Bedrock fracture mapping	1	NA	Sitewide	Fracture trace analysis
SURFACE WATER					
Nature and extent of contamination Human health and ecological risk data	Surface water sampling	12	1	5 along drainage west of Site 2 7 along drainage south of Site 2	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN
	Outfall surface water sampling	2	1	2 NPDES outfalls southwest of Site 2	TSS/TDS Explosives (Method 8330)
SEDIMENT					
Nature and extent of contamination Human health and ecological risk data	Sediment sampling	12	1	5 along drainage west of Site 2 7 along drainage south of Site 2	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN
	Outfall sediment sampling	2	1	2 NPDES outfalls southwest of Site 2	TOC, Grain size Explosives (Method 8330)

TABLE 4-3

SITE SAMPLING PROGRAM
SITE 2 - APPLE ORCHARD LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 4

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis								
			Target Compound List (TCL)			TAL(6)	TCLP(8)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Metals	Explosives (Method 8330)	TOC(9)	TSS/ TDS(10)	Grain Size
SOIL											
2SS100-01-00	2SB100/ 2GW100	0-0.5	•	•	•	•	•	•			
2SU100-0X-00	2SB100/ 2GW100	0.5-10	•	•	•	•	•	•			
2SS101-01-00	2SB101/ 2GW101	0-0.5	•	•	•	•	•	•			
2SU101-0X-00	2SB101/ 2GW101	0.5-10	•	•	•	•	•	•			
2SS102-01-00	2SB102	0-0.5	•	•	•	•	•	•			
2SU102-0X-00	2SB102	0.5-10	•	•	•	•	•	•			
2SS103-01-00	2SB103	0-0.5	•	•	•	•	•	•			
2SU103-0X-00	2SB103	0.5-10	•	•	•	•	•	•			
2SS104-01-00	2SB104	0-0.5	•	•	•	•	•	•			
2SU104-0X-00	2SB104	0.5-10	•	•	•	•	•	•			
2SS105-01-00	2SB105	0-0.5	•	•	•	•	•	•			
2SU105-0X-00	2SB105	0.5-10	•	•	•	•	•	•			
2SS106-01-00	2SB106	0-0.5	•	•	•	•	•	•			
2SU106-0X-00	2SB106	0.5-10	•	•	•	•	•	•			
2SS107-01-00	2SB107	0-0.5	•	•	•	•	•	•			
2SU107-0X-00	2SB107	0.5-10	•	•	•	•	•	•			
2SS108-01-00	2SB108	0-0.5	•	•	•	•	•	•			
2SU108-0X-00	2SB108	0.5-10	•	•	•	•	•	•			
2SS109-01-00	2SB109	0-0.5	•	•	•	•	•	•			

TABLE 4-3

SITE SAMPLING PROGRAM
SITE 2 - APPLE ORCHARD LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 4

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis								
			Target Compound List (TCL)			TAL(6)	TCLP(8)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Metals	Explosives (Method 8330)	TOC(9)	TSS/ TDS(10)	Grain Size
SOIL (Continued)											
2SU109-0X-00	2SB109	0.5-10	•	•	•	•		•			
2SS110-01-00	2SS110	0-0.5	•	•	•	•		•			
2SS111-01-00	2SS111	0-0.5	•	•	•	•		•			
2SS112-01-00	2SS112	0-0.5	•	•	•	•		•			
2SS113-01-00	2SS113	0-0.5	•	•	•	•		•			
2SS114-01-00	2SS114	0-0.5	•	•	•	•		•			
2SS115-01-00	2SS115	0-0.5	•	•	•	•		•			
2SS116-01-00	2SS116	0-0.5	•	•	•	•		•			
2SS117-01-00	2SS117	0-0.5	•	•	•	•		•			
2SS118-01-00	2SS118	0-0.5	•	•	•	•		•			
2SS119-01-00	2SS119	0-0.5	•	•	•	•		•			
2SS120-01-00	2SS120	0-0.5			•						
2SS121-01-00	2SS121	0-0.5			•						
2SS122-01-00	2SS122	0-0.5			•						
2SS123-01-00	2SS123	0-0.5			•						
2SS124-01-00	2SS124	0-0.5			•						
2SS125-01-00	2SS125	0-0.5			•						
GROUNDWATER(11)											
2GW30-00-01	2GW30	--	•	•	•	•		•			
2GW31-00-01	2GW31	--	•	•	•	•		•			
2GW32-00-01	2GW32	--	•	•	•	•		•			
2GW45-00-01	2GW45	--	•	•	•	•		•			
2GW76-00-01	2GW76	--	•	•	•	•		•			

TABLE 4-3

SITE SAMPLING PROGRAM
SITE 2 - APPLE ORCHARD LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 3 OF 4

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis								
			Target Compound List (TCL)			TAL(6)	TCLP(8)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Metals	Explosives (Method 8330)	TOC(9)	TSS/ TDS(10)	Grain Size
GROUNDWATER (Continued)											
2GW100-00-01	2GW100	--	•	•	•	•		•			
2GW101-00-01	2GW101	--	•	•	•	•		•			
2GW102-00-01	2GW102	--	•	•	•	•		•			
2GW103-00-01	2GW103	--	•	•	•	•		•			
2GW104-00-01	2GW104	--	•	•	•	•		•			
2GW105-00-01	2GW105	--	•	•	•	•		•			
SURFACE WATER											
2SW100-00-01	2SW100	--	•	•	•	•		•		•	
2SW101-00-01	2SW101	--	•	•	•	•		•		•	
2SW102-00-01	2SW102	--	•	•	•	•		•		•	
2SW103-00-01	2SW103	--	•	•	•	•		•		•	
2SW104-00-01	2SW104	--	•	•	•	•		•		•	
2SW105-00-01	2SW105	--	•	•	•	•		•		•	
2SW106-00-01	2SW106	--	•	•	•	•		•		•	
2SW107-00-01	2SW107	--	•	•	•	•		•		•	
2SW108-00-01	2SW108	--	•	•	•	•		•		•	
2SW109-00-01	2SW109	--	•	•	•	•		•		•	
2SW110-00-01	2SW110	--	•	•	•	•		•		•	
2SW111-00-01	2SW111	--	•	•	•	•		•		•	
2SW112-00-01	Outfall	--	•	•	•	•		•		•	
2SW113-00-01	Outfall	--	•	•	•	•		•		•	
SEDIMENT											
2SD100-00-01	2SD100	--	•	•	•	•		•	•		•

TABLE 4-3

SITE SAMPLING PROGRAM
SITE 2 - APPLE ORCHARD LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 4 OF 4

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis								
			Target Compound List (TCL)			TAL(6)	TCLP(8)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Metals	Explosives (Method 8330)	TOC(9)	TSS/ TDS(10)	Grain Size
SEDIMENT (Continued)											
2SD101-00-01	2SD101	--	•	•	•	•		•	•		•
2SD102-00-01	2SD102	--	•	•	•	•		•	•		•
2SD103-00-01	2SD103	--	•	•	•	•		•	•		•
2SD104-00-01	2SD104	--	•	•	•	•		•	•		•
2SD105-00-01	2SD105	--	•	•	•	•		•	•		•
2SD106-00-01	2SD106	--	•	•	•	•		•	•		•
2SD107-00-01	2SD107	--	•	•	•	•		•	•		•
2SD108-00-01	2SD108	--	•	•	•	•		•	•		•
2SD109-00-01	2SD109	--	•	•	•	•		•	•		•
2SD110-00-01	2SD110	--	•	•	•	•		•	•		•
2SD111-00-01	2SD111	--	•	•	•	•		•	•		•
2SD112-00-01	Outfall	--	•	•	•	•		•	•		•
2SD113-00-01	Outfall	--	•	•	•	•		•	•		•

• To be analyzed.

(1) "-0X" denotes split-spoon number or hand auger beginning sample depth.
(2) Below ground surface.
(3) Volatile organic compounds.
(4) Semivolatile organic compounds.
(5) Polychlorinated biphenyls.
(6) Target analyte list.
(7) Cyanide.
(8) Toxicity characteristic leachate procedure.
(9) Total organic carbon.
(10) Total suspended solids/Total dissolved solids.
(11) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

description of monitoring well installation is provided in Section 4.3.5. The shallow monitoring wells 2GW100, 2GW101, 2GW103, and 2GW105 will be screened to intersect the water table, and the deep monitoring wells 2GW102 and 2GW104 will be installed with at least a 5 to 10 foot separation between the top of the screen of the deep well and the bottom of the screen of the adjacent shallow well. In the event that the thickness of the water table aquifer (in most cases, the Coastal Plain deposits) is limited to the point that an adequate separation between the well screens cannot be achieved within the aquifer, the deep well will be installed within the upper portion of the next significant water-bearing unit down, i.e., the fractured bedrock aquifer. Groundwater samples will be analyzed for TCL VOCs, SVOCS, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330). All new wells will be slug tested, to provide information regarding the hydraulic characteristics of the screened formations.

A minimum of 14 surface water samples will be collected at Site 2. Five samples will be collected from the drainage west of the landfill, and seven samples will be collected from the drainage south of the landfill (Figure 3-1). Two samples will be collected from NPDES outfalls south of the site. In addition, a visual inspection of the landfill area will be performed and any seeps identified emanating from the landfill will be sampled. Surface water samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), and TSS/TDS.

A minimum of 14 sediment samples will be collected at Site 2. Five samples will be collected from the drainage west of the landfill, and seven samples will be collected from the drainage south of the landfill. (Figure 3-1). Two samples will be collected from NPDES outfalls south of the site. Sediment samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), TOC, and grain size.

4.2.2 Site 3 - Pistol Range Landfill

Data gaps and investigation rationale for Site 3 are provided in Table 4-4. Sampling locations, sample identification numbers, and analyses for Site 2 are summarized in Table 4-5. Sampling locations are illustrated on Figure 3-2.

Prior to beginning sampling activities at the site, a surface sweep of the site area will be performed to check for elevated levels of radium and uranium-related radionuclides (based on historic information, these radionuclides may have been used in early experiments at the base). The survey will be performed by and in accordance with procedures to be identified by the Navy's Radiological Affairs Support Office (RASO). Where elevated levels of radionuclides are identified during the field surveys, the suite of analyses for soil and groundwater samples will be expanded to include radionuclides.

TABLE 4-4

INVESTIGATION RATIONALE
SITE 3 - PISTOL RANGE LANDFILL
NSWC - WHITE OAK, SILVER SPRING MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
Nature and extent of contamination beyond limit of landfill	Soil sampling	7	2	Along perimeter of landfill / Surface (0-6") and subsurface (6"-10')	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Human health risk and ecological risk data		8	1	On surface of landfill /Surface (0-6")	
GROUNDWATER					
Nature and extent of contamination	Groundwater sampling	14	4	7 Existing monitoring wells 7 Proposed monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	16	1	7 Existing monitoring wells 7 Proposed monitoring wells	Potentiometric surface contouring
	Bedrock fracture mapping	1	NA	2 Stream gauges Sitewide	Fracture trace analysis
	Slug tests	7	1	New wells	
	Pumping test	1	NA	To be determined	To be determined
SURFACE WATER					
Nature and extent of contamination Human health and ecological risk data	Surface water sampling	5	1	3 along drainage west of Site 2 2 along drainage south of Dahlgren Road	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TSS/TDS Explosives (Method 8330)
SEDIMENT					
Nature and extent of contamination Human health and ecological risk data	Sediment sampling	5	1	3 along drainage west of Site 2 2 along drainage south of Dahlgren Road	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TOC, Grain size Explosives (Method 8330)

TABLE 4-5

SITE SAMPLING PROGRAM
SITE 3 - PISTOL RANGE LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 3

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis							
			Target Compound List (TCL)			TAL(6)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Explosives (Method 8330)	TOC(8)	TSS/ TDS(9)	Grain Size
SOIL										
3SS101-01-00	3SB101/ 3GW101	0-0.5	•	•	•	•	•			
3SU101-0X-00	3SB101/ 3GW101	0.5-10	•	•	•	•	•			
3SS102-01-00	3SB102/ 3GW102	0-0.5	•	•	•	•	•			
3SU102-0X-00	3SB102/ 3GW102	0.5-10	•	•	•	•	•			
3SS103-01-00	3SB103/ 3GW103	0-0.5	•	•	•	•	•			
3SU103-0X-00	3SB103/ 3GW103	0.5-10	•	•	•	•	•			
3SS104-01-00	3SB104/ 3GW104	0-0.5	•	•	•	•	•			
3SU104-0X-00	3SB104/ 3GW104	0.5-10	•	•	•	•	•			
3SS105-01-00	3SB105	0-0.5	•	•	•	•	•			
3SU105-0X-00	3SB105	0.5-10	•	•	•	•	•			
3SS106-01-00	3SB106	0-0.5	•	•	•	•	•			
3SU106-0X-00	3SB106	0.5-10	•	•	•	•	•			
3SS107-01-00	3SB107	0-0.5	•	•	•	•	•			
3SU107-0X-00	3SB107	0.5-10	•	•	•	•	•			
3SS108-01-00	3SS108	0-0.5	•	•	•	•	•			
3SS109-01-00	3SS109	0-0.5	•	•	•	•	•			
3SS110-01-00	3SS110	0-0.5	•	•	•	•	•			

TABLE 4-5

SITE SAMPLING PROGRAM
SITE 3 - PISTOL RANGE LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 3

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis							
			Target Compound List (TCL)			TAL(6)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Explosives (Method 8330)	TOC(8)	TSS/ TDS(9)	Grain Size
SOIL (Continued)										
3SS111-01-00	3SS111	0-0.5	•	•	•	•	•			
3SS112-01-00	3SS112	0-0.5	•	•	•	•	•			
3SS113-01-00	3SS113	0-0.5	•	•	•	•	•			
3SS114-01-00	3SS114	0-0.5	•	•	•	•	•			
2SS115-01-00	2SS115	0-0.5	•	•	•	•	•			
GROUNDWATER(10)										
3GW17-00-01	3GW17	--	•	•	•	•	•			
3GW18-00-01	3GW18	--	•	•	•	•	•			
3GW19-00-01	3GW19	--	•	•	•	•	•			
3GW47-00-01	3GW47	--	•	•	•	•	•			
3GW77-00-01	3GW77	--	•	•	•	•	•			
3GW78S-00-01	3GW78S	--	•	•	•	•	•			
3GW78D-00-01	3GW78D	--	•	•	•	•	•			
3GW101-00-01	3GW101	--	•	•	•	•	•			
3GW102-00-01	3GW102	--	•	•	•	•	•			
3GW103-00-01	3GW103	--	•	•	•	•	•			
3GW104-00-01	3GW104	--	•	•	•	•	•			
3GW105-00-01	3GW105	--	•	•	•	•	•			
3GW106-00-01	3GW106	--	•	•	•	•	•			
3GW107-00-01	3GW107	--	•	•	•	•	•			
SURFACE WATER										
3SW100-00-01	3SW100	--	•	•	•	•	•		•	
3SW101-00-01	3SW101	--	•	•	•	•	•		•	

TABLE 4-5

SITE SAMPLING PROGRAM
SITE 3 - PISTOL RANGE LANDFILL
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 3 OF 3

Sample ID(1)	Sample Location	Sample Depth (feet bgs(2))	Analysis							
			Target Compound List (TCL)			TAL(6)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Explosives (Method 8330)	TOC(8)	TSS/ TDS(9)	Grain Size
3SW102-00-01	3SW102	--	•	•	•	•	•		•	
3SW103-00-01	3SW103	--	•	•	•	•	•		•	
3SW104-00-01	3SW104	--	•	•	•	•	•		•	
SEDIMENT										
3SD100-00-01	3SD100	--	•	•	•	•	•	•		•
3SD101-00-01	3SD101	--	•	•	•	•	•	•		•
3SD102-00-01	3SD102	--	•	•	•	•	•	•		•
3SD103-00-01	3SD103	--	•	•	•	•	•	•		•
3SD104-00-01	3SD104	--	•	•	•	•	•	•		•

• To be analyzed.

(1) "-0X" denotes split-spoon number or hand auger beginning sample depth.
(2) Below ground surface.
(3) Volatile organic compounds.
(4) Semivolatile organic compounds.
(5) Polychlorinated biphenyls.
(6) Target analyte list.
(7) Cyanide.
(8) Total organic carbon.
(9) Total suspended solids/Total dissolved solids.
(10) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

Fifteen surface soil and seven subsurface soil samples will be collected at Site 3. Eight surface soil samples will be collected from the surface of Pistol Range Landfill, and seven surface soil samples will be collected from the perimeter of the base of the landfill. Three locations along the perimeter of the landfill will be sampled with a hand auger. The remaining locations will be sampled during monitoring well installation. Surface soil samples will be collected from 0 to 6 inches. Subsurface soil samples will be collected between an interval of 6 inches to 10 feet or at the water table, if shallower than 10 feet. Soil samples from Site 3 will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

Fourteen groundwater samples will be collected at Site 3 during each of four quarterly sampling rounds from seven existing monitoring wells (3GW17, 3GW18, 3GW19, 3GW47, 3GW77, 3GW78S, and 3GW78D) and seven proposed monitoring wells (3GW101, 3GW102, 3GW103, 3GW104, 3GW105, 3GW106, and 3GW107) for determination of nature and extent of contamination. The seven proposed monitoring wells will provide groundwater quality data directly downgradient of the landfill. The locations of the seven proposed monitoring wells are shown in Figure 3-2 (subject to revision based on site access restrictions) and a description of monitoring well installation is provided in Section 4.3.5. The shallow monitoring wells 3GW101, 3GW103 , 3GW105 , 3GW106, and 3GW107 will be screened to intersect the water table, and the deep monitoring wells 3GW102 and 3GW104 will be installed with at least a 5 to 10 foot separation between the top of the screen of the deep well and the bottom of the screen of the adjacent shallow well. In the event that the thickness of the water table aquifer (in most cases, the Coastal Plain deposits) is limited to the point that an adequate separation between the well screens cannot be achieved within the aquifer, the deep well will be installed within the upper portion of the next significant water-bearing unit down, i.e., the fractured bedrock aquifer. Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330). All new wells will be slug tested, to provide information regarding the hydraulic characteristics of the screened formations.

A minimum of five surface water samples will be collected from Site 3 as shown on Figure 3-2. Three samples will be collected from the drainage west of the landfill and two samples will be collected from the drainage south of Dahlgren Road. In addition, a visual inspection of the landfill area will be performed and any seeps identified emanating from the landfill will be sampled. Surface water samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330) and TSS/TDS.

A minimum of five sediment samples will be collected from Site 3 as shown on Figure 3-2. Three samples will be collected from the drainage west of the landfill and two samples will be collected from the drainage south of Dahlgren Road. Sediment samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), TOC, and grain size.

A pumping test at Site 3 may be performed to collect hydrogeologic data for RA evaluations. The location for the pumping test will be determined based on site-specific conditions and additional observation wells or piezometers may be installed to support the test. The pumping test will be performed as described in the Master FSP (B&R Environmental, 1998).

4.2.3 Site 4 - Chemical Burial Area

Data gaps and investigation rationale for Site 4 are provided in Table 4-6. Sampling locations, sample identification numbers, and analyses for Site 4 are summarized in Table 4-7. Sampling locations are illustrated on Figure 3-3.

Prior to beginning sampling activities at the site, a surface sweep of the site area will be performed to check for elevated levels of radium and uranium-related radionuclides (based on historic information, these radionuclides may have been used in early experiments at the base). The survey will be performed by and in accordance with procedures to be identified by the Navy's Radiological Affairs Support Office (RASO). Where elevated levels of radionuclides are identified during the field surveys, the suite of analyses for soil and groundwater samples will be expanded to include radionuclides.

Prior to monitoring well installation, an azimuthal resistivity survey will be conducted at Site 4. The survey will be located south of the four chemical burial areas. The methodology for the azimuthal resistivity survey is described in Section 4.3.2. Based on the analysis of the survey, proposed monitoring well locations will be adjusted to align with the apparent fracturing in the area to intercept zones of higher hydraulic conductivity.

Ten surface soil samples and 10 subsurface soil samples will be collected from within and/or adjacent to the former chemical burial areas at Site 4. All samples will be collected from outside the area planned for excavation at the site. At each location a surface soil sample and a subsurface soil sample will be collected from 0 to 6 inches and 2 to 4 feet, respectively, using a hand auger. Soil samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

TABLE 4-6

INVESTIGATION RATIONALE
SITE 4 - CHEMICAL BURIAL AREA
NSWC - WHITE OAK, SILVER SPRING MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
Nature and extent of contamination beyond limit of waste Human health risk and ecological risk data	Soil sampling	10	2	Within 4 chemical burial areas/ Surface (0-6") and subsurface (2'-4')	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
GROUNDWATER					
Lateral and vertical extent of TCE contamination plume	Groundwater sampling	35	4	21 Existing monitoring wells 1 Existing piezometer 13 Proposed monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	35	1	21 Existing monitoring wells 1 Existing piezometer 13 Proposed monitoring wells	Potentiometric surface contouring
	Bedrock fracture mapping	1 1	NA 1	Sitewide South of 4 burial pits	Fracture trace analysis Azimuthal resistivity survey
	Slug tests	13	1	New wells	
	Pumping Test	1	NA	To be determined	To be determined
SURFACE WATER					
None	NA	0	0	NA	None
SEDIMENT					
None	NA	0	0	NA	None

TABLE 4-7

SITE SAMPLING PROGRAM
SITE 4 - CHEMICAL BURIAL AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 3

Sample ID	Sample Location	Sample Depth (feet bgs[2])	Analysis							
			Target Compound List (TCL)			TAL[6]				
			VOCs[3]	SVOCs[4]	Pesticides/ PCBs[5]	Metals plus CN[7]	Explosives (Method 8330)	TOC[8]	TSS/ TDS[9]	Grain Size
SOIL										
4SS100-01-00	4SB100	0-0.5	•	•	•	•	•			
4SU100-02-00	4SB100	2-4	•	•	•	•	•			
4SS101-01-00	4SB101	0-0.5	•	•	•	•	•			
4SU101-02-00	4SB101	2-4	•	•	•	•	•			
4SS102-01-00	4SB102	0-0.5	•	•	•	•	•			
4SU102-02-00	4SB102	2-4	•	•	•	•	•			
4SS103-01-00	4SB103	0-0.5	•	•	•	•	•			
4SU103-02-00	4SB103	2-4	•	•	•	•	•			
4SS104-01-00	4SB104/ 3GW104	0-0.5	•	•	•	•	•			
4SU104-02-00	4SB104	2-4	•	•	•	•	•			
4SS105-01-00	4SB105	0-0.5	•	•	•	•	•			
4SU105-02-00	4SB105	2-4	•	•	•	•	•			
4SS106-01-00	4SB106	0-0.5	•	•	•	•	•			
4SU106-02-00	4SB106	2-4	•	•	•	•	•			
4SS107-01-00	4SB107	0-0.5	•	•	•	•	•			
4SU107-02-00	4SB107	2-4	•	•	•	•	•			
4SS108-01-00	4SB108	0-0.5	•	•	•	•	•			
4SU108-02-00	4SB108	2-4	•	•	•	•	•			
4SS109-01-00	4SB109	0-0.5	•	•	•	•	•			
4SU109-02-00	4SB109	2-4	•	•	•	•	•			
GROUNDWATER[9]										
4GW10-00-01	4GW10	--	•	•	•	•	•			
4GW11-00-01	4GW11	--	•	•	•	•	•			

TABLE 4-7

SITE SAMPLING PROGRAM
SITE 4 - CHEMICAL BURIAL AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 3

Sample ID	Sample Location	Sample Depth (feet bgs(2))	Analysis							
			Target Compound List (TCL)			TAL(6)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Explosives (Method 8330)	TOC(8)	TSS/ TDS(9)	Grain Size
GROUNDWATER (Continued)										
4GW11A-00-01	4GW11A	--	•	•	•	•	•			
4GW12-00-01	4GW12	--	•	•	•	•	•			
4GW45-48-01	4GW48	--	•	•	•	•	•			
4GW49S-00-01	4GW49S	--	•	•	•	•	•			
4GW49D-00-01	4GW49D	--	•	•	•	•	•			
4GW50-00-01	4GW50	--	•	•	•	•	•			
4GW51S-00-01	4GW51S	--	•	•	•	•	•			
4GW52-00-01	4GW52	--	•	•	•	•	•			
4GW13-00-01	4GW13	--	•	•	•	•	•			
4GW15-00-01	4GW15	--	•	•	•	•	•			
4GW79-00-01	4GW79	--	•	•	•	•	•			
4GW80-00-01	4GW80	--	•	•	•	•	•			
4GW81S-00-01	4GW81S	--	•	•	•	•	•			
4GW81D-00-01	4GW81D	--	•	•	•	•	•			
4GW82-00-01	4GW82	--	•	•	•	•	•			
4GW89-00-01	4PZ89	--	•	•	•	•	•			
4GW100-00-01	4GW100	--	•	•	•	•	•			
4GW101-00-01	4GW101	--	•	•	•	•	•			
4GW102-00-01	4GW102	--	•	•	•	•	•			
4GW103-00-01	4GW103	--	•	•	•	•	•			
4GW104-00-01	4GW104	--	•	•	•	•	•			
4GW105-00-01	4GW105	--	•	•	•	•	•			
4GW106-00-01	4GW106	--	•	•	•	•	•			
4GW107-00-01	4GW107	--	•	•	•	•	•			

TABLE 4-7

SITE SAMPLING PROGRAM
SITE 4 - CHEMICAL BURIAL AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 3 OF 3

Sample ID	Sample Location	Sample Depth (feet bgs(2))	Analysis							
			Target Compound List (TCL)			TAL(6)				
			VOCs(3)	SVOCs(4)	Pesticides/ PCBs(5)	Metals plus CN(7)	Explosives (Method 8330)	TOC(8)	TSS/ TDS(9)	Grain Size
GROUNDWATER (Continued)										
4GW108-00-01	4GW108	--	•	•	•	•	•			
4GW109-00-01	4GW109	--	•	•	•	•	•			
4GW110-00-01	4GW110	--	•	•	•	•	•			
5GW01-00-01	5GW01	--	•	•	•	•	•			
5GW02-00-01	5GW02	--	•	•	•	•	•			
13GW01-00-01	13GW01	--	•	•	•	•	•			
13GW02-00-01	13GW02	--	•	•	•	•	•			
13GW03-00-01	13GW03	--	•	•	•	•	•			
13GW04-00-01	13GW04	--	•	•	•	•	•			

• To be analyzed.

(1) Below ground surface.
(2) Volatile organic compounds.
(3) Semivolatile organic compounds.
(4) Polychlorinated biphenyls.
(5) Target analyte list.
(6) Cyanide.
(7) Total organic carbon.
(8) Total suspended solids/Total dissolved solids.
(9) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

Twenty-nine groundwater samples will be collected at Site 4 during each of four quarterly sampling rounds from 18 existing monitoring wells (4GW10, 4GW11, 4GW11A, 4GW12, 4GW13, 4GW15, 4GW48, 4GW49S, 4GW49D, 4GW50, 4GW51S, 4GW52, 4GW79, 4GW80, 4GW81S, 4GW81D, 4GW82, and 4GW100), one existing piezometer (4PZ89), and ten proposed monitoring wells (4GW101, 4GW102, 4GW103, 4GW104, 4GW105, 4GW106, 4GW107, 4GW108, 4GW109, and 4GW110) to determine the extent of TCE contamination. In addition, two shallow monitoring wells (13GW02, 13GW03) and 1 deep well (13GW04) will be installed between Sites 13 and 3 to delineate the extent of groundwater contamination in the Site 13 area. These wells will be sampled along with existing wells 13GW01, 5GW01, and 5GW02. The locations of the proposed monitoring wells are shown on Figure 3-3, and a description of monitoring well installation is provided in Section 4.3.5. The shallow monitoring wells 4GW102, 4GW104, 4GW108, 4GW109, 4GW110, 13GW02, and 13GW03 will be screened to intersect the water table, and the deep monitoring wells 4GW101, 4GW103, 4GW105, 4GW106, 4GW107 and 13GW04 will be installed with at least a 5 to 10 foot separation between the top of the screen of the deep well and the bottom of the screen of the adjacent shallow well. In the event that the thickness of the water table aquifer (in most cases, the Coastal Plain deposits) is limited to the point that an adequate separation between the well screens cannot be achieved within the aquifer, the deep well will be installed within the upper portion of the next significant water-bearing unit down, i.e., the fractured bedrock aquifer. Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330). In addition, if evidence of contaminated soils is discovered at the well locations during drilling operations, the potentially contaminated soil samples will be submitted from the borings for analysis as per the analytical suite for other soil samples at the site.

No surface water or sediment samples will be collected at Site 4 since there are no surface water bodies of stream traces at the site.

Slug tests will be performed on all new wells, to provide information regarding the hydraulic characteristics of the screened formations. A pumping test at Site 4 may also be performed to collect more detailed hydrogeologic data for RA evaluations. Based on the groundwater sampling and analysis, the location for the pumping test will be determined based on site-specific conditions, and additional observation wells or piezometers may be installed. The pumping test will be performed as described in the Master FSP (B&R Environmental, 1998).

4.2.4 Site 7 - Ordnance Burn Area

Data gaps and investigation rationale for Site 7 are provided in Table 4-8. Sampling locations, sample identification numbers, and analyses for Site 7 are summarized in Table 4-9. Sampling locations are illustrated on Figure 3-4.

Prior to beginning sampling activities at the site, a surface sweep of the site area will be performed to check for elevated levels of radium and uranium-related radionuclides (based on historic information, these radionuclides may have been used in early experiments at the base). The survey will be performed by and in accordance with procedures to be identified by the Navy's Radiological Affairs Support Office (RASO). Where elevated levels of radionuclides are identified during the field surveys, the suite of analyses for soil and groundwater samples will be expanded to include radionuclides.

Prior to monitoring well installation, an azimuthal resistivity survey will be conducted at Site 7. The survey will be located south of the burn area. The methodology for the azimuthal resistivity survey is described in Section 4.3.2. Based on the analysis of the survey, proposed monitoring well locations will be adjusted to align with the apparent fracturing in the area to intercept zones of higher hydraulic conductivity.

Seven surface and subsurface soil samples will be collected at Site 7. At five locations within the burn area, a surface soil sample will be collected from 0 to 6 inches, and a subsurface soil sample will be collected from 2 to 4 feet. Two surface/subsurface soil samples will be collected from the ephemeral drainage east of the site. Four of the locations within the burn area and the two locations east of the site will be sampled using a hand auger. One location within the burn area will be sampled during monitoring well installation. Soil samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), and Toxicity Characteristics Leaching Procedure (TCLP) metals.

Eight groundwater samples will be collected at Site 7 during each of four quarterly sampling rounds from four existing monitoring wells (7GW08, 7GW41, 7GW43, and 7GW100), one existing piezometer (4PZ42), three proposed monitoring wells (7GW102, 7GW103, and 7GW104). One existing monitoring well (4GW100) from Site 4 will be used as an upgradient monitoring well location for identifying contaminant migration onto the site. The locations of the three proposed monitoring wells are shown on Figure 3-4, and description of monitoring well installation is provided in Section 4.3.5. Proposed monitoring wells will be screened to intersect the water table. Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

TABLE 4-8

INVESTIGATION RATIONALE
SITE 7 - ORDNANCE BURN AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
Human health risk and ecological risk data	Soil sampling	7 6[9]	2 1	Adjacent to burn area/ Surface (0-6") and subsurface (2'-4') Subsurface (2' - 4")	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330) TCLP Metals
Source characterization	Soil sampling	6	1	Based on field observations	TCL VOC
GROUNDWATER					
Nature and extent of energetics contamination Human health risk data	Groundwater sampling	8	4	4 Existing monitoring wells 1 Existing piezometer 3 Proposed monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	10	1	4 Existing monitoring wells 1 Existing piezometer 3 Proposed monitoring wells 2 Stream gauges west of Site 7	Potentiometric surface contouring
	Slug tests	3	1	New wells	
	Bedrock fracture mapping	1 1	NA 1	Sitewide South of burn area	Fracture trace analysis Azimuthal resistivity survey
SURFACE WATER					
None	NA	0	0	NA	NA
SEDIMENT					
None	NA	0	0	NA	NA

TABLE 4-9

SITE SAMPLING PROGRAM
SITE 7 - ORDNANCE BURN AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 2

Sample ID	Sample Location	Depth (feet bgs(1))	Analysis							
			Target Compound List (TCL)			TAL(5)				
			VOCs(2)	SVOCs(3)	Pesticides/ PCBs(4)	Metals plus CN(6)	Explosives (Method 8330)	TOC(7)	TSS/ TDS(8)	Grain Size
SOIL										
7SS101-01-00	7SB101/ 7GW101	0-0.5	•	•	•	•	•			
7SU101-002-00	7SB101/ 7GW101	2-4	•	•	•	•	•			
7SS102-01-00	7SB102	0-0.5	•	•	•	•	•			
7SU102-02-00	7SB102	2-4	•	•	•	•	•			
7SS103-01-00	7SB103	0-0.5	•	•	•	•	•			
7SU103-02-00	7SB103	2-4	•	•	•	•	•			
7SS104-01-00	7SB104	0-0.5	•	•	•	•	•			
7SU104-02-00	7SB104	2-4	•	•	•	•	•			
7SS105-01-00	7SS105	0-0.5	•	•	•	•	•			
7SU105-02-00	7SS105	2-4	•	•	•	•	•			
7SS106-01-00	7SS106	0-0.5	•	•	•	•	•			
7SU106-02-00	7SS106	2-4	•	•	•	•	•			
7SU107-01-00	7SB107	TBD	•							
7SU108-01-00	7SB108	TBD	•							
7SU109-01-00	7SB109	TBD	•							
7SU110-01-00	7SB110	TBD	•							
7SU111-01-00	7SB111	TBD	•							
7SU112-01-00	7SB112	TBD	•							
GROUNDWATER(10)										
7GW08-00-01	7GW08	--	•	•	•	•	•			
7GW41-00-01	7GW41	--	•	•	•	•	•			
7GW43-00-01	7GW43	--	•	•	•	•	•			

TABLE 4-9

SITE SAMPLING PROGRAM
SITE 7 - ORDNANCE BURN AREA
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 2

Sample ID	Sample Location	Depth (feet bgs[1])	Analysis							
			Target Compound List (TCL)			TAL[5]				
			VOCs[2]	SVOCs[3]	Pesticides/ PCBs[4]	Metals plus CN[6]	Explosives (Method 8330)	TOC[7]	TSS/ TDS[8]	Grain Size
GROUNDWATER (Continued)										
7GW42-00-01	7PZ42	--	•	•	•	•	•			
7GW101-00-01	7GW101	--	•	•	•	•	•			
7GW102-00-01	7GW102	--	•	•	•	•	•			
7GW103-00-01	7GW103	--	•	•	•	•	•			
7GW104-00-01	7GW104	--	•	•	•	•	•			

• To be analyzed.

(1) Below ground surface.
(2) Volatile organic compounds.
(3) Semivolatile organic compounds.
(4) Polychlorinated biphenyls.
(5) Target analyte list.
(6) Cyanide.
(7) Total organic carbon.
(8) Total suspended solids/Total dissolved solids.
(9) To be determined - optional borings/depths.
(10) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

If the additional groundwater sampling data indicates that there is a probable source of chlorinated solvents in the Site 7 area, up to 6 subsurface soil borings will be added to the field investigation program at the locations deemed most likely to be source areas, based on the data available. Soil samples will be collected from potentially contaminated depths and analyzed for TCL VOCs. All new wells will be slug tested, to provide information regarding the hydraulic characteristics of the screened formations.

No surface water or sediment samples will be collected at Site 7 due to the absence of surface water bodies in the vicinity of the site.

4.2.5 Site 8 - Abandoned Chemical Disposal Pit

Data gaps and investigation rationale for Site 8 are provided in Table 4-10. Sampling locations, sample identification numbers, and analyses for Site 8 are summarized in Table 4-11. Sampling locations are illustrated on Figure 3-5.

Prior to beginning sampling activities at the site, a surface sweep of the site area will be performed to check for elevated levels of radium and uranium-related radionuclides (based on historic information, these radionuclides may have been used in early experiments at the base). The survey will be performed by and in accordance with procedures to be identified by the Navy's Radiological Affairs Support Office (RASO). Where elevated levels of radionuclides are identified during the field surveys, the suite of analyses for soil and groundwater samples will be expanded to include radionuclides.

Six surface and six subsurface soil samples will be collected at Site 8. All soil samples will be collected with a hand auger. Surface soil samples will be collected from 0 to 6 inches from locations around the excavated area. Subsurface soil samples will be collected from 2 to 4 feet from locations around the excavated area. Soil samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL metals plus cyanide.

Eight groundwater samples will be collected at Site 8 from five existing monitoring wells (8GW33, 8GW34, 8GW35, 8GW36, and 8GW53) and three existing offsite monitoring wells (B1, B2, and B3). Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL metals plus cyanide.

No surface water or sediment samples will be collected at Site 8 due to the absence of surface water bodies in the vicinity of the site.

TABLE 4-10

INVESTIGATION RATIONALE
SITE 8 - ABANDONED CHEMICAL DISPOSAL PIT
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
Human health/ecological risk data	Soil sampling	6	2	Around excavated area/Surface (0-6") and subsurface (2'-4')	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN
GROUNDWATER					
Human health risk data	Groundwater sampling	8	4	5 Existing monitoring wells 3 Off-site monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN
Hydrogeologic Characterization	Water level measurement	8	1	5 Existing monitoring wells 3 Off-site monitoring wells	Potentiometric surface contouring
SURFACE WATER					
None	NA	0	0	NA	NA
SEDIMENT					
None	NA	0	0	NA	NA

TABLE 4-11

SITE SAMPLING PROGRAM
SITE 8 - ABANDONED CHEMICAL DISPOSAL PIT
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 2

Sample ID	Sample Location	Sample Depth (feet bgs(1))	Analysis							
			Target Compound List (TCL)			TAL(5)				
			VOCs(2)	SVOCs(3)	Pesticides/ PCBs(4)	Metals plus CN(6)	Explosives (Method 8330)	TOC(7)	TSS/ TDS(8)	Grain Size
SOIL										
8SS100-01-00	8SB100	0-0.5	•	•	•	•				
8SU100-02-00	8SB100	2-4	•	•	•	•				
8SS101-01-00	8SB101	0-0.5	•	•	•	•				
8SU101-02-00	8SB101	2-4	•	•	•	•				
8SS102-01-00	8SB102	0-0.5	•	•	•	•				
8SU102-02-00	8SB102	2-4	•	•	•	•				
8SS103-01-00	8SB103	0-0.5	•	•	•	•				
8SU103-02-00	8SB103	2-4	•	•	•	•				
8SS104-01-00	8SS104	0-0.5	•	•	•	•				
8SU104-02-00	8SB104	2-4	•	•	•	•				
8SS105-01-00	8SS105	0-0.5	•	•	•	•				
8SU105-02-00	8SB105	2-4	•	•	•	•				
GROUNDWATER(9)										
8GW33-00-01	8GW33	--	•	•	•	•				
8GW34-00-01	8GW34	--	•	•	•	•				
8GW35-00-01	8GW35	--	•	•	•	•				
8GW36-00-01	8GW36	--	•	•	•	•				
8GW53-00-01	8GW53	--	•	•	•	•				

TABLE 4-11

SITE SAMPLING PROGRAM
SITE 8 - ABANDONED CHEMICAL DISPOSAL PIT
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 2

Sample ID	Sample Location	Sample Depth (feet bgs[1])	Analysis							
			Target Compound List (TCL)			TAL[5]				
			VOCs[2]	SVOCs[3]	Pesticides/ PCBs[4]	Metals plus CN[6]	Explosives (Method 8330)	TOC[7]	TSS/ TDS[8]	Grain Size
GROUNDWATER[9] (Continued)										
8GWB1-00-01	B1	--	•	•	•	•				
8GWB2-00-01	B2	--	•	•	•	•				
8GWB3-00-01	B3	--	•	•	•	•				

- • To be analyzed.
- (1) Below ground surface.
- (2) Volatile organic compounds.
- (3) Semivolatile organic compounds.
- (4) Polychlorinated biphenyls.
- (5) Target analyte list.
- (6) Cyanide.
- (7) Total organic carbon.
- (8) Total suspended solids/Total dissolved solids.
- (9) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

4.2.6 Site 9 - Industrial Wastewater Disposal Area 300

Data gaps and investigation rationale for Site 9 are provided in Table 4-12. Sampling locations, sample identification numbers, and analyses for Site 9 are summarized in Table 4-13. Sampling locations are illustrated on Figure 3-6.

A geophysical survey will be conducted to confirm the presence or absence of leaching wells in Area 300 which were not removed during the Removal Action conducted in the Fall of 1996 (B&R Environmental, 1997). A survey grid of 100 feet by 100 feet will be established in the area of each leaching well, and an EM survey will be conducted for each survey grid. The methodology for the EM survey is described in Section 4.3.4. In addition, a pilot-scale ground penetrating radar (GPR) survey will be attempted at 1 location. If the GPR survey is effective in locating the well, the survey will be expanded to other leaching well locations. Based on the results of the geophysical surveys, suspected leaching well locations will be confirmed in the field by hand augering or excavation with a backhoe.

Prior to monitoring well installation, two azimuthal resistivity surveys will be conducted at Site 9, one in the southern region of Area 300 and one in the northern region of Area 300. The methodology for the azimuthal resistivity survey is described in Section 4.3.2. Based on the analysis of the survey, proposed monitoring well locations at Site 9 will be adjusted to align with the apparent fracturing in the area to intercept zones of higher hydraulic conductivity.

No soil samples will be collected at Site 9 since there are no known releases to surface soils at the site.

Twenty-nine groundwater samples will be collected at Site 9 during each of four quarterly sampling rounds from 17 existing monitoring wells (9GW01, 9GW02, 9GW03, 9GW04, 9GW05, 9GW05G, 9GW06, 9GW07, 9GW57S, 9GW57D, 9GW59, 9GW74, 9GW75, 9GW83, and Army wells C-5, C-6, and C-14), three existing piezometers (9PZ44, 9PZ55, and 9PZ56), and nine proposed monitoring wells (9GW100, 9GW101, 9GW102, 9GW103, 9GW104, 9GW105, 9GW106, 9GW107, and 9GW108). The locations of the proposed monitoring wells are shown on Figure 3-6, and a description of monitoring well installation is provided in Section 4.3.5. The four shallow monitoring wells 9GW100, 9GW101, 9GW102, and 9GW103 and the temporary wells will be screened to intersect the water table. The five deep monitoring wells 9GW104, 9GW105, 9GW106, 9GW107, and 9GW108 will be installed with at least a 5 to 10 foot separation between the top of the screen of the deep well and the bottom of the screen of the adjacent shallow well. In the event that the thickness of the water table aquifer (in most cases, the Coastal Plain deposits) is limited to the point that an adequate separation between the well screens cannot be achieved

TABLE 4-12

INVESTIGATION RATIONALE
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
None	NA	0	0	NA	NA
GROUNDWATER					
Nature and extent of contamination	Groundwater sampling	30-33	4	17 Existing monitoring wells 3 Existing piezometers 9 Proposed monitoring wells 1-4 Temporary wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	34-37	1	17 Existing monitoring wells 3 Existing piezometers 10-14 Proposed monitoring wells 4 Stream gauges	Potentiometric surface contouring
	Bedrock fracture mapping	1 2	NA 1	Sitewide Northern and southern area	Fracture trace analysis Azimuthal resistivity survey
	Slug tests	10-14	1	New wells	
	Pumping test	2	NA	To be determined	To be determined
Presence/absence of leaching wells	Geophysical survey	18	1	Suspected area of leaching wells	EM survey
SURFACE WATER					
Human health and ecological risk data	Surface water sampling	9	1	4 along unnamed tributary to the east 5 along West Farm Branch	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TSS/TDS Explosives (Method 8330)
SEDIMENT					
Human health and ecological risk data	Sediment sampling	9	1	4 along East Farm Branch 5 along West Farm Branch	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TOC, Grain size Explosives (Method 8330)

TABLE 4-13

SITE SAMPLING PROGRAM
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 4

Sample ID	Sample Location	Sample Depth (feet bgs(1))	Analysis							
			Target Compound List (TCL)			TAL(5)				
			VOCs(2)	SVOCs(3)	Pesticides/ PCBs(4)	Metals plus CN(6)	Explosives (Method 8330)	TOC(7)	TSS/ TDS(8)	Grain Size
GROUNDWATER(9)										
9GW01-00-01	9GW01	--	•	•	•	•	•			
9GW02-00-01	9GW02	--	•	•	•	•	•			
9GW03-00-01	9GW03	--	•	•	•	•	•			
9GW04-00-01	9GW04	--	•	•	•	•	•			
9GW05-00-01	9GW05	--	•	•	•	•	•			
9GW05B-00-01	9GW05B	--	•	•	•	•	•			
9GW06-00-01	9GW06	--	•	•	•	•	•			
9GW07-00-01	9GW07	--	•	•	•	•	•			
9GW44-00-01	9PZ44	--	•	•	•	•	•			
9GW55-00-01	9PZ55	--	•	•	•	•	•			
9GW56-00-01	9PZ56	--	•	•	•	•	•			
9GW57S-00-01	9GW57S	--	•	•	•	•	•			
9GW57D-00-01	9GW57D	--	•	•	•	•	•			
9GW59-00-01	9GW59	--	•	•	•	•	•			
9GW74-00-01	9GW74	--	•	•	•	•	•			
9GW75-00-01	9GW75	--	•	•	•	•	•			
9GW83-00-01	9GW83	--	•	•	•	•	•			
9GWC5-00-01	C5	--	•	•	•	•	•			
9GWC6-00-01	C6	--	•	•	•	•	•			
9GWC14-00-01	C14	--	•	•	•	•	•			

TABLE 4-13

SITE SAMPLING PROGRAM
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 4

Sample ID	Sample Location	Sample Depth (feet bgs(1))	Analysis							
			Target Compound List (TCL)			TAL(5)				
			VOCs(2)	SVOCs(3)	Pesticides/ PCBs(4)	Metals plus CN(6)	Explosives (Method 8330)	TOC(7)	TSS/ TDS(8)	Grain Size
GROUNDWATER (Continued)										
9GW100-00-01	9GW100	--	•	•	•	•	•			
9GW101-00-01	9GW101	--	•	•	•	•	•			
9GW102-00-01	9GW102	--	•	•	•	•	•			
9GW103-00-01	9GW103	--	•	•	•	•	•			
9GW104-00-01	9GW104	--	•	•	•	•	•			
9GW105-00-01	9GW105	--	•	•	•	•	•			
9GW106-00-01	9GW106	--	•	•	•	•	•			
9GW107-00-01	9GW107	--	•	•	•	•	•			
9GW108-00-01	9GW108	--	•	•	•	•	•			
9TW001-00-01	9TW001	--	•	•	•	•	•			
9TW002-00-01	9TW002	--	•	•	•	•	•			
9TW003-00-01	9TW003	--	•	•	•	•	•			
9TW004-00-01	9TW004	--	•	•	•	•	•			
SURFACE WATER										
9SW100-00-01	9SW100	--	•	•	•	•	•		•	
9SW101-00-01	9SW101	--	•	•	•	•	•		•	
9SW102-00-01	9SW102	--	•	•	•	•	•		•	
9SW103-00-01	9SW103	--	•	•	•	•	•		•	
9SW104-00-01	9SW104	--	•	•	•	•	•		•	
9SW105-00-01	9SW105	--	•	•	•	•	•		•	

TABLE 4-13

SITE SAMPLING PROGRAM
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 3 OF 4

Sample ID	Sample Location	Sample Depth (feet bgs(1))	Analysis							
			Target Compound List (TCL)			TAL(5)				
			VOCs(2)	SVOCs(3)	Pesticides/ PCBs(4)	Metals plus CN(6)	Explosives (Method 8330)	TOC(7)	TSS/ TDS(8)	Grain Size
SURFACE WATER (Continued)										
9SW106-00-01	9SW106	--	•	•	•	•	•		•	
9SW107-00-01	9SW107	--	•	•	•	•	•		•	
9SW108-00-01	9SW108	--	•	•	•	•	•		•	
SEDIMENT										
9SD100-00-01	9SD100	--	•	•	•	•	•	•		•
9SD101-00-01	9SD101	--	•	•	•	•	•	•		•
SEDIMENT (Continued)										
9SD102-00-01	9SD102	--	•	•	•	•	•	•		•
9SD103-00-01	9SD103	--	•	•	•	•	•	•		•
9SD104-00-01	9SD104	--	•	•	•	•	•	•		•
9SD105-00-01	9SD105	--	•	•	•	•	•	•		•
9SD106-00-01	9SD106	--	•	•	•	•	•	•		•
9SD107-00-01	9SD107	--	•	•	•	•	•	•		•
9SD108-00-01	9SD108	--	•	•	•	•	•	•		•

• *To be analyzed.*

(1) Below ground surface.
(2) Volatile organic compounds.
(3) Semivolatile organic compounds.
(4) Polychlorinated biphenyls.
(5) Target analyte list.

TABLE 4-13

SITE SAMPLING PROGRAM
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 4 OF 4

(6) Cyanide.
(7) Total organic carbon.
(8) Total suspended solids/Total dissolved solids.
(9) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.
(10) Optional temporary well.

within the aquifer, the deep well will be installed within the upper portion of the next significant water-bearing unit down, i.e., the fractured bedrock aquifer. Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

In addition, at least one shallow temporary well (9TW001) will be installed adjacent to leaching well 9, which was found to be contaminated during a removal action. The temporary well will be sampled, and if significant contamination is detected, up to three additional temporary wells will be installed (9TW002, 9TW003, and 9TW004) to delineate the extent of contamination.

Slug tests will be performed on all newly installed wells at Site 9, to obtain data for estimating hydraulic conductivities. Two pumping tests may be performed at Site 9 to collect more detailed hydrogeologic data for RA evaluations. Based on the results of the groundwater analyses, locations for pumping tests and the need for additional observation wells or piezometers will be determined. Pumping tests will be performed as described in the Master FSP (B&R Environmental, 1998).

A minimum of nine surface water samples will be collected, four from an unnamed tributary to the east and five from West Farm Branch, as shown on Figure 3-6. The samples from the unnamed tributary will be collected from locations near 9GW75 extending to approximately 300 feet north of Paint Branch Creek. The samples from West Farm Branch will be collected from locations near LW13 extending to GW83. Surface water samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), and TSS/TDS.

A minimum of nine sediment samples will be collected at Site 9 as shown on Figure 3-6. The sediments will be collected at the same locations as those used to collect the surface water samples and will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), TOC, and grain size.

4.2.7 Site 11 - Industrial Wastewater Disposal Area 100

Data gaps and investigation rationale for Site 11 are provided in Table 4-14. Sampling locations, sample identification numbers, and analyses for Site 11 are summarized in Table 4-15. Sampling locations are illustrated on Figure 3-7.

A geophysical survey will be conducted to confirm the presence or absence of leaching wells in Area 100 which were not removed during the Removal Action conducted in the Fall of 1996 (B&R Environmental, 1997). A survey grid of 100 feet by 100 feet will be established in the area of each leaching well, and an

TABLE 4-14

INVESTIGATION RATIONALE
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
None	NA	0	0	NA	NA
GROUNDWATER					
Lateral and vertical extent of TCE contamination Human health risk data	Groundwater sampling	29	4	19 Existing monitoring wells 3 Existing piezometers 7 Proposed monitoring wells	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN Explosives (Method 8330)
Hydrogeologic characterization	Water level measurement	33	1	19 Existing monitoring wells 3 Existing piezometers 7 Proposed monitoring wells 4 Stream gauges	Potentiometric surface contouring
	Slug tests	7	1	New wells	
	Bedrock fracture mapping	1 1	NA 1	Sitewide East of LW04 and LW05	Fracture trace analysis Azimuthal resistivity survey
	Pumping test	1	NA	To be determined	To be determined
Presence/absence of leaching wells	Geophysical survey	10	1	Suspected area of leaching wells	EM31 survey
SURFACE WATER					
Human health and ecological risk data	Surface water sampling	4	1	2 along drainage southeast of Building 30 2 along drainage east of Bowditch Road	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TSS/TDS Explosives (Method 8330)
SEDIMENT					
Human health and ecological risk data	Sediment sampling	4	1	2 along drainage southeast of Building 30 2 along drainage east of Bowditch Road	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TOC, Grain size Explosives (Method 8330)

TABLE 4-15

SITE SAMPLING PROGRAM
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 1 OF 2

Sample ID	Sample Location	Sample Depth (feet bgs[1])	Analysis							
			Target Compound List (TCL)			TAL[5]				
			VOCs[2]	SVOCs[3]	Pesticides/ PCBs[4]	Metals plus CN[6]	Explosives (Method 8330)	TOC[7]	TSS/ TDS[8]	Grain Size
GROUNDWATER[9]										
11GW22-00-01	11GW22	--	•	•	•	•	•			
11GW23-00-01	11GW23	--	•	•	•	•	•			
11GW24-00-01	11GW24	--	•	•	•	•	•			
11GW25-00-01	11GW25	--	•	•	•	•	•			
11GW26-00-01	11GW26	--	•	•	•	•	•			
11GW27-00-01	11GW27	--	•	•	•	•	•			
11GW28-00-01	11GW28	--	•	•	•	•	•			
11GW62-00-01	11PZ62	--	•	•	•	•	•			
11GW63-00-01	11PZ63	--	•	•	•	•	•			
11GW64-00-01	11PZ64	--	•	•	•	•	•			
11GW66-00-01	11GW66	--	•	•	•	•	•			
11GW67-00-01	11GW67	--	•	•	•	•	•			
11GW68-00-01	11GW68	--	•	•	•	•	•			
11GW69-00-01	11GW69	--	•	•	•	•	•			
11GW70D-00-01	11GW70D	--	•	•	•	•	•			
11GW71-00-01	11GW71	--	•	•	•	•	•			
11GW84-00-01	11GW84	--	•	•	•	•	•			
11GW85-00-01	11GW85	--	•	•	•	•	•			
11GW86-00-01	11GW86	--	•	•	•	•	•			
11GW87-00-01	11GW87	--	•	•	•	•	•			
11GW88-00-01	11GW88	--	•	•	•	•	•			
11GW105-00-01	11GW105	--	•	•	•	•	•			
11GW106-00-01	11GW106	--	•	•	•	•	•			

TABLE 4-15

SITE SAMPLING PROGRAM
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
NSWC - WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 2

Sample ID	Sample Location	Sample Depth (feet bgs[1])	Analysis							
			Target Compound List (TCL)			TAL[5]				
			VOCs[2]	SVOCs[3]	Pesticides/ PCBs[4]	Metals plus CN[6]	Explosives (Method 8330)	TOC[7]	TSS/ TDS[8]	Grain Size
GROUNDWATER (Continued)										
11GW107-00-01	11GW107	--	•	•	•	•	•			
11GW108-00-01	11GW108	--	•	•	•	•	•			
11GW109-00-01	11GW109	--	•	•	•	•	•			
11GW110-00-01	11GW110	--	•	•	•	•	•			
11GW111-00-01	11GW111	--	•	•	•	•	•			
SURFACE WATER										
9SW100-00-01	9SW100	--	•	•	•	•			•	
9SW101-00-01	9SW101	--	•	•	•	•			•	
9SW102-00-01	9SW102	--	•	•	•	•			•	
9SW103-00-01	9SW103	--	•	•	•	•			•	
SEDIMENT										
9SD100-00-01	9SD100	--	•	•	•	•	•	•		•
9SD101-00-01	9SD101	--	•	•	•	•	•	•		•
9SD102-00-01	9SD102	--	•	•	•	•	•	•		•
9SD103-00-01	9SD103	--	•	•	•	•	•	•		•

• To be analyzed.

(1) Below ground surface.
(2) Volatile organic compounds.
(3) Semivolatile organic compounds.
(4) Polychlorinated biphenyls.
(5) Target analyte list.
(6) Cyanide.
(7) Total organic carbon.
(8) Total suspended solids/Total dissolved solids.
(9) Repeated for 4 quarters with last 2 numbers of sample ID changed from -01 to -02, -03, -04.

EM survey will be conducted for each survey grid. The methodology for the EM survey is described in Section 4.3.4. In addition, a pilot-scale ground-penetrating radar (GPR) survey will be attempted at one location. If the GPR survey is effective in locating the leaching well, the survey will be expanded to other leaching well areas. Based on the results of the geophysical surveys, suspected leaching well locations will be confirmed in the field by hand augering or excavation with a backhoe.

Twenty-nine groundwater samples will be collected at Site 11 during each of four quarterly sampling rounds from 19 existing monitoring wells (11GW22, 11GW23, 11GW24, 11GW25, 11GW26, 11GW27, 11GW28, 11GW29, 11GW66, 11GW67, 11GW69, 11GW70D, 11GW71, 11GW84, 11GW85, 11GW86, 11GW87, and 11GW88), three existing piezometers (11PZ62, 11PZ63, and 11PZ64), and seven proposed monitoring wells (11GW105, 11GW106, 11GW107, 11GW108, 11GW109, 11GW110, and 11GW111). The locations of the seven proposed monitoring wells are shown on Figure 3-7 and a description of monitoring well installation is provided in Section 4.3.5. Shallow monitoring wells 11GW105 and 11GW111 will be screened to intersect the water table. The five deep monitoring wells 11GW106, 11GW107, 11GW108, 11GW109, and 11GW110 will be installed with at least a 5 to 10 foot separation between the top of the screen of the deep well and the bottom of the screen of the adjacent shallow well. In the event that the thickness of the water table aquifer (in most cases, the Coastal Plain deposits) is limited to the point that an adequate separation between the well screens cannot be achieved within the aquifer, the deep well will be installed within the upper portion of the next significant water-bearing unit down, i.e., the fractured bedrock aquifer. Groundwater samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, and explosives (Method 8330).

Prior to monitoring well installation, an azimuthal resistivity surveys will be conducted at Site 11. The survey will be located in the area east of LW04 and LW05. The methodology for the azimuthal resistivity survey is described in Section 4.3.2. Based on the analysis of the survey, proposed monitoring well locations at Site 11 will be adjusted to align with the apparent fracturing in the area to intercept zones of higher hydraulic conductivity.

No soil samples will be collected at Site 11 since there are no known releases to surface soils at the site.

All new wells will be slug tested, to provide information regarding the hydraulic characteristics of the screened formations.

Four surface water samples will be collected from Site 11 as shown on Figure 3-7. Two samples will be collected from the drainage southeast of Building 30, and two samples will be collected from the drainage

east of Bowditch Road. Surface water samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), and TSS/TDS.

Four sediment samples will be collected at Site 11 (see Figure 3-7). The sediment samples will be collected from the same locations as for surface water. Sediment samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), TOC, and grain size.

Two pumping tests may be performed at Site 11 to collect hydrogeologic data for RA evaluations. Based on the results of the groundwater analyses, the location for the pumping test and the need for additional observation wells or piezometers will be determined. Pumping tests will be performed as described in the Master FSP (B&R Environmental, 1998).

4.2.8 Paint Branch Creek

Data gaps and investigation rationale for Paint Branch Creek are provided in Table 4-16. Sampling locations, sample identification numbers, and analyses for Paint Branch Creek are summarized in Table 4-17. Sampling locations are illustrated on Figure 3-8.

Five surface water/sediment samples will be collected from Paint Branch Creek. One sample will be collected from the northern and southern property boundaries and three samples will be collected along the middle of the Creek. Sampling locations are shown on Figure 3-8. Surface water samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), and TSS/TDS. Sediment samples will be analyzed for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals plus cyanide, explosives (Method 8330), TOC, and grain size.

4.3 FIELD INVESTIGATION METHODOLOGIES

This section describes the field investigation techniques and methodologies.

4.3.1 Fracture Trace Analysis

Prior to any subsurface investigations, a fracture trace analysis will be conducted using existing aerial photographs of NSWC-White Oak. The fracture trace analysis will identify bedrock fracturing or jointing which may be controlling groundwater flow. The results of the fracture trace analysis will be evaluated and used to adjust locations of proposed monitoring wells, as needed.

TABLE 4-16

INVESTIGATION RATIONALE
PAINT BRANCH CREEK
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Data Gap/Need	Investigation Activity	Number of Locations	Samples Per Locations	Location/Depth	Analysis
SOIL					
None	NA	0	0	NA	NA
GROUNDWATER					
None	NA	0	0	NA	NA
SURFACE WATER					
Human health and ecological risk data	Surface water sampling	5	1	1 at northern property boundary 3 along middle of creek 1 at southern property boundary	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TSS/TDS Explosives (Method 8330)
SEDIMENT					
Human health and ecological risk data	Sediment sampling	5	1	1 at northern property boundary 3 along middle of creek 1 at southern property boundary	TCL VOC, SVOC, Pesticides, PCBs TAL Metals plus CN TOC, Grain size Explosives (Method 8330)

TABLE 4-17

SITE SAMPLING PROGRAM
PAINT BRANCH CREEK
NSWC - WHITE OAK, SILVER SPRING, MARYLAND

Sample ID	Sample Location	Sample Depth (feet bgs[1])	Analysis							
			Target Compound List (TCL)			TAL[5]				
			VOCs[2]	SVOCs[3]	Pesticides/ PCBs[4]	Metals plus CN[6]	Explosives (Method 8330)	TOC[7]	TSS/ TDS[8]	Grain Size
SURFACE WATER										
PBSW100-00-01	PBSW100	--	•	•	•	•	•		•	
PBSW101-00-01	PBSW101	--	•	•	•	•	•		•	
PBSW102-00-01	PBSW102	--	•	•	•	•	•		•	
PBSW103-00-01	PBSW103	--	•	•	•	•	•		•	
PBSW104-00-01	PBSW104	--	•	•	•	•	•		•	
SEDIMENT										
PBSD100-00-01	PBSD100	--	•	•	•	•	•	•		•
PBSD101-00-01	PBSD101	--	•	•	•	•	•	•		•
PBSD102-00-01	PBSD102	--	•	•	•	•	•	•		•
PBSD103-00-01	PBSD103	--	•	•	•	•	•	•		•
PBSD104-00-01	PBSD104	--	•	•	•	•	•	•		•

• To be analyzed.

(1) Below ground surface.
(2) Volatile organic compounds.
(3) Semivolatile organic compounds.
(4) Polychlorinated biphenyls.
(5) Target analyte list.
(6) Cyanide.
(7) Total organic carbon.
(8) Total suspended solids/Total dissolved solids.

4.3.2 Azimuthal Resistivity Survey

Azimuthal resistivity surveys will be performed as described by Taylor and Fleming (1988). The surveys will be performed as a conventional resistivity survey using a Wenner, Schlumberger, or square array rotated about a fixed center point. Resistivity measurements will be taken at 10 degree intervals. Electrode spacings will be approximately four to five times the target depth. Target depths will be determined from existing site-specific stratigraphic data. Azimuthal resistivity measurements will be plotted on rose diagrams and evaluated for fracture trends and orientations.

4.3.3 Geologic Mapping

Fracture and joint features exposed in outcrops at NSWC-White Oak will be measured to supplement fracture trace analysis and azimuthal resistivity surveys. Bedrock orientation (strike and dip) measurements will be taken at selected outcrops throughout the facility. Joint frequencies will be plotted for statistical trends of fractures and joints.

4.3.4 EM Geophysical Survey

EM induction surveys will be performed at Sites 9 and 11 to determine the presence or absence of leaching wells in those areas. EM surveys will be performed as described in Section 2.6.2 of the Master FSP (B&R Environmental, 1998). Survey grids will be approximately 100 feet by 100 feet, centered around each leaching well.

If a leaching well is identified during an EM survey, its presence will be confirmed by hand augering or test pitting. Methodologies for hand augering and test pitting are described in Section 2.2.1 and 2.2.2, respectively, of the Master FSP (B&R Environmental, 1998).

4.3.5 Monitoring Well Installation

Monitoring wells will be installed as described in Section 2.3 of the Master FSP (B&R Environmental, 1998). Monitoring wells will be constructed of 2-inch Polyvinyl Chloride (PVC), flush-threaded riser and screen. Screens will be 10 feet in length with 0.010-inch slots

Shallow monitoring well screens will be positioned to intersect the water table. The top of the screened interval will be placed approximately two feet above the stabilized water table.

Deep monitoring well screen intervals will be positioned approximately 30 feet below the water table in the saprolite or bedrock. Deep monitoring wells may be installed using hollow stem auger techniques, if possible, or fluid rotary drilling techniques.

Monitoring wells will be developed as described in Section 2.3.4 of the Master FSP (B&R Environmental, 1998).

4.3.6 Slug Testing

Slug tests will be performed following well development of each newly installed monitoring well. Slug tests will be performed as described in Section 2.7.1 of the Master FSP (B&R Environmental, 1998).

4.3.7 Pumping Test

If data is required for evaluating RAs at a site as part of the CMS, a pumping test will be performed. Pumping tests will be designed and performed as described in Section 2.7.2 of the Master FSP (B&R Environmental, 1998). A minimum of two piezometers will be installed for each pumping well. Pumping tests will be conducted for 48 hours. Pumping test data analysis will be dependent on site and pumping test characteristics.

4.3.8 Water Level Measurements

One comprehensive round of water levels will measured from existing and proposed monitoring wells, piezometers, and stream gauges at each site to determine facility-wide groundwater flow patterns and hydraulic gradients. The round of water level measurements will be completed within one 24 hour period prior to groundwater sampling and 48 hours after well development. The methodology for water level measurement is described in Section 2.4 of the Master FSP (B&R Environmental, 1998).

4.3.9 Decontamination

Decontamination will be conducted as described in Section 2.10 of the Master FSP (B&R Environmental, 1998).

4.3.10 IDW Handling and Disposal

IDW will be handled and disposed as described in Section 2.11 of the Master FSP (B&R Environmental, 1998).

4.4 FIELD SAMPLING METHODOLOGIES

This section describes the field sampling techniques and methodologies for this investigation.

4.4.1 Soil Sampling

Surface soil samples will be collected in accordance with the methodologies described in Section 3.1.3 of the Master FSP (B&R Environmental, 1998). Surface soil samples will be collected using a hand auger or trowel from a depth of 0 to 6 inches.

Subsurface soil samples will collected in accordance with the methodologies described Section 3.1.4 of the Master FSP (B&R Environmental, 1998). Subsurface soil samples will be collected from hand auger borings and monitoring well/soil borings. Subsurface soil samples from monitoring well and soil borings will be collected continuously with 3-inch split-barrel samplers for the entire depth of the borings. Subsurface soil samples will be collected from an interval between 6 inches to 10 feet, unless otherwise noted. Subsurface soil samples will be selected for analyses based on the highest organic vapor monitoring reading above background levels. In the absence of readings above background levels, samples will be collected from the interval immediately above the water table, unless otherwise noted.

4.4.2 Groundwater Sampling

Low-flow purging and sampling techniques, as described in Section 3.1.1 of the Master FSP (B&R Environmental, 1998), will be used to collect groundwater samples for this investigation. TAL metals analysis will be for total metals only unless turbidity exceeds 10 NTU. If the higher turbidity levels are sustained during purging/sampling, a dissolved TAL metals sample will also be collected.

4.4.3 Surface Water Sampling

Surface water samples will be collected for this investigation as described in Section 3.1.2 of the Master FSP (B&R Environmental, 1998).

4.4.4 Sediment Sampling

Surface water samples will be collected for this investigation as described in Section 3.1.2 of the Master FSP (B&R Environmental, 1998).

4.4.5 Radiological and Background Radiological Sampling

Radiological screening of Sites 2, 3, 4, 7, and 8 will be performed by the Navy's RASO prior to beginning sampling activities.

4.5 SAMPLE HANDLING AND CUSTODY

Samples will be handled as described in Section 3.2 of the Master FSP (B&R Environmental, 1998). Specific requirements for this investigation are outlined in the following sections.

4.5.1 Sample Nomenclature

Each sample will be given a unique sample identification number, as described in Section 3.2.2 of the Master FSP (B&R Environmental, 1998). The groundwater sampling round number will be "01".

4.5.2 Sample Preservation

Sample containers, preservation, and holding times requirements for analysis are summarized in Table 3-1 of the Master FSP (B&R Environmental, 1998) with the following revision: solid samples collected for TCL VOCs will be preserved with methanol and cooled to 4°C in accordance with the SOP in Appendix A of the Master FSP (B&R Environmental, 1998).

4.5.3 Sample Documentation, Sample Packaging, and Shipping

Samples will be packaged and shipped in accordance with Section 3.2.4 of the Master FSP (B&R Environmental, 1998). Field documentation will be in accordance with the SOP SA-6.3 in Appendix A of the Master FSP (B&R Environmental, 1998).

4.6 QUALITY CONTROL SAMPLES

Quality control samples will be sampled at frequencies outlined in the Master QAPP (B&R Environmental, 1998). Trip blanks, field duplicates, source water blanks, rinsate blanks of non-dedicated sampling equipment, and matrix spike (MS) and matrix spike duplicate (MSD) samples will be collected for this investigation.

4.7 SCHEDULE

Figure 1-5 includes the schedule for the field investigation. The field investigation is expected to be completed in five 10-working day shifts. The schedule shown in Figure 1-5 includes Saturday and Sunday as working days for field work only. The fracture trace analysis and azimuthal resistivity surveys will be conducted prior to monitoring well installation.

4.8 FIELD CREW

Field investigation activities will be performed by a field crew consisting of a Field Operations Leader (FOL), and two to three Staff Geologists/Chemists, as necessary to complete the scheduled work.

5.0 DATA MANAGEMENT PLAN

The purpose of the Data Management Plan (DMP) is to track investigation data, to provide adequate levels of quality assurance for the data, and to facilitate the use of the data by technical and regulatory personnel performing and reviewing the environmental investigations conducted under CTO 298. The DMP incorporates a data flow process that designates key personnel responsible for the tracking of data from the date of sample collection to the final repository of electronic and/or hard copy versions of the data. The DMP provides for the efficient inclusion of historic data into the database necessary to prepare the RFI report and subsequent analyses. Finally, the DMP provides for a data storage standard that allows for accurate retrieval of the data in the future, as necessary.

5.1 DATABASE SOFTWARE

Microsoft Visual FoxPro 5.0, Statistica, and Excel will be the primary software packages for all data management and data manipulation activities. This includes the preparation of the analytical database for characterization of nature and extent of contamination, statistical analysis, and the preparation of PCOC selection tables for the HHRA and ERA.

5.2 RESPONSIBILITIES

All analytical and field data will be compiled and maintained in project files that will contain hard copies of the COCs, sample log forms, boring logs, sample location maps, and documentation of quality assurance of data manipulation. All electronic data will be managed on the B&R Environmental Network system under the project directory. The database will be secured by the network backup system on a daily basis.

Internal support will be provided to the project manager and project chemists, geologists, engineers, and other technical specialists in the preparation of deliverables necessary to the environmental investigation. However, the following personnel, in particular, have significant responsibilities in the tracking and manipulation of environmental data:

- Project Manager (PM)
- Data Project Manager (DPM)
- Sample Management Coordinator (SMC)
- GIS lead
- FOL

- Data Validation Manager (DVM)
- Data Validation Coordinator (DVC)

The PM is responsible for assuring that all data users manipulating or using environmental data are informed of the project objectives, schedules, and requirements regarding data. This is facilitated by a project kick-off meeting attended by all technicians working on the project and the completion of a data management checklist specifying project requirements such as the inclusion or exclusion of field screening data from the analytical database. The PM also provides a copy of the WP to the SMC to facilitate the tracking of analytical data and to allow for a check of the samples scheduled to be collected in the WP versus those actually collected in the field. Given the size and complexity of environmental work on-going at NSWC-White Oak, a DPM, often referred to as a project chemist, will also be assigned to the project. The DPM will report to the PM regarding all data related issues for the project and will be responsible for:

- Interfacing/trouble shooting with the analytical laboratories.

- The preparation of the QAPP.

- The documentation of the analytical data quality for the RFI report.

- Interfacing with the analytical laboratory, the regulators, and the client regarding any laboratory audit issues, if necessary.

- The overall coordination of efforts to produce and review the analytical database, calculate any statistics needed for the RFI, and prepare tables and figures to present analytical data in the RFI.

Responsibilities assigned to the other aforementioned personnel are described in the following narrative.

5.3 TRACKING OF ENVIRONMENTAL SAMPLES AND ANALYTICAL DATA

The tracking of environmental samples and data generated as a result of the analysis of those samples is primarily the responsibility of the DPM, SMC, and DVM. A "Cradle-to-Grave" sample tracking system will be employed beginning prior to the field effort. Based on information in the WP, all sample numbers, requested laboratory analyses, and field duplicate information will be entered into a sample tracking database by the SMC. The sample tracking database will then be used by the SMC to generate both sample jar labels and sample log forms to be completed in the field by the FOL. Completed COC forms

will be faxed by the FOL to the SMC and DPM in Pittsburgh and to the analytical laboratory at the end of each day of sampling. The SMC will compare information in the completed COC form against that presented in the sample tracking database. This will allow for early detection of errors made in the field and notification of the DPM so that any necessary adjustments can be made while the crew is mobilized.

An electronic copy of the sample tracking database will be sent to the laboratory by the SMC and DPM to avoid manual entry of sample numbers into the Laboratory Information Management System (LIMS). The SMC and DPM will send an example laboratory deliverable to the laboratory to ensure that analytical data is received from the laboratory in a format that can be accurately and efficiently used. The example deliverable will be attached to the specification package prepared for the laboratory.

After successful completion of all requested analyses, the laboratory will submit an electronic deliverable to the SMC for each Sample Delivery Group (SDG). The SMC will notify the DPM and DVM as data are received. Once all electronic deliverables have been received from the laboratory, the DVC will review the electronic deliverable for structure, content, and consistency with the hard copy deliverable and will print the data for each fraction and SDG. Additionally, queries will be run versus the pre-field effort database to ensure that the laboratory performed all of the requested analyses. The DPM and SMC will be notified as to any discrepancies. Ideally, discrepancies will be noted early enough to avoid resampling.

5.4 SAMPLE INFORMATION

All sample specific information will be entered into the data management system by the SMC. This information will include the depth at which the sample was collected, the area of concern that the sample is associated with, the sample matrix, the sample date, the data validation status, etc. The sample information file will allow for the analytical results to be grouped together properly for statistical purposes in the RFI report. The DPM will be responsible for the quality assurance review of all sample data entered into the database.

5.5 SURVEY DATA

The SMC and the GIS lead will collaborate to ensure that survey coordinates exist in the database for all sampled locations. The SMC will provide a file of distinct sample locations to the GIS lead. The GIS lead will create a diskette of sample locations and survey coordinate specifications to be provided to the surveying subcontractor. Sample coordinate information provided by the surveying subcontractor will be incorporated into the database by the SMC. Per the survey specification requirements, all survey data will be delivered in Excel spreadsheet format. The files will contain a minimum of northing, easting, ground surface elevation, elevation of top of casing, elevation of top of riser, and coordinate datum (i.e. North

American Datum, 1987). The GIS lead will be responsible for the review of the electronic data file from the surveyor to ensure that it is complete. The PM or his designate will be responsible for subcontracting with the surveying contractor and for assuring that all survey data needed for the RFI are provided to the SMC.

5.6 DATA VALIDATION

Data validation and associated activities are primarily the responsibility of the DVM and the DVC. The DVC will obtain a list of field duplicates from the FOL and will incorporate the information into the database. Once all samples and analyses have been accounted for, the DVC will print the electronic data files for each SDG and analytical fraction and the data packages will be submitted to the DVM for data validation. The DVM will assign a validator and will complete a data tracking sheet which documents the chemists assigned to the data validation and the quality assurance review of the data validation deliverable.

Data validation is an objective, systematic process in which analytical data are reviewed to ascertain the validity of the reported results and to identify for the data user the possible limitations of the analytical results. Data validation for the project will be conducted in accordance with the EPA Region III National Functional Guidelines for Organic and Inorganic Data Review. Validators will incorporate data qualifiers into the electronic database and will resubmit the electronic files and hardcopy files (including the data packages) to the DVC. The DVC will flag the data as "validated" in the database and will print the final validated data for the PM. The SMC will provide the original data deliverable disks from the analytical laboratory to the Data Validation Secretary for filing.

The following data qualifiers shall be used during the data review process:

- U - Indicates that the analyte was not detected at the numerical detection limit. Nondetected results from the laboratory are reported using this qualifier.

- B - Indicates that the analyte was detected but the result is considered to be a false positive as a result of laboratory or field blank contamination.

- UJ - Indicates that the analyte was not detected. However, the detection limit is considered to be estimated as a result of a noncompliance encountered during laboratory analysis. The associated detection limit is regarded as imprecise.

- J - Indicates that the analyte was detected and the associated numerical result is considered to be estimated or imprecise. Estimated results indicate the inability to assign a direction of bias.

- L - Indicates that the analyte was detected and the associated numerical result is considered to be biased low.

- UL- Indicates that the analyte was not detected. However, the detection limit is considered to be biased low as a result of a noncompliance encountered during laboratory analysis.

- K - Indicates that the analyte was detected and the associated numerical result is considered to be biased high.

- UR - Indicates that the analyte was not detected by the laboratory. However, the nondetected analyte is considered unreliable and unusable as a result of a gross technical deficiency.

- R - Indicates that the analyte was detected by the laboratory. However, the positive result is considered unreliable and unusable as a result of a gross technical deficiency.

The above qualifications are generally categorized as major and minor problems or deficiencies. Major problems are defined as those which result in the rejection of a data point. Such results are qualified either as R or UR. Minor problems are defined as those which either result in the estimation or the assignment of bias to a given data point. Data qualified as a consequence of minor problems are identified by the following qualifiers: B, UJ, L, K, and J.

The DVM will forward analytical data packages to the storage warehouse maintained by B&R Environmental within two weeks after validation is completed. The analytical data packages will be archived in a manner that will facilitate retrieval.

5.7 PROJECT DATA COMPILATION

Any new environmental data generated under this task order will be incorporated with all previous data generated at NSWC-White Oak. All data such as units of measure and chemical nomenclature will be manipulated to maintain consistency with the project database. The project database is a relational database that ensures data structure integrity and data quality for all NSWC-White Oak data.

5.8 DATA DELIVERABLES

Much of the information presented in the RFI report will be derived from the project database. The project database will be used to generate all data tables and most figures in the NEC, HHRA, ERA, and Data Evaluation sections of the RFI. Information Management Solutions Group (IMSG) personnel will be assigned to prepare data deliverables (data tables, statistics, figures displaying data). IMSG personnel will check the referential integrity of the database, will average field duplicate samples for statistical purposes, and query out quality assurance samples as directed by the technicians assigned to the project. (The normal, duplicate, and average/maximum concentrations will all be presented in the analytical results appendix.) Programs have been written to pull data directly from the database for statistics in order to preserve data integrity and consistency. Report formats have been written in Visual FoxPro to present analytical results in Excel Spreadsheet style format that are typically included as appendices.

At the direction of the technicians assigned to the project, IMSG personnel will compare site-specific contaminant concentrations to RBCs, standards, and criteria. The technicians will be responsible for providing the IMSG personnel with accurate RBCs, standards, and criteria and for the final quality assurance review of all data presented on tables and figures.

IMSG personnel will be responsible for ensuring that all data queries developed to select datasets for tables and figures are reviewed and approved by technicians. The DPM or their will be responsible for the quality assurance review of data displayed on figures versus that presented in the database. The project team members assigned to the NEC, HHRA, and ERA portions of the RFI will be responsible for the quality assurance review of data presented/summarized in tables versus that presented in the database and statistical print outs.

The DPM or a project chemist designated by DPM will be responsible for the preparation of the data quality evaluation sections of the RFI report. The data evaluation will be comprised of an overview of measures taken during the RFI to assure data quality (e.g., the collection of duplicate samples), the protocol used to validate the analytical data, and site-specific summaries of the data validation results. RFI sections presenting the methodology for and the results of the data evaluation will be reviewed and approved by a senior-level risk assessor or chemist prior to inclusion in the RFI report.

The DPM or their designee will be responsible for the quality assurance review of all environmental data to be included in the appendices of the RFI report. Information in the appendices will include, but not be limited to, the following:

- Sample log sheets and COC forms
- Results of the sample location survey
- Boring logs and monitoring well construction sheets
- Aquifer characteristics calculations
- Field screening methods and results
- Analytical database
- Data validation memorandum
- Results of statistical analyses of environmental data
- Spreadsheets (and other supporting information) for the baseline HHRA
- Supporting information for the ERA

The DPM or their designee will assure that the information included in the appendices has been reviewed by appropriate technical personnel, the information is organized in a logical fashion, and all information is legible.

5.9 GEOGRAPHIC INFORMATION SYSTEM

Upon compilation of all sample, chemical, and positional data, the data are incorporated into an ArcView GIS project. The basis of the ArcView project will be existing basemaps for NSWC-White Oak. The GIS system can be used to generate site location maps, sample location maps, contaminant isocontour maps, potentiomentric surface maps, and contaminant tag maps as needed for this and future investigations at NSWC-White Oak.

6.0 HUMAN HEALTH RISK ASSESSMENT

The objective of a HHRA is to determine whether detected concentrations of chemicals pose a significant threat to potential human receptors under current and/or future land use scenarios. The potential risks to human health at sites under investigation at the NSWC-White Oak are estimated based on the assumption that no actions will be taken to control chemical releases.

This WP contains the general methodologies to be used to evaluate site-specific human health risks at the NSWC-White Oak. Detailed site information will be provided in site-specific reports.

A HHRA consists of five components: (1) Data Evaluation; (2) Exposure Assessment; (3) Toxicity Assessment; (4) Risk Characterization, and (5) Uncertainty Analysis. Sections 6.1 through 6.5 below contain detailed discussions of the methodologies followed for each component of a HHRA. A schematic diagram of the general risk assessment process is provided as Figure 6-1.

In order to evaluate potential risks, three major requirements must be fulfilled: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist; and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete and no potential risks will be considered for human receptors.

6.1 DATA EVALUATION

Data evaluation, the first component of a HHRA, is a site-specific task involving the compilation and evaluation of analytical data. The main objective of data evaluation is to develop a media-specific list of PCOCs which is used to quantitatively determine potential human health risks.

6.1.1 Quantitative vs. Qualitative Use of Analytical Data

Current site data, as well as any suitable (validated) historical data, are used to assess risks to potential human receptors at each site of concern. All analytical data used in the quantitative estimation of potential risks are subjected to data validation. Only data of adequate quality, current and historical, are used in the quantitative risk assessment. A discussion of data validation protocol followed for data generated for the NSWC-White Oak is provided in the Master QAPP (B&R Environmental, 1998) and Section 5.0.

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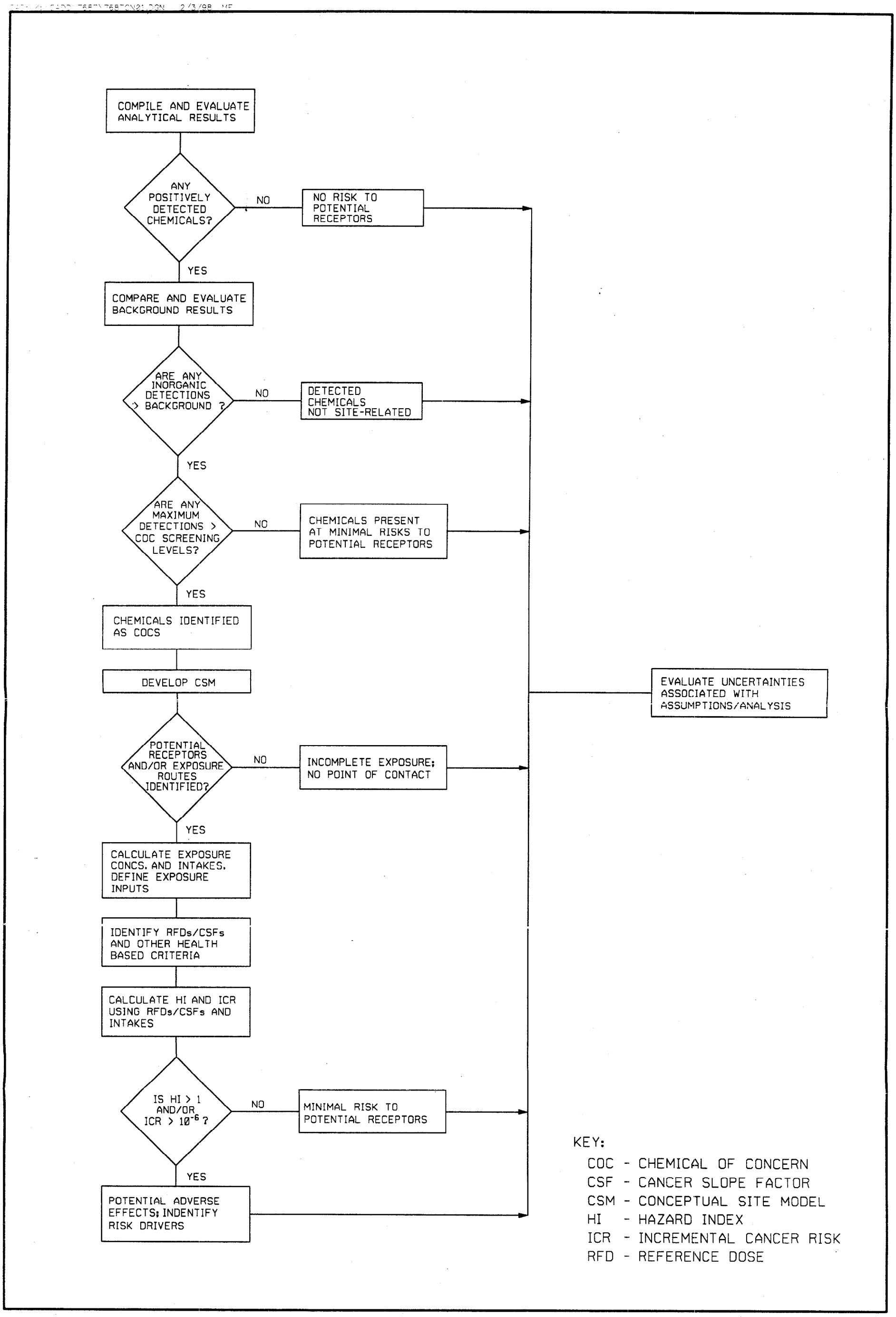

SUMMARY OF HUMAN HEATH RISK ASSESSMENT PROCESS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

FIGURE 6-1

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Fixed based analytical results from the targeted analyte lists are only generally used in the quantitative risk evaluation. Unfiltered results for groundwater and surface water, collected using a low-flow method, are used to assess risks associated with these media. Field screening results (preliminary assessments using field test kits), data regarded as unreliable (i.e., qualified as "B" or "R" during the data validation process), and results of Tentatively Identified Compound (TIC) analyses are not used quantitatively. However, these data may be used qualitatively to substantiate the conclusions of the quantitative risk analysis or to identify potential data gaps.

6.1.2 PCOC Selection

The selection of PCOCs is a qualitative screening process limiting the number of chemicals that are quantitatively evaluated in a HHRA to those site-related constituents that dominate overall potential risks. Screening against USEPA Region III RBC and background is employed to focus the risk assessment on appropriate chemicals and exposure routes.

In general, a chemical is selected as a PCOC and retained for further risk evaluation if the maximum detected concentration in a sampled medium exceeds the risk-based concentration, referred to as the PCOC screening level, and the chemical is determined to be present at concentrations above background. Frequency of detection is used to exclude chemicals when data sets of 20 samples or greater are available. Generally, a detection rate of 5 percent or less justifies elimination of the chemical from further consideration provided that the concentrations detected are not representative of a "hot spot" area. Chemicals eliminated from further evaluation at this step are assumed to present minimal risks to potential human receptors.

Care will be taken to ensure that analytical methods have the sensitivity to achieve screening level concentrations. A discussion of the analytical methods proposed for the investigation is included in the Master Work Plan (B&R Environmental, 1998) for the NSWC-White Oak.

6.1.2.1 PCOC Screening Level Development

The risk-based PCOC screening levels correspond to a systemic hazard quotient of 0.1 (for noncarcinogens) or a lifetime cancer risk of 1E-6 (for carcinogens). The risk-based concentrations were developed using protective default exposure scenarios suggested by USEPA (USEPA, 1991) and the best available reference doses and cancer slope factors.

Risk-based PCOC screening levels for tap water ingestion, which are based on daily, residential exposure assumptions, are used to select PCOCs for groundwater and surface water. In general, the use of tap water screening levels is regarded as an extremely conservative approach to PCOC selection because shallow groundwater at the NSWC-White Oak is not used as a potable drinking water source. The potential human exposure to surface water is expected to be limited to incidental exposures.

Risk-based PCOC screening levels for soil ingestion and site-specific screening levels for transfers from soil to air are used to select PCOCs for soil. Because projected future land use at a particular site is uncertain, soil ingestion screening levels for residential land use are used. PCOCs for soil are also identified using site-specific SSLs, which have been developed using the Office of Solid Waste and Emergency Response's (OSWER) soil screening guidance (USEPA, 1996a). SSLs are used to screen out chemicals detected at insignificant concentrations and to justify the elimination of the inhalation exposure pathway, which is comprised of the generation of fugitive dust and volatile emissions. OSWER SSLs for transfers from soil to groundwater are not used for PCOC selection but are presented for the purposes of groundwater protection. Chemicals with concentrations exceeding the SSLs may potentially migrate from the soil to groundwater in sufficient quantities to pose concerns about groundwater quality.

For sediment, PCOCs are selected by comparing detected site concentrations to residential soil ingestion screening levels only. SSLs for transfers from soil to air are not considered to be appropriate for sediment screening because of high moisture content associated with sediment matrices. The use of soil ingestion screening levels for sediment PCOC identification is regarded as a conservative approach since anticipated exposure to sediment is less than anticipated exposure to soil.

6.1.2.2 Lead as a PCOC

RBCs are not calculated for lead since the USEPA has not derived toxicity values for this constituent. However, guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the OSWER recommends 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting where children are frequently present (USEPA, 1994a and 1994b). Based on this recommendation, a value of 400 mg/kg is used as a screening level for soil and sediment at sites where a future residential scenario is considered to be a likely potential land use. The Safe Drinking Water Act (SDWA) action level of 15 μg/L is used as the screening level for lead in groundwater and surface water.

6.1.2.3 Essential Nutrients and Chemicals Without Toxicity Criteria

The essential nutrients, calcium, magnesium, potassium, and sodium, are not identified as PCOCs at a site. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, because of the lack of toxicity criteria, risk-based PCOC screening levels are not available for some chemicals commonly detected at sites. These chemicals are not selected as PCOCs because they cannot be quantitatively addressed in the risk assessment. However, they would be discussed in the data evaluation section and would be qualitatively addressed in the uncertainty section of the risk assessment. If appropriate surrogate chemicals (which have toxicity criteria) are identified, they may be used for screening purposes as approved.

6.1.2.4 Determination of Site-Related Chemicals

Chemicals found at concentrations indicative of background levels are not considered to be site-related contaminants and are not retained as PCOCs. Site-specific background data (Appendix K) or literature background values are used to determine whether detected chemicals are present at naturally occurring levels. Conventional statistical methods (e.g., Bartlett's Test for homogeneity, T-test, Wilcoxon Rank Sum Test, comparison of maximum detected concentrations to the background upper tolerance limits, etc.) are employed to compare site concentrations to available Base-wide background data. Where Base-specific data are not available, a direct comparison of maximum site concentrations to published regional literature values is used.

6.1.3 PCOC Summary Screening Tables

Media-specific tables summarizing the selection of PCOCs are included in the site-specific risk assessments. At a minimum, maximum concentration of all detected chemicals, frequency of detection, location of maximum detected concentration, PCOC screening level(s), and results of PCOC screening process are included in the summary tables.

Other pertinent health-based criteria (e.g., state and federal drinking water standards, ambient water quality criteria, etc.) are also incorporated in the summary tables on a case-by-case basis. Although these additional criteria are not used to select PCOCs, they can be used for informative purposes and to satisfy regulatory agency requests for comparison of site data to applicable standards.

OSWER SSLs for contamination transfer from soil to groundwater (USEPA, 1996a) are also included in the PCOC summary tables to identify chemicals present in soil at concentrations which may impact groundwater quality. The values are not used to identify PCOCs since they are not based on direct

human exposure, but may indicate the potential ability of a chemical to migrate from soil to groundwater. Where data indicate the potential for contaminant migration from soil to groundwater, groundwater modeling, or additional groundwater sampling may be necessary (if insufficient groundwater data exist) to evaluate the potential impact of soil contamination on groundwater quality.

6.2 EXPOSURE ASSESSMENT

This portion of the risk assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations and applicable exposure pathways, calculate concentrations of PCOCs to which receptors might be exposed, and estimate chemical intakes under the identified exposure scenarios.

Actual or potential exposures at the NSWC-White Oak are based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components, a source of chemicals that can be released to the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor. This compilation of likely exposure pathways and receptors is referred to as the Conceptual Site Model (CSM).

6.2.1 Conceptual Site Model

The development of a CSM is an essential component of the exposure assessment. The CSM graphically integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors evaluated in the risk assessment. A well defined CSM allows for a better understanding of the risks at a site and aids the risk managers in the identification of the potential need for remediation. The CSM for all identified potential exposure pathways is shown in Figure 6-2.

6.2.1.1 Exposure Setting

The exposure setting consists of a description of the physical characteristics (climate, meteorology, geology, groundwater hydrology, vegetation, and nearby surface water bodies) of a site, as well as the identification of potentially exposed populations at or near the site. Exposed populations are identified with respect to both current and future land uses.

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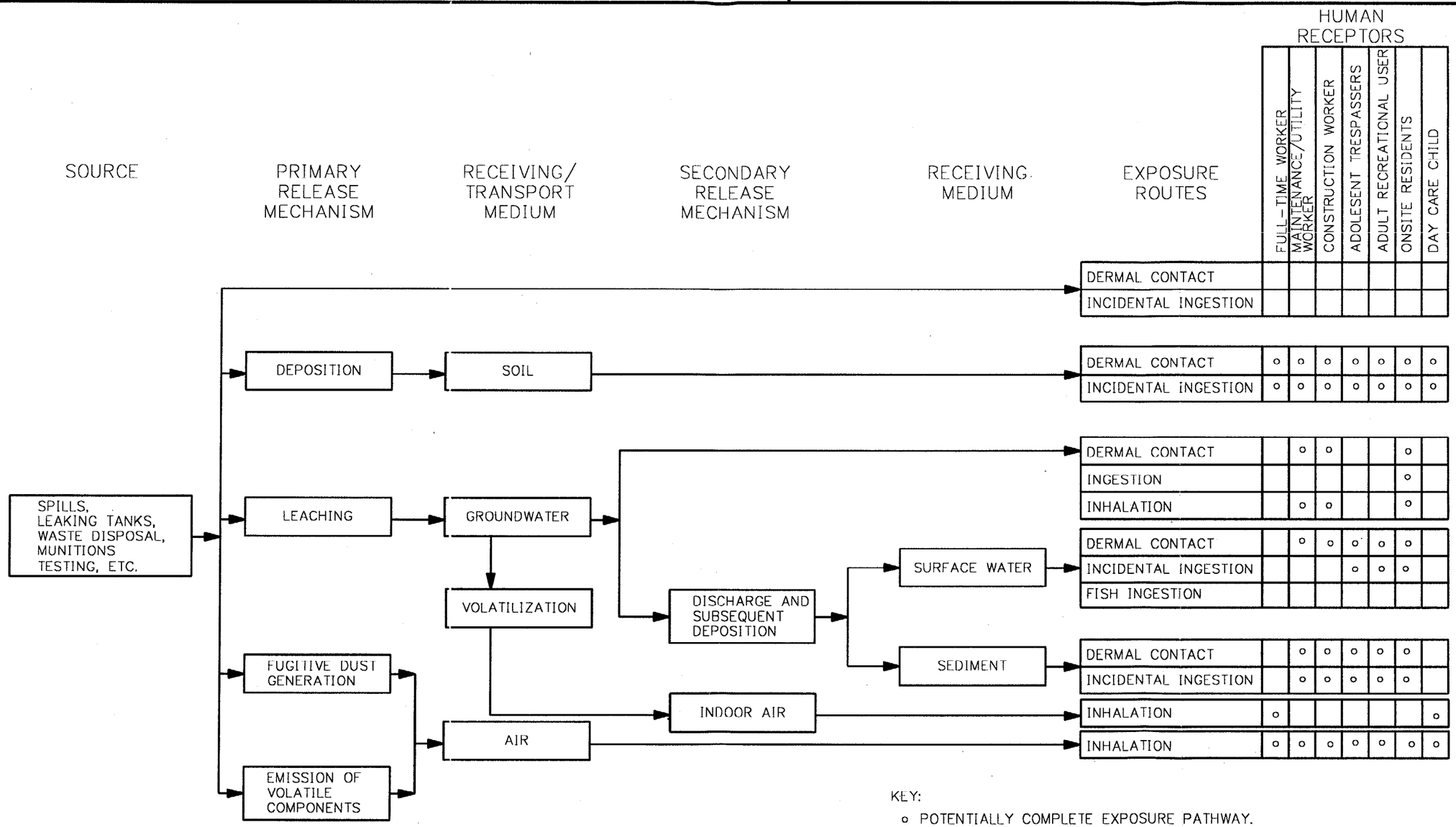

KEY:

o POTENTIALLY COMPLETE EXPOSURE PATHWAY.

BLANK INDICATES INCOMPLETE EXPOSURE, RELATIVELY INSIGNIFICANT, OR NOT APPLICABLE POTENTIAL EXPOSURE.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY MF DATE 1/3/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE NONE

Brown & Root Environmental

CONCEPTUAL SITE MODEL
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

CONTRACT NO. 7687
OWNER NO. 0102
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 6-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

6.2.1.2 Potential Exposure Pathways/Receptors

The course that a chemical takes from the source to the exposed individual is defined as the exposure pathway. The characterization of exposure factors is necessary so that only potentially complete exposure pathways are evaluated in the risk assessment.

Potential receptors can be exposed to site contaminants, directly or indirectly, via five environmental media: air, soil, groundwater, surface water, and sediment. Potential exposure routes for these media include ingestion (swallowing), dermal contact (skin exposure), and/or inhalation (breathing).

In general, the following exposure scenarios may be applicable under current and/or future land use for sites under investigation at the NSWC-White Oak:

- **Full-time employees** may be exposed to site media while performing site inspections or daily duties. Typically, this receptor is evaluated for direct exposure to surface soil only through incidental ingestion and dermal contact. Direct exposure to groundwater is not evaluated for these receptors because shallow groundwater at the NSWC-White Oak is not used as a potable water supply under current conditions and is not anticipated to be used for this purpose under potential projected future land use. However, inhalation of compounds volatilizing from groundwater into indoor air is likely. Exposure to surface water and sediment is expected to be minimal for these receptors, therefore it will not be evaluated. Inhalation of fugitive dust is also evaluated.

- **Maintenance and utility workers** may be exposed to site media while performing maintenance activities (e.g., mowing, landscaping, digging trenches), site inspections or daily duties. These receptors are evaluated for exposures to surface and subsurface soils, groundwater, surface water, and sediment.

- For sites involving current or potential future construction or excavation activities, **construction workers** are evaluated for exposure to surface and subsurface soil, groundwater, surface water, and sediment. Exposure to soil is expected to be through incidental ingestion and dermal contact. Dermal exposure to shallow groundwater and inhalation of organics volatilizing from groundwater is possible while performing work-related activities. However, incidental ingestion of groundwater during work activities would be regarded as insignificant. Moreover, direct exposure to groundwater would not be evaluated because shallow groundwater at the NSWC-White Oak Site is not currently used as a potable water supply and is not anticipated to be used for this purpose in the future. Exposure to

surface water is limited to dermal contact. Ingestion of surface water during routine work activities is expected to be negligible and would not be evaluated. Exposure to sediment is limited to incidental ingestion and dermal contact. Inhalation of fugitive dust is also evaluated.

- Individuals may trespass on the site and come in contact with site media. **Adolescent trespassers** from ages 7 to 16 years are evaluated for infrequent exposure to surface soil, surface water, and sediment. It is unlikely that the trespasser would be exposed to groundwater. Small children (6 years or younger) are not included in this receptor group because they are expected to be supervised by an adult. Exposure to soil is expected to be through incidental ingestion and dermal contact. Exposure to surface water and sediment is also limited to incidental ingestion and dermal contact. Inhalation of fugitive dust is also evaluated.

- **Adult recreational users** are considered as potential receptors. This receptor group is evaluated for exposure to surface soil, surface water, and sediment. Exposure to soil is expected to be through incidental ingestion and dermal contact. Inhalation of fugitive dust is also evaluated. However, like the trespasser, it is unlikely that the recreational user would be exposed to groundwater. Exposure to surface water and sediment is also limited to incidental ingestion and dermal exposure. It is also unlikely that the recreational user would be exposed to fish. The surface water bodies across the site do not provide a viable environment for fish to thrive.

- Future **onsite residents** are evaluated as potential receptors. Future onsite residents are assumed to be exposed to surface soil and groundwater on a daily basis. However, a future residential scenario is not considered to be likely at NSWC-White Oak. Exposure to soil is expected to be through incidental ingestion and dermal contact. Inhalation of fugitive dust will also be evaluated. Exposure to groundwater is expected to be through ingestion, dermal contact and inhalation. Evaluating inhalation of groundwater constituents precludes the need to evaluate indoor air concentrations of volatile organic compounds infiltrating foundation cracks. It is expected that use of groundwater in the house would result in air concentrations significantly greater than those infiltrating through foundation cracks. Residents are also exposed to surface water and sediment. Exposure to surface water and sediment is limited to incidental ingestion and dermal contact. This exposure is assumed to be equivalent to that of the recreational receptor.

- **Day care children** may be exposed to surface soil and compounds volatilizing from groundwater into the indoor air. These children range in age from 1 to 6 years. It is anticipated that children older than age six are in school full time and their time at the day care center would be negligible. Exposure to soil is expected to be through incidental ingestion and dermal contact. Groundwater is currently not

used onsite and its use in the future is not anticipated. Furthermore, it is unlikely that day care children would wantonly wander the site and be exposed to surface water and sediment.

6.2.2 CTE vs. RME

Traditionally, exposures evaluated in the HHRA were based on the concept of a Reasonable Maximum Exposure (RME) only, which is defined as " the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989a). However, more recent risk assessment guidance (USEPA, 1992a) recommends addressing an average case or Central Tendency Exposure (CTE).

If the RME risks exceed the USEPA's target risk range of 10^{-4} to 10^{-6}, both RME and CTE will be evaluated in the site-specific risk assessments for the NSWC-White Oak. It should be noted that the available guidance (USEPA, 1993a) concerning the evaluation of CTE is limited and at times vague. Therefore, professional judgment is exercised when defining CTE conditions for a particular receptor at a site.

6.2.3 Exposure Concentrations

The exposure concentration, which is calculated for PCOCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (USEPA, 1992b). The 95 percent UCL is used as the exposure concentration to assess RME and CTE risks (USEPA, 1993a). For data sets with 10 or more samples and the distribution is undefined (both the normal and lognormal distributions fail the normality test), the data set is assumed to be log-normally distributed provided the 95 percent UCL does not exceed the maximum concentration. For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration is defined as the maximum detection and arithmetic mean (if less than maximum) for RME and CTE scenarios, respectively (USEPA, 1993a).

Conventional statistical methods are used to determine the distribution of a particular data set.. A number of statistical evaluations may be used to determine which, if either, of the distributions are exhibited by a given data set. As recommended by the EPA, the Shapiro and Wilk "W-test" (for sample sets $\leq$ 50) and the Shapiro-Francia "W-test" (for sample sets>50) will be used to determine whether the data are normally or lognormally distributed (EPA, 1992c).

The null hypothesis (H_0) that is tested is that the population has a normal (or lognormal when the data is log-transformed) distribution. The alternate hypothesis (H_A) is that the population does not have a normal (or lognormal when the data is log-transformed) distribution. The equation for the W statistic is:

$$W = \left[\frac{b}{S_R\sqrt{n-1}}\right]^2$$

where

$$b = \sum_{i=1}^{k} a_i\left(x_{[n+1]} - x\right) = \sum_{i=1}^{k} b_i$$

and the coefficients a_i, a_2, a_3, .., a_k are defined in EPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (USEPA, 1992c).

A "W" statistic (W_{calc}) is computed for a data set (or a log transformed data set) and compared to a test statistic (W_{test}). The test statistic is determined at the 5% significance level (EPA 1992e). If $W_{calc} > W_{test}$, then the null hypothesis is not rejected, i.e., the data are assumed to be normally distributed (or lognormally distributed if log-transformed data are tested). If $W_{calc} < W_{test}$, then the null hypothesis is rejected and the alternative hypothesis is accepted, i.e., the data are not assumed to be normally distributed (or not log-normally distributed if log transformed data are tested).

EPA (1992b) defines how the UCL should be calculated. Sample and duplicate analytical results are averaged for statistical use. Nondetected data points are utilized; in general, one-half the sample-specific detection limit is used for these analytical results. If the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum is used as the exposure concentration in place of the UCL.

To evaluate exposure of construction, utility, and maintenance workers to soil, surface and subsurface soil data will be combined to form one data set. To evaluate exposures of receptors to groundwater, surface water, and sediment, only the most recent data will be used.

6.2.4 Chemical Intake Estimation

The methodologies and techniques which are used to estimate exposure intakes are presented in this section. Intakes for the identified potential receptor groups are calculated using current USEPA risk assessment guidance (USEPA, 1989a and 1992b) and presented in risk assessment spreadsheets which will be appended to the RFI. Risk assessment spreadsheets are appended to the site-specific assessment as support documentation.

Noncarcinogenic intakes are estimated using the concept of an average annual exposure. Carcinogenic intakes are calculated as an incremental lifetime exposure, which assumes a life expectancy of 70 years. Equations used to calculate estimated intakes are provided below. Assumptions regarding exposure are presented in Table 6-1.

6.2.4.1 Incidental Ingestion of Soil/Sediment

Direct physical contact with soil (and sediment) may result in the incidental ingestion of chemicals. Exposure associated with the oral route is estimated in the following manner (USEPA, 1989a and 1992b):

$$Intake_{si} = (C_{si})(IR_s)(FI)(EF)(ED)(CF) \ / \ (BW)(AT)$$

where:	$Intake_{si}$	=	intake of contaminant "i" from soil or sediment (mg/kg/day)
	C_{si}	=	concentration of contaminant "i" in soil or sediment (mg/kg)
	IR_s	=	ingestion rate (mg/day)
	FI	=	fraction ingested from contaminated source (dimensionless)
	EF	=	exposure frequency (days/yr)
	ED	=	exposure duration (yr)
	CF	=	conversion factor (1E-6 kg/mg)
	BW	=	body weight (kg)
	AT	=	averaging time (days);
			for noncarcinogens, AT = ED x 365 days/yr;
			for carcinogens, AT = 70 yr x 365 days/yr

The fraction of soil ingested from the source is based on assumed human activity patterns

6.2.4.2 Dermal Contact with Soil/Sediment

Direct physical contact with soil (and sediment) may result in the dermal absorption of chemicals. Exposure associated with the dermal route is estimated in the following manner (USEPA, 1989a and 1992d):

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Surface Soil
Receptor Population: Full Time Worker
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	100	EPA 1993a	50	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	3160	EPA 1997a	3160	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
PAGE 2 OF 25

Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface and Subsurface Soil/Sediment
Receptor Population: Maintenance/Utility Worker
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	100	EPA 1993a	50	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	36	Professional Judgement	18	Professional Judgement	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	3160	EPA 1997a	3160	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	36	Professional Judgement	18	Professional Judgement	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
PAGE 3 OF 25

Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface and Subsurface Soil/Sediment
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	480	EPA 1993a	240	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	180	Professional Judgement	180	Professional Judgement	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	3160	EPA 1997a	3160	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	180	Professional Judgement	180	Professional Judgement	
	ED	Exposure Duration	(years)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK,SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface Soil/Sediment
Receptor Population: Adolescent Trespasser
Receptor Age: 7-16 Years

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	100	EPA 1993a	50	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	52	Professional Judgement	26	Professional Judgement	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	10	Professional Judgement	10	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	43	EPA 1997a	43	EPA 1997a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	EPA 1989a	3650	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	3263	EPA 1997a	3263	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement	26	Professional Judgement	
	ED	Exposure Duration	(years)	10	Professional Judgement	10	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	43	EPA 1997a	43	EPA 1997a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	EPA 1989a	3650	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface Soil/Sediment
Receptor Population: Adult Recreational User
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	100	EPA 1993a	50	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	16	Professional Judgement	8	Professional Judgement	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	30	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	10,950	EPA 1989a	3285	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	9000	EPA 1997a	9000	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	16	Professional Judgement	8	Professional Judgement	
	ED	Exposure Duration	(years)	30	EPA 1993a	9	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	10,950	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface Soil/Sediment
Receptor Population: Resident
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	100	EPA 1993a	50	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2555	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	9000	EPA 1997a	9000	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2555	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Soil/Sediment
Exposure Medium: Soil/Sediment
Exposure Point: Surface Soil/Sediment
Receptor Population: Resident
Receptor Age: Child (0-6 Years)

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	200	EPA 1993a	100	EPA 1993a	Cs x IRs x EF x ED
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	BW x AT x CF
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED
	SA	Skin Surface Area	(cm^2)	3506	EPA 1997a	3506	EPA 1997a	BW x AT x CF
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Surface Soil
Receptor Population: Day Care Child
Receptor Age: Child (0-6 Years)

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRs	Ingestion Rate of Soil	(mg/day)	200	EPA 1993a	100	EPA 1993a	Cs x IRs x EF x ED / BW x AT x CF
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	FI	Fraction Ingested	(unitless)	0.5	Professional Judgement	0.5	Professional Judgement	
	ED	Exposure Duration	(years)	6	Professional Judgement	3	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	1095	EPA 1989a	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) =
	AF	Soil to Skin Adherence Factor	(mg/cm^2)	1	EPA 1993a	0.2	EPA 1993a	Cs x SA x ABS x AF x EF x ED / BW x AT x CF
	SA	Skin Surface Area	(cm^2)	3506	EPA 1997a	3506	EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	EPA 1995b	chemical-specific	EPA 1995b	
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	ED	Exposure Duration	(years)	6	Professional Judgement	3	Professional Judgement	
	CF	Conversion Factor	(mg/kg)	1.00E+06	EPA 1989a	1.00E+06	EPA 1989a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,500	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	1095	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water
Receptor Population: Resident
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRw	Ingestion Rate of Water	(L/day)	2	EPA 1993a	1.4	EPA 1993a	Cw x IRw x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2550	EPA 1989a	
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	SA	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	0.25	EPA 1992d	0.167	EPA 1992d	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2,550	EPA 1989a	
Inhalation	S	Volatile Chemical Generation Rate	(ug/m^3-min shower)	Derived	Foster&Chrostowski 1987	Derived	Foster & Chrostowski 1987	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRsh	Inhalation Rate of volatiles in shower	(L/min)	10	EPA 1991	10	EPA 1991	S x IRsh x K x EF x ED / BW x AT x Ra x CF
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	K	Masss Transfer Coefficient	(min)	Derived	Foster&Chrostowski 1987	Derived	Foster & Chrostowski 1987	K = Ds + exp(-Ra x Dt)/Ra - [exp(Ra) x (Ds-Dt)]/Ra
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	Ra	Air Exchange Rate	(min^{-1})	0.025	Foster&Chrostowski 1987	0.025	Foster & Chrostowski 1987	
	Ds	Shower Duration	(min)	15	EPA 1992d	10	EPA 1992d	
	Dt	Total Time in Bathroom	(min)	20	Professional judgement	15	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2550	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water
Receptor Population: Resident
Receptor Age: Child (0-6 Years)

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRw	Ingestion Rate of Water	(L/day)	1	EPA 1997a	1	EPA 1997a	Cw x IRw x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	SA	Skin Surface Area	(cm^2)	6,970	EPA 1997a	6,970	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	tevent	Duration of Event	(hr)	0.25	EPA 1992d	0.167	EPA 1992d	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	
Inhalation	S	Volatile Chemical Generation Rate	(ug/m^3-min shower)	Derived	Foster&Chrostowski 1987	Derived	Foster & Chrostowski 1987	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRsh	Inhalation Rate of volatiles in shower	(L/min)	10	EPA 1991	10	EPA 1991	S x IRsh x K x EF x ED / BW x AT x Ra x CF
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	K	Masss Transfer Coefficient	(min)	Derived	Foster&Chrostowski 1987	Derived	Foster & Chrostowski 1987	K = Ds + exp(-Ra x Dt)/Ra - [exp(Ra) x (Ds-Dt)]/Ra
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	Ra	Air Exchange Rate	(min^{-1})	0.025	Foster&Chrostowski 1987	0.025	Foster & Chrostowski 1987	
	Ds	Shower Duration	(min)	15	EPA 1992d	10	EPA 1992d	
	Dt	Total Time in Bathroom	(min)	20	Professional judgement	15	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK

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Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Surficial Aquifer
Receptor Population: Maintenance/Utility Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	36	Professional judgement	18	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	8	Professional judgement	4	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2,550	EPA 1989a	
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate of volatiles	(m^3/hr)	4.8	EPA 1989a	4.8	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	36	Professional judgement	18	Professional Judgement	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Surficial Aquifer
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	180	Professional judgement	180	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	1	EPA 1993a	1	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	8	Professional judgement	4	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	
Inhalation	Cair	Chemical Concentration In Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate of volatiles	(m^3/hr)	4.8	EPA 1989a	4.8	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	180	Professional judgement	180	Professional Judgement	
	ED	Exposure Duration	(years)	1	EPA 1993a	1	EPA 1993a	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Surface Water
Receptor Population: Maintenance/Utility Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	36	Professional judgement	18	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	8	Professional judgement	4	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2,550	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Surface Water
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	180	Professional judgement	180	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	1	EPA 1993a	9	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	8	Professional judgement	4	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Surface Water
Receptor Population: Adolescent Trespasser
Receptor Age: 7-16 Years

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day)=
	CR	Contact Rate with Surface Water	(L/hr)	0.05	EPA 1988d	0.05	EPA 1988d	Cw x CR x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	52	Professional judgement	26	Professional Judgement	
	ED	Exposure Duration	(years)	10	Professional judgement	10	Professional Judgement	
	ET	Exposure Time	(hr/day)	4	Professional judgement	2	Professional Judgement	
	BW	Body Weight	(kg)	43	EPA 1989a	43	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	EPA 1989a	3650	EPA 1989a	
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	3,260	EPA 1997a	3,260	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	52	Professional judgement	26	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	10	Professional judgement	10	Professional Judgement	
	BW	Body Weight	(kg)	43	EPA 1989a	43	EPA 1989a	
	tevent	Duration of Event	(hr/event)	4	Professional judgement	2	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	EPA 1989a	3,650	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Surface Water
Receptor Population: Recreational User
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day)=
	CR	Contact Rate with Surface Water	(L/hr)	0.05	EPA 1988d	0.05	EPA 1988d	Cw x CR x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	16	Professional judgement	16	Professional Judgement	
	ED	Exposure Duration	(years)	30	Professional judgement	9	Professional Judgement	
	ET	Exposure Time	(hr/day)	4	Professional judgement	2	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	10,950	EPA 1989a	3285	EPA 1989a	
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	20,000	EPA 1997a	20,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	16	Professional judgement	16	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	30	Professional judgement	9	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	4	Professional judgement	2	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	10,950	EPA 1989a	3,285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
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Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Surface Water
Receptor Population: Resident
Receptor Age: Adult

Exposure Rout	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day)=
	CR	Contact Rate with Surface Water	(L/hr)	0.05	EPA 1988d	0.05	EPA 1988d	Cw x CR x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	ET	Exposure Time	(hr/day)	4	Professional judgement	2	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2550	EPA 1989a	
Dermal	Cw	Chemical Concentration in Water	(mg/L)	95%UCL	EPA 1993a	95%UCL	EPA 1993a	Dermally Absorbed Dose =
	A	Skin Surface Area	(cm^2)	9,000	EPA 1997a	9,000	EPA 1997a	DAevent x EV x EF x ED x A / BW x AT
	Kp	Permeability Constant	(cm/hr)	Chemical-specific	EPA 1992d	Chemical-specific	EPA 1992d	
	EV	Event Frequency	(events/day)	1	Professional judgement	1	Professional Judgement	
	EF	Exposure Frequency	(days/year)	350	Professional judgement	234	Professional Judgement	DAevent = Constants x Kp x Cw x tevent
	ED	Exposure Duration	(years)	24	Professional judgement	7	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	tevent	Duration of Event	(hr/event)	4	Professional judgement	2	Professional Judgement	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25,550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2,550	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Full Time Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	2.5	EPA 1989a	2.5	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	9125	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Maintenance/Utility Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	2.5	EPA 1989a	2.5	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	36	Professional judgement	18	Professional Judgement	
	ED	Exposure Duration	(years)	25	EPA 1993a	9	EPA 1993a	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future

Medium: Air

Exposure Medium: Air

Exposure Point: Air

Receptor Population: Construction Worker

Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	4.8	EPA 1989a	4.8	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	180	Professional judgement	180	Professional Judgement	
	ED	Exposure Duration	(years)	1	EPA 1993a	1	EPA 1993a	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	365	EPA 1989a	365	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

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Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Adolescent Trespasser
Receptor Age: 7-16 Years

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	3.2	EPA 1989a	3.2	EPA 1989a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	52	Professional judgement	26	Professional Judgement	
	ED	Exposure Duration	(years)	10	Professional judgement	10	Professional Judgement	
	ET	Exposure Time	(hr/day)	4	Professional judgement	2	Professional Judgement	
	BW	Body Weight	(kg)	43	EPA 1989a	43	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	EPA 1989a	3650	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future

Medium: Air

Exposure Medium: Air

Exposure Point: Air

Receptor Population: Adult Recreational User

Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	3.2	EPA 1989a	3.2	EPA 1989a	$\frac{Cair \times IRa \times ET \times EF \times ED}{BW \times AT}$
	EF	Exposure Frequency	(days/year)	16	Professional judgement	8	Professional Judgement	
	ED	Exposure Duration	(years)	30	EPA 1993a	9	EPA 1993a	
	ET	Exposure Time	(hr/day)	4	Professional judgement	2	Professional Judgement	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	10,950	EPA 1989a	3285	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	0.833	EPA 1996a	0.833	EPA 1996a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	24	EPA 1993a	7	EPA 1993a	
	ET	Exposure Time	(hr/day)	24	EPA 1993a	24	EPA 1993a	
	BW	Body Weight	(kg)	70	EPA 1989a	70	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	EPA 1989a	2555	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Resident
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989a	Derived	EPA 1989a	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	0.5	EPA 1996a	0.5	EPA 1989a	$\frac{Cair \times IRa \times ET \times EF \times ED}{BW \times AT}$
	EF	Exposure Frequency	(days/year)	350	EPA 1993a	234	EPA 1993a	
	ED	Exposure Duration	(years)	6	EPA 1993a	2	EPA 1993a	
	ET	Exposure Time	(hr/day)	24	EPA 1993a	24	Professional Judgement	
	BW	Body Weight	(kg)	15	EPA 1989a	15	EPA 1989a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989a	25550	EPA 1989a	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989a	730	EPA 1989a	

TABLE 6-1

VALUES USED FOR DAILY INTAKE CALCULATIONS

NSWC-WHITE OAK, SILVER SPRING, MARYLAND

Scenario Timeframe: Future
Medium: Air
Exposure Medium: Air
Exposure Point: Air
Receptor Population: Day Care Child
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	(mg/m^3)	Derived	EPA 1989c	Derived	EPA 1989c	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate	(m^3/hr)	1.2	EPA 1996a	1.2	EPA 1996a	Cair x IRa x ET x EF x ED / BW x AT
	EF	Exposure Frequency	(days/year)	250	EPA 1993a	219	EPA 1993a	
	ED	Exposure Duration	(years)	6	Professional judgement	3	Professional Judgement	
	ET	Exposure Time	(hr/day)	8	Professional judgement	4	Professional Judgement	
	BW	Body Weight	(kg)	15	EPA 1989c	15	EPA 1989c	
	AT-C	Averaging Time (Cancer)	(days)	25,550	EPA 1989c	25550	EPA 1989c	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	EPA 1989c	1095	EPA 1989c	

$$Intake_{si} = (C_{si})(SA)(AF)(ABS)(CF)(EF)(ED) \ / \ (BW)(AT)$$

where:	$Intake_{si}$	=	amount of chemical "i" absorbed during contact with soil/sediment (mg/kg/day)
	C_{si}	=	concentration of chemical "i" in soil/sediment (mg/kg)
	SA	=	skin surface area available for contact (cm^2/day)
	AF	=	skin adherence factor (mg/cm^2)
	ABS	=	absorption factor (dimensionless)
	CF	=	conversion factor (1E-6 kg/mg)
	EF	=	exposure frequency (days/yr)
	ED	=	exposure duration (yr)
	BW	=	body weight (kg)
	AT	=	averaging time (days);
			for noncarcinogens, AT = ED x 365 days/yr;
			for carcinogens, AT = 70 yr x 365 days/yr

The same exposure frequencies and durations used in the estimation of incidental ingestion intakes of soil/sediment are used to estimate exposure via dermal contact. Exposed surface areas of body available for dermal contact are determined on a receptor-specific basis since they correspond with assumed human activities and clothing worn during exposure events. Current guidance (USEPA, 1997a) is used to develop the following default assumptions concerning the amount of skin surface area available for contact for a receptor:

- For maintenance workers, utility workers, full-time employees, and construction workers, the head, hands and forearms (3160 cm^2) are assumed to be available for soil contact.

- For adolescent trespassers, the forearms, lower legs and hands (3263 cm^2) are assumed to be available for soil and/or sediment contact.

- For adult recreational users, the arms, legs, hands and feet (9000 cm^2) are assumed to be available for soil and/or sediment contact.

- For onsite residents, the arms, legs, hands and feet (9000 cm^2 for the adult and 3506 cm^2 for the child) are assumed to be available for soil and /or sediment contact.

- For day care children, the arms, legs, hands and feet (3506 cm^2) are assumed to be available for soil and/or sediment contact.

The published range for the soil adherence factor is 0.2 to 1.0 mg/cm^2 (USEPA, 1992d). Soil adherence factors of 1.0 and 0.2 are used to evaluate RME and CTE, respectively. Current USEPA Region III guidance (USEPA, 1995b) is used to determine chemical-specific absorption factors. Generally, absorption values of 1.0% is used for metals, 3.0% is used for volatile organic compounds and 10.0% is used for semivolatile organic compounds. Absorption values for some specific compounds are outlined in EPA guidance (1995b).

6.2.4.3 Inhalation of Air and Fugitive Dust/Volatile Emissions

The amount of a chemical a receptor takes in as a result of breathing is determined using the concentration of the contaminant in air. Intakes of both particulates and vapors/gases are calculated using the same equation, as follows (USEPA, 1989a):

$$Intake_{ai} = (C_{ai})(IR_a)(ET)(EF)(ED) \ / \ (BW)(AT)$$

where:	$Intake_{ai}$	=	intake of chemical "i" from air via inhalation (mg/kg/day)
	C_{ai}	=	concentration of chemical "i" in air (mg/m^3)
	IR_a	=	inhalation rate (m^3/hr)
	ET	=	exposure time (hours/day)
	EF	=	exposure frequency (days/yr)
	ED	=	exposure duration (yr)
	BW	=	body weight (kg)
	AT	=	averaging time (days);
			for noncarcinogens, AT = ED x 365 days/yr;
			for carcinogens, AT = 70 yr x 365 days/yr

The concentration of a chemical in air will be developed using modeling techniques presented in current SSL guidance, measured soil concentrations, and additional site-specific information.

The need for a quantitative evaluation of the inhalation pathway is not always warranted for the NSWC-White Oak. A qualitative evaluation of exposure (i.e., comparison of maximum site soil data to SSLs for

transfers from soil to air) is used to identify whether a quantitative analysis of this exposure pathway is warranted.

6.2.4.4 Incidental/Direct Ingestion of Groundwater/Surface Water

The same equation is used to estimate intakes for ingestion of groundwater and surface water. Residents may be exposed to groundwater via direct ingestion (drinking). Direct contact with surface waters while swimming could also result in the inadvertent ingestion of small amounts of water. Intakes associated with ingestion of water are evaluated using the following equations (USEPA, 1989a):

$$Intake_{wi} = (C_{wi})(IR_w)(EF)(ED) \ / \ (BW)(AT) \quad \text{for groundwater}$$

$$Intake_{wi} = (C_{wi})(CR)(ET)(EF)(ED) \ / \ (BW)(AT) \quad \text{for surface water}$$

where:

$Intake_{wi}$	=	intake of chemical "i" from water (mg/kg/day)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
IR_w	=	ingestion rate for groundwater (L/day)
CR	=	contact rate for surface water (L/hr)
ET	=	exposure time for surface water (hr/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yr x 365 days/yr

Groundwater ingestion by residential receptors is assumed to occur on a daily basis, while exposure for other receptor groups is limited to infrequent exposure events.

6.2.4.5 Dermal Contact with Groundwater/Surface Water

The same equation is used to estimate intakes for dermal contact with groundwater and surface water. Residential receptors are assumed to use groundwater for domestic purposes (i.e., bathing, showering, washing dishes) which result in dermal exposure. It is also possible under future land use conditions that deep excavations at the NSWC-White Oak, for activities such as utility maintenance and construction, could result in a dermal exposure to the shallow groundwater. Dermal contact with surface water may also occur while receptors are involved in work activities.

The following equation is used to assess exposures resulting from dermal contact with water (USEPA, 1992a):

$$DAD_{wi} = (DA_{event})(EV)(ED)(EF)(A) \ / \ (BW)(AT)$$

where:	DAD_{wi}	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
	DA_{event}	=	absorbed dose per event (mg/cm^2-event)
	EV	=	event frequency (events/day)
	ED	=	exposure duration (yr)
	EF	=	exposure frequency (days/yr)
	A	=	skin surface area available for contact (cm^2)
	BW	=	body weight (kg)
	AT	=	averaging time (days);
			for noncarcinogens, AT = ED x 365 days/yr;
			for carcinogens, AT = 70 yr x 365 days/yr

Groundwater exposure for residential receptors is assumed to occur on a daily basis, while exposure for other receptor groups is limited to infrequent events. Dermal intakes for residents assume total body exposure. For other receptor groups, such as trespassers, recreational users, construction workers, and utility/maintenance workers the exposed surface area of the body available for contact is determined based on assumed activities and is similar to the assumptions outlined for dermal contact with soil and sediment.

The absorbed dose per event is estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\textit{If } t_{event} < t^*, \text{ then: } DA_{event} = (2\,K_p)\,(C_{wi})\,(CF)\left[\frac{\sqrt{6\,\tau\,t_{event}}}{\tau\tau}\right]$$

$$\textit{If } t_{event} > t^*, \text{ then: } DA_{event} = (K_p)\,(C_{wi})\,(CF)\left[\frac{t_{event}}{1+B} + 2\,\tau\left[\frac{1+3\,B}{1+B}\right]\right]$$

where:	(DA_{event})	=	absorbed dose per event
	t_{event}	=	duration of event (hr/event)

t^*	=	time it takes to reach steady-state conditions (hr)
K_p	=	permeability coefficient from water through skin (cm/hr)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
T	=	lag time (hr)
π	=	constant (dimensionless; equal to 3.141592654)
CF	=	conversion factor (1E-3 L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (t_{event}, t^*, K_p, T, and B) are obtained from the current dermal guidance (USEPA, 1992d, Table 5-8). If no published values are available for a particular compound, they are calculated using equations provided in the cited guidance.

The following nonsteady-state equation is used to estimate absorbed dose per event for inorganics:

$$DA_{event} = (K_p)(C_{wi})(t_{event})$$

In general, the recommended default value of 1E-3 is used for the dermal permeability of inorganic constituents.

6.2.4.6 Inhalation of Volatiles in Groundwater (Residential Use)

Groundwater exposure may also result in inhalation of volatiles, typically for residential receptors who may be exposed while showering, bathing, washing dishes, etc. Inhalation exposures are estimated using a mass transfer model, developed specifically for this exposure route, in combination with an air intake estimation model. The mass transfer model accounts for inhalation that occurs during a shower and after a shower while the receptor remains in the closed bathroom. The method employed is as follows (USEPA, 1989c and Foster and Chrostowski, 1987):

$$Intake_{si} = (S)(IR_{sh})(K)(EF)(ED) \;/\; (BW)(AT)(R_a)(CF)$$

$$K = D_s + \frac{\exp(-R_a \times D_t)}{R_a} - \frac{\exp R_a \times (D_s - D_t)}{R_a}$$

where:	$Intake_{wi}$	=	intake of chemical "i" from water via inhalation (mg/kg/day)
	S	=	volatile chemical generation rate (µg/m^3-min - shower)
	IR_{sh}	=	inhalation rate (L/min)

EF	=	exposure frequency (showers/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time or period of exposure (days)
R_a	=	air exchange rate (min^{-1})
K	=	mass transfer coefficient (min)
D_s	=	shower duration (min)
D_t	=	total time in bathroom (min)
CF	=	conversion factor (1E+6 μg-L/mg-m^3)

The estimated volatile chemical generation rate is based on two-phase film theory. The model employs contaminant-specific mass transfer coefficients, Henry's Law constants, droplet diameter, drop time, viscosity, and temperature.

6.2.4.7 Volatilization of Groundwater Constituents into Indoor Air

Volatilization of chemicals into indoor air from groundwater may occur, thereby exposing individuals inside a building. Therefore, it is necessary to evaluate the potential risks associated with indoor air concentrations of chemicals as a result of vapor migration from impacted groundwater. A volatilization model (Johnson and Ettinger, 1991) is used to determine the indoor air concentration of a chemical that is present in the groundwater.

The volatility of a chemical largely determines the significance of this route of exposure. Indoor air concentrations of a chemical will be influenced by the physical and chemical properties of the substance, especially solubility and vapor pressure. Low aqueous solubilities and high vapor pressures increase the likelihood that organic compounds found in water will also be found in air. Additionally, the physical properties of the soil can have a great influence on the rate of diffusion of chemicals through the soil. For example, the rate of diffusion of benzene through soil has been shown to be inversely proportional to the water content of soil, and proportional to the square of the air-filled porosity of the soil.

The model assumes:

- diffusion of vapors from soil through the foundation are the only contributors of chemicals to the air in the building

- convection of vapors through the foundation is negligible because it is assumed that the pressure differential between the soil and basement is negligible

- indoor air exchange with the outside air is the only mechanism for dilution of chemicals in air in a building

- vapor concentrations in the building and in the soil pore spaces are at steady state and in equilibrium with a constant soil concentration

- there are no sources of chemicals to the building other than volatilization through the foundation

- diffusion, as quantified by diffusivity coefficients and concentration gradients, is equal in all directions (vertical and horizontal)

- all groundwater in the aquifer beneath the foundation of the building contains equal concentrations of the chemical

The groundwater concentration of the volatile constituent can be related to an indoor air concentration through a volatilization factor (VF). This can be represented by the following equation:

$$C_{air} = C_{gw} \cdot VF \cdot 10^3 \text{ L/m}^3$$

where: C_{air} = outdoor air concentration of volatile constituent
C_{gw} = groundwater concentration of volatile constituent
VF = volatilization factor

The volatilization factor is related to the Henry's Law constant and the effective diffusion coefficient of the volatile constituent. The Henry's Law constant defines the relation between a chemical's vapor pressure and water solubility to derive an equilibrium concentration between air and water. The effective diffusion coefficient describes the transport of a chemical in a media that is caused by intermolecular collisions resulting from concentration gradients (Lyman et al., 1990). When constituents volatilize from groundwater into the soil, diffusion in soil only takes place in the pore space. Thus, the area of flow is reduced and the effective distance traveled is increased. Second, when a chemical diffuses in soil it is subject to partitioning between pore gas, pore water, and the particulates in the pore water. Thus, the diffusion is slower than if only one phase existed. The volatilization factor accounts for these properties and is defined by the equation:

$$VF = \left[\frac{1}{H'} \left(1 + \frac{D_{eff}}{DF \cdot L_{gw}} + \frac{D_{eff} \cdot L_{crk}}{D_{eff,\,crk} \cdot L_{gw} \cdot \eta} \right) \bullet \frac{DF}{D_{eff}} \bullet L_{gw} \right]^{-1}$$

where: H' = Henry's Law coefficient (cm^3-water/cm^3-air)

D_{eff} = effective diffusivity—averaged water table to surface (cm^2/sec)

$D_{eff,crk}$ = effective diffusivity in soil-filled foundation cracks (cm^2/sec)

DF = dispersion factor for indoor air (cm/sec)

L_{gw} = depth to groundwater (cm)

L_{crk} = enclosed-space foundation or wall thickness (cm)

η = foundation crack fraction (cm^2/cm^2)

The effective diffusivity for constituents between the water table and the surface is defined by the equation:

$$D_{eff} = \frac{L_{gw}}{(h_v \;/\; D_{eff,v}) + (h_{cap} \;/\; D_{eff,cap})}$$

where: L_{gw} = depth to groundwater (cm) = $h_v + h_{cap}$

h_v = vadose zone thickness (cm)

h_{cap} = capillary zone thickness (cm)

$D_{eff,v}$ = effective diffusivity—vadose zone soils (cm^2/sec)

$D_{eff,cap}$ = effective diffusivity—capillary fringe zone (cm^2/sec)

The effective diffusivities in the vadose zone, capillary fringe zone, and the soil-filled foundation cracks account for the reduced flow. A tortuosity factor, defined by the Millington-Quirk model (Farmer, et al., 1972) is applied to the diffusion coefficients of the chemicals. In this model, the fractional volume occupied by a specific matrix in the soil, raised to a power of 3.33, is divided by the total porosity, raised to a power of 2. Thus, the effective diffusivities in the vadose zone, the capillary fringe, and the soil-filled foundation cracks are defined by the following equation:

$$D_{eff,x} = D_{air} \bullet \left(\frac{\theta_{air}^{3.33}}{\theta_T^2} \right) + D_{water} \left(\frac{\theta_{water}^{3.33}}{\theta_T^2} \right) \left(\frac{1}{H'} \right)$$

where: D_{air} = molecular diffusion coefficient in air (cm^2/sec)

D_{water} = molecular diffusion coefficient in water (cm^2/sec)

$D_{eff,x}$ = effective diffusivity—zone x (cm^2/sec)

H' = Henry's Law constant (cm^3 water/cm^3 air)

θ_{air} = soil air content (cm^3 air/cm^3 soil)

θ_{water} = soil water content (cm^3 water/cm^3 soil)

θ_T = soil porosity (cm^3 air/cm^3 soil) = $\theta_{air} + \theta_{water}$

6.2.4.8 Volatilization of Groundwater Constituents into Outdoor Air

Direct exposure to groundwater containing volatile constituents may result in the volatilization of these constituents into ambient air. Therefore, it is necessary to evaluate the potential risks associated with these outdoor air concentrations. The air concentration can be related to the constituent's groundwater concentration through the constituent's Henry's Law Constant. The concentration is defined by the following equation:

$$C_{air} = C_{gw} \cdot H' \cdot 10^3 \ L/m^3$$

where: C_{air} = outdoor air concentration of volatile constituent

C_{gw} = groundwater concentration of volatile constituent

H' = Henry's Law constant (cm^3 water/cm^3 air)

6.2.4.9 Summary of Exposure Parameters

In general, standard default parameters (USEPA, 1991), which combine mid-range and upper-end exposure factors, are used to assess RME. CTE is assessed primarily by the use of mid-range exposure factors presented in current risk assessment guidance (USEPA, 1989a and 1993a). Age-adjusted factors are used to assess RME and CTE risks for residential receptors. General exposure input parameters for the identified potential receptor groups at the NSWC-White Oak are presented in Table 6-1.

6.2.5 Exposure to Lead

The equations and methodology presented in the previous sections cannot be used to evaluate exposure to lead because of the lack of published dose-response parameters. Exposure to lead is assessed using the latest version of the USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (USEPA, 1994c). This model is designed to estimate blood levels of lead in children under 7 years of age, who are extremely susceptible to adverse effects from exposure to lead (including behavioral and developmental

impairments). The IEUBK Model is based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Blood lead levels greater than 10 μg/dL are considered to be potentially harmful.

For sites under investigation at the NSWC-White Oak, the lead model can be used to address exposure to lead in children, when detected concentrations exceed the screening levels discussed in Section 6.1.2. An IEUBK Model for lead may also be used to address exposure to lead in adults, based on fetal blood lead concentration in women exposed to lead in contaminated soils. The 95% UCL lead concentration, as well as default parameters for some input parameters, are employed. Estimated blood lead levels and probability density histograms will be presented when appropriate as support documentation for this analysis and appended to the site-specific risk assessment.

6.3 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to identify the potential adverse health effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified PCOCs. Quantitative toxicity values determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate noncarcinogenic health effects is the Reference Dose (RfD). The RfD is an estimate of the daily exposure level for the human population that is likely to be without appreciable risk during a portion or all of a lifetime. It is based on a review of available animal and/or human toxicity data, with adjustments for various uncertainties associated with the data. Carcinogenic effects are quantified using the Cancer Slope Factor (CSF), which is a plausible upper-bound estimate of the probability of development of cancer per unit intake of chemical over a lifetime. It is based on available dose-response data from human and/or animal studies.

6.3.1 Toxicity Criteria for Oral and Inhalation Exposures

Oral and inhalation RfDs and CSFs to be used in the site-specific risk assessments for the NSWC-White Oak will be obtained from the following primary EPA literature sources:

- Integrated Risk Information System (IRIS)
- Annual Health Effects Assessment Summary Tables (HEAST)

- National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center

Although RfDs and CSFs can be found in several toxicological sources, USEPA's IRIS on-line database is the preferred source of toxicity values. This database is continuously up-dated and values presented have been verified by USEPA RfD and Carcinogenic Risk Assessment Verification Endeavor (CRAVE) work groups. The USEPA Region III RBC Table is also used as a source of toxicity criteria.

6.3.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in literature are typically expressed as administered (not absorbed) doses. Therefore, these values are considered to be inappropriate for estimating the risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made. Because information on administered dermal doses is not always readily available, all oral dose-response parameters are adjusted to provide values for dermal contact.

The adjustment to an absorbed dose is made using chemical-specific absorption efficiencies published in available guidance (i.e., RAGS Appendix A, IRIS, Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles, etc.) and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) \ / \ (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract

Whenever absorption efficiencies are not found in literature, default absorption efficiencies for VOCs (80 percent), SVOCs/pesticides/PCBs (50 percent), and metals (5 percent) are used (USEPA, 1989a).

6.3.3 Toxicity Criteria for Carcinogenic Effects of Polynuclear Aromatic Hydrocarbons

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to Polynuclear Aromatic Hydrocarbons (PAHs). The most extensively studied PAH is benzo(a)pyrene, which is classified by the USEPA as a probable human carcinogen. Although a CSF is available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other carcinogenic PAHs. Toxic effects for these

chemicals are expressed in terms of estimated orders of potential potency (USEPA, 1993b) based on the carcinogenicity of benzo(a)pyrene. The equivalent oral and inhalation CSF for these chemicals is derived by multiplying the CSF for benzo(a)pyrene by the order of potential potency. The EPA Region III RBC tables present the CSFs for the carcinogenic PAHs, as derived from this process. Furthermore, PAHs will not be evaluated for dermal exposure because they impose effects on the skin directly upon contact.

6.3.4 Toxicity Criteria for Carcinogenic Effects of Dioxins/Furans

Similar to the concept of estimated orders of potential potency for PAHs, chlorinated dibenzo-p-dioxins (CDDs) and -dibenzofurans (CDFs) are evaluated using Toxicity Equivalence Factors (TEFs) relative to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) (USEPA, 1989b). Based on a variety of approaches that generate toxicities relative to 2,3,7,8-TCDD, the USEPA developed TEFs for other dioxins/furans from structure-activity relationships and available toxicological information. The equivalent oral CSF for these chemicals is derived by multiplying the CSF for 2,3,7,8-TCDD by the TEF.

6.3.5 Toxicity Criteria for Chromium

Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, of which the latter is considered to be more toxic. Unless chromium speciation is performed at a site, screening of chromium is conducted by assuming that 100 percent of the reported total chromium result is hexavalent. Should chromium, assumed to be all hexavalent, prove to be a significant contributor to risk, further investigation regarding the presence and valence state of chromium should be determined at that time.

6.3.6 Identification of Other Human Health-Based Criteria

Media-specific regulatory and human health-based criteria for PCOCs, other than dose-response parameters, are also provided in the site-specific risk assessments. These criteria, which consist of ARARs and To Be Considered (TBC) values, can also be used to indicate the potential for adverse health effects in human receptors. As discussed in Section 1.3, ARARs are cleanup standards and other environmental protection requirements and criteria promulgated under Federal or State law. TBCs (i.e. health advisories for drinking water), are nonpromulgated, nonenforceable standards or criteria that may be helpful in determining what concentration of a particular chemical is protective of human health.

6.4 RISK CHARACTERIZATION

Potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from the exposures to contaminated media are quantitatively determined during the risk characterization component of the HHRA.

A summary and interpretive discussion of the quantitative risk estimates are provided in the text of the site-specific risk assessments. PCOCs which contribute significantly to elevated risks are identified as "risk drivers" during the interpretive risk discussion. The numeric estimates of risk are contained in the risk assessment spreadsheets, which are appended to the site-specific assessments.

6.4.1 Risk Estimation Methods

Quantitative estimates of risk are calculated using intake and toxicity values according to risk assessment methods outlined in current USEPA guidance (USEPA, 1989a). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as Incremental Cancer Risks (ICRs) which are derived using published CSFs. Noncarcinogenic risk estimates are presented in the form of Hazard Quotients (HQs) that are derived using published RfDs.

ICR estimates are generated for each PCOC using estimated exposure intakes and published CSFs, as follows:

$$ICR = (\text{Estimated Exposure Intake})(CSF)$$

If the above equation results in an ICR greater than 0.01, the following equation is used:

$$ICR = 1 - [\exp(-\text{Estimated Exposure Intake})(CSF)]$$

The ICRs for all PCOCs in an exposure scenario are summed to give a cumulative ICR. An ICR of 10^{-6} indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

Noncarcinogenic risks are assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a PCOC is the ratio of the estimated intake to the RfD, as follows:

$$HQ = (\text{Estimated Exposure Intake}) / (RfD)$$

An HI is generated by summing the individual HQs for all of the PCOCs. It should be noted that HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.4.2 Comparison of Quantitative Risk Estimates to Benchmarks

In order to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks. The USEPA has defined the range of 10^{-4} to 10^{-6} as the ICR "target range" for most hazardous waste facilities addressed under CERCLA. Cumulative ICRs greater than 10^{-4} generally will indicate that some degree of remediation is required, while ICRs below 10^{-6} normally will not result in remedial efforts. Whenever ICRs fall between 10^{-4} and 10^{-6}, decisions for remediation will be made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be chemicals of concern.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects from individual PCOCs contributing to the risk are considered. Only those chemicals which impact the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Thus, PCOCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be chemicals of concern.

6.5 UNCERTAINTY ANALYSIS

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the HHRA. Uncertainties related to each component of the assessment (i.e., data evaluation, exposure assessment, toxicity assessment, and risk characterization) are presented in the site-specific assessments. In addition, the effect of a particular uncertainty on the outcome of the assessment (i.e., risk estimates) is also indicated, where possible.

7.0 ECOLOGICAL RISK ASSESSMENT AND RISK MANAGEMENT

This section provides methods and decision criteria for performing ERAs for Sites 2, 3, 4, 7, 8, 9, and 11 and for the Paint Branch watershed at NSWC-White Oak. The goal of the ERA is to define conditions under which populations or communities of naturally occurring organisms have been or have the potential to be harmed. The ERA evaluates the likelihood of ecological effects due to site contamination at individual sites and at Base-wide levels. A phased approach to ERA at NSWC-White Oak is used, relying on environmental chemistry data and field observations for preliminary assessments, and using biological sampling or testing if further work is needed.

The ERA approach is comprised of eight steps (See Figure 7-1), in accordance with USEPA guidance (USEPA, 1997b). The first two steps complete the screening-level assessment and are described in Section 7.1. Sections 7.2 through 7.7 discuss the remaining steps of the ERA approach. In addition, the methods to be used will be in accordance with a recent informal memorandum circulated by Region III BTAG which outlines ERA methods preferences specific to Region III (USEPA, 1998b). In addition to methods, these sections describe decision points in the process, outline decision criteria, and provide examples of the types of decisions to be made. Risk management considerations are discussed in Section 7.7.

As stated above, ERAs will be performed for each of the seven RFI sites on NSWC-White Oak and for the Paint Branch watershed. The same generalized framework presented in Sections 7.1 through 7.7 will be used to perform each assessment. However, site-specific components to the ERA approach exist for each site and for the Paint Branch watershed assessment. Therefore, Section 7.8 presents a discussion of the site-specific approach to each of the ERAs and the relation of the site-specific approaches to the sampling to be conducted described in Section 4.0. Risk management considerations discussed in Section 7.7 will apply to all of the individual sites and the Paint Branch watershed.

7.1 STEPS 1 AND 2 - SCREENING-LEVEL RISK ASSESSMENT

The first phase in the ERA process is the screening-level risk assessment. In this phase, conservative exposure estimates are made for grouped or individual ecological receptors, and these exposures are compared to screening-levels and threshold toxicity values. The screening-level risk assessment includes:

- Screening-level problem formulation
- Screening-level ecological effects evaluation

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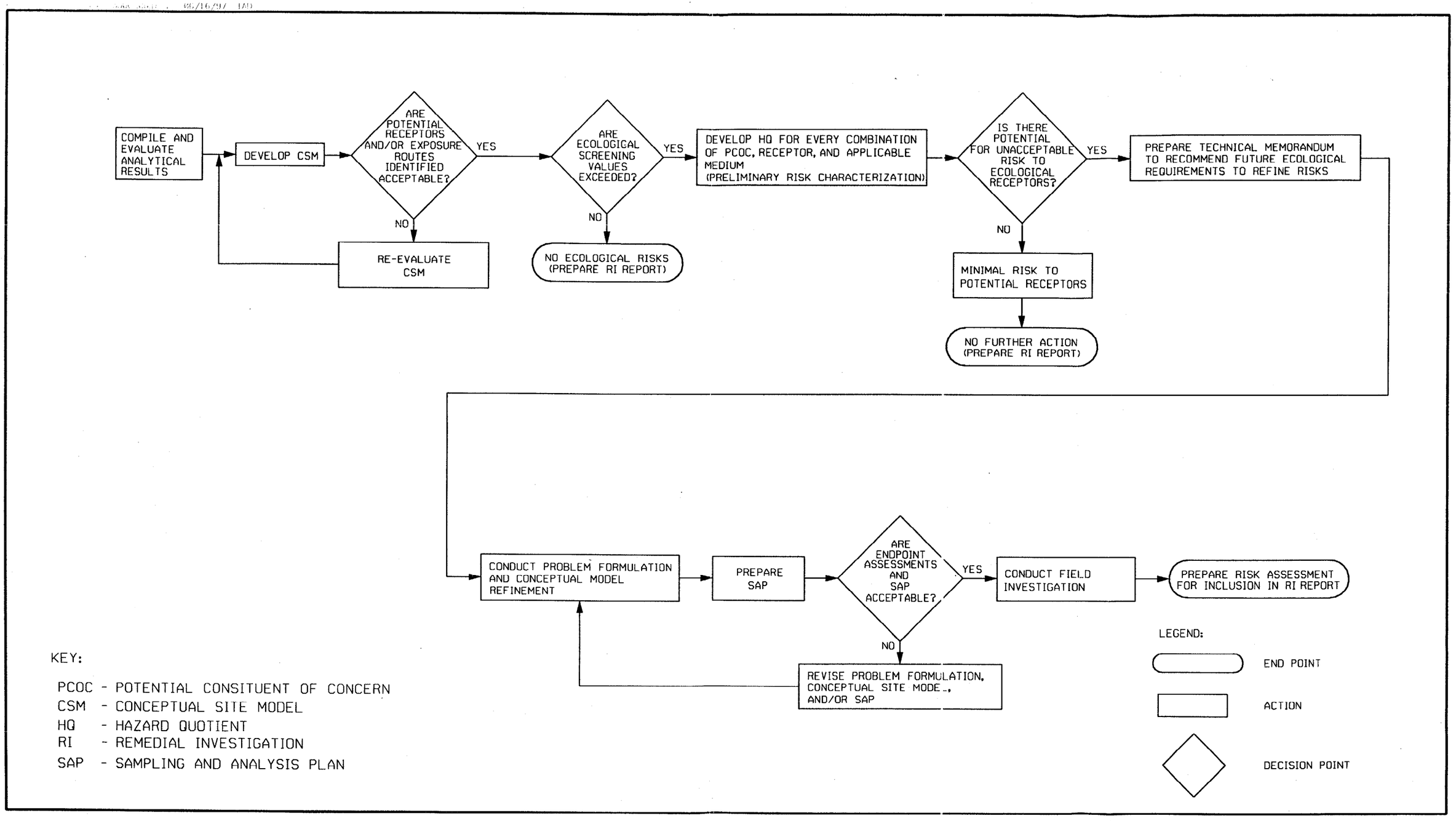

FIGURE 7-1

ERA PROCESS FLOW CHART
NSWC-WHITE OAK, SILVER SPRING, MARYLAND

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- Screening-level exposure estimate
- Screening-level risk calculation

7.1.1 Screening-level Problem Formulation

Screening-level problem formulation includes identification of potential receptor groups, PCOCs, and the mechanisms for fate/transport and toxicity. Determination of the complete exposure pathways that exist on a site is done at this point to facilitate the selection of receptors. As part of receptor identification, site habitats are described and delineated. A site visit is important for receptor identification, analysis of contaminant pathways, and other aspects of the risk assessment. During the site visit, careful attention is paid to evidence of physical disturbance because physical disturbance often coincides with potential contaminant effects at a site.

Receptor selection follows from decisions about which biological groups need to be protected in the vicinity of the site. These decisions are based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors. Specific protection goals for the risk assessment and the manner in which they will be assessed are also parts of screening-level problem formulation. As discussed in USEPA (1997b), one of the major tasks in problem formulation is the selection of assessment and measurement endpoints. An assessment endpoint is defined as "an explicit expression of actual environmental values that are to be protected" (USEPA, 1997b). For this ERA the assessment endpoints are protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- benthic invertebrates
- fish
- insects
- soil invertebrates
- birds feeding on aquatic life
- birds feeding on soil invertebrates
- carnivorous birds
- insectivorous birds
- carnivorous mammals
- omnivorous mammals
- insectivorous mammals
- herbivorous mammals
- vegetation

- amphibians and reptiles

These proposed assessment endpoints will be discussed between all stakeholders prior to initiation of the ERA. Any modifications to the assessment endpoints will be made and agreed to by all stakeholders. The assessment endpoints must be agreed upon by all stakeholders before representative receptors are chosen for the foodchain modeling discussed below. Some or all of the groups listed above will apply to each of the seven sites.

Many receptors in the soil and aquatic environments are adequately described in general categories such as soil invertebrates, vegetation, and sediment-dwelling (benthic) invertebrates. This is due to the nature of the threshold values, effects levels, or water quality criteria that are typically used to characterize risk for such organisms. For vertebrate receptors, selection of particular species may be required so that intake through eating, drinking, and other routes can be estimated.

Receptor identification is influenced by the PCOCs, their likely mode of transport, ultimate fate, and toxicity. For example, most metals have sedimentary transport characteristics and do not bioaccumulate. Accordingly, sediment- and soil-dwelling organisms are selected as receptors for metals if exposure pathways are complete, and other groups may be included as well. For PCOCs that bioaccumulate, such as methylmercury and chlorinated pesticides, effects on predators need to be assessed. Sensitivity to particular PCOCs is also considered. For example, birds and mammals may have different sensitivities to organic compounds, so each group, or the most sensitive group for a particular PCOC, is assessed. As in the HHRA, discussed in Section 6.0, calcium, magnesium, potassium, and sodium will be excluded as PCOCs in most media because they are essential nutrients that can be tolerated by living systems even at high concentrations. The ERA will provide additional justification for the exclusion of essential nutrients from the ERA.

As previously mentioned, receptor species may be identified when ingestion is the primary route of exposure. Indicator species are selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservatism, indicator species may be small and have small home ranges. Species known to be sensitive to particular PCOCs may be selected. For example, mink are sensitive to PCBs for reproductive endpoints and would therefore be selected for a scenario involving exposure to PCBs from an aquatic or sedimentary source. The availability of exposure parameters such as body mass, feeding rate, and drinking rate may also be a factor in selecting indicator species. Exposure factors will be obtained from EPA's *Wildlife Exposure Factors Handbook* (EPA, 1993c), and must be agreed to by all stakeholders prior

to initiation of the ERA. These exposure factors will be submitted to BTAG prior to initiation of this step of the ERA.

7.1.2 Screening-level Ecological Effects Evaluation

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicity study, it can also include descriptions of apparent effects seen during the site visit. Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as surface water for pelagic organisms or soil for soil invertebrates. For other receptors, such as terrestrial vertebrates, toxicity data are typically available as doses, with units of mass of contaminant per unit of body mass per unit of time (usually mg/kg/day). For the screening-level ERA, conservatively low toxicity thresholds are used to evaluate the potential for adverse ecological effects.

USEPA Region III BTAG surface water screening-levels (USEPA, 1995c) are primarily ambient water quality criteria (AWQC) and will be used as thresholds for surface water exposure to aquatic organisms because they have been established to protect a range of organisms, including sensitive species. If criteria are not available for a contaminant, concentrations may be calculated using the same approach used to develop AWQC (USEPA, 1985). Maryland Water Quality Standards (WQS) may also be used, as available.

Screening-levels for assessing potential risks to benthic organisms from sediment contaminants will be USEPA Region III BTAG screening-levels (USEPA, 1995c). These values are primarily Effects Range-Low (ER-L) values (Long and Morgan, 1991; Long et al., 1995), and Apparent Effects Thresholds (AETs) from various literature sources. ER-L values were derived from marine and estuarine systems but are often used to assess freshwater systems.

For surface soils, values from Region III BTAG are used (USEPA, 1995a). It should be noted that significant data gaps exist in BTAG tables as a result of the paucity of values in the primary literature. Therefore, screening-levels from Oak Ridge National Laboratory (ORNL) (Efroymson et al., 1997a and 1997b) may be used. These screening-levels were derived from toxicity data for soil invertebrates (earthworms) and soil microbes. In addition, "Dutch" soil screening-levels may also be used (MHSP&E, 1994).

As per Region III BTAG preference, groundwater contaminant concentrations will be compared to AWQCs when groundwater to surface water and sediment discharge is possible. This is performed as a conservative measure, and does not take into account dilution or changes in bioavailability from medium to medium. However, it provides a qualitative assessment of the potential for risks to aquatic and semi-aquatic receptors from groundwater contaminant discharge. Prior to initiation of the ERA, all guidelines to be used in the screening level ERA will be agreed to by all parties.

To augment the comparison of site concentrations to screening levels, assessment of risks can be performed using threshold toxicity values in foodchain models within the framework of the 8-step EPA ERA process. The models to be used follow the approach of USEPA's Environmental Response Team (ERT) in their use of conservative threshold values and their assumption that all transfer factors are equal to one. Threshold toxicity values, one for each combination of PCOC (those whose maximum concentration exceeds BTAG screening levels) and receptor, will preferentially be taken from ERT reports. If needed, additional threshold toxicity values will be developed from published data. A literature search will be conducted to obtain the most up-to-date toxicity data since ERT values are from a previous literature search. Thresholds will be taken from studies incorporating chronic exposures, organisms similar to the receptors of concern, and exposure routes that are equivalent to those in the exposure model. The lowest values for NOAELs and LOAELs among ecologically relevant endpoints will be used. Ecologically relevant endpoints are typically development or reproductive effects due to their typical sensitivity and potential for population-level effects, but endpoints associated with lower thresholds will be used if population success could be harmed.

There are a number of information sources that may be used for toxicity data; the following are compilations. Data related to fish and wildlife effects may be found in the Contaminant Hazard Reviews of the U.S. Fish and Wildlife Service (Publications Unit, Washington, DC). Mammalian toxicological data are comprehensively reviewed and summarized in ATSDR's Toxicological Profile series. Additional sources include the following databases: USEPA's IRIS (risk assessment data), the privately maintained AQUIRE (aquatic toxicological data), and NIOSH's RTECS (mostly mammalian toxicological data). The "Screening Benchmarks for Ecological Risk Assessments" electronic database prepared by the Environmental Sciences and Health Sciences Research Divisions of ORNL are comprehensive, including soil, wildlife, water, and sediment values, often with a range for each chemical. However, the data used to develop these values should be checked against original sources, and the derivation of benchmarks should be checked for consistency of approach with threshold values developed using this work plan. References for data and techniques for derivation of benchmarks are contained in reports published by ORNL.

7.1.3 Screening-level Exposure Estimate

Screening-level exposure estimates for all pathways include calculation of exposure concentrations. The most conservative exposure concentration is the maximum value observed in a particular medium; if use of the maximum results in a finding of no risk, then that contaminant-medium combination is eliminated from further evaluation.

The Conceptual Site Model (CSM), first considered for selection of receptors, is formalized in the preliminary exposure step. An example of a conceptual site model is shown in Figure 7-2. To help understand the relationship of the conceptual model to the site it describes, an illustration of an example site is provided in Figure 7-3.

For receptor groups like "terrestrial vegetation" or "soil invertebrates," exposure is synonymous with contaminant concentration in the medium of exposure. For wildlife species selected as indicators, exposure is a dose that must be calculated.

Since the bioaccumulation factor is assumed to be 1, the ingestion of prey items (soil invertebrates) is equivalent to ingestion of soil. Therefore, incidental ingestion of soil is not treated as a separate term and bioaccumulation factors are omitted. The following general formula, as presented by BTAG (USEPA, 1998b), will be used:

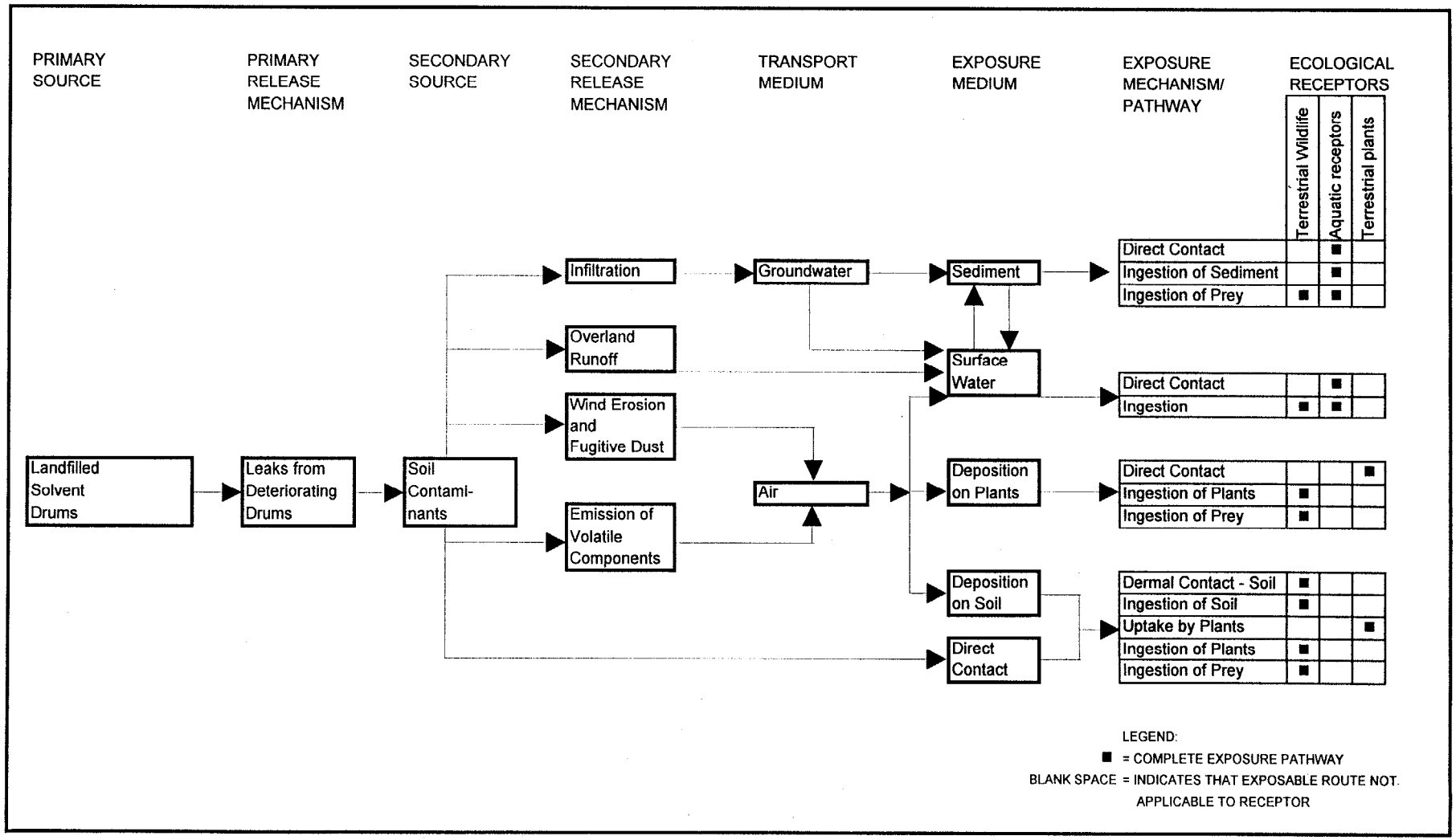
$$\text{Dose (mg/kg/day)} = \frac{(MSI * MSC) + (MWI * MSW) + (MFI * MFC)}{MBW}$$

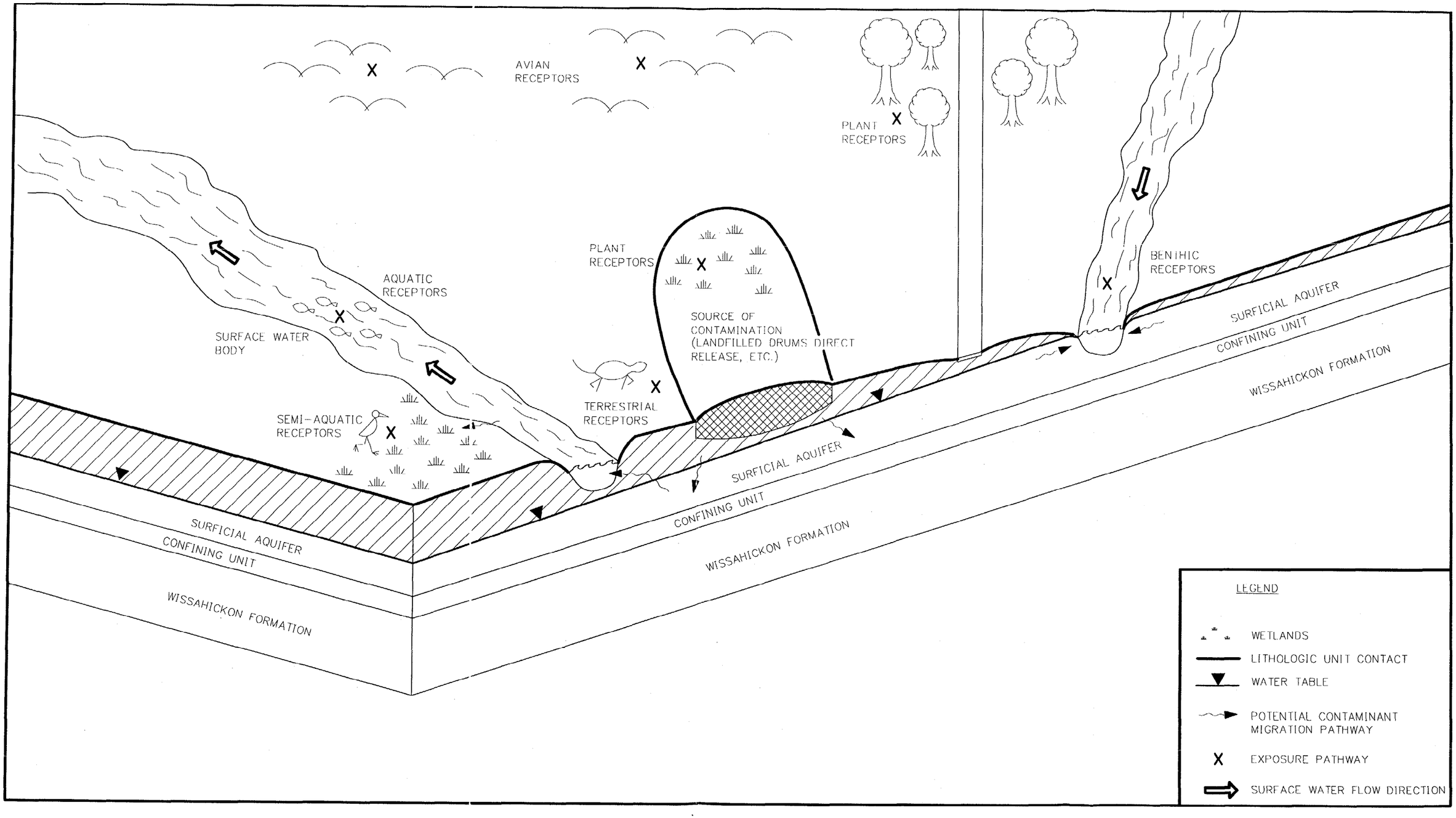
Where:

MSI = Maximum soil ingestion rate
MSC = Maximum soil concentration
MWI = Maximum surface water ingestion rate
MSW = Maximum surface water concentration
MFI = Maximum food ingestion rate
MFC = Maximum food concentration
MBW = Minimum body weight

In a preliminary evaluation it is assumed that all behavior resulting in exposure occurs in contaminated areas and contaminants are completely bioavailable. Receptors to be used in the foodchain modeling will

FIGURE 7-2
EXAMPLE CSM
NSWC WHITE OAK, SILVER SPRING, MARYLAND





ECOLOGICAL CONCEPTUAL SITE MODEL ILLUSTRATION
SITE CROSS SECTION
NSWC-WHITE OAK, SILVER SPRING, MARYLAND
NOT TO SCALE

FIGURE 7-3

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be reflective of the assessment endpoints and will be agreed to by all stakeholders prior to initiation of the ERA.

7.1.4 Screening-level Risk Calculation

The screening-level risk calculation compares exposure concentrations and dose estimates to threshold values, in the form of an ecological effects quotient (EEQ; also referred to as a hazard quotient), which is calculated by dividing the exposure level by the threshold. There is an EEQ for every combination of PCOC, receptor, and applicable medium. An EEQ of less than one indicates a probable lack of effect, while a value greater than unity means that a harmful effect is possible. Unless otherwise specified by BTAG after the screening is completed, only those contaminants whose maximum concentrations exceed screening levels will be included in the foodchain modeling.

A lack-of-effect assessment results in no further analysis for that combination of PCOC and medium, while an EEQ greater than unity may trigger an evaluation of risk management alternatives, including the possibility that more sampling is needed to better characterize risk. BTAG will also allow chemicals to be dropped from further consideration if a valid toxicological reason is presented.

If preliminary assessment results in an EEQ of unity or greater, field activities (e.g., tissue residue analysis, toxicity testing) may be conducted to reduce the uncertainties in the assumptions used in the preliminary assessment. The EEQ is not an expression of probability, and the meaning of values greater than unity must be interpreted in light of attendant uncertainties in risk management. Suggestions for providing balance to the conservative screening-level risk assessment by evaluating risk management considerations are discussed in Section 7.7.

Documentation of the screening-level ERA may be in the form of an alternative deliverable to save time in the review and decision-making process. For example, a technical memorandum may concisely present the results of the assessment and recommendations for further investigation. A more complete account of the assessment may be made in the RFI report, or the alternative deliverable itself may be adequate for such reports. The conclusion of no or low and acceptable potential risks must be adequately documented and technically defensible (USEPA, 1997b). More sampling is usually required if more work is needed, and sampling should be done, and the new results analyzed for inclusion in the RFI report. The main purpose of the alternative deliverable is to avoid delays in the RFI process, including the identification of the need for more sampling. This memorandum also includes recommendations for interim action, if an immediate response is justified. Recommendation for interim action leads to risk management decisions regarding a quick response (see Figure 7-1). It should be noted that although USEPA prefers that the

screening-level ERA be performed prior to an RFI WP and Sampling and Analysis Plan (SAP), it is not always feasible or practical to do so. Specifically, little or no data may be available for the sites to be studied, such as site investigation data (as with some sites at NSWC-White Oak), or ecological risk issues may not have been part of the earlier steps in the RFI/CMS process. In these cases, the screening-level ERA is included as part of the RFI report.

7.2 STEP 3 - BASELINE RISK ASSESSMENT PROBLEM FORMULATION

If the screening-level ERA indicates that the level of potential risk to ecological receptors requires a better characterization of risk, based on collection of more data, then the next step is to develop a Baseline Risk Assessment (BRA) WP and SAP. For example, widespread contamination at concentrations above preliminary threshold values makes remediation a possibility. In order to be more sure of the risks involved and to establish remediation goals, reasonable estimates of risk are needed. Such estimates can be made by refining the exposure and toxicological evaluations introduced in the preliminary assessment, by investigating actual effects through toxicological testing or field measurements of population/community structure, or by combining these approaches. This process is begun through BRA Problem Formulation, the third step in the ERA (see Figure 7-1). The elements of BRA Problem Formulation are discussed below.

7.2.1 Assessment Endpoint Refinement

Assessment endpoints are expressions of environmental values to be protected. They reflect the "effects that drive decision making, such as reduction of key populations or disruption of community structure" (USEPA, 1997b). Assessment endpoints may be refined at this stage in the process. In addition, the assessment endpoints listed for the screening-level assessment can be retained as is. Regardless, they should be geared towards protection of specific trophic levels.

Testable hypotheses are developed to establish whether or not potential threats exist to the environmental values to be protected. Examples of testable hypotheses include:

- No individuals in a population of protected species will die due to exposure to site contaminants
- A maximum of 5 percent of aquatic populations will be excluded due to site contaminants
- No significant mortality or loss of recruitment will occur in wildlife populations
- Plant community diversity and standing crop will not be significantly different from background

7.2.2 Ecological Effects Literature Search and Fate and Transport Analysis

Fate and transport of contaminants may be reconsidered due to changes in the list of PCOCs, or to concentrate effort on those pathways most likely to contribute to risk. Also, the toxicity evaluation may be revised to make fewer conservative assumptions. For example, AWQC or surrogate values may be reassessed if sensitive species are not part of the potentially impacted community, equilibrium partitioning may be considered as appropriate for estimating risk levels for sediments along with ER-Ls, and/or less conservative uncertainty factors may be used in the toxicity evaluation for indicator species.

7.2.3 Conceptual Model Refinement

In conceptual model refinement, the environmental aspects of the exposure model are revised. Also, if additional field work is necessary, the plans are documented.

A conceptual exposure pathway model is formalized in this step and an example of a CSM is presented in Figure 7-2. The CSM includes primary and secondary sources, modes of transport, potentially affected media, inter-media transfer, and routes of entry into receptors. The type(s) of transport model(s) to be used will be selected. These may range from simple equations to sophisticated simulation models requiring parameterization, calibration, and validation steps. Some of the exposure parameters to be considered at this point include bioavailability of contaminants and, for particular receptors, temporal aspects of exposure and the relationship between foraging area and contaminated area. Bioavailability issues may be addressed in the field study. As examples, leaching behavior and the proportion of total chromium that is hexavalent may be established by laboratory analyses of field samples.

This step in the ERA ends with agreement on the scope of the assessment in terms of the resources to be protected and the approach to testing hypotheses in the forthcoming work plan. The criteria used to make these decisions include incorporation of all valuable resources and the acceptability of protection levels for these resources. An example of an issue during this process may be the advisability of protecting populations rather than individuals (i.e., allowing limited mortality if the population is unlikely to be affected).

7.3 STEP 4 - STUDY DESIGN AND DATA QUALITY OBJECTIVES

7.3.1 Measurement Endpoints

Measurement endpoints are measurable characteristics related to environmental values to be protected and are more focused than the broad endpoints of the screening-level assessment. Examples include:

1. Endpoints for predictive assessments based on environmental contaminant concentrations or doses

    - Concentrations or doses associated with reproductive or developmental effects in published toxicological studies
    - Concentrations or doses associated with any effect impacting population fitness

2. Endpoints for toxicity testing

    - Survival
    - Growth
    - Fecundity of test organisms

3. Endpoints for field studies

    - Population size
    - Population recruitment
    - Community taxonomic diversity
    - Community standing crop or density
    - Community functional group composition

7.3.2 Field Investigations and Study Design

Field work for the assessment may include additional sampling of environmental media, biological tissue sampling, aquatic pathway analysis, and population/community studies. The uses of these types of data are presented below.

Additional sampling of surface water, sediment, soil, or air may be required to verify actual concentrations, obtain data for areas not yet sampled, establish temporal trends, and evaluate bioavailability.

For example, sampling of surface water in a creek may be needed to verify concentrations in an area downgradient of groundwater that exceeded water quality criteria. It may be useful to establish temporal trends for organic compounds that are mobile or subject to degradation. Also, sampling may be necessary to supply data on porosity, pH, bulk density, and other measures that are needed for selected transport models.

Tissue sampling for bioconcentrated or bioaccumulated toxicants may be necessary to estimate exposure for herbivores or predators, especially for mammalian and avian receptors. This approach is more accurate than estimating uptake from food chain models that use contaminant concentrations in soil, sediment, or water as input. In complex investigations where use of such models is necessary, tissue sampling may be used to validate these models in addition to providing direct exposure data. An example of the use of tissue data is a situation where the sediment ER-L for PCBs, which are known to bioaccumulate, is exceeded throughout a tidal creek. The most accurate approach for estimating dosage to fish-eating birds and mammals in this case is to sample fish that have a small home range and are eaten by piscivores, and analyze the whole-fish samples for PCB content.

Population or community studies are used to evaluate whether effects due to site contaminants are apparent in the field. Typically, measurements are taken at potentially impacted locations and at background or reference areas. The reference areas are selected carefully to be free of site contaminants or other unusual man-induced influences. If statistical comparison of a reference site to a site under investigation is important, standard techniques will be used for establishing the number of samples to be collected from each area in order to minimize the occurrence of false positive and false negative errors. An example of this type of study is to compare benthic macroinvertebrate community measurements (taxonomic diversity, density, functional group composition) in a potentially impacted creek to a reference creek.

Community studies have been criticized for their lack of sensitivity in detecting effects. This criticism is especially appropriate when population/community studies have few numbers of samples or if they are the only approach used to assess effects in the field. In addition to potential impacts, these studies provide information on the types and abundance of organisms present. A combination of community assessment, toxicity testing, and/or tissue sampling is an efficient design likely to produce useful and conclusive data.

Toxicity testing is usually performed to see if soil, water, or sediment samples are toxic to test organisms; toxicity testing may also be performed using enclosures in the field. As a direct measurement of toxicity, it can remove uncertainty associated with screening values or predictive risk evaluation. Results of toxicity testing are usually less ambiguous than the results of population or community analysis, but are not necessarily predictive of community-level effects. Standardized toxicity tests are available for acute effects, and some endpoints are designed to estimate chronic effects. For example, estuarine sediment may be tested using an amphipod; statistical comparisons are made of survival, fecundity, and growth endpoints between potentially impacted and reference sediments.

Execution of this step in the ERA results in a draft, project-specific SAP. The decision point at the end of this step is the agreement on, and approval of, the WP and SAP. Decision criteria include the applicability of the measurement endpoints to the resources to be protected, applicability of the field study elements to the PCOCs and receptors of concern, and the appropriateness of the study design given the type and magnitude of potential risks estimated in the preliminary assessment. All stakeholders must agree upon the need for and type of additional data collection.

7.4 STEP 5 - FIELD VERIFICATION OF SAMPLING DESIGN

A site assessment is conducted to confirm that the ecological SAP is based on accurate observations. If problems with the WP or the SAP are apparent from the site assessment, then changes to these documents are proposed. For this step the decision point is approval of the project-specific SAP, with appropriate changes, as necessary.

7.5 STEP 6 - SITE INVESTIGATION AND ANALYSIS PHASE

The site field investigation, in which the field work specified in the WP and SAP is carried out is the next step in the ERA procedure. At the completion of field work the process of analysis begins. There is no decision point immediately after the field investigation step, unless alterations to the WP and SAP are required (USEPA, 1997b).

7.6 STEP 7 - RISK CHARACTERIZATION

During risk characterization, the results of the field assessment are reviewed, combined with data collected earlier, and analyzed. There are potentially four approaches to analyzing environmental effects in this step: effects predicted by exposure modeling (including measured contaminant concentrations in tissue) as compared to toxicological data, effects inferred from population/community studies, effects observed in toxicity testing, and chemical data. A risk characterization is developed for each approach, and conclusions are drawn after consideration of each characterization. All available data, their interpretation, and conclusions must be agreed upon by all stakeholders.

Reaching conclusions may be difficult because results from different approaches may be contradictory. If so, a strength-of-evidence approach is used to assess ecological impact (USEPA, 1997b), where the assignment of weight to a particular result is based on the reliability of the data. Reliability is a function of combined measurement error, applicability to the receptors of concern, the degree of realism in modeling, and the confidence and power levels associated with statistical testing. The completed ERA describes risks in detail and relates them to the assessment endpoints. The risk assessment results in conclusions

about the effects of site constituents on ecological receptors, and if necessary, recommendations for site-specific media concentrations that will protect valuable resources. If appropriate, additional recommendations are made for future activities. For example, recommendations may be made for future monitoring, habitat enhancement, or particular types of remediation. These recommendations are used by the risk manager in the risk management phase.

Uncertainty analysis is an important part of risk characterization. Due to the number of potential receptor species and frequent lack of knowledge regarding their life histories, feeding habits, toxicological sensitivities, interactions with other species, and responses to natural environmental changes, the uncertainties surrounding estimates of ecological risk are substantial. Thus, the interpretation of toxicity quotients greater than one, positive results from toxicity testing, or negative results from community comparisons are not necessarily straightforward.

Added to the foregoing sources of uncertainty are those that are common to both human and ecological predictive risk assessments. These include lack of toxicological data, error in analytical data, the PCOC identification process, computation of exposure point concentrations, using conservative fate and transport assumptions, and selection of exposure pathways. These and other sources of uncertainty and their anticipated effect on estimated risks will be discussed in the risk characterization section of the assessment.

The risk characterization is completed with the production of the ERA portion of an RFI or RFI report. Decisions regarding future actions take place in the risk management step.

7.7 STEP 8 - RISK MANAGEMENT

Risk management is the final step in the ERA process. In this step all stakeholders discuss the advisability of no action, remediation, monitoring, or other activities. Although risk management is the final step in the eight-step ERA process (USEPA, 1997b), it may be undertaken after the screening-level assessment if additional ecological work may not be necessary, or to gauge the cost-effectiveness of such work. Risk management considerations are conducted only after risk assessment is completed, and is not considered part of risk assessment.

The use of mean contaminant concentrations, less conservative modeling assumptions, and less conservative guidelines can help add balance to risk management considerations. Frequency of detection, number exceedances, magnitude of exceedances, and location of exceedances can also be used as risk management tools. Furthermore, the concentrations of contaminants at each site (primarily

metals) may be assessed relative to site-specific, Base-wide, and regional background concentrations (Shacklette and Boerngen, 1984). Chemical and biological data collected during earlier phases of the RFI may be discussed qualitatively, where applicable.

Due to the variability in guideline values, sediment screening-levels from other sources may also be presented in risk management for this ERA, including ER-Ms, Ontario Ministry of the Environment screening guidelines (OME, 1992), USEPA sediment quality criteria and "eco-tox" thresholds (USEPA, 1996b), and those derived as part of ongoing Great Lakes sediment research (Smith et al., 1996; Ingersoll et al., 1996).

At the screening level, the risk assessment will be performed using maximum concentrations. However, the maximum imparts little predictive utility to the assessment if the resulting dose or exposure concentration is above the corresponding threshold value. For risk management concerns, midpoints (medians or means) may also be used for exposure concentrations to provide balance to, and reduce uncertainties in, the preliminary estimate.

In addition to their use in decisions regarding the need for more investigation, the EEQs generated for the screening-level ERA may be used to establish site priorities and the need for interim action. Some potential risks may be high enough to initiate an early risk management decision, such as the removal of a small amount of highly contaminated soil in an area where wildlife exposure is likely.

Considerations of habitat quality and quantity inevitably enter into risk management decisions about the need to proceed beyond the screening-level ERA, and there is almost no guidance available on these issues. High levels of contamination limited to poor habitat caused by permanent development (e.g. parking lots and buildings) are reasonable cause for foregoing further risk analysis or consideration of remediation. Good habitat may rule out remediation even if there is potential risk, especially if remediation options are limited to destructive or disruptive techniques. An example is the occurrence of locally high sediment concentrations in an otherwise valuable wetland, where dredging the contaminated areas may cause more harm than benefit. There is a wide range of situations between these two examples where costs and benefits are much less clear. These situations must be evaluated on a case-by-case basis. The issues of potential habitat quality, present land use, and future land use are addressed in risk management evaluations. Also, the decision to continue the assessment does not necessarily mean that remediation will be necessary (USEPA,1997b).

After the screening-level ERA results have been presented to BTAG and all other stakeholders, interim deliverables presenting and discussion risk management considerations may also be presented to BTAG and all other stakeholders.

7.8 SITE-SPECIFIC ERA APPROACHES

The generalized ERA framework and methodology presented in Sections 7.1 through 7.7 will be used at each of the seven RFI sites and for the Paint Branch watershed assessment. This section presents a discussion of the site-specific components of the ERAs for each study area. These site-specific components include, but are not limited to, media to be sampled, sample sizes, sample locations, habitats and receptors, and study objectives. Media to be sampled, sample sizes, and sample locations for each site are described in detail in Section 4.0.

Contaminants in media from each of the seven sites may have migrated downgradient to onsite or offsite media. This presents problems when trying to define the specific area within and around a site to be sampled and a specific area to be used for risk assessment purposes. To address these problems, the term "Zone of Influence (ZOI)" will be used to describe each site and the areas that could have been impacted by their contaminants. Specifically, each ZOI will be defined as "a site and all contiguous areas and media that may have been impacted by contaminants from that site, qualitatively estimated for the purpose of assessing risk to ecological receptors."

ZOIs will also be taken into account in risk management when trying to determine if any sites have contributed contaminants to Paint Branch. It is acknowledged that a site's ZOI could include any downgradient areas in Paint Branch that it may have impacted. In this case the ZOI would be much larger than originally designated for sampling and risk assessment. Nonetheless, the designation of a ZOI is a necessary, practical tool for compartmentalizing each study area for sampling purposes and risk assessment. In addition, the physical nature of some of the sites inhibits offsite migration of contaminants, and thus, less uncertainty exists when designating their ZOIs.

It should be noted that representative receptors for each site will be selected after consensus is reached regarding the assessment endpoints since the types of receptors that may be used in the foodchain modeling will be reflective of the assessment endpoints. An interim deliverable presenting proposed receptors and exposure parameters for each site will be presented to BTAG prior to initiation of the ERA.

7.8.1 Site 2 - Apple Orchard Landfill

Site 2 is a 4.3 acre abandoned landfill located on the south side of Perimeter Road in the northwestern end of NSWC-White Oak. It was operated as an open disposal area and landfill from 1948 until 1982. The top of the landfill is approximately twenty feet higher in elevation than the valley to the west, south, and east. An apartment complex is located to the north, adjacent to the Base property. The landfill toe on the west, south, and east is steep and contains exposed debris. The top of the landfill is flat and comprised of grasses, brush, disturbed bare soil, and gravel. The landfill toe and the adjacent valley are heavily wooded. A drainageway is located along the western edge of the landfill toe. This drainageway empties into an unnamed stream south of the landfill in the bottom of the valley. The stream flows to the northeast and empties into Paint Branch approximately one mile from Site 2. The stream originates a few hundred feet east of Site 2 at two NPDES stormwater outfall culverts that discharge runoff from a large section of the northwestern portion of the Base. A site layout map is provided on Figure 3-1.

The top of the landfill provides marginal but extensive terrestrial (old field) habitat, while the wooded valley provides excellent terrestrial (wooded) habitat. Water flow in the stream next to the landfill is intermittent and dependent on rainfall, but standing water is almost always present. Based on Malcolm Pirnie surveys in the early 1990s (Malcolm Pirnie, 1991) and a December 1997 site visit by B&RE ecologists, no fish are present in the stream in the landfill area. However, the sediments may contain a rudimentary benthic community. A large portion of the stream area has been classified as jurisdictional wetlands (Halliburton NUS, 1995).

Surface water, sediment, and groundwater samples will be collected on and near the landfill. Five surface water/sediment samples will be collected in the drainageway west of the landfill. Seven surface water/sediment samples will be collected in the stream south of the landfill and several hundred feet downgradient of the landfill to investigate offsite contaminant migration. This will constitute the extent of the site's ZOI. Ten surface soil samples will be collected around the landfill perimeter and ten surface soil samples will be collected on the landfill proper. Five existing and five new monitoring wells will also be sampled. Also, two surface water/sediment samples will be collected in the stream south of the landfill upgradient of the landfill. These samples will be used to investigate contaminant inputs to the stream from the stormwater outfalls. Data from those samples may help differentiate contaminant inputs due to the landfill from contaminant inputs due to upgradient sources. Sample locations are provided on Figure 3-1. Potential impacts of site contaminants on Paint Branch are discussed in Section 7.8.8.

Surface water, sediment, surface soil, and groundwater contaminant concentrations will be compared to screening guidelines as discussed in Section 7.1.

7.8.2 Site 3 - Pistol Range Landfill

Site 3 is 1.1 acres in size, located on the eastern half of NSWC-White Oak, directly north of Dahlgren Road and the Monroe Loop. The site was operated as a landfill from the late 1940s to the mid-1970s. The top of the landfill is relatively flat, although the southern end slopes down towards Dahlgren Road. West Farm Branch is located in a valley along the landfill toe to the west of the landfill. The top of the landfill is approximately 15 feet higher in elevation than the bottom of the valley. The landfill toe is steep, contains exposed debris, and impinges on West Farm Branch in some locations. West Farm Branch flows to the south under Dahlgren Road and empties into Paint Branch about two miles south of Site 3. A site layout map is provided on Figure 3-2.

The top of the landfill provides marginal but extensive terrestrial (old field) habitat, while the wooded valley provides excellent terrestrial (wooded) habitat. Water flow in the stream next to the landfill is intermittent and dependent on rainfall, but standing water is almost always present. It is not known whether fish are present in the stream in the landfill area, but the sediments may contain a rudimentary benthic community. A large portion of the stream area has been classified as jurisdictional wetlands (Halliburton NUS, 1995).

Surface water, sediment, and groundwater samples will be collected on and near the landfill. Five surface water/sediment samples will be collected in the stream west of the landfill; two of these will be collected downgradient of the site, south of Dahlgren Road, to investigate offsite migration of contaminants. This will constitute the extent of the site's ZOI. Seven surface soil samples will be collected around the landfill perimeter and eight surface soil samples will be collected on the landfill proper. Eight existing and seven new monitoring wells will also be sampled. Sample locations are presented on Figure 3-2. Also, a surface water/sediment sample was collected in West Farm Branch upgradient of Site 3, just north of the Base boundary. Data from this sample may be used as background data for Site 3 in risk management. Data from that sample and potential impacts of Site 3 contaminants on Paint Branch are discussed in Section 7.8.8.

Surface water, sediment, surface soil, and groundwater contaminant concentrations will be compared to screening guidelines as discussed in Section 7.1.

7.8.3 Site 4 - Chemical Burial Area

Site 4 is located along Perimeter Road in the northeast portion of the installation. The site was used from the mid-1950s to the early 1970s for disposal of chemicals in four locations within the site. The site is relatively flat, and although a small drainage swale is located along the road, rainfall will tend to pond and

infiltrate rather than run off. The site is an open area with disturbed, bare soil, grasses, immature trees, and some brushy areas, which are surrounded by woodlands to the west, east, and south. One small wetland area (0.01 acres) was delineated in the woods east of Site 4 as part of wetland and forest stand delineations on the Base (Halliburton NUS, 1995). As discussed in Section 3.3.2.6, the wetland appears to be man-made, becomes dry in drier seasons, and is too small and isolated to be of significant ecological value. The wetland is upgradient of Site 4 (both surficially and hydrogeologically) and, hence, Site 4-related contaminants are unlikely to migrate to the wetland via overland runoff or groundwater discharge. A site layout map is provided on Figure 3-3.

Potential risks would be confined to terrestrial receptors that inhabit the open area and nearby wooded areas. Therefore, ten surface soil samples will be collected within the four disposal areas on the site. Sample locations are presented on Figure 3-3. The area proper is designated as the site's ZOI since offsite migration via overland flow is unlikely and groundwater to surface water discharge is unlikely. Surface soil data will be compared to screening guidelines as described in Section 7.1.

7.8.4 Site 7 - Ordnance Burn Area

Site 7 is located near the northeastern corner of the Base. Ordnance burning activities were conducted in a drainage swale north of Buildings 501 and 508 from 1948 to 1968. The swale is relatively flat and narrow at its westernmost point and widens out downgradient to the east. The swale passes under Perimeter Road via a culvert approximately 400 feet east of the origin of the swale near Buildings 501 and 508, but the culvert is completely plugged with leaves and other debris, inhibiting water flow under the road. The swale is located in a wooded area and water is present only after periods of heavy rainfall. Since the swale is relatively flat and wide in the wooded area and along Perimeter Road, rainfall ponds and infiltrates. The swale was completely dry during a November 1997 site visit. Therefore, no aquatic or semi-aquatic community is present in the swale. Also, no aquatic resources are present downgradient of the site that contaminants could potentially migrate to via overland flow or groundwater discharge. A site layout map is provided on Figure 3-4.

Potential risks would be confined to terrestrial receptors that inhabit the wooded area on and near the former ordnance burning area. Therefore, five surface soil samples will be collected within the former burn area, and two surface soil samples will be collected downgradient of the burn area in the swale to investigate potential offsite migration. One of these two downgradient samples will be collected approximately halfway between the burn area and Perimeter Road and one will be collected where the drainage swale passes under Perimeter Road. This area will be designated as the site's ZOI. Sample locations are presented on Figure 3-4.

Surface soil contaminant concentrations will be compared to screening guidelines as described in Section 7.1. The ZOI for Site 7 is of limited aerial extent. As a result, it is probably much smaller than the home ranges of most mammals and birds that are found in wooded habitats on the Base.

7.8.5 Site 8 - Abandoned Chemical Disposal Pit

Site 8 is located along the southern facility boundary at the terminus of Perimeter Road. Site 8 was used from 1951 to 1971 for disposal of miscellaneous waste chemicals from facility laboratories. The site is approximately 10 feet by 10 feet wide and 12 feet deep, and was excavated and replaced with clean soil in late 1996. The site is located in a flat, heavily wooded area. No surface waters are located near the site. Paint Branch is located approximately 1,000 feet to the east, but given the flat nature of the site proper and distance to Paint Branch, contaminant migration to the Creek is unlikely. A site layout map is provided on Figure 3-5.

Two surface soil samples will be collected in the excavated and filled area to confirm the absence of post-remediation contamination. Four surface soil samples will be collected immediately outside of the excavated and filled area to investigate the potential for any migration via surface runoff. The four samples to be collected outside of the excavated and filled area are a conservative measure, since the site is flat and offsite migration via overland runoff is expected to be minimal. Thus, that area will be the boundary of the site ZOI. Sample locations are presented on Figure 3-5.

Surface soil contaminant concentrations will be compared to screening guidelines as described in Section 7.1. Due to the small aerial extent of the site (10 feet by 10 feet), foodchain modeling does not appear to be reasonable or appropriate since even the home range of small mammals would be several times larger than this site. However, if the data indicate that significant offsite migration has occurred via overland runoff, foodchain modeling for terrestrial receptors will be considered.

7.8.6 Site 9 - Industrial Wastewater Disposal Area 300

Site 9 is located south of Dahlgren Road along the Montgomery/Prince George County line and extends south to the facility boundary. The site was used from the early 1950s until the mid-1970s for disposal of liquid wastes via a series of leaching wells. Paint Branch is located south of the site, a few hundred feet from the Base boundary. A tributary of Paint Branch is located along the western and southern edge of the site, and is unofficially known as West Farm Branch. An intermittent drainageway is located along the eastern edge of Site 9, and it also connects with Paint Branch south of the site. A site layout map is provided on Figure 3-6.

For the most part, surface soils have not been impacted by disposal activities, and hence, surface soils will not be sampled. Groundwater under the site may discharge to West Farm Branch and the drainage ditch to the east. Therefore, surface water and sediment sampling will be conducted in these two waterbodies to investigate potential impacts to surface water resources primarily via groundwater discharge. Five surface water/sediment samples will be collected along West Farm Branch from the northernmost point of possible groundwater discharge south to near the Base boundary. Four surface water/sediment samples will be collected in the drainageway to the east from the northernmost point of Site 9 south to near the Base boundary. This is thought to encompass the site's ZOI. Sample locations are presented on Figure 3-6. It should be noted that a surface water/sediment sample was collected in each of these waterways near their confluences with Paint Branch as part of a recent background characterization study. The use of these data is discussed in Section 7.8.8, as well as the influence of Site 9-related contaminants on Paint Branch.

The drainageway to the east is intermittent and contains water only after periods of heavy rainfall. The gradient to the south is steep, which causes water in the drainageway to flow swiftly. As a result, the drainageway is usually dry and does not contain a diverse or abundant aquatic community, although some semi-aquatic receptors (e.g., amphibians) may be present in the wetter months of the year along its southernmost reaches (where water would be most prevalent). The tributary to the west (West Farm Branch) is small, but may contain some small fish and a rudimentary benthic community. Surface water, sediment, and groundwater data in both waterbodies will be compared to screening guidelines as described in Section 7.1

7.8.7 Site 11 - Industrial Wastewater Disposal Area 100

Site 11 is located in the western portion of NSWC-White Oak in an area covering approximately 16 acres. The site is comprised of 13 leaching wells in nine areas that were used for disposal of liquid wastes until the late 1970s. The site is highly developed, consisting of buildings, roads, and graveled areas. The only vegetation present is mowed turfgrass and ornamental trees. A site layout map is provided on Figure 3-7.

For the most part, surface soils have not been impacted by disposal activities, and hence, surface soils will not be sampled. Groundwater under the site may discharge to two drainageways to the east. Previous investigations indicate that groundwater under Site 11 flows to the east. Therefore, surface water and sediment sampling will be conducted in these two drainageways to investigate potential impacts to surface water resources primarily via groundwater discharge. Two surface water and sediment samples will be collected in the westernmost portion of the drainageway southeast of Building 30, and two

along the westernmost portion of the drainageway east of Bowditch Road. Water is present in these drainageways only after periods of heavy rainfall, and thus, no aquatic communities are present. This constitutes the extent of the site's ZOI. Sample locations are presented in Figure 3-7. The westernmost portions of the drainageways were completely dry during a November 1997 site visit. This may prevent the collection of surface water samples.

A small drainageway and pond are located to the west and southwest of Site 11 (in the Base golf course) and were included in the Site 11 assessment as part of previous RFIs. However, groundwater flows in the opposite direction (to the east) and no surface soil contamination is associated with Site 11, precluding impacts to the golf course area. Also, the golf course pond is currently being studied under a separate investigation. Therefore, these areas will not be included in the Site 11 assessment.

Surface water and sediment data in the two drainageways will be compared to screening guidelines as described in Section 7.1. Due to the lack of surface soil contamination, the small size of the drainageways, and the absence of aquatic receptors in the drainageways, foodchain modeling may not be applicable. The objective of the assessment of drainageway surface water and sediment is to ascertain whether groundwater contaminants are discharging to these media that could be carried downgradient into the Paint Branch watershed. Potential impacts to the Paint Branch watershed are discussed below.

7.8.8 Paint Branch Watershed

A detailed description of Paint Branch is presented in Section 2.5.8. Briefly, Paint Branch bisects the Base in a north/south direction. Paint Branch and all its tributaries above I-495 are designated as Class III - Natural Trout Waters. As a result, the creek is thought to have the potential for growth and propagation of trout and is capable of supporting self-sustaining trout populations and their associated food organisms.

The presence of brown trout in Paint Branch was documented by Maryland DNR in 1973, from the extreme headwaters to the upper boundary of NSWC-White Oak (C. Gougeon, 1985). The trout population had declined severely by the 1970s due to man-made and natural factors, but has since rebounded. Sampling on the Base in April 1991 confirmed the presence of brown trout in the stream on the facility. However, juvenile trout and fry are limited in this portion of the stream due to fluctuating water levels, temperature, and possible sedimentation. Aside from its ecological value, Paint Branch is also aesthetically, politically, and socially important in the region.

Surface water runoff from almost all sections of the Base eventually flows to Paint Branch via a series of drainageways and tributaries. Therefore, the waterways on the Base are part of the Paint Branch

watershed. Regardless of whether any of the RFI sites have ecological impacts within their ZOIs, they could have cumulative impacts on Paint Branch via contaminant introduction into the watershed. Also, other potential contaminant sources (e.g., RCRA SWMUs, roadways) may exist on the Base that could contribute contaminants to the Creek.

For these reasons, an ERA will be conducted for Paint Branch with emphasis on potential contaminant inputs from its tributaries on the Base. In addition to assessing the potential risks to aquatic, semi-aquatic, and benthic receptors from contaminants in Paint Branch media, the watershed study may also help identify potential contaminant sources via spatial analysis of concentrations. The data from each individual RFI site (specific contaminants and their concentration gradients) will be compared to contaminant data in Paint Branch to identify contaminant sources to the Creek, if any. Contaminant data from Paint Branch can also be used in developing Base-wide preliminary remediation goals (PRGs), if necessary, later in the RFI/CMS process.

Eleven surface water/sediment sampling locations were sampled on and immediately adjacent to the Base as part of a recent background characterization study (Section 3.8). These sampling locations were chosen to identify potential contaminant inputs to Paint Branch from all tributaries on the Base. Background characterization sampling locations are presented on Figure 3-8. Six major tributaries of Paint Branch are located on the Base, and a surface water/sediment sample was collected in each of these tributaries near their confluence's with Paint Branch. Two background surface water/sediment samples were also collected in the drainageway that runs through the Base golf course. This drainageway empties into Paint Branch, but at a location off-Base after flowing through several developed areas. A surface water/sediment sample was collected in West Farm Branch upgradient of Site 3. In addition, one surface water/sediment sample was collected in Paint Branch at the northern Base boundary and one at the southern Base boundary.

The samples described above will be compared to screening guidelines to identify potential contaminant inputs into Paint Branch from the six major tributaries (the watershed). Several of these samples may also implicate individual RFI sites as contaminant sources into the Creek. Specifically, sample BGSW/SD05, collected at the northern Base boundary, can be used to assess potential inputs from Site 2 and offsite sources. Samples BGSW/SD07 and 09 can be used to assess potential inputs from Site 9. BGSW/SD02 and 04 can be used to assess potential inputs from Site 11. BGSW/SD10 can be used to assess potential inputs from Site 7. Sample BGSD06, collected in Paint Branch near its exit from the Base, can be used to assess contaminant inputs leaving the Base, if any. It should be noted that VOCs and some SVOCs were not analyzed for in these samples since it was unlikely that they would be present. Yet, VOCs and the SVOCs that were not analyzed for in those samples are not known to bioaccumulate or biomagnify.

Bioaccumulatable and biomagnifyable contaminants are the major concern in the watershed due to their potential effects on fish and other upper-level consumers.

In addition to the samples described above, five surface water/sediment samples will be collected in Paint Branch throughout its entire reach on the Base to assess potential risks to Creek biota. Samples will be placed spatially along Paint Branch from the northern end to the southern end of the Base (Figure 3-8). Data from these samples may also indicate other potential contaminant sources on the Base.

The background characterization study described above also involved the collection of six surface/water sediment samples in Paint Branch and its tributaries upgradient of the Base. These sample locations are provided on Figure 3-9. Surface water and sediment data from these samples will be used as Paint Branch watershed background data in risk management. Sample BGSW/SD06, collected in West Farm Branch, upgradient of Site 3, north of the Base boundary, may be used as surface water/sediment background data for Site 3.

8.0 ADDITIONAL RFI/CMS OBJECTIVES

The proposed project schedule is shown below. However, this schedule is preliminary and subject to change. The schedule accounts for Navy Review and other periods that will be required between submission dates during this assignment that may impact the project schedule.

RFI Rough Draft Report ..... 3rd Quarter 1999
RFI Draft Report ..... 3rd Quarter 1999
RFI Final Report ..... 4th Quarter 1999
Rough Draft CMS ..... 2nd Quarter 2000
Draft CMS ..... 2nd Quarter 2000
Final CMS ..... 3rd Quarter 2000

8.1 RCRA FACILITY INVESTIGATION

Presentation of information in the RFI Report for NSWC-White Oak is reflected in the Table of Contents provided in Appendix L. This is preliminary and subject to change. The proposed RFI Report will consist of 10 major sections and eight appendices.

The first section will be the Introduction and it will discuss the purpose and organization of the Phase I RFI Report as well as the site background's. At a minimum, the site background's will include facility descriptions and histories, waste and hazardous materials management practices, previous environmental investigations, and environmental baseline surveys. Depending on the specific sites, more topics may be included in this section.

Section 2 in the RFI report will be a summary of RFI activities. The major subsections will include a scope of investigation, general procedures for surface and subsurface investigation, IDW handling, surveying, site-specific investigation activities, and a determination of background concentrations. For NSWC-White Oak, general activities associated with surface and subsurface investigation will consist of surface soil sampling, subsurface soil sampling, monitoring well installation, general groundwater sampling, water level measurements, aquifer testing, sediment sampling, and surface water sampling.

The third section shall be Physical Characteristics of the Study Area. This section will be comprised of meteorology and climatology, site topography, regional geology, regional hydrogeology, water usage, hydrology, and local geology and hydrogeology.

The next seven sections will be site specific. The seven sites to be discussed in the RFI Report are Site 2 - Apple Orchard Landfill; Site 3 - Pistol Range Landfill; Site 4 - Chemical Burial Site; Site 7 - Ordnance Burn Area; Site 8 - Abandoned Chemical Disposal Pit; Site 9 - Industrial Wastewater Disposal Area 300; and Site 11 - Industrial Wastewater Disposal Area 100. Each site specific section will be comprised of a site description and history, a scope of environmental investigation, a discussion of site characteristics such as geology and hydrogeology, nature and extent of contamination of surface and subsurface soil, groundwater, and a summary of environmental condition, contaminant fate and transport, a baseline HHRA that will include data evaluation, exposure assessment, risk characterization, risk management, and sources of uncertainty, a baseline ERA that will include site characterization, risk characterization, risk management, and conclusions and sources of uncertainty, and general summary and conclusions.

Eight appendices will be included in the RFI Report. Appendix A will consist of sample log sheets, COC forms, and survey results. Appendix B will contain the boring logs and monitoring well construction sheets. The aquifer characteristics calculations will be provided in Appendix C. The analytical database will be included in Appendix D. All data validation summaries and memoranda will be provided in Appendix E. The statistical analysis of environmental data will be included in Appendix F. Appendix G will consist of all supporting information for the HHAR. ERA screening tables will be provided in Appendix I. For Appendices D through I, information for each site will be presented separately.

8.2 CORRECTIVE MEASURES STUDY

A single CMS Report will be prepared for the project, encompassing all seven sites. The CMS will be performed concurrently with the RFI. The proposed CMS will define the objectives of the response action, develop remedial action alternatives, and provide an initial screening and detailed analysis of the alternatives.

The CMS submission process will consist of a rough draft report, a draft report, and a final report. The CMS rough draft report will be based on the assumption that each of the sites studied by B&R Environmental will require a CMS Report and B&R Environmental will evaluate the level of effort for a CMS for each site prior to report development. The CMS draft report shall incorporate Navy comments and B&R Environmental modifications. It will be assumed for the CMS draft report that comments on the CMS Rough Draft Report will be received as a single submittal, and will be incorporated into the draft version of the CMS Report as appropriate.

The CMS Final Report will again incorporate government comments and B&R Environmental modifications as appropriate. Again, it will be assumed for the CMS Final Report that comments on the

CMS Draft Report will be received as a single submittal, and will be incorporated into the final version of the CMS Report as appropriate.

Comments received from Navy, State, and/or USEPA representatives will be responded to in a formal Response to Comments Report format and submitted as a separate document. The report will consist of a repetition of the reviewer's comment followed by the appropriate response. Response to Comments documents will be prepared and submitted prior to submission of the Draft and Final CMS. It will be assumed that the Response to Comments report will be submitted in its final form and a draft submission will not be required. A single Response to Comments document will be developed and submitted to all reviewers.

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APPENDIX A

DATA QUALITY OBJECTIVES

HHRA DQO's
ERA/ERM DQO's
NEC DQO's

APPENDIX A : DATA QUALITY OBJECTIVES

Initially meetings were held to establish guidelines for the HHRA DQOs, ERA DQOs, and NEC DQOs. For each DQO and NSWC White Oak site, goals were established in order to have a clear direction on how to develop the work plan, how to implement the work plan and how to satisfy all stakeholders. Based on the established goals, potential remedies for each site at NSWC White Oak were then discussed. Assumptions for each site were then agreed upon. Once the potential remedies and assumptions were completed, specific site issues were then addressed. The remaining DQO process consisted of the seven steps presented on Figure A-1. A detailed summary of each DQO session is presented in Appendices A-1, A-2, and A-3.

A detailed description of the DQO process is beyond the scope of this document; however, guidance from the U.S. Environmental Protection Agency (USEPA, 1993) provides a detailed discussion of the DQO process. Following is a brief summary of each step as they relate to the activities listed in Figure A-1.

Step 1: **State the Problem** - Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

Step 2: **Identify the Decision** - Identify what questions the study will attempt to resolve, and what actions may result.

Step 3: **Identify the Inputs to the Decision** - Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

Step 4: **Define the Study Boundary** - Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

Step 5: **Develop a Decision Rule** - Define the statistical parameter(s) of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

Step 6: **Specify Tolerable Limits on Decision Errors** - Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

Step 7: **Optimize the Design for Obtaining Data** - Evaluate information from the previous steps and generate alternative data collection design. Choose the most resource-effective design that meets all DQOs.

The above steps are generally related in a downward decision flow; however, during development of the DQOs, the answers to subsequent questions may require a review of the previous step(s). In addition, the DQO steps must be reviewed <u>during</u> the data collection activities in order to allow for changes to the proposed plan that can optimize the design. Therefore, the DQO process is an iterative procedure requiring input from decision makers to qualify all decisions made before and during the design and implementation of the data collection activities. Ultimately, the process will define characterization requirements that profile each site according to the following three criteria.

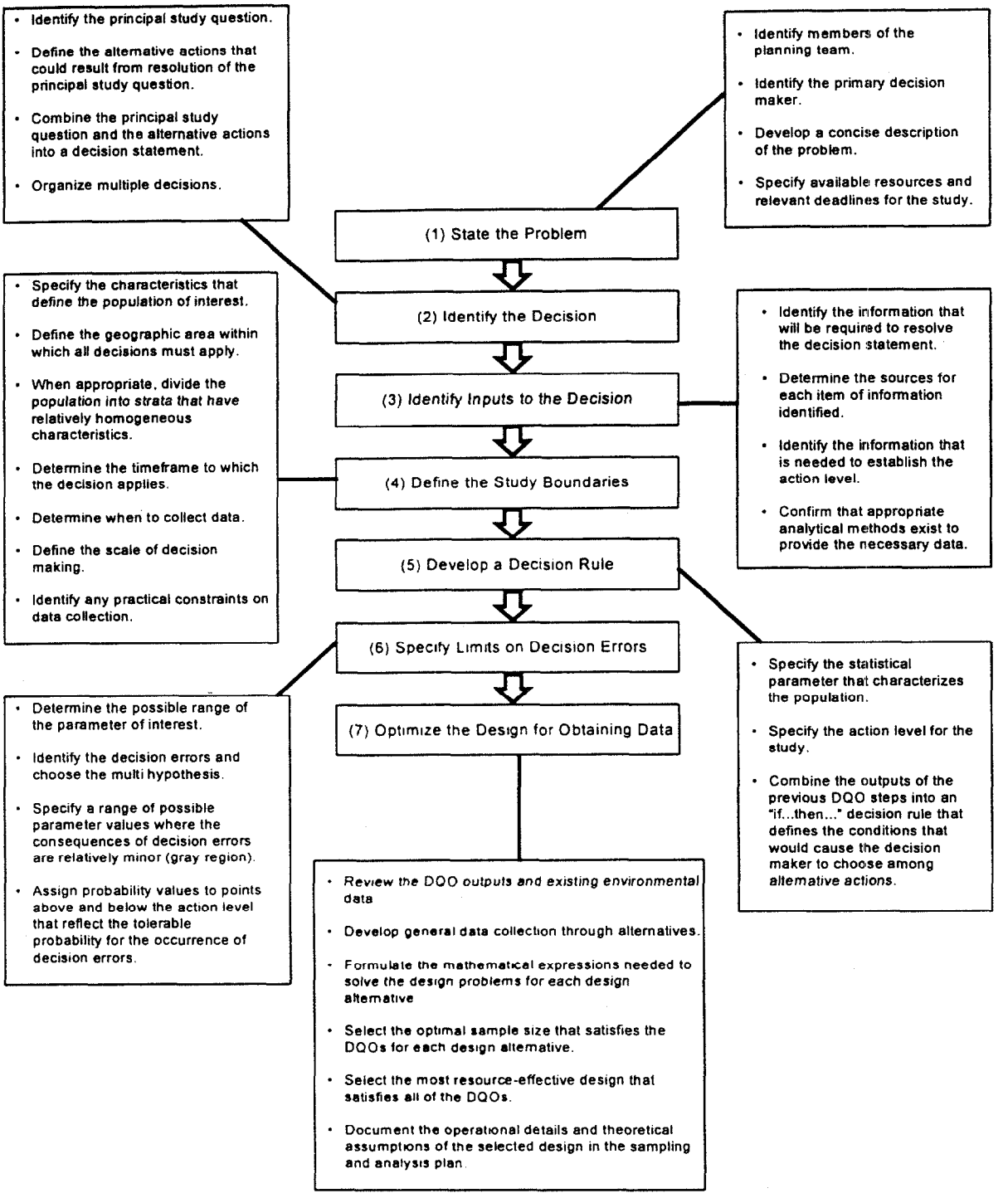
1. **No further action required:** This category is for those sites that are found to be already protective of human health and the environment after the initial investigation. Further characterization is therefore not necessary and remedial activities are not required.

2. **Development and design of appropriate remedy:** If it is determined that the site is NOT protective of human health and the environment, the investigator then will select the appropriate course for future work. This begins through an assessment of existing analytical, physical, and historical data for the site. The goal of the assessment is to determine if the data is sufficient to select a proper remedy that is rapid, safe, and cost effective. A re-examination of the Data quality Objectives [DQO] process is often appropriate at this time (see Section 1.2.2; Data Quality Objectives). It allows the investigator to compare the initial criteria selected for decision making with the quality of the data currently used to determine nature and extent of contamination, risk, and clean-up goals. The project can then proceed forward to the design phase if the data is found to meet the initial criteria and no further issues were developed during the initial investigation.

3. **Further investigation and characterization required:** Additional data may be required if existing results are insufficient to determine the nature and extent of contamination, HHRA, or ERA, define clean-up goals, or otherwise develop a remedy that is rapid, safe, and cost effective. As in step 2, the DQO process would be re-examined, however, this time to determine if the initial data quality criteria should be modified or enhanced to reflect new design conditions. Often the new information is needed to fill in data gaps or to strengthen the statistical basis for a design approach that appears to be imminent. Under these conditions, it may be appropriate to begin a preliminary design phase as a parallel activity to the new data inquiry. The investigator can then adjust the design basis as new data becomes available. The final design for remedy however should not be completed until the new DQOs are fully satisfied.

FIGURE A-1

THE DATA QUALITY OBJECTIVES PROCESS



HHRA DQO's

APPENDIX A-1 : HHRA DQO's

HUMAN HEALTH RISK ASSESSMENT (HHRA)

Goals

DQO Session:

Have clear direction on how to write the work plan

Implement a work plan that will, to the extent possible, satisfy all stakeholders

Project Goals - Human Health Perspective

Complete RI within schedule that will satisfy all stakeholders

Human Health Risk Assessment Goals

Assess risk potential future on-site receptors

Potential Remedies

Source reduction (Soil, GW and non PB sediment)

Natural attenuation is very likely, however we do not currently have enough data to definitize.

Rerouting of streams/tributaries is not acceptable.

Pump and treat would be most likely remediation alternative for the groundwater

Excavation of soil for source reduction

- Bioremediation must be considered
- Capping should be considered

Current Chemical Classes of Concern

Target Analyte List (TAL) Metals + CN

- Target Compound List (TCL) Volatile Organic Compound(VOC), Semi-Volatile Organic Compound (SVOC), Pesticides, Polychlorinated Biphenyls (PCBs)
- 8330 Explosives
- Acid Volatile Sulfides (AVS) / Simultaneously Extractable Metals (SEM)
- Total Suspended Solids (TSS) / Total Dissolved Solids (TDS)
- Total Organic Carbon (TOC)

Assumptions

We will use a risk-based approach for evaluating the site (and remediation if necessary)

Site specific chemical, geological and hydrogeologic data and possibly groundwater modeling will be used to evaluate the potential for chemical migration beyond the site boundaries

The Exposure Domain will be the site boundary

Region III RBCs, MCLs, and MD GW, Federal AWQC (state if available) standards will be used for COPC screening

- We will collect all groundwater samples using a low flow method, thereby eliminating the need for filtered samples

A public water supply is currently available and will continue to be available for the base and communities surrounding the base.

- It is unlikely that anyone on-site will use the groundwater underlying NSWC White Oak as a potable water supply.
- A risk assessment will be performed for on-site groundwater to determine the potential need for institutional controls at the site
- Use of base-specific background will be used in the risk management phase in determining the final list of COCs.
- Biased sampling was adequate to identify the most likely and most concentrated sources of all contaminants
- Geophysical analysis will be used for confirmation of leaching well presence/absence at Sites 9 and 11

Current operations will not increase contaminant concentrations significantly or add new significant sources of contaminants. Therefore, our assumptions will remain valid throughout the duration of the study

The analytical methods chosen for existing data (non MP) are of adequate sensitivity to calculate risks

- The background data collected as of December 1997 will be adequate for use in the HHRA

Only validated data will be used for risk assessment purposes

Soils that have been excavated will not be used for risk assessment nor nature and extent

The site conceptual model will be based on future land use.

Sustenance fishing on or near the facility is unlikely. Therefore, it will not be evaluated as part of the HHRA.

- Only overburden and weathered bedrock wells will be used for HHRA (with the exception of the on-site resident)
- Hydrogeologic data will be collected for evaluation of remedial action alternatives

Issues to Deal With

For any site/media where the only existing data is from MP investigations, will use the MP data for evaluating sample sizes.

Problem Definition

Waste management practices at 7 specific IR sites at NSWC White Oak may have adversely impacted various environmental media and may impose an unacceptable risk to human receptors. Risks to human receptors due to contaminants originating from the each of the 7 sites need to be assessed and a risk management approach acknowledging cost/time constraints needs to be developed for each site.

Identify the Decision

Do the COPC concentrations in environmental media pose an unacceptable risk to human receptors within the site boundary? If so, manage the risk. If not, no action alternative.

Inputs into the Decision

Receptors: Same for each site

On-site worker:

SS: Ingestion, Dermal, Inhalation

- **GW: Inhalation**
  - Resident (Adult/Child):

- **SS: Ingestion, Dermal, Inhalation**

- **GW: Ingestion, Dermal, Inhalation**

- **SW: Ingestion, Dermal**

- **SED: Ingestion, Dermal**
  - Construction Worker: [SS,SB,GW,SW,SED]

- **SS/SB: Ingestion, Dermal, Inhalation**

- **GW: Ingestion, Dermal, Inhalation**

- **SW: Ingestion, Dermal**

- **SED: Ingestion, Dermal**

- Receptors: Same for each site
  - Day Care Child:

- **SS: Ingestion, Dermal, Inhalation**

- **GW: Inhalation**
  - Trespasser

SS: Ingestion, Dermal, Inhalation

SW: Ingestion, Dermal

SED: Ingestion, Dermal

- Recreational

SS: Ingestion, Dermal, Inhalation

SW: Ingestion, Dermal

SED: Ingestion, Dermal

- Utility/Maintenance Worker

SS/SB: Ingestion, Dermal, Inhalation

GW: Ingestion, Dermal, Inhalation

SW: Ingestion, Dermal

SED: Ingestion, Dermal

- Exposure domain concentrations:
  - Soil: 95% UCL on the mean (distribution specific) or maximum whichever is lower. For the evaluation of the construction worker and maintenance worker, surface and subsurface soils will be combined
  - Groundwater: 95% UCL on the mean (distribution specific) or maximum whichever is lower. For wells with temporal samples, only the most recent sample will be used
  - Surface Water: 95% UCL on the mean (distribution specific) or maximum whichever is lower. Only unfiltered surface water will be evaluated in the HHRA.
  - Sediment: 95% UCL on the mean (distribution specific) or maximum whichever is lower.
-
- Data Sources:
  - × IAS (1984)
  - × Confirmation Study (1985)
  - × MP RI/FS Data (1989 - 1991)
  - ✓ BRE Site 8 Sampling (1993)
  - ✓ BRE Design Verification (1995) [Not validated, but will be]
  - ✓ BRE Confirmation for RAS (1996)
  - ✓ BRE GW Characterization (1997)
  - ✓ BRE Basewide Stream Verification (1997)

- Integrated Natural Resources Conservation Plan (1994)
- Wetland and Forest Stand Delineation Report (1995)
- EBS/BRAC Cleanup Plan (1997)
- RFA (1990)

◆ Data that will be collected in the RI/FS sampling effort
  - A decision for a no action alternative can be made with no further data.

  Further information is required before a human health risk assessment and a decision for a remedial alternative can be determined
  - There is sufficient information to define risk to human receptors and a remedial alternative can be determined.

◆ Groundwater data collected will be used to satisfy HHRA purposes as will as N&E, plume delineation, and modeling

◆ Any data collected outside of the HHRA needs may not be validated.

◆

◆ **Identify Study Boundaries**

◆ IR Site boundary
  - No clear site boundaries exist and will need to be defined prior to the submittal of the work plan

◆ Surface soil is defined as 0-6"

◆ Subsurface soil is defined as 0-10'

◆ Sediments will be collected from 0-6"

◆ If a plume can be clearly identified, a risk analysis will be performed for that plume in addition to the sitewide HHRA. Additional data may be required to perform a quantitative HHRA on a distinct plume.

◆

◆ **Decision Rule**

If the calculated carcinogenic risk to one of the identified human receptors in a given exposure domain exceeds the EPA target risk range (10^{-4} or 10^{-6}), then we will recommend a preferred alternative for risk management. If not, no action alternative. If noncarcinogenic HI > 1, target organ HQs will be developed. If these HQs exceed 1, then we will recommend a preferred alternative for risk management. If not, no action alternative. If HI does not exceed 1, no action alternative.

◆

Action Items

◆. Brian will evaluate existing data for each site/media using approved statistical equations in order to determine if the existing sample population size meets the required confidence level for HHRA. He will come to one of the following conclusions:

◆. Further information is required before a human health risk assessment and a decision for a remedial alternative can be determined

  ◆ There is sufficient information to define risk to human receptors and a remedial alternative can be determined.

- In the event that further information is required, he will then formulate a sample population that will augment the existing data
- The Project team will determine all placements of new sample locations so as to support as many data users as possible.

For SW/SED, Brian will first determine the data requirements for the HHRA within the site boundary. A further evaluation is necessary to determine what further data is required for that ZOI in the ERA.

- For purposes of placement of additional sample locations within the ZOI, the sample population may increase to accommodate requirements of the ERA that go beyond the numbers generated from the statistical evaluation.
- No clear site boundaries exist and will need to be defined prior to the submittal of the work plan

ERA/ERM DQO's

APPENDIX A-2: ERA/ERM DQO's

ECOLOGICAL RISK ASSESSMENT (ERA)

Goals

❶ DQO Session:

- Have clear direction on how to write the work plan
- Implement a work plan that will, to the extent possible, satisfy all stakeholders

❷ Project Goals - Ecological Perspective

Project goals are essentially the ERA assessment endpoints. Assessment endpoints are protection of the following groups of receptors from the adverse effects of contaminants (on their growth, survival, and reproduction): benthic invertebrate communities, fish communities, soil invertebrate communities, birds that feed on aquatic organisms, birds that feed on soil invertebrates, carnivorous birds, carnivorous mammals, omnivorous mammals, mammals that feed on soil invertebrates, herbivorous mammals, terrestrial vegetation, and amphibians and reptiles.

The areas to be protected are as follows:

- Paint branch watershed
- The 7 IR site Zones of Influence (ZOI), which include primary and secondary sources

- Complete RI within schedule that will satisfy all stakeholders

Ecological Risk Assessment Goals

- Assessment of risk to terrestrial, aquatic and semi-aquatic receptors within the IR Site ZOI.
- Propose ERA approach for aquatic and semi-aquatic receptors in the Paint Branch (PB) tributaries in Work Plan
- Determine whether any of the 7 IR sites are contaminant sources to the PB Watershed.

Current Chemical Classes of Concern

- TAL Metals + CN
- TCL VOC, SVOC, Pest, PCB
- 8330 Explosives
- TSS/TDS
- TOC/Grain Size
- Radiologicals (if necessary)

Assumptions

- We will use a risk-based approach for evaluating the site (and remediation if necessary)
- A tiered approach will be used for the ERA, in which the results of the screening-level assessment (Tier 1) will be used to determine the need for additional ecological study (Tier 2 or semi-quantitative ERA), and Tier 2 results would be used to determine the need for a quantitative ERA (Tier 3). The results of each Tier would also help determine the type(s) of additional study to be performed.
- Input from Region III BTAG will be used to determine the need for additional ecological study beyond the screening-level assessment
- Site specific chemical, geological, and hydrogeologic data will be used to evaluate the potential for chemical migration beyond the site boundaries
- The PB Watershed will be proposed in the Work Plan as if it were an Operable Unit.
- The site boundary will not necessarily be the exposure point for that site. All potential downgradient areas via runoff, groundwater discharge, or erosion will be defined as part of the ZOI for each site.
- We will use food chain modeling as a secondary screening process for those chemicals that exceed the BTAG values.
- Food chain models will be those currently accepted by Region III BTAG.
- Biased sampling was adequate to identify the most likely and most concentrated sources of all contaminants
- Only validated data will be used for risk assessment purposes
- Soils that have been excavated will not be used for risk assessment nor nature and extent

Outstanding Issues

- How do we deal with the basewide Paint Branch watershed issue within the scope of the seven site RI?
- The only data available for Sites 2, 3 and 7 are the MP data which is not of usable quality for risk assessment. We will use the MP data for evaluating sample sizes for these sites only.

Problem Definition

1. Waste management practices at 7 specific IR sites at NSWC White Oak may have adversely impacted various environmental media and may impose an unacceptable risk to ecological receptors. Potential risks to ecological receptors due to contaminants originating from the each of the 7 sites need to be assessed (as per the assessment endpoints).
2. Developments on and around the NSWC White Oak facility may have degraded the quality of the PB watershed. Potential risks to ecological receptors need to be assessed (as per the assessment endpoints).

Identify the Decision

- Do the COPC concentrations in environmental media associated with each site pose an unacceptable risk to ecological receptors within the site boundary or zone of influence?
- Do the COPC concentrations in environmental media within the PB watershed pose an unacceptable risk to ecological receptors? If so, can we determine whether those elevated concentrations are originating from any of our 7 sites?
- Receptors:

Site 2		
Surface Soil Terrestrial	**Surface Water** Aquatic/Semi-aquatic	**Sediment** Benthic Invertebrates
Site 3		
Surface Soil Terrestrial	**Surface Water** Aquatic/Semi-aquatic	**Sediment** Benthic Invertebrates
Site 4		
Surface Soil Terrestrial	**Surface Water** NA	**Sediment** NA
Site 7		
Surface Soil Terrestrial	**Surface Water** NA	**Sediment** NA
Site 8		
Surface Soil Terrestrial	**Surface Water** NA	**Sediment** NA
Site 9		
Surface Soil NA	**Surface Water** Aquatic/Semi-aquatic	**Sediment** Benthic Invertebrates
Site 11		
Surface Soil NA	**Surface Water** Aquatic/Semi-aquatic	**Sediment** Benthic Invertebrates

Inputs into the Decision

- Exposure domain concentrations: Maximum detection
- Calculate hazard quotient and hazard index
- The risk level in which we will retain chemicals as PCOCs is EEQ = 1

- Data Sources:
  - IAS (1984)
  - Confirmation Study (1985)

- × MP RI/FS Data (1989 - 1991)
- ✓ BRE Site 8 Sampling (1993)
- ✓ BRE Design Verification (1995) [Not validated, but will be]
- ✓ BRE Confirmation for RAS (1996)
- ✓ BRE GW Characterization (1997)
- ✓ BRE Basewide Stream Verification (1997)
- – Integrated Natural Resources Conservation Plan (1994)
- – Wetland and Forest Stand Delineation Report (1995)
- – EBS/BRAC Cleanup Plan (1997)
- – RFA (1990)

◆ Evaluation of Existing Data

1) Can a decision to not to proceed with an ERA be made with no further data?
2) Is there sufficient information to define potential risks to ecological receptors?
3) Is further information required before the need for an ERA can be determined?

Zones of Influence: A site and all areas associated with that site that could potentially be impacted by contaminant migration from that site. The ZOI can include both primary and secondary sources.

1) Paint Branch Creek and all waterways on and near the base that are hydrologically connected to PB Creek.
2) Surface soil will be defined as 0-6"
3) Surface sediments will be collected from 0-6". No subsurface sediments will be collected for this RI/FS.
4) Contaminant impacts to groundwater will also be assessed, although ecological receptors will not receive direct exposure to groundwater

Decision Rule

If the Weight of Evidence indicates potential risk to the representative ecological receptors, then we will evaluate the following:

- Additional ecological study
- Need to proceed directly to the FS

If not, ERA will be complete.

ECOLOGICAL RISK MANAGEMENT

Goals

- DQO Session:
  - Have clear direction on how to interpret the results of the ERA with regard to the need for and type(s) of additional ecological study.
- ◆ Complete RI within schedule that will satisfy all stakeholders

Ecological Risk Management Goals

- Determine the need for additional ecological study for each site.
- If additional ecological study is necessary, determine the location, types, and number of samples and analyses to be performed at each site
- Determine the need for additional ecological study in the PB watershed.
- If additional ecological study is necessary, determine the location, types, and number of samples and analyses to be performed in the watershed
- Determine the need to proceed directly to the FS after the screening-level ERA and risk management are complete

Potential Remedies (FS considerations)

- Source reduction (Soil, GW and non PB sediment)
- Natural attenuation is very likely, however we do not currently have enough data to definitize.
- Excavation of contaminated PB sediments will not be acceptable.
- Rerouting of streams/tributaries is not acceptable.

Assumptions

- Input from Region III BTAG will be used to determine a list of final PCOCs
- Use of base-specific background available as of December 1997 will be used in risk management in determining the list of final PCOCs.
- Other factors, including frequency of detection, magnitude of exceedances, number of exceedances, location of exceedances, and alternate guidelines will be used in determining the list of final PCOCs

Outstanding Issues

- How do we deal with the basewide Paint Branch watershed issue within the scope of the seven site RI with regards to risk management?
- Determination of the list of final PCOCs will use a weight-of-evidence approach, and therefore, will be somewhat subjective. That is, different interpretations of the need for and types of additional study are possible.

Problem Definition

1. Waste management practices at 7 specific IR sites at NSWC White Oak may have adversely impacted various environmental media and may impose an unacceptable risk to ecological receptors. If EEQs greater than 1.0 are present from the ERA, a risk management approach acknowledging cost/time constraints needs to be developed for each site.
2. Developments on and around the NSWC White Oak facility may have degraded the quality of the PB watershed. If EEQs greater than 1.0 are present from the ERA, a risk management approach acknowledging cost/time constraints needs to be developed for the watershed.

Identify the Decision

- Do the COPC concentrations in environmental media pose an unacceptable risk to ecological receptors within the site boundary or zone of influence based on consideration of risk management factors? If not, ERA for each site is complete. If so, is additional study necessary and what studies should be performed?
- Do the COPC concentrations in environmental media within the PB watershed pose an unacceptable risk to ecological receptors based on risk management considerations? If not, ERA is complete. If so, is additional study necessary and what studies should be performed? If conclusion cannot be made, recommendations will be offered under separate cover.

Inputs into the Decision

- Consideration of risk management factors (frequency of detection, background (metals), spatial analysis of elevated EEQs, # of exceedances, alternate screening guidelines)
- Weight of evidence for potential risks posed by COPCs
- Region III BTAG input

- Data Sources:
  - × IAS (1984)
  - × Confirmation Study (1985)
  - × MP RI/FS Data (1989 - 1991)
  - ✓ BRE Site 8 Sampling (1993)
  - ✓ BRE Design Verification (1995) [Not validated, but will be]
  - ✓ BRE Confirmation for RAS (1996)
  - ✓ BRE GW Characterization (1997)
  - ✓ BRE Basewide Stream Verification (1997)
  - – Integrated Natural Resources Conservation Plan (1994)
  - – Wetland and Forest Stand Delineation Report (1995)
  - – EBS/BRAC Cleanup Plan (1997)
  - – RFA (1990)
  - -- The primary data source will be the RI data to be collected (1998)

Decision Rule

If the Weight of Evidence indicates potential risk to the representative ecological receptors, then we will evaluate the following:

- Additional ecological study, including types of studies, location of sampling, and number of samples
- The need to proceed directly to the FS

If not, the ERA is complete.

NEC DQO's

APPENDIX A-3 : NEC DQO's

SITE CHARACTERIZATION

Goals

- ❶ DQO Session:
- Have clear direction on how to write the work plan
- Implement a work plan that will, to the extent possible, satisfy all stakeholders
- ❷ Project Goals - Human Health Perspective
- Complete RI within schedule that will satisfy all stakeholders

Site Characterization Goals

- Accurately characterize the following properties of the hydrogeology for the entire facility:
  - Nature & Extent of contamination
  - Transmissivity
  - Horizontal and Vertical Flow path: local and regional groundwater, GW/SW interactions, GW/SW interconnections

Current Chemical Classes of Concern

- TAL Metals + CN
- TCL VOC, SVOC, Pest, PCB
- 8330 Explosives
- AVS/SEM
- TSS/TDS
- TOC

Assumptions

- Site specific chemical, geological and hydrogeologic data and possibly groundwater modeling will be used to evaluate the potential for chemical migration beyond the site boundaries
- We will collect all groundwater samples using a low flow method, thereby eliminating the need for filtered samples
- Use of base-specific background will be used in order to determine nature of contamination.
- Biased sampling was adequate to identify the most likely and most concentrated sources of all contaminants
- Geophysical analysis will be used for confirmation of leaching well presence/absence at Sites 9 and 11

- Current operations will not increase contaminant concentrations significantly or add new significant sources of contaminants. Therefore, our assumptions will remain valid throughout the duration of the study
- All data will be used for site characterization purposes
- Hydrogeologic data will be collected for evaluation of remedial action alternatives
- All well constructions for existing wells are of adequate quality
- All geology has been adequately characterized in previous investigations

Issues to Deal With

- Sampling interval for existing wells is too large in some cases based on MDE comments

Problem Definition

Waste management practices at 7 specific IR sites at NSWC White Oak may have adversely impacted various environmental media. The nature and extent of these impacts need to be assessed for each site.

Identify the Decision

Are the available data sufficient to adequately define the nature and extent of contamination for each environmental media at each of the 7 IR sites? If so, characterization is complete. If not, further investigation may be required.

Inputs into the Decision

- Data Sources:
  - × IAS (1984)
  - × Confirmation Study (1985)
  - × MP RI/FS Data (1989 - 1991)
  - ✓ BRE Site 8 Sampling (1993)
  - ✓ BRE Design Verification (1995) [Not validated, but will be]
  - ✓ BRE Confirmation for RAS (1996)
  - ✓ BRE GW Characterization (1997)
  - ✓ BRE Basewide Stream Verification (1997)
  - – Integrated Natural Resources Conservation Plan (1994)
  - – Wetland and Forest Stand Delineation Report (1995)
  - – EBS/BRAC Cleanup Plan (1997)
  - – RFA (1990)
  - – SCS documents
  - – USGS/MDGS documents
- Data that will be collected in the RI/FS effort
  - – Further information is required before nature and extent of contamination can be defined
  - – There is sufficient information to define nature and extent of contamination.

- To the extent possible, data collected will be used to satisfy HHRA purposes as will as N&E, plume delineation, and modeling
- Any data collected may be used to define nature and extent.

Identify Study Boundaries

- IR Site boundary and base boundary
  - Possible off property boundaries associated with groundwater evaluations for Sites 4, 7 and 9
- Surface soil is defined as 0-6"
- Subsurface soil is defined as > 6"
- Perched, overburden and bedrock aquifers may be evaluated separately.

Decision Rule

If the existing and/or RI/FS data have sufficiently identified and delineated all sources of contamination in each environmental media at each of the 7 IR sites, then characterization is complete. If not, further investigation may be required.

Action Items

- Tim will work with Jeff to determine viability of screen intervals of existing wells
- Tim will determine what additional proposed wells will be installed and what additional testing will be performed.

APPENDIX B

DQO STATISTICS

Procedure for Selecting the Optimal Sample Size at the NSWC - White Oak

Two common goals of the USEPA and the regulated community are to minimize expenditures by eliminating unnecessary data and to collect data of sufficient quality and quantity to support defensible decision making. As an efficient method of accomplishing both goals the USEPA has developed the Data Quality Objectives (DQO) Process.

The DQO Process is a strategic planning approach based on the Scientific Method that is used to prepare for a data collection activity. By implementing this process, we assure that representative data is utilized to support effective decision-making.

Samples were taken from seven sites on the NSWC White Oak property. The sample size needed to characterize each tested parameter relative to its action level was determined by using the sample size formula for testing mean of normal distribution versus an action level [Equation (7) from Appendix C of USEPA QA / G-4 (Guidance for the Data Quality Objectives Process); September 1994].

$$n = \frac{\left[(Z_{1-\alpha} + Z_{1-\beta})\sigma\right]^2}{\Delta^2} + (0.5)Z_{1-\alpha}^2$$

where n = sample size; Z_p = p^{th} percentile of the standard normal distribution;
α = The false positive (Type I) error rate [deciding the site is contaminated when it truly is not];
β = The false negative (Type II) error rate [deciding the site is not contaminated when it truly is];
σ^2 = variance; and Δ = (U - AL); U is a constant value greater than the action level (AL).

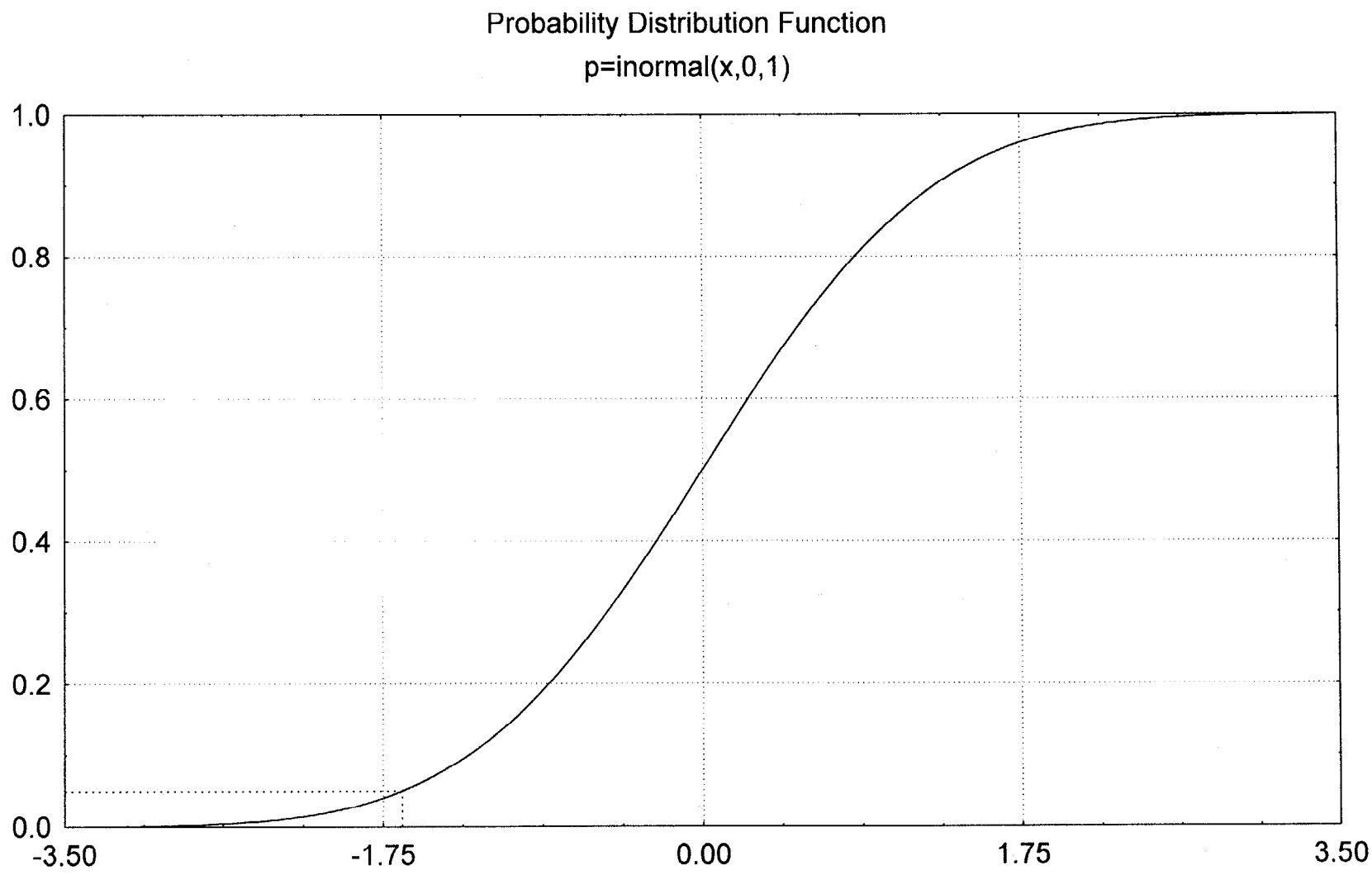
The action levels used for these calculations were the Region III Soil BTAG criteria for soil samples and the more conservative (i.e., lower) of the Region III Tap Water RBC and the USEPA Ambient Water Quality (MCL) criteria for ground water samples.

The null hypothesis (H_0) for this situation, where testing has suggested that none of the parameters of interest are above their action level, is :

H_0: $\mu \leq AL$ (The average concentration within the soil of the incinerator area is less than the action level)

The consequence of a Type I error [rejecting H_0 when it is true] is unnecessary remediation and the associated expenses. The consequence of a Type II error [accepting H_0 when it is false] is incomplete remediation which could possibly endanger human health and the environment. Values of α=0.05, β=0.05, and U= 1.50xAL were assigned to reflect the minimal probability of the occurrence of decision errors.

An optimal sample size calculation was performed at each site, for each media, for each chemical with a positive detection. The sample sizes determined through this calculation result in the optimal sample size to distinguish a mean NEAR the gray region from the action level. When the mean is much less than the action level, very small sample sizes are determined (2 or 3 samples). When the mean is much greater than the action level, very large sample sizes are determined (sometimes over 1 million samples). Because the mean is easily distinguished from the action level in these two situations, particular attention is paid to chemicals with sample means near the action level.


Probability Distribution Function
p=inormal(x,0,1)
1.0
0.8
0.6
0.4
0.2
0.0
-3.50
-1.75
0.00
1.75
3.50

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 2 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Explosives (μg/L)									
HMX	3	1800	2	0.002	1.3	10.1	2	5	0
Inorganics (μg/L)									
ALUMINUM	**7716.4**	50	1	154.3	-	**18800 (4)**	**904,937**	5	**904,932**
ARSENIC	**6.2**	0.045	2	137.8	**2.6**	**24.6**	**2,259,734**	5	**2,259,729**
BARIUM	87.6	2000	1	0.04	-	207	2	5	0
BERYLLIUM	**2.2**	0.016	2	137.5	**1.1**	**9.9**	**3,116,723**	5	**3,116,718**
CADMIUM	2.8	5	1	0.6	0.52	**12**	48	5	*43*
CHROMIUM	12.8	100	1	0.1	0.4	33	3	5	0
COBALT	33.1	2200	2	0.02	-	134	2	5	0
COPPER	33.8	1300	1	0.03	-	83.7	2	5	0
CYANIDE	8.3	200	1	0.04	5	25.5	2	5	0
IRON	**6461.2**	300	1	21.5	-	**14500**	**24,486**	5	**24,481**
LEAD	8.6	15	1	0.6	1.1	**21.5**	16	5	*11*
MANGANESE	**5613.4**	50	1	112.3	-	**21300**	**1,421,989**	5	**1,421,984**
MERCURY	0.274	2	1	0.1	-	0.52	2	5	0
NICKEL	48.7	100	1	0.5	7.3	**171**	23	5	*18*
SILVER	0.4	100	1	0.004	0.5	0.62	2	5	0
VANADIUM	6.5	260	2	0.03	0.6	19.2	2	5	0
ZINC	142.8	5000	1	0.03	-	442	2	5	0
Semivolatile Organics (μg/L)									
DI-N-BUTYL PHTHALATE	2.4	3700	2	0.001	8	2	2	5	0
Volatile Organics (μg/L)									
CIS-1,2-DICHLOROETHENE	0.8	61	2	0.01	1	2	2	5	0
TRICHLOROETHENE	**17.4**	1.6	2	10.9	1	**81**	**21,395**	5	**21,390**
Miscellaneous (μg/L)									
NITRATE	4.1	5800	2	0.001	0.5	17.4	2	5	0
SULFATE	99	500000	1	0.0002	-	175	2	5	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 2 - Non-MP Data
Groundwater Detections

CADMIUM ($\mu g/L$)			
Sample Variance =	***26.887***	***Action Level[1] =***	**5**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	9
U = 1.50 x AL	8	13	26
U = 1.25 x AL	30	48	96
U = 1.10 x AL	178	293	585

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	8	13
U = 1.50 x AL	18	25	42
U = 1.25 x AL	67	94	158
U = 1.10 x AL	413	580	972

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	8	11	17
U = 1.50 x AL	30	39	59
U = 1.25 x AL	114	149	227
U = 1.10 x AL	708	923	1403

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	11	13	20
U = 1.50 x AL	38	48	71
U = 1.25 x AL	149	188	275
U = 1.10 x AL	922	1166	1699

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	15	19	26
U = 1.50 x AL	57	70	96
U = 1.25 x AL	225	273	376
U = 1.10 x AL	1401	1698	2331

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\beta} + z_{1-\alpha})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
02GW30	1.4	J		1.4
02GW31	0.52	U		0.26
02GW32	12	J		12
02GW45	0.23	U		0.115
02GW76	0.2	U		0.1
Sample Variance	***26.887***			
Average Value =	2.775			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 th ·ction limit is used to calculate value, average value, and sample variance for non-detects (samp' 'th 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 2 - Non-MP Data
Groundwater Detections

LEAD(µg/L)			
Sample Variance =	***72.895***	***Action Level[1] =***	**15**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.60 x AL	3	5	10
U = 1.25 x AL	10	16	31
U = 1.10 x AL	55	90	179

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	6
U = 1.60 x AL	6	9	15
U = 1.25 x AL	21	30	50
U = 1.10 x AL	125	176	295

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	7
U = 1.60 x AL	10	13	20
U = 1.25 x AL	35	46	71
U = 1.10 x AL	214	279	425

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	5	8
U = 1.60 x AL	12	16	24
U = 1.25 x AL	46	58	85
U = 1.10 x AL	279	352	514

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	7	10
U = 1.60 x AL	18	22	31
U = 1.25 x AL	69	84	115
U = 1.10 x AL	423	513	705

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
02GW30	12.8			12.8
02GW31	5.4	L		5.4
02GW32	21.5			21.5
02GW45	1.1	U		0.55
02GW76	2.9	L		2.9
Sample Variance	***72.895***			
Average Value =	8.630			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 2 - Non-MP Data
Groundwater Detections

NICKEL (µg/L)			
Sample Variance =	***4932.712***	***Action Level[1] =***	**100**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	6
U = 1.60 x AL	5	7	14
U = 1.25 x AL	14	23	46
U = 1.10 x AL	82	135	270

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	8
U = 1.60 x AL	9	12	21
U = 1.25 x AL	32	44	74
U = 1.10 x AL	190	267	447

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	6	10
U = 1.60 x AL	14	19	29
U = 1.25 x AL	53	69	106
U = 1.10 x AL	325	424	645

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	7	11
U = 1.60 x AL	18	23	34
U = 1.25 x AL	69	87	128
U = 1.10 x AL	424	536	781

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	8	10	14
U = 1.60 x AL	27	33	46
U = 1.25 x AL	104	126	174
U = 1.10 x AL	643	780	1071

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
02GW30	35.1	J		35.1
02GW31	33.5			33.5
02GW32	171	J		171
02GW45	0.9	U		0.45
02GW76	7.3	U		3.65
Sample Variance	***4932.712***			
Average Value =	48.740			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 th' 'ection limit is used to calculate value, average value, and sample variance for non-detects (samp' 'ith 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 3 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Inorganics (μg/L)									
ALUMINUM	**2290.5**	50	1	**45.810**	**70.6 (4)**	**13100**	**396,312**	9	**396,303**
BARIUM	74.4	2000	1	0.04	-	145	2	9	0
CADMIUM	0.3	5	1	0.1	0.39	1.1	2	9	0
CHROMIUM	8.7	100	1	0.1	0.4	35.8	3	9	0
COBALT	10.7	2200	2	0.005	0.5	27.2	2	9	0
COPPER	7.2	1300	1	0.01	6.4	34.4	2	9	0
CYANIDE	4.1	200	1	0.02	5	6.3	2	9	0
IRON	**10767.7**	300	1	**35.9**	-	**32800**	**57,121**	9	**57,112**
LEAD	4.4	15	1	0.29	1.5	**22.4**	14	9	**5**
MANGANESE	**509.2**	50	1	**10.18**	-	**1150**	**3,326**	9	**3,317**
MERCURY	0.061	2	1	0.03	0.1	0.13	2	9	0
NICKEL	22.1	100	1	0.2	9.2	48.4	3	9	0
SELENIUM	1.2	50	1	0.02	1.6	2.3	2	9	0
SILVER	0.5	100	1	0.01	0.5	1.8	2	9	0
VANADIUM	4.8	260	2	0.02	0.6	5.6	2	9	0
ZINC	29	5000	1	0.01	4.3	5.5	2	9	0
Semivolatile Organics (μg/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	2.2	4.8	2	0.46	**6**	1	3	9	0
DI-N-BUTYL PHTHALATE	2.1	3700	2	0.00	6	2	2	9	0
Volatile Organics (μg/L)									
ACETONE	3.3	3700	2	0.001	-	6	2	2	0
CHLOROBENZENE	22.3	39	2	0.572	1	13	2	9	0
CIS-1,2-DICHLOROETHENE	3	61	2	0.049	1	18	2	9	0
TRANS-1,2-DICHLOROETHENE	0.9	100	1	0.009	1	3	2	9	0
VINYL CHLORIDE	**0.7**	0.019	2	**36.842**	**1**	**2**	**38,545**	9	**38,536**
Miscellaneous (μg/L)									
SULFATE	9.2	500000	1	0.00002	-	0.79	2	9	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 3 - Non-MP Data
Groundwater Detections

LEAD(μg/L)			
Sample Variance =	***64.155***	***Action Level[1] =***	**15**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.50 x AL	3	5	9
U = 1.25 x AL	9	14	28
U = 1.10 x AL	48	79	158

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	6
U = 1.50 x AL	6	8	13
U = 1.25 x AL	19	26	44
U = 1.10 x AL	110	155	260

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	7
U = 1.50 x AL	9	12	18
U = 1.25 x AL	31	41	63
U = 1.10 x AL	189	246	374

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	5	8
U = 1.50 x AL	11	14	21
U = 1.25 x AL	40	51	75
U = 1.10 x AL	246	310	453

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	6	9
U = 1.50 x AL	16	20	28
U = 1.25 x AL	61	74	102
U = 1.10 x AL	372	452	620

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\beta} + z_{1-\alpha})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
03GW17	1.1	U		1.1
03GW18	1.1	U		1.1
03GW19	1.5	L		1.5
03GW47	22.4			22.4
03GW77	1.1	U		0.55
03GW78D	1.1	U		0.55
03GW78S	3.35	L		3.35
Sample Variance	***64.155***			
Average Value =	4.364			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 th ction limit is used to calculate value, average value, and sample variance for non-detects (samp 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 4 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Explosives (µg/L)									
HMX	0.946	1800	2	0.001	1.3	2.1	2	12	0
RDX	**0.708**	0.61	2	**1.161**	**1.3 (4)**	**1.1**	4	12	**0**
Inorganics (µg/L)									
ALUMINUM	**1790**	50	1	**35.8**	**620**	**11500**	**151,479**	18	**151,461**
ANTIMONY	1.583	6	1	0.264	2	**6.5**	5	18	0
ARSENIC	**1.688**	0.045	2	**37.51**	**2.6**	**7.5**	**51,360**	18	**51,342**
BARIUM	79.4	2000	1	0.04	-	332	2	18	0
CADMIUM	1.02	5	1	0.204	0.87	**6.1**	6	18	0
CHROMIUM	16.04	100	1	0.160	2.3	78.7	4	18	0
COBALT	79.05	2200	2	0.036	2.8	32.6	2	18	0
COPPER	15.31	1300	1	0.012	8.1	107	2	18	0
CYANIDE	7.131	200	1	0.036	7.2	30.8	2	18	0
IRON	**7014**	300	1	**23.38**	35.7	**51300**	**75,321**	18	**75,303**
LEAD	3.753	15	1	0.25	1.1	**15.6**	6	18	0
MANGANESE	**293.1**	50	1	**5.862**	35.8	**1260**	**1,933**	18	**1,915**
MERCURY	1.904	2	1	0.952	0.43	**5.4**	33	18	15
NICKEL	19.77	100	1	0.198	6.5	85	4	18	0
SELENIUM	1.731	50	1	0.035	8.1	4.6	2	18	0
SILVER	0.462	100	1	0.005	0.5	2.9	2	18	0
VANADIUM	7.75	260	2	0.03	0.6	48	2	18	0
ZINC	91.41	5000	1	0.018	12.6	1120	2	18	0
Semivolatile Organics (µg/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	4.639	4.8	2	0.966	**6**	2	3	18	0
FLUORENE	2.556	1500	2	0.002	6	2	2	18	0
Volatile Organics (µg/L)									
1,1,1-TRICHLOROETHANE	0.833	54	2	0.015	1	6	2	5	0
1,1,2,2-TETRACHLOROETHANE	**10.56**	0.052	2	**203.077**	**1**	**59**	**5,134,169**	18	**5,134,151**
1,1,2-TRICHLOROETHANE	**0.528**	0.19	2	**2.779**	**1**	**1**	**19**	18	**1**
1,2-DICHLOROETHANE	**0.694**	0.12	2	**5.783**	**1**	**2**	**721**	18	**703**
ACETONE	3.4	3700	2	0.001	5	7	2	18	0
BENZENE	**0.917**	0.36	2	**2.547**	**1**	**8**	**1,046**	18	**1,028**
CHLOROBENZENE	0.639	39	2	0.016	1	2	2	18	0
CHLOROFORM	**0.694**	0.15	2	**4.627**	**1**	**2**	**462**	18	**444**
CIS-1,2-DICHLOROETHENE	6.222	61	2	0.102	1	**80**	6	18	0
TETRACHLOROETHENE	**1.417**	1.1	2	**1.288**	1	**5**	**99**	18	**81**
TRICHLOROETHENE	**99.97**	1.6	2	**62.481**	1	**1110**	**1,166,310**	18	**1,166,292**
VINYL CHLORIDE	**0.722**	0.019	2	**38**	**1**	**3**	**53,688**	18	**53,670**
Miscellaneous (µg/L)									
NITRATE	0.532	5800	2	0.00009	-	1.85	2	18	0
SULFATE	35.58	500000	1	0.00007	-	122	2	18	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil
Detections

Analyte	Mean	Action Level (1)	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (2)	Samples Taken	Samples Needed
Inorganics (mg/kg)								
ALUMINUM	**5544**	1	**5544**	-	**23600 (3)**	**1,223,896,333**	27	**1,223,896,306**
ANTIMONY	0.326	0.48	0.679	**1.595**	**3.61**	117	27	90
ARSENIC	1.129	328	0.003	1.575	3.85	2	27	0
BARIUM	22.71	440	0.052	4.815	175	2	27	0
BERYLLIUM	**0.185**	0.02	**9.250**	**0.57**	**0.44**	**2,819**	27	**2,792**
CADMIUM	0.259	2.5	0.104	1.18	1.36	3	27	0
CHROMIUM	**11.25**	0.0075	**1500**	**8.15**	**31.2**	**43,001,847**	27	**43,001,820**
COBALT	1.631	100	0.016	3.99	6.62	2	27	0
COPPER	**37.46**	15	**2.497**	5.6	**743**	**3,943**	27	**3,916**
CYANIDE	**0.2**	0.005	**40**	-	**2.28**	**729,832**	27	**729,805**
IRON	**7428**	12	**619**	-	**23300**	**14,018,991**	27	**14,018,964**
LEAD	**14.44**	0.01	**1444**	**0.69**	**242**	**1,006,922,765**	27	**1,006,922,738**
MAGNESIUM	467.6	4400	0.106	-	**4750**	4	27	0
MANGANESE	38.16	330	0.116	0.735	**444**	5	27	0
MERCURY	**0.35**	0.058	**6.034**	**0.1**	**6.12**	**17,480**	27	**17,453**
NICKEL	**3.167**	2	**1.584**	-	**17.4**	**230**	27	**203**
SELENIUM	0.535	1.8	0.297	-	**10.5**	56	27	**29**
SILVER	**0.377**	0.0000098	**38469.388**	-	**7.15**	**924,382,367,752**	27	**924,382,367,725**
VANADIUM	**16.53**	0.5	**33.060**	**20.75**	**48.2**	**28,987**	27	**28,960**
ZINC	**37.73**	10	**3.773**	1.955	**517**	**6,142**	27	**6,115**
Semivolatile Organics (µg/kg)								
1,4-DICHLOROBENZENE	1.5	100	0.015	-	40.5	2	27	0
ANTHRACENE	31.15	100	0.312	-	**841**	115	27	**88**
BENZO(A)ANTHRACENE	32.11	100	0.321	-	**554**	65	27	**38**
BENZO(A)PYRENE	37.37	100	0.374	-	**666**	89	27	**62**
BENZO(B)FLUORANTHENE	23.3	100	0.233	-	**382**	34	27	**7**
BENZO(G,H,I)PERYLENE	23.22	100	0.232	-	**406**	35	27	**8**
BENZO(K)FLUORANTHENE	33.93	100	0.339	-	**550**	69	27	**42**
CHRYSENE	41.96	100	0.420	-	**800**	119	27	**92**
FLUORANTHENE	78.7	100	0.787	-	**1610**	450	27	**423**
FLUORENE	48.15	100	0.482	-	**1300**	273	27	**246**
INDENO(1,2,3-CD)PYRENE	5.074	100	0.051	-	**137**	5	27	0
NAPHTHALENE	**133.2**	100	**1.332**	-	**3200**	**1,642**	27	**1,615**
PENTACHLOROPHENOL	8	100	0.08	-	**216**	9	27	0
PHENANTHRENE	**263.7**	100	**2.637**	-	**6000**	**5,892**	27	**5,865**
PYRENE	71.85	100	0.719	-	**1430**	**362**	27	**336**
Volatile Organics (µg/kg)								
1,2-DICHLOROETHANE	5.542	300	0.018	-	133	2	27	0
BENZENE	2.168	100	0.022	-	31.4	2	27	0
CHLOROBENZENE	4.046	100	0.04	-	45.8	3	27	0
CHLOROFORM	2.358	300	0.008	-	30.7	2	27	0
ETHYLBENZENE	4.801	100	0.048	-	93.1	3	27	0
TETRACHLOROETHENE	5.633	300	0.019	-	129	2	27	0
TRICHLOROETHENE	**383.8**	300	**1.279**	-	**4400**	**601**	27	**574**
XYLENES, TOTAL	41.9	100	0.419	-	**799**	118	27	**91**

1 = Region III BTAG
2 = α=5%, β=5%, Δ=0.5xAction Level
3 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

SELENIUM (mg/kg)			
Sample Variance =	*4.067*	*Action Level[1] =*	1.8

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	10
U = 1.50 x AL	10	15	30
U = 1.25 x AL	34	56	112
U = 1.10 x AL	207	341	682

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	9	15
U = 1.50 x AL	21	29	48
U = 1.25 x AL	78	110	184
U = 1.10 x AL	482	677	1133

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	10	13	20
U = 1.50 x AL	34	45	69
U = 1.25 x AL	133	174	265
U = 1.10 x AL	826	1077	1637

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	12	15	23
U = 1.50 x AL	44	56	82
U = 1.25 x AL	173	219	320
U = 1.10 x AL	1076	1360	1983

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	18	22	30
U = 1.50 x AL	67	81	112
U = 1.25 x AL	263	319	438
U = 1.10 x AL	1635	1981	2720

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	10.5			10.5
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	1.14			1.14
04-SB08-0809-D	1.07			1.07
04-SB09-0809	0.488			0.488
04-SB10-0708	0.451			0.451
04-SB11-0809	0	ND		0
04-SB12-1012	0	ND		0
04-SB13-0506	0	ND		0
04-SB14-0506	0.342			0.342
04-SB15-0812	0.443			0.443
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*4.067*			
Average Value =	0.535			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

ANTHRACENE (mg/kg)			
Sample Variance =	*26195.593*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	9	17
U = 1.50 x AL	19	30	60
U = 1.25 x AL	70	115	230
U = 1.10 x AL	432	711	1421

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	11	16	27
U = 1.50 x AL	41	58	98
U = 1.25 x AL	162	227	381
U = 1.10 x AL	1004	1411	2362

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	19	24	37
U = 1.50 x AL	70	92	140
U = 1.25 x AL	277	361	549
U = 1.10 x AL	1722	2245	3413

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	24	30	45
U = 1.50 x AL	91	115	168
U = 1.25 x AL	360	455	664
U = 1.10 x AL	2245	2837	4134

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	35	43	60
U = 1.50 x AL	138	167	230
U = 1.25 x AL	547	663	911
U = 1.10 x AL	3411	4133	5674

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\alpha} + z_{1-\beta}]^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	841			841
04-SB12-1012	0	ND		0
04-SB13-0506	0	ND		0
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*26195.593*			
Average Value =	31.148			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

BENZO(A)ANTHRACENE (mg/kg)			
Sample Variance =	*14501.718*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	11
U = 1.50 x AL	11	18	35
U = 1.25 x AL	39	65	129
U = 1.10 x AL	239	394	788

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	7	10	16
U = 1.50 x AL	24	33	55
U = 1.25 x AL	90	127	212
U = 1.10 x AL	556	782	1309

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	11	14	22
U = 1.50 x AL	39	52	79
U = 1.25 x AL	154	201	305
U = 1.10 x AL	954	1244	1891

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	14	18	26
U = 1.50 x AL	51	66	95
U = 1.25 x AL	200	253	369
U = 1.10 x AL	1243	1571	2290

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	20	25	35
U = 1.50 x AL	77	93	129
U = 1.25 x AL	303	368	505
U = 1.10 x AL	1889	2289	3142

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	554			554
04-SB12-1012	0	ND		0
04-SB13-0506	313			313
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*14501.718*			
Average Value =	32.111			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.
[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

BENZO(A)PYRENE (mg/kg)			
Sample Variance =	*20134.550*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	7	14
U = 1.50 x AL	15	24	47
U = 1.25 x AL	54	89	178
U = 1.10 x AL	332	547	1093

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	9	13	21
U = 1.50 x AL	32	45	76
U = 1.25 x AL	125	175	293
U = 1.10 x AL	772	1085	1816

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	15	19	29
U = 1.50 x AL	54	71	108
U = 1.25 x AL	213	278	423
U = 1.10 x AL	1324	1726	2624

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	19	24	35
U = 1.50 x AL	70	89	130
U = 1.25 x AL	277	350	511
U = 1.10 x AL	1726	2181	3179

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	28	34	47
U = 1.50 x AL	106	129	178
U = 1.25 x AL	421	510	701
U = 1.10 x AL	2622	3177	4362

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\alpha} + z_{1-\beta}]^2 + (0.6)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	666			666
04-SB12-1012	0	ND		0
04-SB13-0506	343			343
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*20134.550*			
Average Value =	37.370			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.
[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

BENZO(B)FLUORANTHENE (mg/kg)			
Sample Variance =	*7395.370*	*Action Level[1] =*	100

$1-\beta = 0.50$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	3	4	7
U = 1.50 x AL	6	10	19
U = 1.25 x AL	21	34	67
U = 1.10 x AL	123	202	403

$1-\beta = 0.75$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	4	6	10
U = 1.50 x AL	13	18	30
U = 1.25 x AL	47	66	110
U = 1.10 x AL	284	400	669

$1-\beta = 0.90$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	6	8	13
U = 1.50 x AL	21	27	42
U = 1.25 x AL	79	103	157
U = 1.10 x AL	487	635	966

$1-\beta = 0.95$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	8	10	15
U = 1.50 x AL	27	34	50
U = 1.25 x AL	103	130	190
U = 1.10 x AL	635	802	1169

$1-\beta = 0.99$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	11	14	19
U = 1.50 x AL	40	49	67
U = 1.25 x AL	155	188	259
U = 1.10 x AL	964	1168	1604

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	382	J		382
04-SB12-1012	0	ND		0
04-SB13-0506	247			247
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*7395.370*			
Average Value =	23.296			

Null Hypothesis (H_0): the true mean is less than the action level.

Action Level (AL): value that determines acceptance or rejection of H_0

α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.

β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.

Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

BENZO(GHI)PERYLENE (mg/kg)			
Sample Variance =	*7658.333*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	7
U = 1.50 x AL	6	10	20
U = 1.25 x AL	21	35	70
U = 1.10 x AL	127	209	418

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	10
U = 1.50 x AL	13	18	31
U = 1.25 x AL	48	68	114
U = 1.10 x AL	294	414	693

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	8	13
U = 1.50 x AL	21	28	43
U = 1.25 x AL	82	107	163
U = 1.10 x AL	504	658	1000

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	8	10	15
U = 1.50 x AL	28	35	52
U = 1.25 x AL	106	134	196
U = 1.10 x AL	657	831	1211

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	11	14	20
U = 1.50 x AL	41	50	70
U = 1.25 x AL	161	195	268
U = 1.10 x AL	998	1210	1661

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	406			406
04-SB12-1012	0	ND		0
04-SB13-0506	221			221
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*7658.333*			
Average Value =	23.222			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level

[1] = Action Level based on Region III Soil BTAG.
[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

BENZO(K)FLUORANTHENE (mg/kg)			
Sample Variance =	***15591.533***	***Action Level[1] =***	**100**

$1-\beta = 0.50$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	4	6	12
U = 1.50 x AL	12	19	37
U = 1.25 x AL	42	69	138
U = 1.10 x AL	257	424	847

$1-\beta = 0.75$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	7	10	17
U = 1.50 x AL	25	35	59
U = 1.25 x AL	97	136	228
U = 1.10 x AL	598	841	1407

$1-\beta = 0.90$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	12	15	24
U = 1.50 x AL	42	55	84
U = 1.25 x AL	165	215	328
U = 1.10 x AL	1026	1337	2033

$1-\beta = 0.95$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	15	19	28
U = 1.50 x AL	55	69	102
U = 1.25 x AL	215	272	397
U = 1.10 x AL	1337	1689	2462

$1-\beta = 0.99$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	22	26	37
U = 1.50 x AL	83	100	138
U = 1.25 x AL	326	395	543
U = 1.10 x AL	2031	2461	3378

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	550			550
04-SB12-1012	0	ND		0
04-SB13-0506	366			366
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	***15591.533***			
Average Value =	33.926			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

CHRYSENE (mg/kg)			
Sample Variance =	*27051.729*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	9	18
U = 1.50 x AL	19	31	62
U = 1.25 x AL	72	119	237
U = 1.10 x AL	446	734	1467

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	12	16	28
U = 1.50 x AL	43	60	101
U = 1.25 x AL	167	235	393
U = 1.10 x AL	1036	1457	2439

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	19	25	38
U = 1.50 x AL	72	95	144
U = 1.25 x AL	286	373	567
U = 1.10 x AL	1778	2319	3524

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	24	31	46
U = 1.50 x AL	94	*119*	174
U = 1.25 x AL	372	470	686
U = 1.10 x AL	2318	2929	4269

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	37	45	62
U = 1.50 x AL	142	172	237
U = 1.25 x AL	565	684	940
U = 1.10 x AL	3523	4268	5859

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5) z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	800			800
04-SB12-1012	0	ND		0
04-SB13-0506	333			333
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*27051.729*			
Average Value =	41.963			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

FLUORANTHENE (mg/kg)			
Sample Variance =	***103464.601***	***Action Level[1] =***	**100**

$1-\beta = 0.50$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	18	30	59
U = 1.50 x AL	69	114	227
U = 1.25 x AL	273	450	899
U = 1.10 x AL	1701	2801	5603

$1-\beta = 0.75$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	41	58	96
U = 1.50 x AL	160	224	376
U = 1.25 x AL	635	892	1494
U = 1.10 x AL	3960	5568	9320

$1-\beta = 0.90$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	69	90	138
U = 1.50 x AL	273	356	542
U = 1.25 x AL	1089	1420	2158
U = 1.10 x AL	6798	8862	13471

$1-\beta = 0.95$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	90	114	166
U = 1.50 x AL	356	***450***	656
U = 1.25 x AL	1419	1793	2614
U = 1.10 x AL	8862	11199	16320

$1-\beta = 0.99$	$1-\alpha = 0.90$	$1-\alpha = 0.95$	$1-\alpha = 0.99$
U = 2.00 x AL	136	165	227
U = 1.50 x AL	540	655	899
U = 1.25 x AL	2156	2613	3587
U = 1.10 x AL	13469	16319	22401

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	1610			1610
04-SB12-1012	0	ND		0
04-SB13-0506	515			515
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	***103464.601***			
Average Value =	78.704			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

FLUORENE (mg/kg)			
Sample Variance =	*62592.593*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	12	19	37
U = 1.50 x AL	42	70	139
U = 1.25 x AL	166	273	545
U = 1.10 x AL	1029	1695	3391

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	25	36	60
U = 1.50 x AL	97	137	229
U = 1.25 x AL	384	541	905
U = 1.10 x AL	2396	3369	5640

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	42	55	85
U = 1.50 x AL	166	216	329
U = 1.25 x AL	659	860	1307
U = 1.10 x AL	4113	5362	8151

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	55	70	102
U = 1.50 x AL	216	273	398
U = 1.25 x AL	859	1086	1583
U = 1.10 x AL	5362	6776	9874

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	83	101	139
U = 1.50 x AL	327	397	545
U = 1.25 x AL	1305	1581	2171
U = 1.10 x AL	8149	9873	13553

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\alpha} + z_{1-\beta}]^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	1300			1300
04-SB12-1012	0	ND		0
04-SB13-0506	0	ND		0
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*62592.593*			
Average Value =	48.148			

Null Hypothesis (H_0): the true mean is less than the action level.

Action Level (AL): value that determines acceptance or rejection of H_0

α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.

β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.

Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

PYRENE (mg/kg)			
Sample Variance =	*83292.593*	*Action Level[1] =*	100

1-β = 0.80	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	15	24	48
U = 1.50 x AL	56	92	184
U = 1.25 x AL	220	362	724
U = 1.10 x AL	1369	2255	4511

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	33	47	78
U = 1.50 x AL	129	181	303
U = 1.25 x AL	511	719	1203
U = 1.10 x AL	3188	4482	7504

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	56	73	112
U = 1.50 x AL	220	287	437
U = 1.25 x AL	877	1143	1738
U = 1.10 x AL	5473	7135	10845

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	73	92	135
U = 1.50 x AL	287	362	529
U = 1.25 x AL	1143	1444	2105
U = 1.10 x AL	7134	9016	13139

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	110	133	184
U = 1.50 x AL	435	527	724
U = 1.25 x AL	1736	2104	2888
U = 1.10 x AL	10843	13137	18034

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\alpha} + z_{1-\beta}]^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	0	ND		0
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	0	ND		0
04-SB10-0708	0	ND		0
04-SB11-0809	1430			1430
04-SB12-1012	0	ND		0
04-SB13-0506	510			510
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	0	ND		0
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	0	ND		0
04-SB20-0607D	0	ND		0
04SB-21	0	ND		0
04SB-22	0	ND		0
04SB-22-D	0	ND		0
04SB-23	0	ND		0
04SB-24	0	ND		0
Sample Variance	*83292.593*			
Average Value =	71.852			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

(1) = Action Level based on Region III Soil BTAG.

(2) = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 4 - Non-MP Data
Subsurface Soil Detections

XYLENES (TOTAL) (mg/kg)			
Sample Variance =	*26748.463*	*Action Level[1] =*	100

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	9	18
U = 1.50 x AL	19	31	61
U = 1.25 x AL	72	118	235
U = 1.10 x AL	441	726	1451

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	12	16	27
U = 1.50 x AL	42	59	100
U = 1.25 x AL	165	232	389
U = 1.10 x AL	1025	1441	2412

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	19	25	38
U = 1.50 x AL	72	93	142
U = 1.25 x AL	282	368	560
U = 1.10 x AL	1759	2293	3485

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	24	31	45
U = 1.50 x AL	93	*118*	172
U = 1.25 x AL	368	465	678
U = 1.10 x AL	2292	2897	4222

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	36	44	61
U = 1.50 x AL	141	171	235
U = 1.25 x AL	558	677	930
U = 1.10 x AL	3483	4220	5794

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
04-SB01-1216	0	ND		0
04-SB02-1216	0	ND		0
04-SB03-1214	0	ND		0
04-SB04-1214	3.17	J		3.17
04-SB05-0406	0	ND		0
04-SB06-0408	0	ND		0
04-SB07-1822	0	ND		0
04-SB08-0809	0	ND		0
04-SB08-0809-D	0	ND		0
04-SB09-0809	4.87	J		4.87
04-SB10-0708	4.25	J		4.25
04-SB11-0809	0	ND		0
04-SB12-1012	0	ND		0
04-SB13-0506	0	ND		0
04-SB14-0506	0	ND		0
04-SB15-0812	0	ND		0
04-SB16-1012	0	ND		0
04-SB17-1214	799			799
04-SB18-1012	0	ND		0
04-SB19-1012	0	ND		0
04-SB20-0607	93.2			93.2
04-SB20-0607D	101			101
04SB-26	0	ND		0
04SB-26-D	0	ND		0
Sample Variance	*26748.463*			
Average Value =	41.895			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Explosives (μg/L)									
2,4,6-TRINITROTOLUENE	**11.98**	2.2	2	**5.445**	0.6	**47 (4)**	**4,878**	4	**4,874**
2-AMINO-4,6-DINITROTOLUENE	**11.23**	2	2	**5.615**	0.6	**44**	**5,169**	4	**5,165**
HMX	15.74	1800	2	0.009	1.3	61	2	4	0
RDX	**42.99**	0.61	2	**70.475**	**1.3**	**170**	**834,115**	4	**834,111**
Inorganics (μg/L)									
ALUMINUM	**8487**	50	1	**169.740**	**184**	**32600**	**4,475,847**	4	**4,475,843**
ARSENIC	**6.325**	0.045	2	**140.556**	**2.6**	**21.4**	**2,159,144**	4	**2,159,140**
BARIUM	75.3	2000	1	0.038	-	150	2	4	0
CHROMIUM	40.41	100	1	0.404	3.6	**153**	26	4	**22**
COBALT	3.763	2200	2	0.002	3.3	6.1	2	4	0
COPPER	23.86	1300	1	0.018	6.1	87.8	2	4	0
CYANIDE	21.05	200	1	0.105	5	50.7	2	4	0
IRON	**13210**	300	1	**44.033**	-	**49300**	**278,454**	4	**278,450**
LEAD	8.775	15	1	0.585	-	**21.9**	18	4	**14**
MANGANESE	**94.33**	50	1	**1.887**	-	**147**	**26**	4	**22**
MERCURY	1.34	2	1	0.670	0.32	**2.8**	15	4	**11**
NICKEL	14.38	100	1	0.144	7.9	49.1	4	4	0
SELENIUM	19.1	50	1	0.382	2.4	**70.7**	22	4	**18**
SILVER	0.513	100	1	0.005	0.5	1.3	2	4	0
VANADIUM	60.8	260	2	0.234	-	237	11	4	7
ZINC	9.2	5000	1	0.002	6.2	21.1	2	4	0
Volatile Organics (μg/L)									
1,1,1-TRICHLOROETHANE	0.625	54	2	0.012	1	1	2	4	0
1,1,2,2-TETRACHLOROETHANE	**16.38**	0.52	2	**31.500**	**1**	**61**	**14,187,752**	4	**14,187,748**
1,1,2-TRICHLOROETHANE	**0.875**	0.19	2	**4.605**	**1**	**2**	**676**	4	**672**
1,1-DICHLOROETHENE	**0.875**	0.044	2	**19.886**	**1**	**2**	**12,579**	4	**12,575**
1,2-DICHLOROETHANE	**0.625**	0.12	2	**5.208**	**1**	**1**	**190**	4	**186**
CIS-1,2-DICHLOROETHENE	20.25	61	2	0.332	1	**74**	17	4	**13**
TRICHLOROETHENE	**119.6**	1.6	2	**74.750**	1	**400**	**610,167**	4	**610,163**
VINYL CHLORIDE	**1.125**	0.019	2	**59.211**	**1**	**3**	**187,366**	4	**187,362**
Miscellaneous (μg/L)									
NITRATE	1.343	5800	2	0.0002	-	3	2	4	0
SULFATE	25.8	500000	1	0.00005	-	50.8	2	4	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

CHROMIUM (µg/L)			
Sample Variance =	***5638.761***	***Action Level[1] =***	**100**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	6
U = 1.50 x AL	5	8	15
U = 1.25 x AL	16	26	52
U = 1.10 x AL	94	154	308

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	8
U = 1.50 x AL	10	14	24
U = 1.25 x AL	36	50	84
U = 1.10 x AL	217	305	511

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	7	11
U = 1.50 x AL	16	21	33
U = 1.25 x AL	61	79	121
U = 1.10 x AL	372	485	737

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	8	12
U = 1.50 x AL	21	26	39
U = 1.25 x AL	79	99	145
U = 1.10 x AL	484	612	892

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	9	11	15
U = 1.50 x AL	31	37	52
U = 1.25 x AL	119	144	199
U = 1.10 x AL	735	891	1224

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
WO-7GW08	153	J		153
WO-7GW41	3.6	U		1.8
WO-7GW43	1.7	U		0.85
WO-7PZ42	6	J		6
Sample Variance	***5638.761***			
Average Value =	40.413			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

(1) = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

(2) = 1/2 th ection limit is used to calculate value, average value, and sample variance for non-detects (samp th 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

LEAD(µg/L)			
Sample Variance =	*81.983*	*Action Level[1] =*	15

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.50 x AL	4	6	11
U = 1.25 x AL	11	18	35
U = 1.10 x AL	61	100	200

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	6
U = 1.50 x AL	7	10	16
U = 1.25 x AL	24	33	56
U = 1.10 x AL	141	198	331

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	5	8
U = 1.50 x AL	11	14	22
U = 1.25 x AL	40	52	79
U = 1.10 x AL	241	314	477

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	9
U = 1.50 x AL	14	*18*	26
U = 1.25 x AL	51	65	95
U = 1.10 x AL	313	396	578

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	8	11
U = 1.50 x AL	20	25	35
U = 1.25 x AL	77	94	129
U = 1.10 x AL	476	576	792

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
WO-7GW08	21.9	J		21.9
WO-7GW41	4.5	J		4.5
WO-7GW43	7.2	J		7.2
WO-7PZ42	1.5	J		1.5
Sample Variance	***81.983***			
Average Value =	8.775			

Null Hypothesis (H_0): the true mean is less than the action level.

Action Level (AL): value that determines acceptance or rejection of H_0

α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.

β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.

Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

MERCURY (µg/L)			
Sample Variance =	***1.188***	***Action Level[1] =***	**2**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.50 x AL	3	5	10
U = 1.25 x AL	9	15	29
U = 1.10 x AL	50	82	164

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	6
U = 1.50 x AL	6	8	14
U = 1.25 x AL	19	27	46
U = 1.10 x AL	115	162	271

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	7
U = 1.50 x AL	9	12	19
U = 1.25 x AL	33	43	65
U = 1.10 x AL	196	256	390

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	5	8
U = 1.50 x AL	11	15	22
U = 1.25 x AL	42	53	78
U = 1.10 x AL	256	323	471

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	7	10
U = 1.50 x AL	17	21	29
U = 1.25 x AL	63	77	106
U = 1.10 x AL	388	470	646

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\beta} + z_{1-\alpha})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
WO-7GW08	1.2			1.2
WO-7GW41	0.32	U		0.16
WO-7GW43	1.2			1.2
WO-7PZ42	2.8			2.8
Sample Variance	***1.188***			
Average Value =	1.340			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 th ction limit is used to calculate value, average value, and sample variance for non-detects (samp h 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

SELENIUM (µg/L)			
Sample Variance =	*1185.007*	*Action Level[1] =*	50

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	6
U = 1.50 x AL	4	7	13
U = 1.25 x AL	14	22	44
U = 1.10 x AL	79	130	260

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	7
U = 1.50 x AL	9	12	20
U = 1.25 x AL	30	43	72
U = 1.10 x AL	183	257	430

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	9
U = 1.50 x AL	14	18	28
U = 1.25 x AL	51	67	102
U = 1.10 x AL	313	408	620

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	7	11
U = 1.50 x AL	18	22	33
U = 1.25 x AL	66	84	123
U = 1.10 x AL	407	515	751

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	7	9	13
U = 1.50 x AL	26	32	44
U = 1.25 x AL	100	121	167
U = 1.10 x AL	618	749	1029

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
WO-7GW08	70.7			70.7
WO-7GW41	1.6	U		0.8
WO-7GW43	2.4	U		1.2
WO-7PZ42	3.7			3.7
Sample Variance	***1185.007***			
Average Value =	19.100			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on UPEPA Ambient Water Quality Criteria (MCL).

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 7 - Non-MP Data
Groundwater Detections

CIS-1,2-DICHLOROETHENE (µg/L)			
Sample Variance =	***1290.750***	***Action Level[1] =***	**61**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.50 x AL	4	6	11
U = 1.25 x AL	10	17	33
U = 1.10 x AL	58	96	191

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	6
U = 1.50 x AL	7	9	16
U = 1.25 x AL	23	32	53
U = 1.10 x AL	134	188	316

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	5	8
U = 1.50 x AL	10	14	21
U = 1.25 x AL	38	49	75
U = 1.10 x AL	229	299	455

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	9
U = 1.50 x AL	13	17	25
U = 1.25 x AL	49	62	91
U = 1.10 x AL	298	377	550

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	7	11
U = 1.50 x AL	19	24	33
U = 1.25 x AL	74	89	123
U = 1.10 x AL	453	549	754

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\beta} + z_{1-\alpha}]^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
WO-7GW08	1	U		0.5
WO-7GW41	74	J		74
WO-7GW43	6			6
WO-7PZ42	1	U		0.5
Sample Variance	***1290.750***			
Average Value =	20.250			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region II Tap Water RBC.

[2] = 1/2 th ction limit is used to calculate value, average value, and sample variance for non-detects (sampl h 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 8 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Inorganics (μg/L)									
ALUMINUM	**5989**	50	1	**119.780**	-	**27900**	**1,225,005**	16	**1,224,989**
ANTIMONY	**9.425**	6	1	**1.571**	**24**	**25.8**	**57**	16	**41**
ARSENIC	**1.275**	0.045	2	**28.333**	**2.6**	**31**	**6,800**	16	**6,784**
BARIUM	74.83	2000	1	0.037	-	219	2	16	0
BERYLLIUM	**1.046**	0.016	2	**65.375**	**1**	**3**	**169,793**	16	**169,777**
CADMIUM	1	5	1	0.2	2	3.6	3	16	0
CHROMIUM	34.56	100	1	0.346	4	**290**	26	16	10
COBALT	10.77	2200	2	0.005	5	30.9	2	16	0
COPPER	17.81	1300	1	0.014	7.4	81.2	2	16	0
IRON	**10178**	300	1	**33.927**	8	**53400**	**117,794**	16	**117,778**
LEAD	5.875	15	1	0.392	1	**16.5**	7	16	0
MANGANESE	**451.8**	50	1	**9.036**	-	**1340**	**3,163**	16	**3,147**
MERCURY	0.144	2	1	0.072	0.2	1	2	16	0
NICKEL	35.33	100	1	0.353	27	**226**	15	16	0
SELENIUM	1.475	50	1	0.03	3	3.9	2	16	0
SILVER	1.334	100	1	0.013	3	3.4	2	16	0
VANADIUM	12.25	260	2	0.047	4	55.1	2	16	0
ZINC	82.91	5000	1	0.017	-	390	2	16	0
Semivolatile Organics (μg/L)									
1,3-DICHLOROBENZENE	2.5	540	2	0.005	11	2	2	11	0
BIS(2-ETHYLHEXYL)PHTHALATE	2.818	4.8	2	0.587	**6**	**6**	6	11	0
DI-N-BUTYL PHTHALATE	3.327	3700	2	0.001	11	0.6	2	11	0
Volatile Organics (μg/L)									
1,1,2-TRICHLOROETHANE	**10.55**	0.19	2	**55.526**	**10**	**43**	**293,517**	11	**293,506**
ACETONE	5.313	3700	2	0.001	10	8	2	11	0
CHLOROFORM	**5.773**	0.15	2	**38.487**	**10**	**13**	**32,455**	11	**32,444**
METHYLENE CHLORIDE	3	4.1	2	0.732	**10**	3	12	11	**1**
Miscellaneous (μg/L)									
NITRATE	0.386	5800	2	0.00007	-	0.49	2	5	0
SULFATE	2.15	500000	1	0.000004	-	8.98	2	5	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 8 - Non-MP Data
Groundwater Detections

METHYLENE CHLORIDE (µg/L)			
Sample Variance =	*4.000*	*Action Level[1] =*	4.1

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	2	4
U = 1.50 x AL	3	4	8
U = 1.25 x AL	8	12	24
U = 1.10 x AL	40	66	132

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	2	3	5
U = 1.50 x AL	5	7	12
U = 1.25 x AL	16	22	37
U = 1.10 x AL	92	130	217

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	6
U = 1.50 x AL	8	10	16
U = 1.25 x AL	26	34	53
U = 1.10 x AL	158	206	313

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	4	7
U = 1.50 x AL	9	12	18
U = 1.25 x AL	34	43	63
U = 1.10 x AL	205	259	378

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	4	6	8
U = 1.50 x AL	14	17	24
U = 1.25 x AL	51	62	86
U = 1.10 x AL	311	377	518

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 [z_{1-\beta} + z_{1-\alpha}]^2}{\Delta^2} + (0.5)\, z_{1-\alpha}^2$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
8GW33	10	U		5
8GW34	3	B		3
8GW35	10	U		5
8GW36	10	U		5
8GW36-D (8GW54	10	U		5
8GW53	10	U		5
WO-8GW33	2	U		1
WO-8GW34	2	U		1
WO-8GW35	2	U		1
WO-8GW36	2	U		1
WO-8GW53	2	U		1
Sample Variance	***4.000***			
Average Value =	3.000			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Tap Water RBC.

[2] = 1/2 th ction limit is used to calculate value, average value, and sample variance for non-detects (samp th 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 9 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)
Explosives (μg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.328	2	2	0.164	0.6	0.75	2
HMX	1.6	1800	2	0.0009	1.3	9.3	2
RDX	**8.1**	0.61	2	**13.279**	**1.3 (4)**	**101**	**71,818**
Inorganics (μg/L)							
ALUMINUM	**4007.9**	50	1	**80.158**	**148**	**37700**	**1,569,981**
ANTIMONY	1.1	6	1	0.183	2	2.8	2
ARSENIC	**3.3**	0.045	2	**73.333**	**2.6**	**22.8**	**734,591**
BARIUM	57.8	2000	1	0.029	-	73.7	2
CADMIUM	0.4	5	1	0.08	0.97	1.4	2
CHROMIUM	18.3	100	1	0.183	2	**139**	7
COBALT	6.8	2200	2	0.003	2.65	21.1	2
COPPER	21.3	1300	1	0.016	7.2	108	2
CYANIDE	3.4	200	1	0.017	5	7.6	2
IRON	**11024.5**	300	1	**36.748**	-	**84400**	**216,321**
LEAD	9	15	1	0.6	1.2	**49.9**	34
MANGANESE	**264.7**	50	1	**5.294**	-	**1980**	**4,251**
MERCURY	0.5	2	1	0.25	0.1	**4**	12
NICKEL	12.6	100	1	0.126	9.2	63.5	3
SELENIUM	5.6	50	1	0.112	3.4	47.9	5
SILVER	0.3	100	1	0.003	0.5	0.63	2
VANADIUM	24.6	260	2	0.095	1.4	213	4
ZINC	40.6	5000	1		4	201	2
Semivolatile Organics (μg/L)							
DIETHYL PHTHALATE	2.5	29000	2	0.00009	6	2	2
Volatile Organics (μg/L)							
ACETONE	3	3700	2	0.0008	5	**4**	2
BROMODICHLOROMETHANE	**1.9**	0.17	2	**11.176**	**1**	**10**	**11,760**
CARBON TETRACHLORIDE	**0.5**	0.16	2	**3.125**	**1**	**1**	**28**
CHLOROFORM	**8.1**	0.16	2	**50.625**	**1**	**43**	**279,715**
CIS-1,2-DICHLOROETHENE	0.9	61	2	0.015	1	5	2
DIBROMOHLOROMETHANE	**0.7**	0.13	2	**5.385**	**1**	**3**	**1,016**
TETRACHLOROETHENE	0.8	1.1	2	0.727	1	**6**	69
TRICHLOROETHENE	**5.7**	1.6	2	**3.563**	1	**39**	**2,124**
Pesticides/PCBs (μg/L)							
ALPHA-CHLORDANE	0.05	0.1	2	0.5	0.058	**0.35**	**35**
DIELDRIN	**0.05**	0.0042	2	**11.905**	**0.14**	**0.05**	**486**
GAMMA-CHLORDANE	0.04	0.1	2	0.4	0.058	**0.32**	30
HEPTACHLOR EPOXIDE	**0.03**	0.0012	2	**25.000**	**0.058**	**0.039**	**468**
Miscellaneous (μg/L)							
NITRATE	0.9	5800	2	0.0002	0.05	1.885	2
SULFATE	5.2	500000	1	0.00001	-	15.7	2

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 9 - Non-MP Data
Subsurface Soil
Detections

Analyte	Mean	Action Level		Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (2)	Samples Taken	Samples Needed
Inorganics (mg/kg)									
ALUMINUM	**7273**	1		**7273**	-	**17800**	**908,894,212**	37	**908,894,175**
ANTIMONY	0.43	0.48		0.896	**1.43**	**1.89**	46	37	**9**
ARSENIC	2.5	328		0.008	4.23	8.04	2	37	0
BARIUM	22.9	440		0.052	5.58	102	2	37	0
BERYLLIUM	**0.3**	0.02		**15**	**0.528**	**1.94**	**18,956**	37	**18,919**
CADMIUM	0.25	2.5		0.1	1.48	**2.79**	4	37	0
CHROMIUM	**14.3**	0.0075		**1906.7**	-	**34.2**	**40,911,827**	37	**40,911,790**
COBALT	2.1	100		0.021	3.49	18.9	2	37	0
COPPER	14.6	15		0.973	**30**	**95.3**	58	37	**21**
IRON	**27686**	12		**2307.167**	-	**95400**	**224,857,544**	37	**224,857,507**
LEAD	**21**	0.01		**2100**	**1.38**	**277**	**1,073,571,994**	37	**1,073,571,957**
MAGNESIUM	548	4400		0.125	-	**5570**	5	37	0
MANGANESE	88	330		0.267	5.15	**1120**	22	37	0
MERCURY	**2.57**	0.058		**44.31**	**0.318**	**66**	**1,529,583**	37	**1,529,546**
NICKEL	**4.2**	2		**2.1**	-	**18**	**239**	37	**202**
SELENIUM	0.65	1.8		0.361	0.394	**4.55**	11	37	0
SILVER	**0.357**	0.0000098		**36428.571**	**0.327**	**42.3**	**154,219,067,859**	37	**154,219,067,822**
THALLIUM	**0.14**	0.001		**140**	**0.909**	**0.502**	**1,463,751**	37	**1,463,714**
VANADIUM	**25.1**	0.5		**50.2**	-	**56.7**	**24,093**	37	**24,056**
ZINC	**25.4**	10		**2.54**	9.13	**184**	**882**	37	**845**
Semivolatile Organics (μg/kg)									
ACENAPHTHENE	**194**	100		**1.94**	**2000**	**4900**	**2,222**	49	**2,173**
ANTHRACENE	**294**	100		**2.94**	**2000**	**9900**	**8,677**	49	**8,628**
BENZO(A)ANTHRACENE	**402**	100		**4.02**	**2000**	**15000**	**19,804**	49	**19,755**
BENZO(A)PYRENE	**247**	100		**2.47**	**534**	**10700**	**10,078**	49	**10,029**
BENZO(B)FLUORANTHENE	**280**	100		**2.8**	**2000**	**9100**	**7,345**	49	**7,296**
BENZO(G,H,I)PERYLENE	**224**	100		**2.24**	**2000**	**6400**	**3,695**	49	**3,646**
BENZO(K)FLUORANTHENE	**305**	100		**3.05**	**2000**	**11000**	**10,646**	49	**10,597**
CHRYSENE	**362**	100		**3.62**	**2000**	**13000**	**14,891**	49	**14,842**
FLUORANTHENE	**783**	100		**7.83**	**2000**	**34000**	**101,709**	49	**101,660**
FLUORENE	**192**	100		**1.92**	**2000**	**4800**	**2,138**	49	**2,089**
INDENO(1,2,3-CD)PYRENE	**218**	100		**2.18**	**2000**	**6100**	**3,368**	49	**3,319**
NAPHTHALENE	**174**	100		**1.74**	**2000**	**3900**	**1,462**	49	**1,413**
PHENANTHRENE	**773**	100		**7.73**	**2000**	**33000**	**95,800**	49	**95,751**
PYRENE	**682**	100		**6.82**	**2000**	**29000**	**73,960**	49	**73,911**
Volatile Organics (μg/kg)									
4-METHYL-2-PENTANONE	7.66	100000		0.0001	12.1	5.84	2	37	0
CHLOROFORM	1.39	300		0.005	6.5	3.2	2	37	0
METHYLENE CHLORIDE	6	300		0.020	22.4	62	2	37	0
TRICHLOROETHENE	1.8	300		0.006	6.5	14.4	2	37	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 9 - Non-MP Data
Subsurface Soil Detections

ANTIMONY (mg/kg)			
Sample Variance =	***0.235***	***Action Level[1] =***	**0.48**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	9
U = 1.50 x AL	8	13	25
U = 1.25 x AL	28	46	92
U = 1.10 x AL	169	278	556

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	5	7	12
U = 1.50 x AL	17	24	40
U = 1.25 x AL	64	90	150
U = 1.10 x AL	392	551	923

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	8	11	17
U = 1.50 x AL	28	37	56
U = 1.25 x AL	109	142	216
U = 1.10 x AL	672	877	1333

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	10	13	19
U = 1.50 x AL	36	46	68
U = 1.25 x AL	141	179	261
U = 1.10 x AL	876	1107	1614

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	15	18	25
U = 1.50 x AL	55	66	92
U = 1.25 x AL	214	260	357
U = 1.10 x AL	1331	1613	2214

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples	
σ^2=estimated variance in concentration	
z_p=the pth percentile of the standard normal distribution	
Δ=width of gray region (U-AL)	

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
09-LW-01	1.89			1.89
09-LW-09	0.606			0.606
09-SB02-1012	1.1	U		0.55
09-SB03-CUT	0	ND		0
09-SB04-1012	0.352			0.352
09-SB05-1012	0	ND		0
09-SB06-1214	0	ND		0
09-SB07-1012	0.455	U		0.2275
09-SB08-1214	0.346	U		0.173
09-SB10-1214	0	ND		0
09-SB11-1012	0	ND		0
09-SB12-1012	0	ND		0
09-SB13-0810	0	ND		0
09-SB14-1012	0	ND		0
09-SB15-1214	0.742			0.742
09-SB15-1214D	0	ND		0
09-SB16-1012	1.42			1.42
09-SB17-1416	0	ND		0
09-SB18-1012	0	ND		0
09-SB19-1012	0.756	U		0.378
09-SB20-1416	0	ND		0
DL9B-09-01	0.963			0.963
DL9B-09-02	0.26			0.26
DL9B-09-03	1.79			1.79
LW9A-09-01	1.23	U		0.615
LW9A-09-02	1.22	U		0.61
LW9A-09-03	1.27	U		0.635
LW9A-09-04	1.24	U		0.62
LW9A-09-05	1.29	U		0.645
LW9A-09-1D	1.23	U		0.615
LW9A-09-1R	0.224	U		0.112
LW9A-09-2R	0.221	U		0.1105
LW9A-09-3R	0.214	U		0.107
LW9B-09-01	1.24	U		0.62
LW9B-09-02	1.23	U		0.615
LW9B-09-03	1.43	U		0.715
LW9B-09-04	1.24	U		0.62
Sample Variance	***0.235***			
Average Value =	0.432			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.

[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Derived Sample Size (n) Based on
Sample Variance and Action Level
Site 9 - Non-MP Data
Subsurface Soil Detections

COPPER (mg/kg)			
Sample Variance =	***292.745***	***Action Level[1] =***	**15**

1-β = 0.50	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	3	5	10
U = 1.50 x AL	10	16	31
U = 1.25 x AL	36	58	116
U = 1.10 x AL	215	354	707

1-β = 0.75	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	6	9	15
U = 1.50 x AL	21	30	50
U = 1.25 x AL	81	114	191
U = 1.10 x AL	499	702	1175

1-β = 0.90	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	10	13	20
U = 1.50 x AL	36	46	71
U = 1.25 x AL	138	180	274
U = 1.10 x AL	856	1116	1697

1-β = 0.95	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	12	16	24
U = 1.50 x AL	46	58	85
U = 1.25 x AL	180	227	332
U = 1.10 x AL	1116	1410	2055

1-β = 0.99	1-α = 0.90	1-α = 0.95	1-α = 0.99
U = 2.00 x AL	18	22	31
U = 1.50 x AL	69	84	116
U = 1.25 x AL	272	330	454
U = 1.10 x AL	1695	2054	2820

Probability	*z-Score*
0.50	0.00000
0.75	0.67449
0.90	1.28155
0.95	1.64485
0.99	2.32634

$$n = \frac{\sigma^2 (z_{1-\beta} + z_{1-\alpha})^2 + (0.5)\, z_{1-\alpha}^2}{\Delta^2}$$

n=required # of samples
σ^2=estimated variance in concentration
z_p=the pth percentile of the standard normal distribution
Δ=width of gray region (U-AL)

SITE	RESULT	QUAL	SAMP DATE	VALUE[2]
09-LW-01	30	U		15
09-LW-09	95.3			95.3
09-SB02-1012	9			9
09-SB03-CUT	8.67			8.67
09-SB04-1012	9.94	U		4.97
09-SB05-1012	14.8	U		7.4
09-SB06-1214	46.7			46.7
09-SB07-1012	16	U		8
09-SB08-1214	14.7	U		7.35
09-SB10-1214	7.88			7.88
09-SB11-1012	12			12
09-SB12-1012	7.1	U		3.55
09-SB13-0810	8.19			8.19
09-SB14-1012	7.58			7.58
09-SB15-1214	18.1			18.1
09-SB15-1214D	1.84			1.84
09-SB16-1012	5.54	U		2.77
09-SB17-1416	7.5			7.5
09-SB18-1012	9.45			9.45
09-SB19-1012	35.1			35.1
09-SB20-1416	6.74	U		3.37
DL9B-09-01	12			12
DL9B-09-02	6.71			6.71
DL9B-09-03	20.1			20.1
LW9A-09-01	11.5			11.5
LW9A-09-02	9.43			9.43
LW9A-09-03	13.4			13.4
LW9A-09-04	7.06			7.06
LW9A-09-05	12.5			12.5
LW9A-09-1D	15.2			15.2
LW9A-09-1R	3.34			3.34
LW9A-09-2R	3.65			3.65
LW9A-09-3R	3.58			3.58
LW9B-09-01	10.2			10.2
LW9B-09-02	22.8			22.8
LW9B-09-03	40.7			40.7
LW9B-09-04	26.9			26.9
Sample Variance	***292.745***			
Average Value =	14.562			

Null Hypothesis (H_0): the true mean is less than the action level.
Action Level (AL): value that determines acceptance or rejection of H_0
α: probability that a Type I (false positive) error will be made. That is rejecting H_0 when it is True.
β :probability that a Type II (false negative) error will be made. That is failing to rejecting H_0 when it is False.
Gray Region: A range of values of the mean concentration where consequences of making a decision error are relatively minor. The gray region is bounded on the lower side by the action level and on the upper side by the other bound (U).

[1] = Action Level based on Region III Soil BTAG.
[2] = 1/2 the detection limit is used to calculate value, average value, and sample variance for non-detects (samples with 'U' in QUAL column).

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 11 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
Inorganics (μg/L)									
ALUMINUM	**53546**	50	1	**1070.920**	**76.5**	**937000**	**566,623,408**	38	**566,623,370**
ANTIMONY	3.001	6	1	0.500	**64.9**	**22.2**	53	38	*15*
ARSENIC	**7.603**	0.045	2	**168.947**	**2.6**	**104**	**92,559,108**	38	**92,559,070**
BARIUM	270.8	2000	1	0.135	-	**2900**	6	38	0
BERYLLIUM	**9.312**	0.016	2	**582.023**	**2.2**	**159**	**164,971,690**	38	**164,971,652**
CADMIUM	**5.254**	5	1	**1.051**	2.1	**72**	**408**	38	**370**
CHROMIUM	90.56	100	1	0.906	0.4	**902**	202	38	*164*
COBALT	82.42	2200	2	0.037	3.3	1540	2	38	0
COPPER	460.9	1300	1	0.355	6.2	**9280**	69	38	*-31*
CYANIDE	3.292	200	1	0.016	5	12.2	2	38	0
IRON	**139463**	300	1	**464.876**	-	**2410000**	**110,293,534**	38	**110,293,496**
LEAD	**110.5**	15	1	**7.369**	1.1	**2370**	**31,488**	38	**31,450**
MANGANESE	**3644**	50	1	**72.884**	-	**65400**	**2,077,379**	38	**2,077,341**
MERCURY	**57.19**	2	1	**28.597**	0.1	**2170**	**1,340,954**	38	**1,340,916**
NICKEL	**103.5**	100	1	**1.035**	6.1	**1330**	**284**	38	**246**
SELENIUM	7.155	50	1	0.143	**93.9**	**146**	12	38	0
SILVER	1.077	100	1	0.011	5	25	2	38	0
THALLIUM	**10.50**	2	1	**5.252**	**174**	**230**	**16,753**	38	**16,715**
VANADIUM	75.49	260	2	0.290	1.8	**1140**	43	38	*5*
ZINC	973.1	5000	1	0.195	-	**26200**	34	38	0
Semivolatile Organics (μg/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	2.388	4.8	2	0.498	**6**	3	3	38	0
DI-N-BUTYL PHTHALATE	2.493	3700	2	0.001	9	5	2	38	0
Volatile Organics (μg/L)									
1,1,1-TRICHLOROETHANE	0.513	54	2	0.010	1	1	2	38	0
1,1-DICHLOROETHANE	0.513	810	2	0.001	1	1	2	38	0
1,2-DICHLOROETHANE	**0.632**	0.12	2	**5.263**	**1**	**4**	2	38	**0**
1,3 DICHLOROBENZENE	0.513	540	2	0.001	1	1	2	38	0
ACETONE	3.591	3700	2	0.001	5	6	2	11	0
CHLOROBENZENE	0.645	39	2	0.017	1	6	2	38	0
CHLOROFORM	**0.750**	0.15	2	**5.000**	**1**	**4**	**905**	38	**867**

CTO 298 White Oak
Summary of Derived Sample Sizes (n) Based on Sample Variance and Action Level
Site 11 - Non-MP Data
Groundwater Detections

Analyte	Mean	Action Level	Ref.	Mean /Action Level	Highest ND	Highest Detect	Representative Sample Size (3)	Samples Taken	Samples Needed
CHLOROMETHANE	0.566	1.4	2	0.404	1	**3**	2	38	0
CIS-1,2-DICHLOROETHENE	8.737	61	2	0.143	1	**215**	17	38	0
TETRACHLOROETHENE	**2.474**	1.1	2	**2.249**	1	**71**	**5,925**	38	**5,887**
TRICHLOROETHENE	**4.632**	1.6	2	**2.895**	1	**61**	**2,801**	38	**2,763**
Pesticides (μg/L)									
ALPHA-BHC	**0.027**	0.011	2	**2.489**	**0.065**	**0.021**	**3**	36	**0**
ALPHA-CHLORDANE	0.033	0.1	2	0.332	0.065	**0.23**	7	36	0
AROCLOR-1260	1.033	2.6	2	0.397	1.3	**18**	56	36	20
DIELDRIN	**0.054**	0.0042	2	**12.917**	**0.12**	**0.043**	**44**	36	**8**
ENDRIN	0.054	2	1	0.027	0.13	0.02	2	36	0
GAMMA-CHLORDANE	0.034	0.1	2	0.338	0.065	**0.25**	8	36	0
HEPTACHLOR EPOXIDE	**0.029**	0.0012	2	**24.167**	**0.065**	**0.08**	**2,389**	36	**2,353**
Miscellaneous (μg/L)									
NITRATE	1.965	5800	2	0.0003	0.1	11.2	2	38	0
SULFATE	6.293	500000	1	0.00001	0.5	58.1	2	38	0

1 = USEPA Ambient Water Quality Criteria (MCL)
2 = Region III Tap Water RBC
3 = α=5%, β=5%, Δ=0.5xAction Level
4 = Boldface indicates value exceeds Action Level

APPENDIX C

HEALTH AND SAFETY PLAN

DRAFT HEALTH AND SAFETY PLAN

NAVAL SURFACE WARFARE CENTER
WHITE OAK
SILVER SPRING, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Chesapeake
Environmental Branch Code 18
Naval Facilities Engineering Command
Washington Navy Yard, Building 212
Washington, D.C. 20374-2121

Submitted by:
Brown & Root Environmental
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0298

FEBRUARY 1998

APPROVED BY:

R. D. GEORGE
PROJECT MANAGER
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PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide the minimum safety and health practices and procedures for Brown & Root Environmental (B&R Environmental) and subcontractor personnel engaged in remedial investigatory activities at the Naval Surface Warfare Center - White Oak, Silver Springs, Maryland.

The investigatory activities to be conducted at NSWC - White Oak for which this HASP applies is as follows:

- Multi-media sampling
  - Surface and subsurface soil sampling - This sampling may be accomplished through Direct push technology or by hand.
  - Sediment sampling
  - Groundwater sampling
- Monitoring well installation - Hollow stem auger
- Newly installed wells
- Removal of vegetation
- Investigative Derived Waste (IDW) sampling
- Surveying - Physical, azimuthal resistivity, geological mapping, and electromagnetic geophysical surveying

This HASP specifies personnel responsibilities, restrictions, evaluation techniques, and establishes requirements to be incorporated into the above planned activities for the purpose of protecting personnel from hazards which may be inherent to the site or task associated.

This HASP is supported by the B&R Environmental Health and Safety Guidance Manual. The Guidance Manual provides detailed information pertaining to the HASP, as well as, applicable B&R Environmental Standard Operating Procedures (SOPs). This HASP and the contents of the Guidance Manual were developed to comply with the requirements stipulated in 29 CFR 1910.120 (OSHA's Hazardous Waste Operations and Emergency Response Standard) and applicable portions of 29 CFR 1926 Construction Industry Standards, as they may apply. In order to be in compliance with the above standards, both of these documents must be present at the site during the performance of all site activities.

This HASP has been developed using the latest available information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work at the site. This

HASP will be modified if new information becomes available. All changes to the HASP will be made with the approval of the B&R Environmental Project Health and Safety Officer (PHSO) and the B&R Environmental Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the SSO who will make applicable recommendations to the PHSO regarding change content as it may apply to site conditions or the task to be performed. All changes made by the PHSO will be communicated to the Task Order Manager (PM), who will notify all affected personnel of changes.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for B&R Environmental and subcontractor employees engaged in on-site activities. Personnel assigned to these positions will exercise the primary responsibility for all on-site health and safety. These persons will be the primary point of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities.

- The B&R Environmental Project Manager (PM) is responsible for the overall direction of health and safety for this project.

- The Project Health and Safety Officer (PHSO) is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:

  i. Providing information regarding site contaminants and physical hazards associated with the site.
  ii. Establishing air monitoring and decontamination procedures.
  iii. Assigning personal protective equipment.
  iv. Determining emergency response procedures and emergency contacts.
  v. Stipulating training requirements and reviewing appropriate training and medical surveillance certificates.
  vi. Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.
  vii. Making any changes to this document as it may apply to site conditions or task s to be conducted.

- The B&R Environmental Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed SSO. The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

- The SSO supports site activities by advising the FOL on all aspects of health and safety on-site. These duties may include:

  i. Coordinates all health and safety activities with the FOL.
  ii. Selects, applies, inspects, and maintains personal protective equipment.
  iii. Establishes work zones and control points.
  iv. Implements air monitoring program for on-site activities.
  v. Verifies training and medical clearance of on-site personnel status in relation to site activities.
  vi. Implements Hazard Communication and Respiratory Protection and other associated safety and health programs, as they may apply to the operations identified as part of this project.
  vii. Coordinates emergency services.
  viii. Provides site specific training for all on-site personnel.

Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the B&R Environmental CLEAN HSM.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Surface Warfare Center - White Oak
Silver Springs, Maryland

Client Contact: Robert Ridgway
Phone Number: (301) 344-8120

Project Team:

B&R Environmental Personnel:	Discipline/Tasks Assigned:	Phone Number:
R.D. George	Project Manager (PM)	(412) 921-8425
Scott Nesbit, P.E.	Site Coordinator	(412) 921-7134
Tim Evans	Field Operations Leader (FOL)/ Project Geologist	(412) 921-7160
TBD	Site Safety Officer (SSO)	( ) -
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager(HSM)	(412 921-8912
Thomas Dickson, ASP	Project Health and Safety Officer (PHSO)	(412) 921-8457

Other Potential B&R Environmental Project personnel:	Affiliation/Discipline/Tasks Assigned:	Phone Number
TBD	Field Geologist	
Tom Patton	Equipment Manager	(412) 262-4583

Non-B&R Environmental Personnel:	Affiliation/Discipline/Tasks Assigned:	Phone Number
TBD	Drilling Subcontractor (Supervisor)	
TBD	Direct Push Subcontractor (Supervisor)	
TBD	Analytical Laboratory (Point of Contact)	
FedEx	Parcel Shipment	1(800)463-3339

Prepared by: Thomas Dickson, ASP

Reviewed and Approved by:

R. D. George
Project Manager

Matthew M. Soltis, CIH, CSP
CLEAN Health and Safety Manager

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a preplanning effort to direct and guide field personnel in the event of an emergency. All site activities will be coordinated with local Fire Protection and Emergency Services prior to commencement. In the event of an emergency, which cannot be handled using on-site resources, personnel will evacuate to a safe place of refuge and the appropriate emergency response agencies will be notified. It has been determined that a majority of potential emergency situations would be better supported by outside emergency responders. Based on this determination, B&R Environmental and subcontractor personnel will not provide emergency response support beyond the capabilities of on-site response. Workers who are ill or who have suffered a non-serious injury may be transported by site personnel to nearby medical facilities, provided that such transport does not aggravate or further endanger the welfare of the injured/ill person. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. GSA Physical Security in Washington, D.C. will be notified anytime outside response agencies are notified. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

B&R Environmental will provide the following initial response measures:

- Initial stage fire fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Initial medical support for injuries or illnesses requiring only first-aid level support
- Site control and security measures as necessary

2.2 PRE-EMERGENCY PLANNING

Through the initial hazard/risk assessment efforts, injuries or illnesses resulting from exposure to chemical or physical hazards or fire are the most probable emergencies that could be encountered during site activities.

To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with local Emergency Response personnel to ensure that B&R Environmental emergency action activities are compatible with existing emergency response procedures.
- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:
  - Chemical Inventory (used on-site), with Material Safety Data Sheets.
  - On-site personnel medical records (Medical Data Sheets).
  - A log book identifying personnel on site each day.

It will be the responsibility of the B&R Environmental FOL to:

- Identify a chain of command for emergency action.
- Educate site workers to the hazards and control measures associated with planned activities at the site, and to provide early recognition and prevention where possible.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation is primarily relevant for physical hazards that may be associated with the proposed scope of work. Visual observation may also play a role in detecting some chemical exposures. To adequately recognize exposures to site contaminants, site personnel must have a clear knowledge of signs and symptoms of exposure associated with the site contaminants. This information is provided in Table 6-1 of this HASP. Potential site hazards, the activities that they have been associated with, and the recommended control methods are discussed in detail in Section 5.0 and 6.0 of this HASP. Additionally, early recognition of emergency situations will be supported by periodic site surveys to eliminate any situation predisposed to an emergency. The FOL, SSO, and the subcontractor supervisor will be responsible for performing surveys. Site surveys will be conducted at all work locations prior to the commitment of resources and personnel. This will be done for the purpose of removing or barricading identified physical hazards. Additionally, site surveys will be conducted at least once a week at all resource/staging areas. All site surveys conducted during this effort and will be documented in the Field Operations Logbook.

The above actions will provide early recognition for potential emergency situations. Should an incident occur, B&R Environmental will take measures in the beginning stages to control these situations. However, if the FOL and the SSO determine that an incident has progressed to a serious emergency

situation, B&R Environmental will withdraw and notify the appropriate response agencies listed in Table 2-1.

2.3.2 Prevention

B&R Environmental and subcontractor personnel will minimize the potential for emergencies by following the direction and guidance provided within the HASP and applicable OSHA regulations as they apply to the tasks to be conducted. Additionally, prevention will be facilitated through employment of offensive and defensive measures in removing or denying access to hazards identified through the site survey activities.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, all personnel will immediately stop activities and report to the designated safe place of refuge. Safe places of refuge will be identified prior to the commencement of site activities and will be conveyed to personnel as part of issuing a Safe Work Permit to conduct exclusion zone activities within an identified area. As part of this issuance, a safety meeting will be conducted to preview hazards and control measures identified on the Safe Work Permit and through the site survey for that particular area. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the B&R Environmental FOL or the on-site Incident Commander of the Emergency Response Team. The FOL or the SSO will take a head count at this location to account for and to confirm the location of all site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel.

2.5 EVACUATION ROUTES AND PROCEDURES

An evacuation to the identified refuge location will be initiated whenever the health, safety or welfare of site workers is compromised. Specific examples of conditions that may initiate an evacuation include, but are not limited to the following: severe weather conditions; a fire or explosion occurs; readings on monitoring instrumentation indicate levels of contamination that are greater than instituted action levels; if personnel show signs or symptoms of overexposure to potential site contaminants. In the event of an evacuation, personnel will proceed immediately to the designated place of refuge unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain until further notification from the B&R Environmental FOL.

Evacuation procedures will be discussed prior to the initiation of any work at the site. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed

and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers relative to the site location where work is being performed.

2.6 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During an evacuation, decontamination procedures will be performed only, if doing so does not further jeopardize the welfare of site workers. However, it is unlikely that an evacuation would occur at this site which would require workers to evacuate the site without first performing decontamination procedures. B&R Environmental will provide medical treatment to the level of first-aid. Personnel requiring treatment greater than first-aid will constitute an emergency situation for which the appropriate agency must be notified. First-aid kits will be maintained on-site and accessible to all field personnel during operations as described within this document.

2.7 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

At each site, B&R Environmental personnel will be working in close proximity to each other. As a result, hand signals, voice commands, and air horns will be sufficient to alert site personnel of an emergency. If teams will be working simultaneously as part of this project, two-way radios will be used to communicate between teams of workers. The use of two-way radio communication at NSWC, will require prior approval by NSWC.

If an emergency occurs, the following procedures are to be initiated:

- Initiate an evacuation by hand signals, voice commands, air horn, or two-way radios. Report to the designated refuge point.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and as many details as possible. Once all personnel are evacuated, appropriate beginning stage response procedures will be enacted to control the situation.

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL and SSO will enact the emergency notification procedures to secure additional assistance in the following manner:

- Call 911 or other emergency contacts (Table 2-1) and report the emergency. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

- Call GSA Physical Security, after notifying the appropriate emergency response agency, to inform them of the condition or situation which lead to the notification of the emergency response agency.

2.8 PPE AND EMERGENCY EQUIPMENT

A first-aid kit, eye wash units, and fire extinguishers will be maintained on-site at all active work locations and shall be immediately available for use in the event of an emergency. PPE used in day-to-day activities will be used will serve as the primary defense for all chemical hazards encountered. Emergency situations surpassing the level of protection offered by the PPE used on a daily basis again will constitute an emergency and require evacuation and notification of the appropriate response agency.

2.9 EMERGENCY CONTACTS

Prior to performing work at any of the sites, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted on site where it is readily available to all site personnel.

2.10 INJURY AND ILLNESS REPORTING

After the initial response (e.g. first aid, etc) to an injury or illness has taken place, the incidence and details of the injury or illness must be properly reported and documented. Within 24 hours of occurrence, any occupational injury or illness must be reported to the Health Sciences Manager at (412) 921-8912. An OSHA 101 form (Attachment III) must be completed and submitted to the HSM within three working days of the event. A copy of this form will be maintained at the site.

It should be noted that "near misses" as well as actual injuries and illnesses should be reported. By identifying near miss situations, possible recommendations for preventing a recurrence can be made.

TABLE 2-1

EMERGENCY CONTACTS

NSWC - WHITE OAK, SILVER SPRINGS MARYLAND

CONTACT	PHONE NUMBER
EMERGENCIES(1st Contact) GSA Physical Security, Washington, D.C. - Federal Protective Services National Capital Region	(202)708-1111
EMERGENCY(Alternative Contact) (Montgomery County - Police, Fire, Ambulance Service)	911
Primary Hospital -	TBD
Secondary Hospital -	TBD
Chemtrec National Response Center	(800) 424-9300 (800) 424-8802
NSWC - White Oak (Point-of-Contact) Robert Ridgway	(301)344-8120
Unexploded Ordnance	
B&R Environmental, Pittsburgh Office	(412) 921-7090
Project Manager R. D. George	(412) 921-8425
Health and Safety Manager Matthew M. Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer Thomas Dickson, ASP	(412) 921-8457
Utilities Gas Water Sewage Telephone Fiber Optics	TBD

NOTE: All emergency contacts to emergency services off-base require the notification of GSA Physical Security. Information to be provided will include the type and extent of the emergency and agencies notified.

2.11 EMERGENCY ROUTE TO HOSPITAL

Directions to (Primary)

Prior to site mobilization for field activities, a legible map indicating the travel route from the site to the Medical Center will be obtained and inserted as Figure 2-1 of this HASP.

Directions to (Alternate)

The alternate source of medical assistance is . Directions to this hospital are:

This information will be determined prior to the initiation of site activities.

3.0 SITE BACKGROUND

3.1 SITE DESCRIPTION/HISTORY

NSWC White Oak is located east of Maryland Route 650 (New Hampshire Avenue), approximately one mile north of Interstate 495 (Washington, DC beltway). The facility encompasses approximately 710 acres and is located in Silver Spring, Maryland, in both Montgomery and Prince George's counties. Approximately 635 acres of land at NSWC White Oak is undeveloped. Adjacent to the south end of the property is the U.S. Army's Adelphi Laboratory Center (ALC). Additional properties adjacent to NSWC White Oak include residential, commercial, and wooded parcels.

NSWC White Oak was originally established in 1944 as the Naval Ordnance Laboratory (NOL), with a mission to carry out research in guns and explosives. Throughout the years, the mission was expanded to include research involving torpedoes, mines, and projectiles. In September 1974, NOL combined with the Naval Weapons Laboratory, Dahlgren, Virginia, to become the Naval Surface Weapons Center, which was renamed the Naval Surface Warfare Center, Dahlgren Division, in 1988. Since that time, it has functioned as the principal Navy Research Development, Test, and Evaluation Center for surface warfare weapon systems, ordnance technology, strategic systems, and underwater weapons systems.

NSWC White Oak was identified as a Base Realignment and Closure (BRAC) facility and was closed in 1997, with the property transferred to the General Services Administration (GSA). GSA and the local redevelopment authority are currently investigating plans for the reuse and development of the NSWC White Oak property.

3.2 SITES TO BE INVESTIGATED - DESCRIPTION/HISTORY

3.2.1 Site 2 - Apple Orchard Landfill

The Apple Orchard Landfill is an abandoned landfill located on the south side of Perimeter Road in the northwestern end of the NSWC White Oak property. The landfill forms a small hill at an elevation of approximately 340 feet mean sea level within the valley of an unnamed stream. The stream is located along the south side of the site and flows north/northeast towards Paint Branch Creek. A drainage swale is present along the western perimeter of the landfill which conveys stormwater flow from neighboring properties. The landfill is approximately 4.3 acres in size.

The Apple Orchard Landfill was reportedly operated as an open disposal area and landfill from 1948 until 1982. The landfill is a single unit that is composed of several disposal areas. In addition to domestic refuse, wastes reportedly disposed of consisted of oils containing polychlorinated biphenyls (PCBs),

solvents, paint residue, acids and miscellaneous compounds. An estimated 500 gallons of PCB-contaminated oils were deposited at the site prior to 1970. It has been estimated that the landfill contains 75,000 cubic yards of waste/fill

3.2.1.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Sediments - PCBs were detected in the sediments. The concentrations indicate a progressive decrease in concentration in the downstream direction.

Surface soil samples - Indicated metals (chromium, copper, lead and zinc), PCBs, VOCs and semi-volatiles were detected in the surface soils. The semi-volatiles consisted primarily of anthracene, fluoranthene, naphthalene, phthalate and pyrene species.

Subsurface soils - VOCs (acetone and methylene chloride) were detected in the subsurface soil

Groundwater monitoring wells (existing and installed) - Analytical results indicated measurable concentrations of cadmium, mercury and TCE were detected in the groundwater.

Of these contaminants, the only one which has been detected at sufficient concentrations to represent a potential overexposure threat via inhalation is methylene chloride.

3.2.2 Site 3 - Pistol Range Landfill

The Pistol Range Landfill is located on the eastern half of the NSWC White Oak property, directly north of Dahlgren Road and the Monroe Loop. The landfill is estimated to be 1.1 acres in size.

The Pistol Range Landfill was operated as a landfill from the late 1940s until the mid-1970s. Fill materials were pushed into the West Farm Branch valley from Perimeter Road forming the site. Wastes reportedly disposed in the landfill include solid wastes, ordnance cases, solvents, oils possibly containing PCBs, sodium nitrate, and miscellaneous metallic objects. An estimated 8,000 gallons of solvents and oils were reportedly disposed of at the site during a 30 year period. It has been estimated that the landfill contains 20,000 cubic yards of waste/fill.

3.2.2.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Confirmation Study/Verification Phase, Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Groundwater - Methylene chloride, 1,2-dichloroethene, TCE, and chlorobenzene were found in the groundwater. The metals found in unfiltered samples above the MCLs during Phase II included chromium, copper, lead and zinc.

Surface and subsurface soils - metals including chromium, copper, lead, and zinc. Semi-volatile compounds were also detected.

> **Note:** A vadose zone investigation was conducted which included the collection of two surficial soil samples and a soil gas survey of the soil adjacent to the landfill. A soil gas survey sampling grid was also established west and south of the landfill to measure the release of gaseous volatile organic contamination through the soil. The results of the soil gas survey indicated the presence of VOCs in the soils with the highest concentrations along the landfill side of the stream and in the area south of Dahlgren Road. The results of the surficial soil sampling confirmed the presence of metals contamination along the face of the landfill. Semi-volatile organic compounds were identified in the surface soil during the Phase I investigation.

Additional activities which took place in an effort to define boundaries of Site 3 included an electromagnetic survey, test pit placement, and the completion of a topographic survey. The EM survey and test pits were used to define the limits of waste along the eastern boundary of the landfill and determine if waste extended beyond Perimeter Road.

Results of the survey indicated that EM anomalies were present in several locations along the western boundary of the EM survey grid. These anomalies appear to indicate that the edge of the fill material does not extend past Perimeter Road. The remainder of the site showed no significant EM anomalies which may indicate buried landfill contents.

Following completion of the EM survey at Site 3, seven (7) test trenches were placed along the Perimeter Road to the and east of the landfill in an attempt to define the limits of waste placement.

During the prior site reconnaissance, potential UXO hazards were observed in the face and along the toe of the landfill. Accordingly, a B&R Environmental UXO specialist was utilized to screen all locations prior to and during intrusive work to avoid contact with potential UXO hazards. The UXO specialist surveyed

the trenching locations with a magnetometer at 2 foot depth intervals to limit contact with UXO which may have been disposed at the site.

During trench excavation, several fuses were unearthed which were not detectable by the magnetometer. Following this discovery, Navy EOD staff were notified, and the fuses were removed from the site.

Test trenches were excavated to a depth of approximately five feet. The test trenches were successful in determining the limits of waste placement at the landfill. A well defined waste/natural soil interface was evident in the test trenches placed at the site. The test trenches were successful in determining that waste placement at the site does not consist of thin veneer along the stream bank.

None of these contaminants were present in sufficient concentrations to represent a potential overexposure via inhalation. Therefore, exposure concerns to site personnel are considered negligible during planned field activities.

3.2.3 Site 4 - Chemical Burial Site

The Chemical Burial Site is located south of Perimeter Road and 400 yards northeast of the Pistol Range Landfill. The overall area of the site is approximately 1.1 acre in size. The site was reportedly used from the mid-1950s until the early 1970s for chemical disposal in four discrete locations within the site. Past investigations have identified two disposal areas. Two distinct disposal sites may be present within the large suspected disposal trench area; however, only one large trench was suggested from the review of an aerial photograph of the site taken in 1985. Wastes reportedly disposed at this location included acids, explosive compounds, kerosene, chlorinated solvents and numerous unidentified laboratory compounds. The total volume of chemicals disposed in the areas was estimated to be 400 cubic feet.

3.2.3.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Confirmation Study/Verification Phase, Remedial Phase I and Phase II concluded that a significant threat to human health and the environment exists through potential contaminant exposure via groundwater. Activities conducted in an effort to further define the extent (vertically and horizontally) included:

An electromagnetic (EM) survey of Site 4 was completed to define the extent of buried objects which might indicate the location of the chemical burial pits. The survey was conducted across the entire site and extended to the fence line north of Perimeter Road. Results of the survey indicated that EM anomalies were present in four locations within Site 4. The most significant EM readings occurred in the central and western portion of the suspected disposal trench area and near the suspected burial pit

location along the southeastern edge of the site. Readings consistent with subsurface variability were noted and these locations were staked in the field to be sampled. These locations appear to be consistent with the results of the previous investigations. In addition, slight EM anomalies were present behind the telephone pole storage area, and within the suspected burial pit location in the southwestern corner of the site. Readings consistent with small buried objects were noted and these locations were marked in the field to be sampled. The limited magnitude of the EM deflections in these areas indicates that these burial pits are likely to be small and probably do not contain large metal containers or drums. The remainder of the site showed no significant EM anomalies which may indicate buried objects.

The previous investigations indicated contaminant concentrations were found in the following media:

Groundwater: Metals - Chromium, copper, lead, mercury, and zinc. VOCs - Benzene, chloroform, 1,2-dichloroethene, methylene chloride, 1,1,2,2-tetrachloroethane, acetone, MEK, and trichloroethene.

Surface and subsurface soils: Metals - Chromium, copper, lead, and zinc. VOCs - methylene chloride, acetone, xylene, carbon disulfide, and 1,1,1-trichloroethane.

Of the compounds detected, methylene chloride (groundwater and soils) and trichloroethene (groundwater) represent the only potential inhalation exposure threat to site personnel during planned activities.

3.2.4 Site 7 - Ordnance Burn Area

Site 7, the Ordnance Burn Area, is located north of Dahlgren Road, approximately 300 yards southeast of Site 4 (the Chemical Burial Area), north of Buildings 501 and 508. The site was reportedly used for the thermal destruction of waste ordnance compounds between 1948 and 1968. The site consists of a swale approximately 250 feet long and 20 feet wide. Waste disposed at this site included various types of explosives, primarily nitroaromatics and nitroaliphatics. It has been reported that approximately 33,000 pounds of explosives were burned at this site over a period of 20 years.

3.2.4.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Confirmation Study/Verification Phase, Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Groundwater - The Confirmation Study/Verification Phase involved the placement of 1 groundwater monitoring well (7GW09). Monitoring well 7GW08 was sampled on two occasions during this

investigation. Nitroaromatic contamination was identified in the monitoring well during both events. HMX, RDX, TNT, DNT, TNB, and DNB were found during the sampling activities.

Surface and subsurface soils -Nitroaromatic contamination were detected in previous investigations. Concentrations of HMX and RDX were identified up-to 160,000 ug/kg and 8,300 ug/kg, respectively. In addition concentrations of 2,4,6-TNT up to 34,000 ug/kg were also detected during previous investigations.

None of these contaminants were present in excessive concentrations, therefore potential exposure to site personnel are considered negligible during planned field activities.

3.2.5 Site 8 - Abandoned Chemical Burial Pit

Site 8 was used from 1951 until 1971 for disposal of miscellaneous waste chemicals from laboratories at the NSWC White Oak facility. Wastes disposed at this site included acids, mercury, solvents and numerous unidentified waste chemicals. The primary wastes of concern include solvents and mercury. It has been estimated that approximately 180 pounds of mercury were disposed at this location.

The Abandoned Chemical Disposal Pit is located along the southern facility boundary, at the end of Perimeter Road. The site has been described as a pit 10-feet by 10-feet by 12-feet. The location of the site was identified during the design verification study with the location confirmed through a site geophysical investigation in the summer of 1996 and the excavation activities conducted in the fall of 1996. The removal action was conducted in October and November of 1996. At that time, 100 tons of non-hazardous solid waste, including soil and debris, were excavated from the site and transported off-site for disposal. Excavated materials included mercury filled vials, a white powder, and a Plexiglas cube filled with saline solution. Soil samples were collected at various stages during the excavation activities to confirm the removal of contaminants.

3.2.5.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Confirmation Study/Verification Phase, Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Groundwater - Methylene chloride, chloroform, mercury. and bis(2-ethylhexyl) phthalate. The metals found included chromium, copper, lead and zinc.

Surface and subsurface soils - metals including chromium, copper, lead, and zinc.

None of these contaminants were present in excessive concentrations, therefore potential exposure to site personnel are considered negligible during planned field activities.

3.2.6 Site 9 - Industrial Wastewater Disposal Area 300

The Industrial Waste Water Disposal Area 300 is located south of Dahlgren Road along the Montgomery/Prince George County line and extends southward to the facility boundary. A perennial tributary of Paint Branch Creek is located west and south of the site and an intermittent tributary of the creek is located to the east.

The Industrial Waste Water Disposal Area 300 was used from the early 1950s until the mid-1970s. Several leaching wells and above ground discharges to the soil were used in this area for disposal of liquid wastes containing explosive related compounds. Waste water disposed at the site contained TNT, RDX and several other explosive related compounds. It is estimated that at least 7,200 pounds of these waste waters were disposed at this site over a period of approximately 25 years. It is also reported that solvents were disposed in the same manner as the explosive compounds.

3.2.6.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Confirmation Study/Verification Phase, Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Groundwater - Methylene chloride, acetone, trichloroethene, chloroform, mercury, HMX, RDX, and 1,2-dichloroethene. The metals found included chromium, copper, lead and zinc.

Surface and subsurface soils - metals including chromium, copper, lead, and zinc. VOCs - acetone methylene chloride, MEK, and fluoranthene and pyrene.

None of these contaminants were present in excessive concentrations, therefore potential exposure to site personnel are considered negligible during planned field activities.

3.2.7 Site 11 - Industrial Wastewater Disposal Area 100

Site 11, Wastewater Disposal Area 100, contains thirteen leaching wells in nine areas that were used for wastewater disposal from laboratory activities. The wells are located in an area covering approximately 16 acres. The wells were used for liquid waste disposal until 1976. Original construction consisted of an eight

foot diameter, brick or concrete well approximately nine feet in depth. Each well was accessible through a 24 inch diameter manhole cover. One supply line transported wastewater to each well.

Wastes that were disposed at Site 11 include metals, acids, chlorinated and non-chlorinated solvents, alcohols, lead, and organic explosive compounds. The Initial Assessment Study (1984) reports that an estimated 20,000 gallons of waste were disposed in these leaching wells. Both listed and characteristic hazardous wastes are believed to have been disposed.

The currently at Site 11, the wells were abandoned, while the associated supply lines are believed to be in place.

In response to the draft FS recommendations related to soil contamination at the site, a removal action was conducted in October and November of 1996. Six existing leaching wells were excavated and disposed off-site. Surrounding soils were also excavated and disposed off-site. Soil samples were collected at various stages during the excavation activities to confirm the removal of contaminants.

3.2.7.1 Previous Investigations

Previous investigations including an Initial Assessment Study (IAS), Remedial Phase I and Phase II indicated contaminant concentrations were found in the following media:

Groundwater - Results from the groundwater analysis indicated that numerous site wells contained elevated levels of VOCs and metals. Analytical results indicated that elevated levels of copper, zinc, PCE, acetone, TCA, DCE and DCA were present in the groundwater. Contamination was highest in wells down-gradient of Building 2 and 5.

Surface water and sediments - Sediment samples were found to contain elevated levels of semi-volatile organic compounds and metals including cadmium, chromium and lead. One surface water sample was found to contain an elevated level of lead.

None of these contaminants were present in excessive concentrations, therefore potential exposure to site personnel are considered negligible during planned field activities.

4.0 SCOPE OF WORK

This section discusses the activities that are to be performed at the NSWC - White Oak. Table 5-1 of this HASP provides information related to each of the tasks that are to be performed as part of the scope of work. The planned activities involved in this effort are presented in detail in the Work Plan developed for this project. If new tasks are to be performed at the site, Table 5-1 and this section will be modified accordingly. If tasks other than those described below are performed at the site, this section and this HASP will be modified accordingly.

Field investigations to be performed by B&R Environmental and subcontractor personnel will be as follows:

Further determine the vertical and lateral extent of contamination through the following activities:

- Install monitoring wells (shallow wells - intersecting the water table; Deep wells 30-50 feet below the water table). Monitoring well installation will proceed through hollow stem augering methods.

- Groundwater sampling - Samples will be collected from the new and existing wells upon development of the new and re-development of the existing wells. Sample acquisition will be accomplished through the use of low-flow acquisition means including, but not limited to, peristaltic pumps (primary), redi-flow pumps, and/or by hand through the use of disposable or stainless steel bailers.

- Surface soil sampling, 0 to 6 inches in depth - Establish a grid patterns over suspect areas, identifying locations to obtained representative samples over potentially impacted area for surface and subsurface soils samples. Sample acquisition by hand.

- Subsurface soil sampling, 6 inches to 10 feet. The selection of the collection point will be based on the interval where the highest monitoring instrument reading above background (or in the absence of monitoring instrument readings, the interval prior to groundwater) below ground surface. If groundwater is encountered, the sample will be collected at the groundwater interface. Sample acquisition by split-spoon, direct push techniques, geoprobe operations, or by hand augering.

- Sediment samples - Sample acquisition by direct collection.

- Electromagnetic geophysical surveys. Identify geophysical anomalies, buried objects, in an effort to focus subsurface investigation efforts.

- Test pit(s) operations - This activity will employ a back-hoe or track-hoe to dig pits of an established dimension.

Additional activities will be conducted as part of this field effort, however, are not the primary tasks to be completed. These additional tasks include the following:

- Mobilization/demobilization activities
- Slug testing, specific capacity testing, and water level measurements
- Decontamination of sampling and heavy equipment
- Investigative Derived Waste (IDW) sampling
- Geographical/geophysical surveying
- Site access/preparation - Removal of vegetation/temporary roads/etc.

4.1 SITE-SPECIFIC ACTIVITIES

Activities to be conducted at each location are presented in the following text.

4.1.1 Site 2 - Apple Orchard Landfill

Soils - Surface soil sampling to determine and define the limits of the landfill.

Groundwater - 5 existing monitoring wells and 3 proposed monitoring well installations, specific capacity testing, water level measurements, and sampling by low flow acquisition.

Surface water sampling at 2 out-fall stations and within 2 drainage swales west and south of the area.

Sediments sampling at 2 out-fall stations and within 2 drainage swales west and south of the area.

4.1.2 Site 3 - Pistol Range Landfill

Soils - Surface soil sampling along the perimeter limits of the landfill.

Groundwater - 8 existing monitoring wells and 6 proposed monitoring well installations; specific capacity testing, water level measurements, and sampling by low flow acquisition.

Note: Pumping tests of installed or existing wells may be conducted at Site 3. However, this has yet to be confirmed.

Surface water sampling at 2 drainage swales west and south of the area.

Installation of 2 staff gauges.

Sediments sampling at 2 out-fall stations and within 2 drainage swales west and south of the area.

4.1.3 Site 4 - Chemical Burial Area

Soils - Surface and Subsurface soil sampling within the confines of the burial area and along the perimeter.

Groundwater - 19 existing monitoring wells, 7 proposed monitoring well installations and 1 existing piezometer; specific capacity testing, water level measurements, and sampling (with the exception of the piezometer) by low flow acquisition.

Note: Pumping tests of installed or existing wells may be conducted at Site 4. However, this has yet to be confirmed.

4.1.4 Site 7 - Ordnance Burn Area

Soils - Surface and subsurface (2-4 feet) soil sampling within the burn area. Surface soil sampling east of the burn area.

Groundwater - 4 existing monitoring wells, 5 proposed monitoring well installations; specific capacity testing, water level measurements, and sampling by low flow acquisition. One existing piezometer will be used for hydrogeologic characterization.

Installation of 2 staff gauges in the stream, west of Site 7.

4.1.5 Site 8 - Abandoned Chemical Burial Pit

Soils - Surface and subsurface (2-4 feet) soil sampling around previously excavated area.

Groundwater - 6 existing monitoring wells and 1 off-site monitoring well. Activities to be conducted include specific capacity testing, water level measurements, and sampling by low flow acquisition.

4.1.6 Site 9 - Industrial Waste Water Disposal Area, Area 300

Groundwater - 14 existing monitoring wells, 9 proposed monitoring well installations, and 3 existing piezometers. Activities to be conducted include specific capacity testing, water level measurements, and sampling by low flow acquisition.

Note: Pumping tests of installed or existing wells may be conducted at Site 9. However, this has yet to be confirmed.

Surface water sampling along East and West Farm Branches.

Installation of 4 staff gauges.

Sediments sampling along East and West Farm Branches.

4.1.6 Site 11 - Industrial Waste Water Disposal Area, Area 100

Groundwater - 25 existing monitoring wells, 6 proposed monitoring well installations, and 4 existing piezometers. Activities to be conducted include specific capacity testing, water level measurements, and sampling by low flow acquisition.

Note: Pumping tests of installed or existing wells may be conducted at Site 11. However, this has yet to be confirmed.

Surface water sampling - 2 samples along the drainage swales southeast of Building 30; 2 samples along drainage swale east of Bowditch Road.

Installation of 4 staff gauges.

Sediments sampling at along East and West Farm Branches.

Electromagnetic geophysical survey over 10 locations site wide in the suspected area of the leaching wells.

Should additional tasks or sites be added this section and the HASP will be modified accordingly.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site specific HASP which identifies the tasks that are to be performed as part of the scope of work. This table will be modified and incorporated into this document as new or additional tasks are performed at the site. The anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task are discussed in detail. This table and the associated control measures shall be changed, if the scope of work, contaminants of concern, or other conditions change.

Through using the table, site personnel can determine which hazards are associated with each task and at each site, and what associated control measures are necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to use based on proper air monitoring techniques and site-specific conditions.

As discussed earlier, this table and HASP are accompanied by a Health and Safety Guidance Manual. The manual is designed to further explain supporting programs and elements for other site specific aspects as required by 29 CFR 1910.120. The Guidance Manual should be referenced for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of Brown & Root Environmental's SOPs are also provided in this Guidance Manual.

Safe Work Permits issued for all exclusion zone activities (See Section 10.10) will use elements defined in Table 5-1 as it's primary reference. Additional information, site-specific in nature will be added by the FOL and/or the SSO completing the Safe Work Permit. In situations, where the Safe Work Permit is more conservative, due to the incorporation of site-specific elements, than the direction provided in Table 5-1, the Safe Work Permit will be followed.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization	***Chemical hazards:*** Exposure to potential site contaminants are not anticipated during this activity. However, chemicals brought on site in support of field activities are to be identified, logged, accompanied by an appropriate MSDS, properly stored, and evaluated for purposes of hazard communication. ***Physical hazards:*** Potential physical hazards associated with this task may include: 1) Lifting (muscle strains and pulls) 2) Pinches and compressions 3) Slip, trips, and falls 4) Moving machinery 5) Vehicular and foot traffic 6) Emergency preparedness	***Chemical hazards:*** To eliminate potential chemical hazards associated with this task ensure the following: - A chemical inventory list is generated for all chemical brought on site (Complete Section 5.0 of the B&R Health and Safety Guidance Manual). - Material Safety Data Sheets must be available for all chemicals brought on site (Complete Section 5.0 of the B&R Health and Safety Guidance Manual). - Materials are stored in accordance with recommended practices and according to compatibility (See MSDS for storage and compatibility recommendations). ***Physical hazards:*** 1) Employ machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 2) Use pinch bars or other equipment to keep hands from the point of operation. 3) Preview and prepare work locations where unstable/uneven terrain exists. Barricade all excavations and embankments deeper than 2 feet. 4) All equipment to be employed will be - Inspected in accordance with OSHA, and manufacturers design. The inspection will include the completion of the Equipment Record Sheet documenting the review and acceptance/failure of safety devices, guards, emergency stops. The Equipment Inspection Checklist may be found in Attachment II of this HASP. - Operated by knowledgeable operators, and knowledgeable ground crew, as applicable. - Establish safe zones of approach. - Secure all loose articles to avoid possible entanglement. 5) Identify all access/egress routes and locations to within established areas of operation. - All equipment capable of self propelled movement will be equipped with movement alarms as applicable. - Traffic regulations for NSWC - White Oak are to be followed as posted. - Traffic regulations for B&R Environmental, operational areas will be posted by the SSO as required. 6) The FOL and/or SSO shall finalize emergency action preparedness by completing the following actions: - Secure or generate a map to the hospital. Then drive this route to ensure it is unimpeded by traffic restrictions or other barriers. - Submit Chemical Inventory Lists to facility contact and emergency services as required.	Not required during mobilization/demobilization.	Mobilization/demobilization activities is intended to initiate and proceed in Level D protection: Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants; or coveralls) - Safety shoes or boots with steel toe - Safety glasses - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. As a general rule of thumb, if you need to raise your voice to be heard while engaged in conversation with someone who is within 2 feet of your position you may be exposed to excessive noise levels and should employ hearing protection until the SSO can quantify the potential hazard through sound level measurements or noise dosimetry. **Note:** The Safe Work Permit(s) (See Section 10.10) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations cr conditions associated with any identified task.	As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. Failure to pass inspection will prohibit entering or exiting the site as applicable. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site. All equipment permitted to pass on/off site will be documented using an Equipment Inspection Checklist. This form may be found in Attachment II of this HASP.

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TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Tasks/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring/Type and Action Levels	Personal Protective Equipment	Decontamination Procedures
Soil Borings/ Monitoring Well Installation/Geoprobe Operations	***Chemical hazards:*** Previously identified contaminants of concern and the maximum concentrations of these contaminants are as follows: **Site 2:** Methylene Chloride; surface soil (0.10 mg/kg) **Site 4:** Methylene Chloride; surface soil (0.35 mg/kg) Trichloroethylene; groundwater (1,000 ug/L) **Site 3, 7, 8, 9 and 11:** Air and particulate borne contaminants are not anticipated to be present at these sites in sufficient concentrations to present an overexposure potential to site personnel during planned activities. 2) Transfer of contamination into clean areas or onto persons ***Physical hazards:*** 3) Rotating machinery (entanglement, pinch points and compression) 4) Noise 5) Energized systems 6) Lifting 7) Slips, trips, and falls 8) Traffic hazards 9) Natural hazards (poisonous plants, disease carrying insects and animals, etc.)	***Chemical hazards:*** 1) Use real-time monitoring instrumentation, action levels, visual observation(dusts and particulates), and identified PPE to control exposures to potentially contaminated medias (e.g., air, water, soils, etc.). - Identify and physically barricade operational zones where potential contamination may exist to prevent incidental contact and transfer outside of the operational area. For drilling operations the zone dimensions will be the height of the mast, plus 3 feet surrounding the point of operation. 2) Decontaminate all equipment and supplies between drilling events and excavations as well as prior to leaving the site. ***Physical hazards:*** 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Inspection Checklist which may be found in Attachment II of this HASP. Failure to pass the Equipment Inspection due to nonfunctional or missing safety devices such as emergency stop devices, guards, improper or non-approved equipment will result in the operation being temporarily halted until these corrections can be made. - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (i.e., pins for auger flights etc.). - All drill rig operations will be done so by a Certified operators, and knowledgeable ground crew. In addition to the equipment considerations, the following standard operating procedures will be employed: - All loose clothing/protective equipment will be secured to avoid possible entanglement. - Hand signals will be established prior to the commencement of drilling activities. - The driller and helper can simultaneously handle moving augers or flights only when there is a standby person to activate the emergency stop device. - The driller must never leave the controls while tools are rotating unless all personnel are clear of the rotating equipment. - A long handled shovel or equivalent shall be used to clear away drill cuttings from the hole and rotating equipment. Hands or feet shall **not** be used for this purpose. - A remote sampling device must be used to sample drill cuttings near rotating tools. - Never climb a drill mast while equipment is rotating. - Use ANSI approved fall protection (i.e., belts, lanyards and a fall protection slide rail) or portable ladders which meet OSHA's requirements for climbing drill masts will be used. - Work areas will be kept clear of clutter. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of drill rigs, backhoes and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - Drill rigs and support vehicles will be moved no closer to banks, ditches, and excavations than 3 feet unless the wall is supported. This distance may be expanded based on soil classification and activities to be conducted. 4) Excessive noise levels will be mitigated through the use of hearing protection. Any piece of equipment or operation that has the potential to generate excessive noise levels (You must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 5) All utility clearances shall be obtained in writing prior to subsurface activities. The locations of all underground utilities will be identified and marked prior to all subsurface investigations. Where the clearance cannot be obtained in a reasonable period, or not located, drilling shall proceed with extreme caution using a magnetometer for periodic downhole surveys to at least 10 feet in total depth. - Drill masts or other projecting devices shall be at least 20 feet from overhead power lines and a minimum of 3 feet from identified underground locations. 6) Employ machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 7) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (I.e.,Mast + 3 feet). - Where necessary, use traffic barricade devices to isolate field personnel from traffic flow. - All self propelled movable equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. - Vehicle operators are required to wear seat belts while operating vehicles on NSWC and follow the site traffic rules. Traffic patterns will be dictated supporting on site activities. However, regulated patterns in and about the work zones and support thereof will be established to safely control the flow patterns of mechanized vehicles and pedestrians. 9) Wear appropriate clothing and PPE. Avoid potential nesting areas and suspicious vegetation (poison ivy, poison oak, etc., See section 6.2). When feasible, necessary, and approved for use by the FOL use commercially available insect repellents. Refer to Section 6.2 of this HASP or the Health and Safety Guidance Manual for additional information regarding ticks and Lyme's disease.	**Elevated airborne concentrations impacting the field crews or downwind receptors are only anticipated at Sites 2 and 4 at this time.** **Instruments will be employed at Site 2 in the following manner:** 1) Monitor area at the source using a PID 2020 with 11.7 eV lamp for methylene chloride. 2) Detection on the 11.7 eV unit indicates methylene chloride (given the ionization potential). 3) Results obtained at the source > background or, at times as directed by the SSO, require high risk employee's breathing zones to be monitored for potential exposure. 4) Any readings greater than 13 ppm on the 11.7 PID, evacuate and notify the PHSO and PM. Note: Continued work would require an upgrade to Level B protection. 5) As a back-up and qualification for results obtained for high risk employee job classifications, use a Methylene Chloride 100/a sorbent tube to determine the exposure level. **For Site 4:** The same actions required for Site 2 will be taken at Site 4. In addition: 1) Monitor area at the source using a PID 101 with a 10.6 eV lamp for trichloroethylene. 2) If the detection is on the 10.6 eV unit, is assumed that the contaminant detected is TCE (given the ionization potential). 3) Results obtained at the source > background or, at times as directed by the SSO, require high risk employee's breathing zones to be monitored for potential exposure. 4) Any readings greater than 20 ppm on the 10.6 PID, evacuate and notify PHSO and PM. Note: Continued work would require an upgrade to Level C. Direct reading instruments employed for general screening to detect volatile organic compounds, elemental decomposition products and carrier substances, as applicable. **For Sites 3, 7, 8, 9, and 11:** These instruments will only be employed as a screening devices to be employed in the following manner: 1) Source monitoring of the borehole and excavated materials will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained reading (greater than 1 minute in duration) above background in the breathing zone of the at-risk employees requires the person (SSO/sampler, etc.) monitoring to: - Evacuate the area. If background is regained, continue working. - Elevate the level of protection until the breathing zone readings subside or the source of the readings can be identified and quantified. - Sustained readings greater than established background to 5 ppm, Level C protection. 4) The SSO may perform noise dosimetry to ensure the drilling, and any contributional levels associated with the operation do not surpass the noise attenuation factors associated with the hearing protection selected. 5) When utilities cannot be identified a procedure permitting downhole magnetometer surveys every 2 feet to a total of 6 feet.	All drilling operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection - Standard field dress (Long pants, sleeved shirts - Steel toe safety shoes or boots These following items will be incorporated during drilling operations: - Nitrile gloves with a cotton liner, - Hard-hat, safety glasses, and earplugs or muffs. - *Tyvek coveralls will be worn if there is a possibility of soiling work attire* - *Impermeable boot covers* - *PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* *(These items are optional as conditions dictate)* **For Sites 2:** An upgrade to Level B is possible if sustained readings greater than 13 ppm are detected by the 11.7 PID. If this occurs, site personnel will suspend site activities until the situation can be further evaluated. **For Sites 4:** An upgrade to Level B may occur if sustained readings greater than 13 ppm are detected by the 11.7. Suspend further activity until the situation is evaluated. An upgrade to Level C is possible if sustained readings greater than 20 ppm are detected by the 10.6 PID. **For Sites 3, 7, 8, 9, and 11:** Level C protection upgrade will be done based on monitoring instrument results to the following: - Air-Purifying Respirator (APR) with organic vapor/HEPA cartridges for any breathing zone readings greater than background levels but below 5 ppm. Chemical protective clothing will consist of impermeable boot covers, nitrile gloves, Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PE splash suit. Any sustained breathing zone readings greater than 5 ppm above background levels will require the evacuation to a place of refuge and the immediate notification of the PHSO and PM. As site conditions may change the following equipment will be maintained during all on site activities - Fire Extinguishers (Strategically placed) - Basket stretcher, blankets, and first-aid kit	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g., boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the drilling operations bordering the support zone. This decontamination procedure for **Level D** protection will consist of - Equipment drop - Soap/water wash and rinse of outer gloves and outer boots, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Outer suit, boot covers, outer glove removal - Wash hands and face, leave contamination reduction zone

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVALSURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring/Type and Action Levels	Personal Protective Equipment	Decontamination Procedures
Multi-media sampling including soils (surface and subsurface); sediments; groundwater; slug tests; and Investigative Derived Waste (IDW). The protective measures identified for this activity will also apply to activities such as water-level measurements, aquifer testing, and installation of staff gauges.	***Chemical hazards:*** 1) Previously identified contaminants of concern and the maximum concentrations of these contaminants are as follows: Site 2: Methylene Chloride; sediments (0.10 mg/kg) Site 4: Methylene Chloride; sediments (0.35 mg/kg) Trichloroethylene; groundwater (1,000 ug/L) Site 3, 7, 8, 9 and 11: Air and particulate borne contaminants are not anticipated to be present at these sites. Previous surveys results have determined exposure to site contaminants to be minimal. 2) Transfer of contaminants into clean areas or onto persons ***Physical hazards:*** 3) Noise 4) Lifting (muscle strains and pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Biological hazards (Insect/animal bites and stings) 8) Water hazards.	***Chemical hazards:*** 1) Employ real-time monitoring instrumentation, action levels, and identified PPE to identify, quantify, and control exposures to potentially contaminated medias (e.g., air, water, soils). 2) Restrict the cross use of equipment and supplies between sampling locations without first going through a suitable decontamination. ***Physical hazards:*** 3) Due to operational and contributory activities in and about work areas, generated noise levels may be excessive. Noise control will be facilitated through the use of hearing protection. As a general rule of thumb, anytime you must raise your voice to speak to someone to be heard within 2 feet of where you are standing the potential exists that sound pressure levels may be excessive. Therefore, personnel will be required to employ hearing protection in these situations until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 4) Employ machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Use pinch bars or other equipment to keep hands from the point of operation, when acquiring samples. 6) Preview work locations for unstable/uneven terrain. Barricade all excavations deeper than 2 feet. 7) Avoid insect nesting areas. Report potential hazards to the SSO. 8) Any activities conducted near or over bodies of water will require site personnel to use U.S. Coast Guard approved personal floatation devices and/or lifelines.	Monitoring instrumentation will be employed as a general screen for volatile compounds. Information provided to date indicate previously measured source concentrations were not significant enough to warrant potential exposure considerations. It should also be noted that monitoring instrumentation will be employed as specified in the QA/QC plan to bias environmental samples. Collection of groundwater samples will not require air monitoring. Wells to be sampled will require opening to allow venting and equilibration prior to sampling. Subsurface soils monitoring direction and action levels will proceed in the following manner. Photoionization detectors w/10.6 eV and 11.7 eV and/or flame ionization detectors. **Elevated airborne concentrations impacting the field crews or downwind receptors are not anticipated. The following information is provided as a contingency action only.** 1) Source monitoring will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source location (the soil sample) which may impact operations crew will require the following actions: - Monitor the breathing zone of high risk employees. Any sustained reading above background in the breathing zone of the at-risk employees requires the person (SSO/sampler, etc.) monitoring to: - Evacuate area. Reevaluate area. If background is regained, continue work. - If not, elevate the level of protection to Level C until the source of the readings may be identified and quantified. - Background to 5 ppm, Level C protection These action levels have been excerpted from the EPA Standard Operating Safety Guides	All sampling activities are anticipated to proceed in a modified Level D protection, or as specified on the Safe Work Permit. Level D - (Minimum Requirements) For sampling activities: - Standard field attire (Sleeved shirt; long pants) - Safety shoes or boots(Steel toe) - Safety glasses - Inner nitrile gloves (Clean pair for each sample location) - *Hard-hat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* *Italicize text represents optional equipment to be worn as conditions dictate.* If an upgrade to Level C is required: - Air purifying respirator with organic vapor/HEPA filters for breathing zone concentrations greater than background levels up to 5 ppm. Level C chemical protective clothing will consist of impermeable boot covers, layered (inner nitrile gloves) if necessary, Tyvek coveralls. Free phase product or splash potential will require the use of PVC or Saranex splash suit.	Decontaminate sample containers in accordance with the QA/QC Plan. **Personnel decontamination:** - Wash and rinse outer protective garments - Remove outer protection garments and containerize for disposal - Wash hands and face, leave contamination reduction zone. **Equipment decontamination:** All sampling equipment will undergo a soap/water wash and rinse utilizing a suitable potable water source until visibly clean. Sampling equipment may also be high pressure soap/water wash and rinse or steam cleaned. All chemical decontamination will proceed in accordance with the other site documents such as QA/QC, Work Plan, and/or the Sampling Analysis Plan.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring/Type and Action Level	Personal Protective Equipment*	Decontamination Procedures
Geoprobe - Direct push/hammer soil borings.	***Chemical hazards:*** Previously identified contaminants of concern and the maximum concentrations of these contaminants are as follows: Site 2: Methylene Chloride; sediments (0.10 mg/kg) Site 4: Methylene Chloride; sediments (0.35 mg/kg) Trichloroethylene; groundwater (1,000 ug/L) Site 3, 7, 8, 9 and 11: Air and particulate borne contaminants are not anticipated to be present at these sites. Previous surveys results have determined exposure to site contaminants to be minimal. 2) Transfer of contamination into clean areas or onto clean persons. ***Physical hazards;*** 3) Pinch/compression and traffic-related hazards 4) Noise 5) Energized systems 6) Biological hazards	1) Use real-time monitoring instrumentation, action levels, identified PPE, and work practices to control exposures to potentially contaminated medias (e.g. air, water, soils, etc.). 2) Decontaminate all equipment and supplies between borings and prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturer's design. All inspections will be documented using the Equipment Inspection Checklist found in Attachment II of this HASP. - Operated and supported by knowledgeable operators, and ground crew. - One person handling the push rods and controls - Used within establish safe work zones, with routes of approach clearly demarcated. All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. This will be the area identified as the exclusion zone. In addition to equipment considerations, the following safe operating procedures will be incorporated: - Hydraulic masts or other projecting devices shall be at least 20 feet from overhead power sources and a minimum of 3 feet from underground utilities. - Hand signals will be established prior to the commencement of the operation. - Only manufacturer-approved equipment may be used in conjunction with equipment repair procedures (i.e., flight connectors etc.). - Work areas will be kept clear of clutter. - Secure all loose articles to avoid possible entanglement, during coring activities.. - All self propelled equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility, and to establish unimpeded work areas around the operation. This activity may require areas of the Building 199 and Building 88 to be cordoned off during this operation. - All personnel will be instructed in the location and operations of the emergency shut-off device(s). This device will be tested initially (and then periodically) to ensure its operational status. - Areas will be inspected prior to the movement of Geoprobe and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - The Geoprobe and support vehicles will be moved no closer than 3 feet to floor openings, unsupported side-walls of excavations and embankments. 4) Hearing protection will be used during all Geoprobe intrusive activities. Noise levels in exceedance of 102 dBA at 3 feet from the Geoprobe (during hammering activity driving the soil sampler) will require the zone to be increased to 30 feet. 5) All utility clearances shall be obtained prior to any subsurface investigation. Prior to any subsurface investigations, the locations of all underground utilities will be identified and marked. The FOL will obtain written permit clearance prior to all subsurface investigations. 6) As this activity will take place in remote locations biological hazards are of concern. To control this hazard: - Preview all work areas to remove or barricade physical hazards or potential nesting areas. - Clear sufficient area around the Geoprobe to permit unimpeded work. - Follow section 6.2 of this HASP for protection against biological hazards.	**Elevated airborne concentrations impacting the field crews or downwind receptors are only anticipated at Sites 2 and 4 at this time. Instruments will be employed at Sites 2 and 4 in the following manner:** 1) Monitor area at the source using a PID 2020 with 10.6 eV lamp for methylene chloride and a PID 101 with a 11.7 eV lamp for trichloroethylene. 2) If the detection is on the 10.6 eV unit, is assumed that the contaminant detected is TCE (given the ionization potential). Detection on the 11.7 eV unit indicates methylene chloride (given the ionization potential). 3) Results obtained at the source > background or, at times as directed by the SSO, require high risk employee's breathing zones to be monitored for potential exposure. 4) Any readings greater than 13 ppm for methylene chloride, evacuate and notify the PHSO and PM. Note: Continued work would require an upgrade to Level B protection. Any readings greater than 20 ppm for trichloroethene, evacuate and notify PHSO and PM. Note: Continued work would require an upgrade to Level C. 5) As a back-up and qualification for results obtained for high risk employee job classifications, use a Methylene Chloride 100/a sorbent tube to determine the exposure level. Direct reading instrument such as photoionization detectors with an 10.6 eV source or flame ionization detectors will be employed as a general screening instrument to detect volatile organic compounds, elemental decomposition products and carrier substances, as applicable. **For Sites 3, 7, 8, 9, and 11:** These instruments will only be employed as a screening devices to be employed in the following manner: 1) Source monitoring of the borehole and excavated materials will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained reading (greater than 1 minute in duration) above background in the breathing zone of the at-risk employees requires the person (SSO/sampler, etc.) monitoring to: - Elevate the level of protection until the breathing zone readings subside or the source of the readings can be identified and quantified. - Sustained readings greater than established background to 5 ppm, Level C protection. 4) The SSO will perform sound-level measurements to determine noise levels during Geoprobe operations. Additionally, noise dosimetry may be performed to quantify worst-case scenarios. 5) Where the utility clearance cannot be determined, subsurface activities shall proceed with extreme caution using a magnetometer for periodic down-hole surveys every 2 feet to a depth of at least 10 feet.	All subsurface Geoprobe operations are to be initiated in level D protection. Level D protection constitutes the following minimum protection - Standard field dress (Long pants, sleeved shirts - Steel-toe safety shoes or boots These following items will be incorporated during Geoprobe operations: - Nitrile gloves with a cotton liner. - Hard-hat, safety glasses, and earplugs or muffs. *- Tyvek coveralls will be worn if there is a possibility of soiling work attire.* *- PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* Level C protection upgrade will be done based on monitoring instrument results to the following: - Air-Purifying Respirator (APR) with organic vapor/HEPA cartridges for Chemical-protective clothing will consist of nitrile gloves with a cotton liner. Tyvek coveralls (unless free-phase product is encountered); Free-phase product or splash potential PVC or PE splash suit will be utilized as conditions dictate or at the direction of the FOL or SSO. **For Sites 2 and 4:** An upgrade to Level B is possible if sustained readings greater than 13 ppm are detected for methylene chloride. If this occurs, site personnel will suspend site activities until the situation can be further evaluated. **For Sites 3, 7, 8, 9, and 11:** Level C protection upgrade will be done based on monitoring instrument results to the following: - Air-Purifying Respirator (APR) with organic vapor/HEPA cartridges for any breathing zone readings greater than background levels but below 5 ppm. Chemical protective clothing will consist of impermeable boot covers, nitrile gloves with a cotton liner, Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PE splash suit. Any sustained breathing zone readings greater than 5 ppm above background levels will require the evacuation to a place of refuge and the immediate notification of the PHSO and PM. As site conditions may change the following equipment will be maintained during all on site activities - Fire Extinguishers (Strategically placed) - Basket stretcher, blankets, and first-aid kit	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g. boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the drilling operations bordering the support zone. This decontamination procedure for **Level D** protection will consist of - Equipment drop - Soap/water wash and rinse of outer gloves - Soap/water wash and rinse of the outer splash suit, and boots as applicable - Wash hands and face; leave contamination reduction zone For **Level C** in addition to that described above: **Note:** APR cartridge change-out would take place at this point. - Outer suit, boot covers, outer glove removal - Respiratory (face mask) protection removal - Wash hands and face; leave contamination reduction zone **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment, such as the Geoprobe and drill rigs, will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will be restricted access to exclusion zones, or also have their wheels/tires sprayed off so as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on site and that which is to leave the site. No equipment will be authorized access or exit without this authorization.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring/Type and Action Levels	Personal Protective Equipment	Decontamination Procedures
Decontamination of sampling and heavy equipment	***Chemical hazards:*** 1) Air, water, and particulate borne contaminants at low concentrations primarily consisting of metals, semi-volatile organics, and chlorinated hydrocarbons. - Decontamination fluids - Liquinox (detergent), isopropanol, methanol, hexane, and possibly 10% solution of nitric acid. ***Physical hazards:*** 2) Lifting (muscle strains and pulls) 3) Pinches and compressions 4) Noise	1) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. - Have a means by which the eyes and/or skin may be flushed (i.e., portable camp shower, emergency eyewash, etc.) readily accessible. - Obtain manufacturer's MSDS for any decontamination solvents used on-site. Users of solvents must review the MSDS and have ready access to it on-site. Maintain a Chemical Inventory and a file of MSDSs for all hazardous chemicals brought to the site. Users must observe MSDS requirements with regard to chemical use, storage, spill response, PPE, and other aspects. Use of solvents will be restricted to outdoor locations (i.e., this activity is restricted from inside a trailer or other small or poorly-ventilated space). 2) Use multiple persons where necessary for lifting and handling heavy pieces of equipment for decontamination purposes. 3) Place or stack equipment securely during decontamination and air drying to prevent unstable items from falling. 4) Steam/pressure washer operators will wear hearing protection. Other personnel will be restricted from the area (i.e., no closer than 20 feet) to minimize their potentials to exposure to noise, overspray, and flying projectiles.	1) Use visual observation, and real-time monitoring instrumentation to ensure all equipment and/or areas which has been cleaned and dried is properly cleaned of potentially contaminated medias (e.g., air, water, soils). **Elevated airborne concentrations impacting field crews or downwind receptors are not anticipated for this task.**	***For Drill Rigs:*** This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (Sleeved shirt; long pants) - Safety shoes or boots(Steel toe) - Chemical resistant boot covers - Nitrile outer gloves - Safety glasses underneath a splash shield - *PVC Rain suits or PE or PVC coated Tyvek as protection from splash as required* - Hearing protection (plugs or muffs) *Italicized PPE specifies optional equipment to be used as conditions dictate.* ***For sampling equipment including trowels, split spoons, bailers, etc.:*** Observe MSDS requirements, but not less than Level D Minimum requirements - - Standard field attire (Sleeved shirt; long pants) - Safety shoes or boots(Steel toe) - Nitrile outer gloves - Safety glasses underneath a splash shield In the event of overspray of chemical decontamination fluids employ PVC Rain suits or PE or PVC coated Tyvek as necessary. Respiratory protection is not anticipated for these activities.	This decontamination procedure for **Level D** protection will consist of - Soap/water wash and rinse of outer gloves and boot covers - Soap/water wash and rinse of the outer splash suit, as applicable - Remove boot covers - Remove outer gloves - Remove splash suit, as applicable - Wash hands and face, leave contamination reduction zone. **Equipment Decontamination** - All equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment such as drill rigs and backhoes, will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will be restricted access to exclusion zones, or also have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the on site activity. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on site and that which is to leave the site. No equipment will be authorized access or exit without this authorization. Evaluation will consist of - Visual inspection - Scanning equipment with monitoring instruments

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES SUMMARIZATION
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring/Type and Action Levels	Personal Protective Equipment*	Decontamination Procedures
Surveying activities (geographical, geophysical, electromagnetic geophysical and radiation surveys)	***Chemical hazards:*** **The majority, if not all, of the surveying will take place after site restoration has been completed. This will minimize any potentials for exposure resulting from surface contamination. Therefore, exposure to site contaminants during this activity is anticipated to be unlikely.** ***Physical hazards:*** 1) Slip, trips, and falls 2) Biological hazards (Insect/animal bites and stings, poisonous plants) 3) Inclement weather	1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain(i.e., rope ladders, etc.) 2) Avoid potential nesting areas of biting/stinging insects and animals. Use commercially available insect repellents. Avoid contact with poisonous vegetation. Wear appropriate clothing. Tape ankle and wrists areas to prevent ticks, chiggers, etc. from attaching themselves to you skin. Wear light colored clothing so that ticks and other biting insects can be easily visible and be removed. Follow directions as specified in section 6.2 concerning biological hazards. 3) All operations will be temporarily suspended during electrical storms. - Personnel must be aware of the conditions of heat stress and make it a practice to re-hydrate periodically as elevated temperature conditions dictate.	No air monitoring is needed given the unlikelihood that volatile contaminants are present. The potential for exposure to site contaminants during this activity is considered minimal. Minimize the generation of airborne dusts since many site contaminants are in the form of a particulate or may be bound to particulates.	Surveying activities shall be performed in Level D protection Level D Protection consists of the following: - Standard field dress including sleeved shirt and long pants - Steel-toe work boots or shoes - Safety glasses, hard hats (if working near machinery) - Snake chaps for heavily wooded area where encounters are likely. - Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks. Work gloves may be worn if desired.	Personnel Decontamination - A structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. However, survey parties should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.
Removal of Vegetation	***Chemical hazards:*** ***Chemical hazards associated with this task are not anticipated.*** ***Physical hazards:*** 1) Rotating/cutting machinery 2) Noise 3) Biological hazards (Insect/animal bites and stings) 4) Foot and equipment traffic	***Physical hazards:*** 1) All equipment to be employed will be - Inspected in accordance with OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Inspection Checklist provided in Attachment II of this HASP. - Only manufacturer approved parts may be used in repair of site equipment. - Operated by knowledgeable ground crew. - Restrictions at the operation (All personnel not directly supporting this clearance activity will remain at least 50-100 feet from the point of this operation). - Hand signals with the chipper operator, if one is employed, will be established prior to the commencement of activities. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - A back-hoe or the equivalent shall be used to pull away brush from the brush piles pushed together, which have sat for any extended period of time. This will be done to avoid reaching into potential nesting areas. Hands or feet shall **not** be used for this purpose. - Work areas will be kept clear of clutter. - Chain saws will be kept sharp to avoid personnel attempting to force the cutting action. 2) Due to operations generated noise levels, excessive noise control will be facilitated through the use of hearing protection. 3) Use insect repellents. Report potential hazards to the SSO. 4) Traffic considerations - Establish safe zones and routes of approach to the operation. - All personnel working in amongst equipment traffic are required to wear reflective vests for high visibility. - Secure all loose articles to avoid possible entanglement. - All self-propelled equipment shall be equipped with movement warning systems.	**It is not anticipated that field crews participating in this activity will be impacted by the site contaminants.** Air monitoring will not be conducted in support of this operation as encountering chemical contaminants is unlikely. The SSO will perform noise dosimetry to ensure the operational activities, and any contributional levels associated with the operation do not surpass the noise attenuation factors associated with the hearing protection selected. Traffic patterns will be dictated supporting on-site activities. However, regulated patterns in and about the work zones and support thereof will be established to safely control moving equipment, vehicles, and pedestrians around the area of operation.	The removal of vegetation is anticipated to be initiated in a modified Level D protection. Level D - (Minimum Requirements) For vegetation clearance activities: - Tyvek coveralls (Based on site conditions, time of the year, etc.) - Field attire (Sleeved shirt; long pants) - Safety shoes or boots(Steel toe) - Safety glasses/chippers shield - Hard-hat (when overhead hazards exists, or identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection - Work gloves - Chain saw chaps for chain saw operator As a contingency the following emergency equipment will be kept at the work site and available for use. - First-aid kit - Eyewash - Stretcher - Fire extinguisher	**Personnel Decontamination** It is not anticipated that site personnel engage in this task will encounter any of the associated site contaminants. Therefore, personnel decontamination will consist of - Equipment drop - Remove disposable outer protective garments as applicable - Wash hands and face, leave contamination reduction zone

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and biological hazards which may be associated with the NSWC - White Oak site and the activities that are to be conducted as part of the scope of work. Table 6-1 provides information related to the chemical hazards that may be present at the site. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are discussed in this table. Section 6.1 provides a general list of all contaminants that may be present at the site. Table 5-1 discusses what contaminants and physical hazards are associated with each of the proposed tasks that are to be performed at the seven sites. Additionally section 6.2 discusses potential biological hazards which may be encountered and the control measures necessary to minimize or eliminate these hazards.

6.1 CHEMICAL HAZARDS

NOTE: Exposure to any of the suspected contaminants at concentrations that could present a health hazard is unlikely given the low concentrations detected in previous samples at NSWC - White Oak, and the particulate nature of some of the contaminants expected to be encountered at these sites.

The potential health hazards associated with each of the sites include inhalation, ingestion, and dermal contact of various contaminants which may be present in shallow and deep soils as well as sediments and groundwater. As the focus of this field investigation is to conduct confirmation sampling of various media, to determine the exact type and concentrations of the chemical hazards which may be present. Information provided to date have not been all inclusive. Based on prior activities at these sites, however, there are numerous contaminants that are likely to be present and the following have been identified as the primary classes of hazards for the sites to be investigated:

- Metals
- Volatile organic compounds (VOCs)
- Semi-volatile organic compounds (SVOCs)
- Polynuclear aromatic hydrocarbons (PAHs)
- Total petroleum hydrocarbons (TPHs)

Table 6-1 provides information on the most common and significant of the substances likely to be present at NSWC - White Oak. Included is information on the toxicological, chemical, and physical properties of

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
NAVAL SURFACE WARFARE CENTER - WHITE OAK, SILVER SPRINGS, MARYLAND
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Methylene chloride	75-09-2	PID: I.P. 11.32 eV, High response with PID and 11.7 eV lamp. FID: 100% response with FID.	Air sample using charcoal or Anasorb CMS sorbent tube; carbon disulfide desorption; gas chromatography-flame ionization detector; Sampling and analytical protocol shall proceed in accordance with OSHA Method #59, 80, or NIOSH Method #1005.	OSHA: 50 ppm, 100 ppm (Ceiling) ACGIH: 50 ppm NIOSH: Lowest feasible concentration IDLH: 2300 ppm	Inadequate - Odor threshold 160 ppm. Use a gas mask with a Type N canister for concentrations up to 25 ppm. In excess of 25 ppm, use a supplied air respirator (airline respirator with emergency escape cylinder or a Self-Contained Breathing Apparatus - (SCBA). **Recommended gloves:** Nitrile rubber latex glove 3.00 hrs (vendor specific); supported Polyvinyl alcohol glove, unsupported 1-8 hrs; Silver shield 1.90 hrs	**Boiling Pt:** 104°F; 39.8°C **Melting Pt:** -141°F; -96°C **Solubility:** 2% **Flash Pt:** Not available **LEL/LFL:** 13% **UEL/UFL:** 12% **Vapor Density:** 2.93 **Vapor Pressure:** 380 mmHg @ 72°F; 22° C **Specific Gravity:** 1.33 **Incompatibilities:** Strong oxidizers, caustics, metals (i.e. aluminum, magnesium, potassium, sodium, lithium), and concentrated acids **Appearance and Odor:** Colorless liquid with a chloroform-like odor. (Note: A gas above 104°F; 40°C).	Effects of overexposure may include CNS effects - cause sleepiness, fatigue, weakness, lightheadedness, numbness of the limbs, altered cardiac rate and incoordination. These signs and symptoms may be accompanied by nausea, gastric and pulmonary irritation leading possibly to pulmonary edema. In addition to the narcosis long term effects may include liver injury. Listed as possessing carcinogenic properties by NTP, IARC, and ACGIH.
Trichloroethylene	79-01-6	PID: I.P. 9.45 eV, High response with PID and 10.2 eV lamp. FID: 70% Response with FID.	Air sample using charcoal tube; carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1022 or #1003.	OSHA: 50 ppm; 200 ppm (Ceiling) ACGIH: 50 ppm; 100 ppm STEL NIOSH: 25 ppm IDLH: 1000 ppm	Inadequate - Odor threshold 82 ppm. APRs with organic vapor/acid gas cartridges may be used for escape purposes. Exceedances over the exposure limits require the use of positive pressure-demand supplied air respirator. **Recommended gloves:** PV Alcohol unsupported >16.00 hrs; Silver shield >6.00 hrs; Teflon >24.00 hrs; or Viton >24.00 hrs; Nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection)	**Boiling Pt:** 188°F; 86.7°C **Melting Pt:** -99°F; -73°C **Solubility:** 0.1% @ 77°F; 25°C **Flash Pt:** 90°F; 32°C **LEL/LFL:** 8% @ 77°F; 25°C **UEL/UFL:** 10.5 @ 77°F; 25°C **Vapor Density:** 4.53 **Vapor Pressure:** 100 mmHg @ 90°F; 32° C **Specific Gravity:** 1.46 **Incompatibilities:** Strong caustics and alkalis, chemically active metals (barium, lithium, sodium, magnesium, titanium, and beryllium) **Appearance and Odor:** Colorless liquid with a chloroform type odor. Combustible liquid, however, burns with difficulty.	Central nervous system effects including euphoria, analgesia, anesthesia, paresthesia, headaches, tremors, vertigo, and somnolence. Damage to the liver, kidneys, heart, lungs, and skin have also been reported. Contact may result in irritation to the eyes, skin, and mucous membranes. Ingestion may result in GI disturbances including nausea, and vomiting NIOSH lists this substance a potential human carcinogen.

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these substances. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (drilling, test pit operations, sampling, etc.). Solvent compounds (VOCS) will present themselves as a inhalation hazard due to their physical properties under standard temperature and pressure. These compounds, however, should not be ruled out as a dermal hazard as a potential route of exposure. In addition, many of the contaminant compounds will present themselves as particulates or be bound to particulates. Exposure to these compounds is most likely to occur through inhalation of airborne particulates or through ingestion of contaminated soil or water through hand-to-mouth contact during soil disturbance activities.

6.2 BIOLOGICAL HAZARDS

During field based activities field personnel will have to contend with several biological hazards. These hazards including, but not limited to the following:

- Insect bites and stings
- Vector(Ticks and mosquito's) transmitted illnesses and diseases
- Snakes and other wild animal encounters
- Poisonous plants

In order to minimize or eliminate these hazards, the following control measures will be enacted where possible.

6.2.1 Insect Bites and Stings

Insect bites and stings are difficult to control given the climate and environmental setting of NSWC - White Oak. However, in an effort to minimize this hazard the following control measures will be enacted where possible.

- Commercially available bug sprays and repellents - The products will be permitted to be used only at the FOL's direction. In site areas where pesticides are identified as part of the analytical screening, the use of commercially available repellents will not be permitted. In areas where pesticides are not part of the overall analytical screening, the use of these products will be at the discretion of the FOL. Loose fitting clothing with long sleeves, where possible (given heat stress considerations) should be employ to provide a barrier between the field person and the insects. Products such as DEET should not be applied directly to the skin due to potential irritation. This product when permitted for use should be applied over clothing articles. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- The FOL and/or the SSO will preview all access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will flagged and communicated to all site personnel.

- All personnel will be directed in the administration of antidotes for personnel who suffer allergic reactions to bee stings. Commercially available bee sting kits as well as dermal applications for the bite areas will be maintained as part of the first-aid kit.

Note: To all personnel it is imperative that any allergic sensitization be reported on the medical data sheets and to the SSO. Additionally, any specific procedure for administering treatment as directed by your physician, be also communicated to enable the quickest and most efficient response possible.

6.2.2 Vector (Ticks And Mosquito's) Transmitted Illnesses And Diseases

Ticks and mosquitoes, in this case, are the primary vectors of concern. These insects have been identified in the transmission of diseases including Lymes disease and malaria. During warm months (spring through early fall) is the most predominant time for this hazard, however, due to the climate and environmental setting this hazard may occur year round.

Information concerning vector transmitted Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Attachment I of this HASP and in Section 4.0 of the Health and Safety Guidance Manual.

Malaria occurs when vectors such as mosquito sucks blood from an infected person becomes infected by the parasite. The parasite reproduces within the mosquito then is passed on to another person through the biting action.

Acute symptoms include chills accompanied by and followed by fever with its general flu like symptoms. This generally terminates in a sweating stage. These symptoms recur every 48 to 72 hours as the reproduction cycle of the parasite within the body of the host cycles.

Conditions such as this should not be taken for granted and should be reported to the SSO immediately.

6.2.3 Snakes And Other Wild Animal Encounters

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may have to be contended with, as part of this as part of this field operations.

This may be due to some of the work locations may encroach on nesting or territories claimed by these animals.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations.

- FOL and/or SSO will preview access routes and work locations for nesting areas, signs or animal activities (i.e., tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. Where avoidance of these areas or the animals which inhabit them is not possible, the relocation of animals and nests will be done through the coordination of the Maryland Fish and Wildlife Commission.

6.2.3.1 Snake Bites

As stated above, all initial efforts will be directed to avoid, where possible, nesting and territorial areas claimed by these reptiles. However, should field personnel come in close enough contact through startling these animals and receive a bite, the following actions are necessary.

1. Obtain a detailed description of the snake. This and the bite mark will enable medical personnel administering medical aid to provide prompt and correct antidotes as necessary.

2. Immobilize the bite victim to the extent possible. Physical exertion will mobilize the toxins (if poisonous varieties) from the bite point systemically through the body.

3. Apply a pressure wrap (for extremities), just above and over the bite area. With a couple wraps of the pressure wrap in place over the bite area, apply a splint, and continue the application of the pressure wrap. The purpose for the splint is to restrict the movement of the extremity, this along with the pressure wrap will aid in restricting the toxins from leaving the site of the bite.

4. Seek medical attention immediately.

6.2.4 Poisonous Plants

Various plants which can cause allergic reactions may be encountered during field work. These include, but not limited to, poison ivy, poison oak, and poison sumac. Interaction between field personnel may occur when clearing vegetation to access to and around work areas, or through movement through these plants. The mechanism which takes place occurs when direct contact is achieved between the plant and

the field person. Oils are transferred from the plant to exposed skin or clothing. The occurrence may also occur through hand to body transfer.

Protective measures to control and minimize the effects of this hazard, include, but not limited to, the following:

- Identify plants for field personnel. These are as follows:
  - Poison Ivy - Suspect plants are characterized climbing shrubbery, three leaf configuration ovate to elliptical in shape, greenish flowers, and white berries that produce irritating oils.

  - Poison Sumac - Suspect plants characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with axillary clusters of white fruit producing irritating oils.

  NOTE: These white fruits and berries may exist only during pubescent stages.

  - Poison oak - Suspect plants are characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.

Protective measures may include, but not limited to wear disposable garments such as Tyvek when clearing brush. These may be removed and disposed of along with any oils accumulated from the plants.

Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's protective skin layer is penetrated. This can accomplished through pores open when perspiring, cuts, nicks, scratches, etc.. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunch time, etc. wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the dermal layer.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and will not be addressed.

7.0 HAZARD MONITORING

This section presents requirements for the use of real-time air monitoring instruments during site activities. It establishes the types of instruments to be used. Information on specific instrumentation for specific tasks, the frequency of which they are to be used, techniques for their use, action levels for upgrading/downgrading levels of protection, and contaminants can be found in Table 5-1 of this document. Methods for instrument maintenance and calibration can be ascertained in Section 1.0 of the Health and Safety Guidance Manual.

7.1 INSTRUMENTS AND USE

The information provided in this section addresses the use of real-time monitoring instrumentation during on-site activities. These instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location. This approach (coupled with the use of personal protective equipment and the observance of the other control requirements presented in this HASP) has been selected to minimize potential for personnel exposures to hazardous concentrations of airborne contaminants. These instruments will be utilized as screening tools to detect the presence of some of the site contaminants identified within Table 6-1 in the air.

7.1.1 Photoionization Detector

Recognizing that the history of these sites included the use of a variety of solvents and chemical substances within the processes and activities performed at those locations. In order to accurately monitor for substances which may present an exposure potential to site personnel, a photoionization detector (PID) using lamp energies of 10.6 and 11.7 eV have been selected. These lamps will be used to monitor potential source areas and to screen the breathing zones of employees during the monitoring well installation, test pitting, and other subsurface or intrusive procedures. The PID has been selected because it is capable of detecting organic gases and vapors and some inorganic gases and vapors. In some cases the contaminants of concern will not be detected by the PID, so emphasis will be placed on engineering controls and PPE to control airborne particulate hazards.

Long term measurement Drager tubes for Methylene Chloride 100/a will be used as a back-up to further qualify and quantitate exposure levels for high risk employees.

Prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination.

These readings, any influencing conditions (i.e., weather, temperature, humidity), location, and the other information specified in the field operations logbook or preferably on the activities sheet (i.e., Boring log, sample log sheet, etc.).

7.1.2 Radiation Survey Meter

Conflicting information has been presented regarding NWSC - White Oak and radiological concerns. Information which arose and has persisted through historical accounts describe a radiological laboratory on-site. This, however, was never able to be confirmed. NWSC - White Oak was equipped with a license from the Nuclear Regulatory Commission for instruments and equipment with radiological sources. These sources have been accounted for under the licensing agreement. Due to this factor, it has been determined that radiological samples will be taken to confirm or deny the presence of radiological sources. Additionally, as the accounts as to how, when, and where these potential radiological sources were used or may have gone, subsurface soil extractions, samples selected for analytical analysis to be shipped off of NWSC - White Oak will require a radiological screening or frisking as it is more commonly referred to.

The radiological survey instrument to be employed at NWSC - White Oak will utilize a Ludlum Model 2 Survey Meter or a Victoreen Model 490, Thyac III with a Geiger-Mueller pancake probe for monitoring surface source activity.

7.1.3 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring and the action levels indicating when elevated levels of protection may be required, as it may apply to the tasks to be conducted. However, based on instrument responses and site observations, the SSO may decide to increases these frequencies. Reduction in monitoring frequencies will not be permitted without obtaining the prior consent of the PHSO and the CLEAN HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Hazard monitoring instruments will be maintained and pre-field calibrated by the B&R Environmental Equipment Manager or the manufacturer (in the case of the radiation survey meter). Operational checks and field calibration will be performed on all instruments each day prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure (copies of which

can be found in the B&R Health & Safety Guidance Manual which will be maintained on site for reference). All calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field Health and Safety Logbook, provided that all of the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

7.3 PARTICULATES

It is not anticipated that significant concentrations of dusts will be generated as a result of site activities. If dusts are generated during site operations, exposure to these dusts will be minimized by the use of area wetting methods and/or avoidance of the dusts (moving upwind of source, evacuation, etc.). Monitoring for particulates, therefore, is not anticipated for this project.

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ PROJECT NO.: _____

Date of Calibration	Instrument Name and Model	B & R Environmental Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for both B&R Environmental and subcontractor personnel participating in site activities.

8.1.1 Requirements for B&R Environmental Personnel

All B&R Environmental personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the NSWC - White Oak. Additionally, B&R Environmental personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of B&R Environmental introductory, supervisory, and refresher training as well as site-specific training will be maintained at the project. Copies of certificates or other official documentation will be used to fulfill this requirement.

B&R Environmental will also conduct a brief meeting daily to discuss operations planned for that day and to issue Safe Work Permits for those operations. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered. This activity will be supported through the use of a Safe Work Permit System (See Section 10.10).

8.1.2 Requirements for Subcontractors

All B&R Environmental subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at the NSWC - White Oak. All subcontractor personnel serving as supervisors must also provide documentation of supervisory training as per 29 CFR 1910.120(e)(4). B&R Environmental subcontractors must certify that each employee has had such training by sending B&R Environmental a letter, on company letterhead, containing the information in the example letter provided as in Figure 8-1 and by providing copies of certificates for all subcontractor personnel participating in site activities.

FIGURE 8-1

TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. R. D. George
Project Manager
B&R Environmental
Foster Plaza 7, 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training for NSWC - White Oak, Silver Springs, Maryland

Dear Mr. George:

As an officer of XYZ Corporation, I hereby state that I am aware of the potential hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 126.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as applicable and as required by 29 CFR 1910.120(e)(8) and that site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

Enclosed: Copies of Training Certificates

8.2 SITE-SPECIFIC TRAINING

B&R Environmental will provide site-specific training to all B&R Environmental employees and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to all personnel [U.S. Department of Defense (DOD), EPA, etc.] who may wish to enter exclusion zones of the site to perform functions that may or may not be directly related to site operations during site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Use and application of the Safe Work Permits
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets

Site-specific documentation will be established through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for B&R Environmental Personnel

All B&R Environmental personnel participating in project field activities will have had a physical examination meeting the requirements of B&R Environmental's medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection

Documentation for medical clearances will be maintained in the B&R Environmental Pittsburgh office and made available, as necessary.

FIGURE 8-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing remedial investigation activities at NSWC - White Oak, Silver Springs, Maryland, and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Use and application of the Safe Work Permits
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

I further state, by the presence of my signature below, that the dates provided pertaining to my training (introductory, refresher, and supervisory, as applicable) and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name	40-Hour General Site Worker Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Date of Medical Surveillance	SIGNATURE

8.3.2 Medical Surveillance Requirements for Subcontractors

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

8.3.3 Requirements for All Field Personnel

Each field team member (including subcontractors) and visitors entering the exclusion zone(s) shall be required to complete and submit a copy of Medical Data Sheet presented in Section 7 of the Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

Subcontractors who will not enter the exclusion zone during operation, and whose activities involve no potential for exposure to site contaminants, may not be required to meet the requirements for training/medical surveillance other than site-specific training as stipulated in Section 8.2. This exception can only be granted under the sole authority of the CLEAN HSM.

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____
Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the NSWC - White Oak work site
   ( ) not qualified to perform work at the NSWC - White Oak work site

   and,

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

   _____
   _____
   _____

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

   _____
   _____
   _____

3. Recommended limitations upon the employee's assigned work:

   _____
   _____
   _____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the NSWC - White Oak work site, this participant

( ) may
( ) not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

_____
Address

FIGURE 8-4

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. R. D. George
Project Manager
B&R Environmental Corp.
Foster Plaza 7, 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance for NSWC - White Oak, Silver Springs, Maryland

Dear Mr. George:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative-pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the NSWC - White Oak, Silver Springs, Maryland site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

9.0 SPILL CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

It is anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) will be handled during some of the site activities conducted as part of the scope of work. Significant quantities of waste water (decontamination, purge and development) and Investigative-Derived Wastes (IDW) may be generated as part of site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Further, it is possible that as the job progresses disposable PPE and other non-reusable items may be generated. As needed, 55 -gallon drums will be used to contain waste waters, IDW, and other unwanted items generated during investigatory activities. These drums will be labeled with the site name (SWMU and location), drum number, the type of contents (purge waters), volume, the date, point of contact with telephone number. An updated Inventory Log will be provided to the Base Contact (Mr. Bob Ridgway) and to the PM at the termination of every 10-day shift. This will be done to keep a running tab of containers retained within an established marshaling area.

Samples will be collected and analyzed to characterized the material and determine appropriate disposal measures. Once characterized they can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, there are various areas vulnerable to this hazard including the following:

- Areas used for central staging of resources
- Areas used for central staging of IDW materials
- Decontamination area

Additionally, areas designated for handling, loading, and unloading of potentially contaminated soils, waters, and debris present limited potential for leaks or spills. Monitoring of these areas will be done at least weekly.

9.2.1 Site Drums/Containers

All drums/containers used for containing soils and liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal. Drums used for the storage and transportation of IDW will meet the packaging requirements for steel drums category U.N. 1A2, removable head as specified in paragraph 9.6.1, United Nations Transport of Dangerous Goods.

9.2.1.1 Staging Area Configuration

The staging or marshaling area as referred to before will be configured to support this spill prevention and control program. The area will be configured as follows:

- Where possible secondary containment should be provided. This would include a bermed area sufficient in size to hold 10% of the total volume or the largest container whichever is greater. This calculation of secondary containment should also consider any displacement by containers or pallets. This bermed area should be lined (plastic liner or other impermeable surface) to prevent any spillage inside the containment from saturating the ground.

- Drums will be organized no more than four to a pallet. The drums label and the head bolt arranged as such to permit reading/review or removal of the head without requiring the drum to be moved on the pallet. Drums will be segregated to site and media. A minimum of two feet shall be maintained between each row of pallets to permit access for spill response measures.

9.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic (once a week) walk around by the SSO will be conducted during working hours to visually determine that containers are not leaking. If a leak is detected, the first approach will be to transfer the container contents using a hand pump into a new container. Other provisions for the transfer of container contents will be made and appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand, which will be stored at the staging area in a conspicuously marked drum. This material too, will be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

9.4 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed on the procedures for spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

9.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment which will be maintained at the staging area at all times for the purpose of supporting this Spill Prevention/Containment Program.

Spill Response Equipment:

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.N 1A2)
- Portable storage tanks or additional drums
- Shovels, rakes, and brooms
- Hand operated drum pump with hose
- Labels
- Drum Patch kit

PPE stored at the staging area:

- Rubber boot covers, nitrile outer gloves, PVC rain-suit or other form of impermeable splash protection, should it be required.

9.6 SPILL CONTROL PLAN

This section describes the procedures the B&R Environmental field crew members will employ upon the detection of a spill or leak.

1) Notify the SSO or FOL immediately upon the detection of a leak or spill.

2) Employ the personnel protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the drum or raising the leak to the highest point. Spread the absorbent material in the area of the spill covering completely.

3) Transfer the material to a new container, collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.

4) All spills occurring on soils, grassy areas, gravel lots will be re-containerized including 2-inches of top cover on which the spill occurred, and await test results for treatment or disposal options.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur notification of appropriate emergency response agencies will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which B&R Environmental will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

10.1 EXCLUSION ZONE

The exclusion zone will be considered those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are present in the proposed work areas of this site. It is anticipated that this will remain so until/unless contaminants are brought to the surface by intrusive activities, such as soil boring or sampling operations. Furthermore, once intrusive activities have been completed and surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the contamination reduction zone. Therefore, the exclusion zones for this project will be limited to those areas of the site where active work is being performed plus a designated area surrounding the point of operation (see Table 5-1 for specific operation). The exclusion zone for this activity will be fragmented to represent the areas where the soil is disturbed through drilling, direct push, test pit operations, or sampling activities. When possible, exclusion zones will be delineated using barrier tape, cones and/or drive poles, and postings to inform personnel other than the field crew.

10.1.1 Exclusion Zone Clearance

Prior to the initiation of site activities, utility locations will be identified by commercial utility location companies and drawings made available through the NSWC - White Oak Contact (Mr. Robert Ridgway). The positions of identified utilities will be field located and staked, to minimize the potential for damage during intrusive activities. Sample locations can be located to avoid buried utilities. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Section 2.9 and Table 2-1 will be notified.

Access to work areas will be controlled by B&R Environmental personnel. No persons will be permitted to enter site exclusion zones without site-specific training. Site visitors will be provided site-specific training and will be escorted by B&R Environmental personnel at all times (see Section 10.4).

10.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. The personnel and equipment decontamination will not take place in this area, but will take place at a central location established for this project. This area instead will serve as a focal point in supporting exclusion zone activities. When applicable, this area will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct facility personnel.

10.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

10.4 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by B&R Environmental
- Regulatory personnel (EPA, OSHA, etc.)
- NSWC - White Oak or DOD Personnel
- Other authorized visitors

All personnel working on this project are required to gain initial access to the NSWC - White Oak by coordinating with the B&R Environmental FOL or designee and following established NSWC - White Oak access procedures.

Once access to NSWC - White Oak is obtained, all personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and SSO. The prerequisites for all site visitors wishing to observe operations in progress in the exclusion zone are discussed below:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- All site visitors will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training (40-hours of HAZWOPER training) and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. All visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Any and all visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all on-site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the Base Contact and GSA Physical Security. All site visitors granted access to the exclusion zones during ongoing operations will be escorted by a B&R Environmental representative (arranged for by the FOL) at all times while the visitor remains in the exclusion zone.

10.5 SITE SECURITY

B&R Environmental will retain control over active operational areas. The FOL will serve as a focal point for site personnel, and will serve and the final line of security for the work areas. As stated above all work will cease in the event of unauthorized personnel entering the exclusion zone. Work will remain temporarily suspended until the unauthorized visitor can be removed. The Base Contact will serve as the primary enforcement contact for removing unauthorized visitors.

10.6 SITE MAP

Once the areas of contamination, access routes, utilities, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. These maps will show utility locations, potential points of contact with the public, roadways, and other significant characteristics that may impact site operations and safety. Site maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

10.7 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

10.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

B&R Environmental and subcontractor personnel will provide MSDSs for all chemicals brought on-site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of these substances on site. A chemical inventory of all chemicals used on site will be developed using Tab 5 of the Health and Safety Guidance Manual. A copy of the Chemical Inventory List will be provided to the Fire Department, as they would serve as primary responders to the work/storage trailer should the need arise. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

10.9 COMMUNICATION

As personnel may not always be working in proximity to one another during field activities, a supported means of communication between field crews will be used as necessary. As a result, two-way radio communication devices will be used by field personnel while at the site. All two-way radio communications intended for use at NSWC - White Oak, will have GSA approval prior to being brought on-site for use.

External communication will be accomplished by using provided telephones at the site. External communication will primarily be used for the purpose of resource and emergency resource communications.

10.10 SAFE WORK PERMITS

All exclusion zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used is illustrated in Figure 10-1. These work permits will be further supported by the daily meetings conducted during their generation. This effort will ensure all site specific considerations and changing conditions are incorporated into the planning effort. All permits will require the signature of the FOL and/or SSO. All personnel engaged in on-site activities will be aware of the elements indicating levels of protection and precautionary measures to be used.

Use of these permits will provide the communication line for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The safe work permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

Upon completion of work specified on the Safe Work Permit, the person accepting the permit will return it to the SSO.

Any problems encountered regarding control measures taken will be annotated on the permit or a separate sheet of paper and returned to the SSO for review and evaluation.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): _____

Equipment used: _____

II. Names: _____

III. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
B&RE

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☐ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☐

Modifications/Exceptions: _____

V.

Chemicals of Concern	Action Level(s)	Response Measures

VI. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type)	☐ Yes	☐ No
Steel toe Work shoes or boots	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No

Modifications/Exceptions: _____

VII.

	Yes	NA		Yes	NA
Procedure review with permit acceptors					
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces**. A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed and this HASP modified accordingly.

12.0 MATERIALS AND DOCUMENTATION

The B&R Environmental FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on site, including decon solutions, fuels, lime, sample preservatives, calibration gases, etc.
- Follow-up Reports
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted at the site for quick reference purposes. In situations where posting of these documents is not feasible (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing - This list represents all chemicals brought on site, including decontamination solutions, sample preservatives, fuel, calibration gases, etc.. This list should be posted in a central area.

Material Safety Data Sheets (MSDSs) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance Posting - This listed is found within the training section of the HASP (See Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards - Medical Data Sheets will be filled out by all on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) - This standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring - All results generated through personnel sampling (levels of airborne toxics, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels - Where chemical inventories have been separated, because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable [Hazard Communication 29 CFR 1910.1200 (f)] labels.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
AOC	Area of Concern
CFR	Code of Federal Regulations
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
DOD	Department of Defense
DOT	Department of Transportation
EPA	Environmental Protection Agency
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
LEL/O_2	Lower Explosive Limit/Oxygen
N/A	Not Available
NIOSH	National Institute Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PVC	Poly Vinyl Chloride
SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
SWMU	Solid Waste Management Unit
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
UV	Ultra Violet
WP	Work Plan

ATTACHMENT I

TICK CONTROL
AND
LYME DISEASE

TICK CONTROL
AND
LYME DISEASE

The occurrence of Lyme disease has become a worldwide problem since its identification in 1976. This disease is characteristically recognized as being transmitted by ticks, which may be encountered by field personnel while working at this site. As a result, this discussion has been included with this Health and Safety Plan to provide for adequate recognition, evaluation, and control efforts to minimize the occurrence and effects of this potential hazard.

The discovery of Lyme disease is credited to Dr. Allen Steere of Yale University Medical School, and is named after the community where it was (reportedly) first encountered, Lyme, Connecticut. This disease can be transmitted to man through the bite of ticks that are infected with a cork screw-shaped microbe (spirochete). The spread of this disease has been so rapid that in 1984 it surpassed Rocky Mountain Spotted fever as the most common tick-borne disease in the United States. In this country, most of the incidents of this disease have been recorded in the Northeast, and the tick species most commonly attributed with its spread is the deer tick.

Recognition

This hazard potential exists primarily in the spring and summer months, as these are the seasons that tick populations and activity flourish. In fact, 90 percent of the reported cases have occurred from early June through September. Also, this concern exists primarily in heavily vegetated areas. Therefore, recognition of these factors can aid in the awareness and control of this threat.

To aid in the recognition and identification of these insects, an example illustration of the tick species common to the region where this site is located has been included with this discussion. This species (the American Dog tick) is common in the eastern half of the United States, and typically exists in areas covered with grass or underbrush. These insects will attach themselves to animals (including man) that pass through the area and rub against them. After finding a host, the tick inserts its mouthparts and sucks blood until it is fully engorged. This requires a time period of three to twelve days, then the tick will drop off. In addition to Lyme disease concerns, this tick has also been identified as a transmitter of Rocky Mountain Spotted Fever, and the organisms of tularemia and possibly relapsing fever. The wounds left by tick bites can be painful, and can also have a paralyzing effect commonly referred to as tick paralysis.

The earliest symptom of the onset of this disease is the occurrence of an unusual red skin rash. This is commonly the first indication since it has been evidenced that many persons who have contracted this disease were, in fact, unaware that they had been bitten. This rash can appear at the site of the bite anywhere from several days to a few weeks after the bite. It typically starts as a small red spot, and then expands as the spirochetes expand from the bite location. Rash sizes can vary, but have been most commonly associated in a 2 to 3 inch diameter size range. This rash will fade (with or without treatment) after a few weeks. Close inspection is necessary to detect this symptom as the rashes are easy to miss because they're often very faint. Body sites where rashes frequently occur include the thigh areas, groin, and armpits. Also, it is not uncommon for a rash to develop in more than one place.

Other early symptoms include profound fatigue, a stiff neck, and flu-like symptoms such as headache, chills, fever, and muscle aches. Recognition of the onset of any of these symptoms is important since tick bites do not always produce a rash. If left untreated, the disease will progress to its second stage within weeks or months after the infection. This stage involves affects to the heart and nervous system. A common second stage symptom is a paralysis on one or both sides of the face. Others include severe headache, encephalitis, or meningitis. The third and final stage involves the development of chronic inflammatory arthritis, which can occur up to a year or more after the bite.

Evaluation

Evaluation of this hazard potential principally involves field personnel performing close self-inspections for the presence of ticks each time they leave the site. This should involve careful examination, especially of the individuals' heads. Personnel should be aware that when a tick attaches itself to its host, it inserts its entire head under the surface of the skin.

Control

Control of this threat involves several components. First, field personnel must be aware of the climate and area conditions which are commonly associated with being conducive to tick infestation. Second, when working in or walking through potential infested areas, personnel must ensure that they do not have exposed body parts (i.e. at least long sleeved shirts and long pants, particularly when protective coveralls are not worn). In heavily vegetated areas where infestation is likely, Tyvek coveralls will be required to minimize this hazard potential. Also, several commercial products have been demonstrated as being effective in repelling ticks. Examples include Permanone, Off!, and Cutter. These types of repellents will be used at the direction and discretion of the Brown & Root Environmental Health and Safety Officer, and only in accordance and observation of manufacturer's recommendations. In most instances, however, such repellents are typically applied to the outside surfaces of clothing (and not directly onto the skin), and should be applied also to shoe tops, socks, pants cuffs, and other areas most susceptible to ticks.

Tick Removal

In the event that a tick is discovered to be attached to a member of the field team, timely removal of the insect is critical to reducing the potential for contracting the disease. According to available information and research, there is apparently a grace period of at least a few hours from the time of the bite before the tick transmits the microbe (the spirochetes are not present in the mouth parts of the tick). However, the incident of a tick bite is frequently unnoticed, and the discovery of the tick may not occur until after this suspected grace period has already elapsed. Therefore, timely removal is very important. The preferred method of tick removal is to pull it out using tweezers or small forceps. In this method, the tick should be grasped as close to the mouth as possible, and then pulled steadily upward. Care must be exercised so as not to pull in a jerking motion as this can result in the head becoming detached. After the tick has been removed, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). The tick must not be handled as the microbes can enter the body through any breaks in intact skin. The bite should be checked occasionally for at least a two-week period to see if a rash forms. If it does, medical attention must be promptly sought.

In order to provide for proper and timely response to the occurrence of a tick bite, the SSO will ensure that the site First Aid kit is properly equipped with medical forceps and rubbing alcohol, in addition to the standard kit contents. Also, an adequate supply of commercial insect (tick) repellents will be maintained on-site, and all personnel will be trained in its proper application and will be required to use it, at the direction of FOL.

ATTACHMENT II

EQUIPMENT INSPECTION CHECKLIST

EQUIPMENT INSPECTION

COMPANY: **UNIT NO.**
FREQUENCY: Inspect daily, document prior to use and as repairs are needed.

Inspection Date: ____/____/____ Time: _____ Equipment Type: (e.g., bulldozer)

	Good	Need Repair	N/A
Tires or tracks	☐	☐	☐
Hoses and belts	☐	☐	☐
Cab, mirrors, safety glass	☐	☐	☐
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	☐	☐	☐
- Is the equipment equipped with audible back-up alarms and back-up lights?	☐	☐	☐
Horn and gauges	☐	☐	☐
Brake condition (dynamic, park, etc.)	☐	☐	☐
Fire extinguisher (Type/Rating -_____)	☐	☐	☐
Fluid Levels:			
- Engine oil	☐	☐	☐
- Transmission fluid	☐	☐	☐
- Brake fluid	☐	☐	☐
- Cooling system fluid	☐	☐	☐
- Windshield wipers	☐	☐	☐
- Hydraulic oil	☐	☐	☐
Oil leak/lube	☐	☐	☐
Coupling devices and connectors	☐	☐	☐
Exhaust system	☐	☐	☐
Blade/boom/ripper condition	☐	☐	☐
Accessways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	☐	☐	☐
Power cable and/or hoist cable	☐	☐	☐
Steering (standard and emergency)	☐	☐	☐

Safety Guards:

	Yes	No
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?	☐	☐
– Hot pipes and surfaces exposed to accidental contact?	☐	☐
– All emergency shut offs have been identified and communicated to the field crew?	☐	☐
– Have emergency shutoffs been field tested?	☐	☐
– Results?	☐	☐
– Are any structural members bent, rusted, or otherwise show signs of damage?	☐	☐

EQUIPMENT INSPECTION (Continued)

- Are fueling cans used with this equipment approved type safety cans? ❒ ❒
- Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use? ❒ ❒

Portable Power Tools:

- Tools and Equipment in Safe Condition? ❒ ❒
- Saw blades, grinding wheels free from recognizable defects (grinding wheels have been sounded)? ❒ ❒
- Portable electric tools properly grounded? ❒ ❒
- Damage to electrical power cords? ❒ ❒
- Blade guards in place? ❒ ❒
- Components adjusted as per manufacturers recommendation? ❒ ❒

Cleanliness:

- Overall condition (is the decontamination performed prior to arrival on-site considered acceptable)?
- Where was this equipment used prior to its arrival on site?
- Site Contaminants of concern at the previous site?
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?
- Does the operator, understand the equipments operating instructions?
- Is the operator experienced with this equipment?
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?
- Is the operator 21 years of age or more?

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?

Additional Inspection Required Prior to Use On-Site

	Yes	No
Does equipment emit noise levels above 90 decibels?	❒	❒
If so, has an 8-hour noise dosimetry test been performed?	❒	❒

- Results of noise dosimetry:
- Defects and repairs needed:
- General Safety Condition:
- Operator or mechanic signature:

Approved for Use: ❒ Yes ❒ No

Site Safety Officer Signature

ATTACHMENT III

OSHA FORM 101

Bureau of Labor Statistics
Supplementary Record of
Occupational Injuries and Illnesses

U.S. Department of Labor

This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain can result in the issuance of citations and assessment of penalties.	Case or File No.	Form Approved O.M.B. No. 1220-0029

Employer

1. Name
2. Mail address *(No. and street, city or town, State, and zip code)*
3. Location, if different from mail address

Injured or Ill Employee

4. Name *(First, middle, and last)* — Social Security No.
5. Home address *(No. and street, city or town, State, and zip code)*
6. Age — 7. Sex *(Check one)* Male ☐ Female ☐
8. Occupation *(Enter regular job title, not the specific activity he was performing at time of injury.)*
9. Department *(Enter name of department or division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)*

The Accident or Exposure to Occupational Illness

If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurred on a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury as accurately as possible.

10. Place of accident or exposure *(No. and street, city or town, State, and zip code)*
11. Was place of accident or exposure on employer's premises? Yes ☐ No ☐
12. What was the employee doing when injured? *(Be specific. If he was using tools or equipment or handling material, name them and tell what he was doing with them.)*
13. How did the accident occur? *(Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happened. Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident. Use separate sheet for additional space.)*

Occupational Injury or Occupational Illness

14. Describe the injury or illness in detail and indicate the part of body affected. *(E.g., amputation of right index finger at second joint; fracture of ribs; lead poisoning; dermatitis of left hand, etc.)*
15. Name the object or substance which directly injured the employee. *(For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc., the thing he was lifting, pulling, etc.)*
16. Date of injury or initial diagnosis of occupational illness — 17. Did employee die? *(Check one)* Yes ☐ No ☐

Other

18. Name and address of physician
19. If hospitalized, name and address of hospital

Date of report	Prepared by	Official position

OSHA No. 101 (Feb. 1981)

APPENDIX D

SITE 2 - HISTORICAL DATA

Groundwater Level Measurements
Confirmatory Study - Summary of Analytical Data
Phase I RI Summary Data
Phase II RI Summary Data
Design Verification Study - Soil/Sediment Results
Groundwater Characterization Study - Summary of Analytical Data

Groundwater Level Measurements

	WELL ID	RIM ELEV (ft)	GW ELEV (ft)	GW DEPTH (ft)	GW DEPTH (ft)	GW DEPTH (ft)	GW DEPTH (ft)
			3/29/95	3/29/95	6/16/97	10/9/97	12/23/97
SITE 2							
	2GW30	299.10	293.00	6.10	5.80	6.30	15.60
	2GW31	314.35	299.95	14.40	14.19	16.77	5.95
	2GW32	305.32	298.52	6.80	6.31	6.81	5.88
	2GW45	298.39	292.79	5.60	5.20	7.70	6.51
	2GW76	341.20	321.80	19.40	15.17	19.81	19.36
SITE 3							
	3GW17	223.62	217.12	6.50	5.45	8.49	7.09
	3GW18	222.23	215.93	6.30	5.53	8.17	7.27
	3GW19	220.75	213.25	7.50	8.01	8.37	8.28
	3GW47	214.91	206.81	8.10	7.86	8.31	7.82
	3GW77	211.12	203.52	7.60	7.35	8.33	7.77
	3GW78D	214.53	205.63	8.90	7.72	11.00	10.40
	3GW78S	215.29	204.39	10.90	9.28	11.99	9.24
SITE 4							
	4GW10	284.19	250.49	33.70	25.68	30.82	32.91
	4GW11	280.12	249.62	30.50	22.29	27.14	28.89
	4GW11A	278.22	271.72	6.50	6.63	9.10	9.16
	4GW12	288.24	247.24	41.00	31.93	37.54	39.60
	4GW13	298.75	245.85	52.90	43.45	49.11	51.33
	4GW15	293.74	248.44	45.30	36.22	41.37	43.31
	4GW48	287.78	251.88	35.90	29.27	34.64	37.32
	4GW49D	294.00	294.00	0.00	35.51	41.42	42.50
	4GW49S	293.13	248.63	44.50	36.32	40.61	43.35
	4GW50	307.32	244.02	63.30	54.10	59.64	61.78
	4GW51S	304.59	304.59	0.00	50.72	56.59	58.78
	4GW52	297.38	246.58	50.80	41.38	47.21	56.69
	4GW79	304.13	243.53	60.60	51.66	57.10	60.31
	4GW80	299.29	243.69	55.60	46.22	51.93	54.10
	4GW81D	303.03	243.53	59.50	49.78	55.56	68.30
	4GW81S	303.33	243.43	59.90	50.54	56.26	58.40
	4GW82	288.36	246.76	41.60	33.14	37.96	40.07
	4PZ89				50.36	55.85	57.86
	4GW101						60.78
SITE 5							
	5GW01						13.97
	5GW02						23.70
SITE 7							
	7GW08	282.35	244.95	37.40	32.47	37.38	39.21
	7GW41	293.50	241.20	52.30	44.27	49.42	51.22
	7GW43	289.59	241.59	48.00	38.78	44.63	46.68
	7PZ42	292.01	241.81	50.20	41.85	46.98	48.78
	7GW101						27.40
SITE 8							
	8GW33	287.39	247.69	39.70	31.98	37.73	39.89
	8GW34	280.49	245.89	34.60	26.09	33.54	35.20
	8GW35	279.56	247.46	32.10	25.09	32.21	33.22
	8GW36	279.98	248.18	31.80	24.83	31.34	32.36
	8GW53	283.52	249.62	33.90	26.41	32.34	33.58
SITE 9							
	9GW01	207.47	191.77	15.70	15.09	16.94	16.52
	9GW02	197.62	188.82	8.80	8.62	9.33	8.88
	9GW03	222.98	211.48	11.50	10.58	11.67	11.17
	9GW04	250.84	234.24	16.60	10.20	15.27	16.65
	9GW05	290.67	239.07	51.60	42.96	49.00	50.31
	9GW05B	282.86					
	9GW06	297.77	240.87	56.90	47.02	53.30	55.48
	9GW07	299.15	241.55	57.60	47.46	53.88	56.02
	9GW57D	201.28	187.28	14.00	13.70	15.34	14.59
	9GW57S	202.08	190.88	11.20	10.84	12.53	11.99
	9GW58				35.16	41.90	43.87
	9GW59	231.96	222.66	9.30	7.73	10.47	9.71
	9GW74	201.15	191.75	9.40	9.61	14.01	10.69
	9GW75	245.43	235.43	10.00	7.34	10.52	11.39
	9GW83	163.27	153.97	9.30	9.32	9.79	9.30
	9PZ44	276.46	236.56	39.90	32.36	38.86	40.07
	9PZ55	262.73	226.43	36.30	31.55	35.59	36.35
	9PZ56	246.70	233.20	13.50			
SITE 11							
	11GW22	371.99	344.59	27.40	23.01	27.20	28.12
	11GW23	373.24	342.84	30.40	26.45	30.18	30.84
	11GW24	361.11	340.51	20.60	18.09	21.32	21.41
	11GW25	359.28	337.78	21.50	18.95	21.74	22.10
	11GW26	356.14	338.44	17.70	15.83	19.02	18.11
	11GW27	356.88	339.58	17.30	15.20	18.70	18.45

	WELL ID	RIM ELEV (ft)	GW ELEV (ft)	GW DEPTH (ft)	GW DEPTH (ft)	GW DEPTH (ft)	GW DEPTH (ft)
			3/29/96	3/29/96	6/16/97	10/9/97	12/23/97
	11GW28	349.84	332.04	17.80	16.86	19.20	18.72
	11GW29	333.00	319.40	13.60	12.61	13.80	13.24
	11PZ62	338.40	333.60	4.80	5.44	8.55	5.67
	11PZ63	378.03	361.23	16.80	12.45	20.93	20.81
	11PZ64	360.49	334.59	25.90	26.30	28.70	39.15
	11PZ65	372.56	355.16	17.40	13.30	24.51	22.85
	11GW66	348.73	337.63	11.10	10.41	14.90	11.48
	11GW67	348.55	335.85	12.70	12.85	16.29	14.05
	11GW68	348.69	332.09	16.60	14.51	19.32	19.09
	11GW69	367.99	341.79	26.20	23.09	27.13	26.82
	11GW70D	354.47	320.67	33.80	33.20	35.49	34.17
	11GW71	352.71	339.51	13.20	11.57	14.11	13.27
	11GW72	351.99	332.49	19.50	20.20	23.52	21.72
	11GW73	343.41	322.91	20.50	16.35	21.79	22.14
	11GW84	351.25	335.95	15.30	14.90	18.88	16.63
	11GW85	365.83	334.23	31.60	29.94	32.81	32.18
	11GW86	346.79	330.59	16.20	14.76	17.51	16.76
	11GW87	343.66	328.06	15.60	14.42	16.56	14.63
	11GW88	359.11	340.81	18.30	15.55	18.87	18.83
	11GW101					30.11	31.10
	11GW102					27.74	28.09
	11GW103					34.44	34.91
	11GW104					25.27	24.12
SITE 46							
	46GW121						53.11
	46GW122						28.84
	46GW123						20.51
	46GW124						18.26
	46GW125						9.11
BACKGROUND							
	BGGW16	310.90	340.81	-29.91	47.55	52.37	53.70
	BGGW40	397.33	375.83	21.50	19.15	21.89	21.84
	BGW100						26.64
	BGW101						22.28
	BGW02						31.19
ARL							
	A-1						15.57
	A-2						5.14
	A-3						18.92
	A-4						18.97
	C-5						23.64
	C-6						17.28
	C-7						8.32
	C-8						7.02
	C-9						13.29
	C-10						7.17
	C-11						23.22
	C-13						2.10
	C-14						19.55
	C-15						9.94

Confirmatory Study - Summary of Analytical Data

N

Table 8

SITE 2 (Apple Orchard Landfill) - ELEVATED PARAMETER VALUES

Sample Location	Event(s)	Parameter	Analytical Value(s)
2GW30	A	TOC	36
	B	TOX	135
	A, B	TDS	1746, 2108
	A, B	pH	5.0, 4.9
	A, B	Conductivity	3900, 4300
	A, B	Trichloroflouromethane	8, 12
	B	Trichloroethylene	6
2GW31	A	Cadmium	17
	A	Chromium	216
	A	Nickel	316
	A	Lead	95
2GW32	A, B	Cadmium	29, 28
	A, B	Nickel	609, 557
	A	Lead	70
	A, B	TOX	112, 665
	A, B	TDS	2930, 30000
	A, B	pH	4.5, 3.8
	A, B	Conductivity	25000, 40000
	A	Trichloroethylene	17
	A	Trichloroflouromethane	24
2SW1	A	TOC	37
	A	TOX	191
	A	TDS	1370
	A, B	Conductivity	3500, 1700
2SW2	A	TOX	160
	A, B	Conductivity	1700, 2150
2SW3	A, B	TOX	144, 241
	A, B	Conductivity	2150, 1750

Notes

Metals (ug/L)
TOX (ug/L)
TDS (mg/L)
Conductivity (umhos)
Oil & Grease (mg/L)
TOC (mg/L)
pH (su)
VOC (ug/L)
Nitroaromatics (ug/L)

Phase I RI Summary Data

TABLE 2-3
SITE 2 – APPLE ORCHARD LANDFILL
STREAM SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations												Detection Limit	Units
	2SD1	2SD2	2SD3	2SD4	2SD5	2SD7	2SD9	2SD10	2SD11	2SD12	2SL1	2SL2		
TOTAL METALS:														
Cadmium	U	U	U	U	U	[illegible]	U	1.9	0.87	U	U	U	0.78	mg/kg
Chromium	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.3	15.2	22.9	34.4	0.70	mg/kg
Copper	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32.4	[illegible]	23.8	26.7	16.2	33.6	28.5	0.30	mg/kg
Lead	12.6	[illegible]	14.0	13.3	64.9	10.1	32.6	118.0	17.4	9.9	15.0	7.8	3.60	mg/kg
Zinc	56.4	47.1	34.8	58.7	100.4	67.1	50.6	299.0	73.4	58.7	80.9	50.7	0.50	mg/kg
Chromium VI	U	U	U	U	U	U	U	U	U	U	--	--	10.0	ug/l
pH	7.65	7.30	7.31	7.01	7.72	6.70	7.50	7.32	7.13	7.16	5.81	7.88	--	su
PCBs	210	1,210	1,200	4,700	4,600	470	2,900	140,000	520	470	3,200	8,700	70.0	ug/kg
TOC	5,580	6,110	2,885	4,500	14,300	3,530	4,130	13,500	3,115	5,965	12,200	3,325	100	mg/kg
TOX	U	92.6	35.4	248.0	19.2	128.0	28.3	151.0	98.4	70.4	18.8	U	15.0	mg/kg
VOLATILE ORGANICS:														
Acetone	U	U	U	U	U	U	10 J	U	U	U	U	U	14	ug/kg
Methylene Chloride	7	U	U	U	U	5 J	U	U	8	8	U	U	7	ug/kg
Siloxane	U	U	U	5 J	5 J	U	U	U	U	U	U	U	5	ug/kg
Trichlorofluoromethane	U	U	17 J	17 J	7 J	U	U	U	U	U	U	U	17	ug/kg
SEMIVOLATILES:														
Diethylphthalate	--	--	--	--	--	--	--	--	--	--	U	410 J	500	ug/kg
Phenanthrene	--	--	--	--	--	--	--	--	--	--	250 J	850	500	ug/kg
Anthracene	--	--	--	--	--	--	--	--	--	--	U	220 J	500	ug/kg
Fluoranthene	--	--	--	--	--	--	--	--	--	--	U	1600	500	ug/kg
Pyrene	--	--	--	--	--	--	--	--	--	--	270 J	1100 X	500	ug/kg
Benzo(a)Anthracene	--	--	--	--	--	--	--	--	--	--	250 JX	710	500	ug/kg
Chrysene	--	--	--	--	--	--	--	--	--	--	300 J	880	500	ug/kg
bis(2-Ethylhexyl)Phthalate	--	--	--	--	--	--	--	--	--	--	U	520 J	500	ug/kg
Benzo(b)Fluoranthene	--	--	--	--	--	--	--	--	--	--	300 JX	610	500	ug/kg
Benzo(k)Fluoranthene	--	--	--	--	--	--	--	--	--	--	200 J	610	500	ug/kg
Benzo(a)Pyrene	--	--	--	--	--	--	--	--	--	--	270 JX	690	500	ug/kg
Indeno(1,2,3-cd)Pyrene	--	--	--	--	--	--	--	--	--	--	U	380 JX	500	ug/kg
Benzo(g,h,i)Perylene	--	--	--	--	--	--	--	--	--	--	U	370 JX	500	ug/kg
Hexadecanoic Acid	--	--	--	--	--	--	--	--	--	--	230 J	U	500	ug/kg

Notes:
U – Not detected.
J – Compound is present but less than the detection limit.
X – EPA CLP criteria for confirmation not met but compound is present.

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TABLE 2-6
SITE 2 - APPLE ORCHARD LANDFILL
GROUNDWATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations 2GW30	2GW31	2GW32	2GW45	Detection Limit	Units
TOTAL METALS:						
Cadmium	U	U	U	U	3.0	ug/l
Chromium	31.6	55.0	261.0	34.7	7.0	ug/l
Copper	24.6	80.2	241.0	40.8	3.0	ug/l
Lead	U	34.2	U	U	28.0	ug/l
Mercury	U	U	62.7	U	0.20	ug/l
Zinc	83.4	173.0	1640.0	94.1	3.0	ug/l
Chromium VI	U	U	U	U	10.0	ug/l
FILTERED METALS:						
Cadmium	U	U	27.6	3.7	3.0	ug/l
Chromium	U	U	U	U	7.0	ug/l
Copper	21.6	U	208.0	U	3.0	ug/l
Lead	U	U	U	U	28.0	ug/l
Mercury	U	U	10.9	U	0.20	ug/l
Zinc	59.2	29.4	961.0	24.0	3.0	ug/l
Chromium VI	U	U	U	U	10.0	ug/l
pH	5.80	5.50	4.70	6.10	--	su
PCBs	U	U	U	U	1.0	ug/l
TOC	9,300	900	3,300	5,400	500	ug/l
TOX	48	8	35	33	8	ug/l
TDS	2,050	U	37,700	1,020	20	mg/l
TSS	719	1,930	7,690	1,650	4	mg/l
VOLATILE ORGANICS:						
Methylene Chloride	U	U	6 B	U	5	ug/l
Trichloroethene	7	U	240	U	5	ug/l
Trichlorofluoromethane	7 J	U	U	U	10	ug/l
SEMIVOLATILE ORGANICS:						
bis(2-ethylhexyl)phthalate	U	8 J	U	23	10	ug/l

Notes: U - Not detected.

J - Compound is present but below detection limit (Estimated Value).

B - Compound also found in the blank.

TABLE 2-8
SITE 2 – APPLE ORCHARD LANDFILL
SURFACE WATER ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations						Detection Limit	Units
	2SW1	2SW2B	2SW3	2SW4	2SW5	2SW6		
TOTAL METALS:								
Cadmium	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	U	U	7.0	ug/l
Copper	12.4	6.7	14.4	18.9	16.1	5.0	3.0	ug/l
Lead	U	U	U	U	U	U	28.0	ug/l
Zinc	35.4	32.5	58.9	58.6	54.6	10.4	3.0	ug/l
FILTERED METALS:								
Cadmium	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	U	U	7.0	ug/l
Copper	11.1	3.3	12.2	11.7	11.7	6.7	3.0	ug/l
Lead	U	U	U	U	U	U	28.0	ug/l
Zinc	49.5	74.8	59.3	25.0	58.7	27.8	3.0	ug/l
pH	6.84	7.10	6.89	7.41	6.76	7.06	--	su
TOC	3,000	2,300	2,600	8,100	2,800	2,200	500	ug/l
TOX	27	25	33	21	35	20	8	ug/l
TDS	671	563	721	182	588	482	20	mg/l
TSS	U	7	4	55	6	U	4	mg/l
VOLATILE ORGANICS:								
Trichloroethene	U	U	5	U	U	U	5	ug/l

Note: U – Not detected.

Phase II RI Summary Data

TABLE 2-4
SITE 2 – APPLE ORCHARD LANDFILL
SURFICIAL SOIL ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations												Detection Limits	Units
	2SL3	2SL4	2SL5	2SL6	2SL7	2SL8	2SL9	2SL10	2SL11	2SL12	2SL13	2SL14		
TOTAL METALS:														
Cadmium	U	U	U	U	U	U	U	3.9	U	U	U	1.9	5	mg/kg
Chromium	[illegible]	[illegible]	[illegible]	8.4	[illegible]	[illegible]	[illegible]	8.7	[illegible]	[illegible]	[illegible]	[illegible]	10	mg/kg
Copper	[illegible]	[illegible]	[illegible]	U	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	mg/kg
Lead	[illegible]	U	12	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	mg/kg
Zinc	[illegible]	24	[illegible]	5.2	27	[illegible]	[illegible]	[illegible]	40	[illegible]	[illegible]	[illegible]	10	mg/kg
PCBs (1)	[illegible]	[illegible]	U	U	U	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	(2)	ug/kg
VOLATILE ORGANICS:													(2)	
Acetone	U	9 B	U	U	210 B	R	70 B	720	6 B	6	U	U	--	ug/kg
Methylene Chloride	[illegible]	11	R	R	[illegible]	R	[illegible]	[illegible]	67	62	[illegible]	64	--	ug/kg
Carbon Disulfide	[illegible]	U	U	U	U	U	U	U	U	U	2	U	--	ug/kg
1,2-Dichloroethane	[illegible]	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Dichloropropane	U	U	U	U	U	[illegible]	U	U	U	U	U	U	--	ug/kg
2-Butanone	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Ethylbenzene	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
m & p Xylenes	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
o-Xylenes	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Toluene	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
1,1,2,2-Tetrachloroethane	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Benzene	[illegible]	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
SEMIVOLATILES:													(2)	
Diethylphthalate	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Phenanthrene	[illegible]	U	[illegible]	[illegible]	U	U	U	200	760	U	2700	200	--	ug/kg
Anthracene	[illegible]	U	[illegible]	[illegible]	U	U	U	U	99	U	990	41	--	ug/kg
Fluoranthene	[illegible]	U	350	200	[illegible]	[illegible]	U	320	850	65	5900	330	--	ug/kg
Pyrene	[illegible]	U	310	290	[illegible]	[illegible]	U	630	470	95	3000	380	--	ug/kg
Butylbenzylphthalate	U	U	U	U	U	U	U	U	U	34	U	U	--	ug/kg
Benzo(a)Anthracene	[illegible]	U	[illegible]	[illegible]	[illegible]	41	U	230	300	U	2800	180	--	ug/kg
Chrysene	[illegible]	U	[illegible]	[illegible]	[illegible]	[illegible]	U	[illegible]	350	U	3000	200	--	ug/kg
bis(2-Ethylhexyl)Phthalate	U	U	U	U	U	U	U	U	170	U	U	200	--	ug/kg
Di-n-octyl Phthalate	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Benzo(b)Fluoranthene	[illegible]	U	[illegible]	[illegible]	[illegible]	U	U	220	220	U	2400	220	--	ug/kg
Benzo(k)Fluoranthene	[illegible]	U	[illegible]	[illegible]	[illegible]	U	U	[illegible]	350	U	2000	200	--	ug/kg
Benzo(a)Pyrene	[illegible]	U	230	340	12	40	U	300	280	U	2500	150	--	ug/kg
Indeno(1,2,3-cd)Pyrene	[illegible]	U	180	390	22	U	U	290	200	U	1500	160	--	ug/kg
Benzo(g,h,i)Perylene	[illegible]	U	230	600	42	U	U	300	200	U	1200	180	--	ug/kg
Acenaphthylene	[illegible]	U	39	350	U	U	U	U	U	U	U	U	--	ug/kg
Acenaphthene	U	U	40	U	U	U	U	U	55	U	770	U	--	ug/kg
Dibenzofuran	U	U	U	U	U	U	U	U	25	U	510	U	--	ug/kg
Dibenzo(a,h)Anthracene	U	U	49	130	U	U	U	U	60	U	340	U	--	ug/kg
Di-n-butylphthalate	U	U	U	U	U	U	U	110	U	U	U	160	--	ug/kg
Bis(2-chloroisopropyl)ether	U	U	U	U	U	U	U	100	U	U	U	300	--	ug/kg
Benzoic Acid	U	U	U	U	R	U	U	370 B	U	U	U	U	--	ug/kg
Benzyl Alcohol	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Naphthalene	U	U	U	U	U	U	U	U	U	U	150	U	--	ug/kg
2-Methylnaphthalene	U	U	U	U	U	U	U	U	U	U	44	U	--	ug/kg
Fluorene	U	U	U	46	U	U	U	U	U	U	460	U	--	ug/kg
3,3-Dichlorobenzidine	U	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg

NOTES: (1) The PCB compound for which values are given here is AR1260.
(2) The detection limits are based on % moisture determination.
U – Not detected.

TABLE 2-4 (CONTINUED)
SITE 2 – APPLE ORCHARD LANDFILL
SURFICIAL SOIL ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations											Detection Limits	Units
	2SL15	2SL16	2SL17	2SL18	2SL19	2SL20	2SL21	2SL22	2SL23	2SL24	2SL25		
TOTAL METALS:													
Cadmium	1.3	U	U	U	U	U	U	U	U	U	U	5	mg/kg
Chromium	[illegible]	[illegible]	8.6	9.9	7.9	10	10	9.7	12	25	16	10	mg/kg
Copper	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.8	[illegible]	[illegible]	5.8	25	mg/kg
Lead	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	11	34	37	19	3	mg/kg
Zinc	52	[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]	15	23	98	20	10	mg/kg
PCBs (1)	140	U	850	1200	U	U	33	120	1000	U	U	(2)	ug/kg
VOLATILE ORGANICS:												(2)	
Acetone	670	[illegible]	[illegible]	[illegible]	[illegible]	U	[illegible]	U	>200	140 B	170	--	ug/kg
Methylene Chloride	140	160	[illegible]	100	30	[illegible]	[illegible]	38	30	190	73	--	ug/kg
Carbon Disulfide	3	4	U	4	U	2	U	3	U	7	U	--	ug/kg
1,2-Dichloroethane	U	U	U	U	U	U	U	U	U	U	U		
Dichloropropane	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
2-Butanone	34 B	U	U	U	U	U	U	U	37 B	U	U	--	ug/kg
Ethylbenzene	7	2	U	U	U	U	U	U	U	U	U	--	ug/kg
m & p Xylenes	13	10	U	U	U	U	U	U	U	U	U	--	ug/kg
o-Xylenes	7	3	U	U	U	U	U	U	U	U	U	--	ug/kg
Toluene	U	2	U	U	U	U	U	U	U	U	U	--	ug/kg
1,1,2,2-Tetrachloroethane	9 B	U	U	U	U	U	U	U	U	U	U		
Benzene	U	U	U	U	U	U	U	U	U	U	U		
SEMIVOLATILES:												(2)	ug/kg
Diethylphthalate	37	47	U	U	U	U	U	U	U	110	79	--	ug/kg
Phenanthrene	[illegible]	[illegible]	[illegible]	170	34	U	[illegible]	U	700 B	110	U	--	ug/kg
Anthracene	U	U	[illegible]	100	31	U	[illegible]	U	150 B	U	U	--	ug/kg
Fluoranthene	29	130	2100	450	110	U	36	35	2400 B	180	U	--	ug/kg
Pyrene	29	120	1400	270	73	U	16	26	950 B	170	U	--	ug/kg
Butylbenzylphthalate	U	U	72	U	U	U	U	U	U	U	U	--	ug/kg
Benzo(a)Anthracene	U	U	650	100	32	U	18	18	600 B	78	U	--	ug/kg
Chrysene	U	U	160	450	43	U	[illegible]	25	130 B	95	U	--	ug/kg
bis(2-Ethylhexyl)Phthalate	U	U	120	210	170	U	400	210	440 B	130	120	--	ug/kg
Di-n-octyl Phthalate	U	U	31	U	U	110	U	15	U	35	U	--	ug/kg
Benzo(b)Fluoranthene	U	[illegible]	[illegible]	320	94	U	U	U	790 B	92	U	--	ug/kg
Benzo(k)Fluoranthene	U	[illegible]	[illegible]	[illegible]	119	U	U	U	1200 B	91	U	--	ug/kg
Benzo(a)Pyrene	U	72	[illegible]	200	36	U	18	U	450 B	63	U	--	ug/kg
Indeno(1,2,3-cd)Pyrene	U	65	170	110	33	U	U	U	400 B	70	U	--	ug/kg
Benzo(g,h,i)Perylene	U	72	320	100	U	U	U	U	370 B	61	U	--	ug/kg
Acenaphthylene	U	U	220	120	U	U	U	U	95 B	U	U	--	ug/kg
Acenaphthene	U	U	85	U	U	U	U	U	47 B	U	U	--	ug/kg
Dibenzofuran	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Dibenzo(a,h)Anthracene	U	U	138	54	U	U	U	U	130 B	U	U	--	ug/kg
Di-n-butylphthalate	440	310	220	U	U	U	U	U	U	760	740	--	ug/kg
Bis(2-chloroisopropyl)ether	260	900	320	U	U	39	170	U	U	790	900	--	ug/kg
Benzoic Acid	U	210 B	R	R	91	U	U	U	U	270	250 B	--	ug/kg
Benzyl Alcohol	U	U	U	U	U	U	U	U	U	40	U	--	ug/kg
Naphthalene	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
2-Methylnaphthalene	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Fluorene	U	U	U	U	U	U	U	U	65 B	U	U	--	ug/kg
3,3-Dichlorobenzidine	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg

NOTES: (1) The PCB compound for which values are given here is AR1260.
(2) The detection limits are based on % moisture determination.
U – Not detected.
B – Quantitation Estimated

TABLE 2-5 (CONTINUED)
SITE 2 – APPLE ORCHARD LANDFILL
SOIL BORING ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations (1)															Detection Limit (3)	Units
	2SB1A	2SB1B	2SB2A	2SB2B	2SB3A	2SB3B	2SB4A	2SB4B	2SB4C	2SB5A	2SB5B	2SB5C	2SB6A	2SB6B	2SB6C		
SEMIVOLATILES:																	
Diethylphthalate	U	U	U	U	U	U	U	U	U	130 B	170	150	U	U	U	--	ug/kg
Phenanthrene	180	U	250 B	240	U	U	5400 B	U	U	U	U	U	U	U	130 B	--	ug/kg
Anthracene	41	U	U	U	U	U	900 B	U	U	U	U	U	U	U	U	--	ug/kg
Fluoranthene	320	U	200 B	520	U	U	6000 B	140 B	46	U	U	U	U	U	180 B	--	ug/kg
Pyrene	200	U	320 B	480	U	U	7500 B	130	40	U	U	U	U	U	130 B	--	ug/kg
Benzo(a)Anthracene	140	U	U	320	U	U	3000 B	47	U	U	U	U	U	U	U	--	ug/kg
Chrysene	140	U	U	370	U	U	3100 B	53	U	U	U	U	U	U	U	--	ug/kg
bis(2-Ethylhexyl)Phthalate	U	U	U	250	U	U	U	U	U	95 B	210	460	U	U	U	--	ug/kg
Benzo(b)Fluoranthene	120	U	280 B	350	U	U	2400 B	73	U	U	U	U	U	U	U	--	ug/kg
Benzo(k)Fluoranthene	100	U	U	410	U	U	3400 B	120	U	U	U	U	U	U	U	--	ug/kg
Benzo(a)Pyrene	130	U	U	350	U	U	2500 B	46	U	U	U	U	U	U	U	--	ug/kg
Indeno(1,2,3-cd)Pyrene	70	U	U	250	U	U	1900 B	32	U	U	U	U	U	U	U	--	ug/kg
Dibenzo(a,h)anthracene	22	U	U	U	U	U	620 B	U	U	U	U	U	U	U	U	--	ug/kg
Di-n-octyl Phthalate	63	U	U	U	U	U	U	U	U	170 B	U	U	U	U	U	--	ug/kg
Benzo(g,h,i)Perylene	67	U	U	240 B	U	U	2000 B	U	U	U	U	U	U	U	U	--	ug/kg
N-Nitrosodiphenylamine	U	U	U	U	U	U	U	1510	U	U	U	U	U	U	U	--	ug/kg
Di-n-butylphthalate	U	U	U	U	U	U	U	180	U	220 B	1700	2000	4100 B	3400 B	U	--	ug/kg
Butylbenzylphthalate	U	U	U	U	U	U	U	U	U	U	73	47	920 B	300 B	730 B	--	ug/kg
bis(2-chloroisopropyl)ether	U	U	U	U	U	U	U	U	U	280 B	U	U	U	U	U	--	ug/kg
Acenaphthene	15	U	U	U	U	U	170 B	U	U	U	U	U	U	U	U	--	ug/kg
Dibenzofuran	U	U	U	330	U	U	220 B	U	U	U	U	U	U	U	U	--	ug/kg
Fluorene	U	U	U	U	U	U	590 B	U	U	U	U	U	U	U	U	--	ug/kg
Benzoic Acid	U	U	U	U	U	U	U	190 B	240 B	330 B	170 B	360 B	U	U	U	--	ug/kg
Butyl Alcohol	U	U	U	U	U	U	U	U	U	U	43	U	U	U	U	--	ug/kg
1,2,4-Trichlorobenzene	U	U	U	U	42	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Naphthalene	U	U	U	U	U	U	100 B	U	U	U	U	U	U	U	U	--	ug/kg
2-Methylnaphthalene	U	U	U	U	U	U	84 B	U	U	U	U	U	U	U	U	--	ug/kg
Nitrobenzene	U	U	U	U	U	U	U	110	U	U	U	U	U	U	U	--	ug/kg
Isophorone	U	U	U	U	U	U	U	260	U	U	U	U	U	U	U	--	ug/kg
2,6-Dinitrotoluene	U	U	U	U	U	U	U	230	U	U	U	U	U	U	U	--	ug/kg
2,4-Dinitrotoluene	U	U	U	U	U	U	U	340	U	U	U	U	U	U	U	--	ug/kg
2,4-Dinitrophenol	U	U	U	U	U	U	U	370	U	U	U	U	U	U	U	--	ug/kg

NOTES(1) The letter at the end of each sample location indicates the depth at which the sample was collected:
A – 1 foot below the surface.
B – 3 feet below the surface.
C – 5 feet below the surface.
(2) The PCB compound for which values are given here is AR1260.
(3) The detection limits are based on % moisture determination.
U – *Not detected.*
E – Quantitation Estimated.

TABLE 2–5
SITE 2 – APPLE ORCHARD LANDFILL
SOIL BORING ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations (1)															Detection Limit	Units
	2SB1A	2SB1B	2SB2A	2SB2B	2SB3A	2SB3B	2SB4A	2SB4B	2SB4C	2SB5A	2SB5B	2SB5C	2SB6A	2SB6B	2SB6C		
TOTAL METALS:																(3)	
Cadmium	U	1.1	U	8.1	U	U	0.5	1.1	1.2	U	U	U	U	U	U	5	mg/kg
Chromium	12	18	22	32	9.0	21	38	16	3.3	5.2	11	12	11	13	19	10	mg/kg
Copper	18	28	28	1530	5.2	22	19	14	U	4.1	15	13	11	11	23	25	mg/kg
Lead	14	11	12	533	3.4	7.4	42	23	21	14	6.7	11	5.6	72	18	3	mg/kg
Zinc	32	60	97	1140	7.2	1.5	32	34	15	16	35	21	23	51	30	20	mg/kg
PCBs (2)	U	U	400	4600	1400	395	3700	180	76	U	U	U	lost in extraction	U	U	(3)	ug/kg
VOLATILE ORGANICS:																(3)	
Acetone	U	9	U	U	24	40	15	210 R	160 B	170 B	92 B	160 B	170	54	23	--	ug/kg
Methylene Chloride	23	16	28	25 B	6.1	15	37	83 R	90	81	72	76	36	11	36	--	ug/kg
Carbon Disulfide	1	U	2	3 B	U	2	U	U	U	U	U	U	U	U	U	--	ug/kg
1,2-Dichloroethene (Total)	U	U	U	3	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Trichloroethene	U	U	U	3 B	U	U	U	U	U	U	U	U	U	U	U	--	ug/kg
1,1,2-Trichloroethane	U	U	U	U	U	U	3	U	U	U	U	U	U	U	U	--	ug/kg
1,1,2,2-Tetrachloroethene	U	U	U	U	U	U	U	3 B	U	U	U	U	U	U	U	--	ug/kg

NOTES(1) The letter at the end of each sample location indicates the depth at which the sample was collected:
A – 1 foot below the surface.
B – 3 feet below the surface.
C – 5 feet below the surface.
(2) The PCB compound for which values are given here is AR 1260.
(3) The detection limits are based on % moisture determination.
U – Not detected.
E – Quantitation Estimated.
R – Rejected.

TABLE 2-7
SITE 2 – APPLE ORCHARD LANDFILL
GROUNDWATER ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations 2GW30	2GW31	2GW32	2GW45	2GW76	Detection Limit	Units
TOTAL METALS:							
Cadmium	6.0	74	10	7.0	39	5.0	ug/l
Chromium	31	179 R	53	77	147	10	ug/l
Copper	79	1680	102	158	141	25	ug/l
Lead	44	377	41	41	235	3	ug/l
Mercury	R	R	16 R	R	R	0.2	ug/l
Zinc	147	3400	508	349	893	20	ug/l
FILTERED METALS:							
Cadmium	U	U	6.0	U	U	5.0	ug/l
Chromium	U	U	U	U	U	10	ug/l
Copper	39	U	U	U	U	25	ug/l
Lead	U	U	17	U	9.3	3	ug/l
Mercury	R	R	P R	R	R	0.2	ug/l
Zinc	73	32	381	75	61	20	ug/l
PCBs (1)	U	U	No report	U	U	1.0	ug/l
VOLATILE ORGANICS:							
Methylene Chloride	U	U	U	U	U	5	ug/l
Trichloroethene	5	U	140	1	U	5	ug/l
cis-1,2-Dichloroethene	U	U	1	U	U	10	ug/l
1,1,2,2-Tetrachloroethane	U	U	1	U	U	5	ug/l
SEMIVOLATILE ORGANICS:							
bis(2-ethylhexyl)phthalate	U	U	U	U	R	10	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.
U – Not detected.
E – Quantitations Estimated
R – Quantitation Rejected.
P – Present

TABLE 2-9
SITE 2 - APPLE ORCHARD LANDFILL
SURFACE WATER ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations						Detection Limit	Units
	2SW1	2SW2B	2SW3	2SW4	2SW5	2SW6		
PCBs (1)	U	U	U	U	U	U	1.0	ug/l
VOLATILE ORGANICS:								
Trichloroethene	2	U	5	U	3	U	5	ug/l
Acetone	U	U	U	R	U	U	10	ug/l
Methylene Chloride	U	U	U	U	1	U	5	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.
U - Not detected.
R - Quantitation Rejected.

TABLE 2-10
SITE 2 – APPLE ORCHARD LANDFILL
SEDIMENT ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations										Detection Limits	Units
	2SD1	2SD3	2SD4	2SD5	2SD6	2SD7	2SD9	2SD10	2SD11	2SD12		
TOTAL METALS:												
Cadmium	U	U	U	3.1	U	1.2	U	3.8	U	2.4	5	mg/kg
Chromium	8.8	8.7	8.5	12	13	8.3	43	34	13	15	10	mg/kg
Copper	14	13	13	42	12	25	20	52	13	43	25	mg/kg
Lead	37	20	23	22	12	12	41	119	6.1	18	3	mg/kg
Zinc	43	34	38	48	38	42	70	182	91	111	10	mg/kg
PCBs (1)	1400	1900	2700	4300	140	480	240	54,000	430	630	(2)	ug/kg
VOLATILE ORGANICS:											(2)	
Acetone	U	15	R	5	52	50	47	14	U	U	--	ug/kg
Methylene Chloride	U	5	R	130	4	4	5	11	2	3	--	ug/kg
Carbon Disulfide	U	U	U	37	U	U	U	U	U	U	--	ug/kg
1,2-Dichloroethane	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Dichloropropane	U	U	U	U	U	U	U	U	U	U	--	ug/kg
2-Butanone	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Ethylbenzene	U	U	U	U	U	U	U	U	U	U	--	ug/kg
m & p Xylenes	U	U	U	U	U	U	U	U	U	U	--	ug/kg
o-Xylenes	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Toluene	U	U	U	U	U	U	U	U	U	U	--	ug/kg
1,1,2,2-Tetrachloroethane	U	U	U	U	U	U	U	U	U	U	--	ug/kg
Benzene	7	U	U	U	U	U	U	U	U	U	--	ug/kg
Trichloroethene	U	U	31	U	U	U	U	U	U	U	--	ug/kg

NOTES: (1) The PCB compound for which values are given here is AR1260.
(2) The detection limits are based on % moisture determination.
U – Not detected.
E – Quantitation Estimated
R – Quantitation Rejected.

Design Verification Study - Soil/Sediment Results

TABLE 2-1
SITE 2
APPLE ORCHARD LANDFILL
DVSAP PCB FIELD SCREENING RESULTS
NSWC - WHITE OAK

STREAM SEDIMENT SAMPLES			
	Aroclor 1260	Aroclor 1260	Aroclor 1260
SAMPLE	< 0.4 ppm	> 0.4 ppm; < 4.0 ppm	> 4.0 ppm
02-SD-01			X
02-SD-02			X
02-SD-03			X
02-SD-04			X
02-SD-05		X	
02-SD-06	X		
02-SD-07		X	
02-SD-08			X
02-SD-09			X
02-SD-10			X
02-SD-11			X
02-SD-12			X
02-SD-13		X	
02-SD-14		X	
02-SD-15			X
02-SD-16			X
02-SD-17		X	
02-SD-18			X
02-SD-19			X
02-SD-20		X	
02-SD-21	X		
02-SD-22			X
02-SD-23		X	
02-SD-24			X
02-SD-25	X		

PCBSITE2.XLS

TABLE 2-1
SITE 2
APPLE ORCHARD LANDFILL
DVSAP PCB FIELD SCREENING RESULTS
NSWC - WHITE OAK

SURFACE SOIL SAMPLES			
	Aroclor 1260	Aroclor 1260	Aroclor 1260
SAMPLE	< 0.4 ppm	> 0.4 ppm; < 4.0 ppm	> 4.0 ppm
02-SO-01		X	
02-SO-02		X	
02-SO-03	X		
02-SO-04	X		
02-SO-05		X	
02-SO-06		X	
02-SO-07		X	
02-SO-08		X	
02-SO-09	X		
02-SO-10	X		
02-SO-11	X		
02-SO-12	X		
02-SO-13			X
02-SO-14		X	
02-SO-15		X	
02-SO-16		X	
02-SO-17	X		
02-SO-18		X	
02-SO-19	X		
02-SO-20	X		
02-SO-21			X
02-SO-22			X
02-SO-23			X
02-SO-24			X
02-SO-25		X	
02-SO-26			X
02-SO-27			X
02-SO-28		X	
02-SO-29			X

T/ 2-2

SITE 2

APPLE ORCHARD LANDFILL

DVSAP ANALYTICAL RESULTS

NSWC - WHITE OAK

PARAMETERS	02-SD-02		02-SD-05		02-SD-06		02-SD-07		02-SD-10		02-SD-11	
Pesticides/PCBs (ug/Kg)												
AROCLOR 1016	ND		ND		ND		ND		NA		ND	
AROCLOR 1221	ND		ND		ND		ND		NA		ND	
AROCLOR 1232	ND		ND		ND		ND		NA		ND	
AROCLOR 1242	ND		ND		ND		ND		NA		ND	
AROCLOR 1248	ND		ND		ND		ND		NA		ND	
AROCLOR 1254	ND		ND		ND		ND		NA		ND	
AROCLOR 1260	*1,247		*1,063		380		622.0		NA		143,000	
HEPTACHLOR EPOXIDE	NA		NA		NA		NA		NA		NA	
DIELDRIN	NA		NA		NA		NA		NA		NA	
4,4'-DDE	NA		NA		NA		NA		NA		NA	
4,4'-DDT	NA		NA		NA		NA		NA		NA	
MISCELLANEOUS												
TOTAL ORGANIC CARBON (mg/Kg)	NA		2,750		NA		NA		1,660		NA	
PERCENT SOLIDS (%)	86.6		87.6		77.8		82.8		93.7		81.7	
VOLATILE SOLIDS (%)	NA		17.4		NA		NA		2.31		NA	

ND - Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
J - Positive result is considered estimated

[CTO18002.XLW]A

T/ E 2-2

SITE 2
APPLE ORCHARD LANDFILL
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETERS	02-SD-15		02-SD-19		02-SD-20		02-SO-21		02-SD-23		02-SO-28	
Pesticides/PCBs (ug/Kg)												
AROCLOR 1016	NA		ND		NA		ND		ND		ND	
AROCLOR 1221	NA		ND		NA		ND		ND		ND	
AROCLOR 1232	NA		ND		NA		ND		ND		ND	
AROCLOR 1242	NA		ND		NA		ND		ND		ND	
AROCLOR 1248	NA		ND		NA		ND		ND		ND	
AROCLOR 1254	NA		ND		NA		ND		ND		ND	
AROCLOR 1260	NA		47,100		NA		477.0		*1,146		1,840	J
HEPTACHLOR EPOXIDE	NA		NA		NA		NA		NA		NA	
DIELDRIN	NA		NA		NA		NA		NA		NA	
4,4'-DDE	NA		NA		NA		NA		NA		NA	
4,4'-DDT	NA		NA		NA		NA		NA		NA	
MISCELLANEOUS												
TOTAL ORGANIC CARBON (mg/Kg)	10,300		NA		20,100		NA		NA		NA	
PERCENT SOLIDS (%)	60.5		70.5		80.8		67.1		74.0		83.5	
VOLATILE SOLIDS (%)	10.4		NA		7.69		NA		NA		NA	

ND - Not Detected
NA - Not Analyzed
* - Resu' 'en from dilution analysis
J - Pos' 'sult is considered estimated

TA 2-2

SITE 2
APPLE ORCHARD LANDFILL
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETERS	AFI-SO-01		AFI-SO-01-D		AFI-SO-02		AFI-SO-03	
Pesticides/PCBs (ug/Kg)								
AROCLOR 1016	ND		ND		ND		ND	
AROCLOR 1221	ND		ND		ND		ND	
AROCLOR 1232	ND		ND		ND		ND	
AROCLOR 1242	ND		ND		ND		ND	
AROCLOR 1248	ND		ND		ND		ND	
AROCLOR 1254	ND		ND		ND		ND	
AROCLOR 1260	ND		ND		ND		ND	
HEPTACHLOR EPOXIDE	ND		ND		0.710	J	ND	
DIELDRIN	ND		ND		0.930	J	ND	
4,4'-DDE	0.83	J	0.75	J	1.60	J	ND	
4,4'-DDT	ND		ND		1.70	J	ND	
MISCELLANEOUS								
TOTAL ORGANIC CARBON (mg/Kg)	NA		NA		NA		NA	
PERCENT SOLIDS (%)	83.5		83.5		83.5		83.5	
VOLATILE SOLIDS (%)	NA		NA		NA		NA	

ND - Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
J - Positive result is considered estimated

T .E 2-3
PCB FIELD KIT ANI BORATORY ANALYSIS
DVSAI RESULTS
NSWC - WHITE OAK

Sample ID Number	Sample Date	Ensys PCB Field Kit (1) Aroclor 1260 (ppm)	GP Environmental Organic Analysis (2) Aroclor 1260 (ppm)	Comments
02-SD-02	3/21/95	> 4.0	1.247	False Positive for greater than 4.0 ppm (3)
02-SD-05	3/22/95	> 0.4 but < 4.0	2.750	
02-SD-06	3/22/95	< 0.4	0.379	
02-SD-07	3/22/95	> 0.4 but < 4.0	0.622	
02-SD-11	3/23/95	> 4.0	143	
02-SO-21	3/23/95	> 4.0	0.477	False Positive for greater than 4.0 ppm (3)
02-SO-28	3/24/95	> 0.4 but < 4.0	1.84	
02-SD-23	3/27/95	> 0.4 but < 4.0	1.146	
02-SD-19	3/27/95	> 4.0	47.1	
04-SB09-0809	3/27/95	< 0.4	0.239	

(1) For the purpose of this investigation, the Ensys PCB Field Kits were pre-packaged for analysis of Aroclor 1260 at concentrations less than 0.4 ppm, between 0.4 and 4.0 ppm, and greater than 4.0 ppm. The Ensys PCB Field Kits are a semi-quantitative measure of PCB concentration.

(2) Analysis using EPA SOW 3/90

(3) Ensys Field Kit successfully identified Aroclor 1260 at a concentration greater than 0.4 ppm in the sample. However, the field analysis indicated Aroclor 1260 concentrations were greater than 4.0 ppm (False Positive).

Groundwater Characterization Study - Summary of Analytical Data

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02
UNFILTERED GROUNDWATER DATA

DRAFT

SAMPLE NUMBER:	WO-2GW30	WO-2GW31	WO-2GW32	WO-2GW45	WO-2GW76	/ /	/ /
COLLECTION DATE:	06/12/97	06/10/97	06/12/97	06/12/97	06/11/97		
LOCATION:	SITE 02	SITE 02	SITE 02	SITE 02	SITE 02		
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1,2,2-TETRACHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2,4 TRICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,3 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,4 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	NA	NA
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	NA	NA
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	NA	NA
ACETONE	5 UR	5 UR	5 UR	5 UR	5 UR	NA	NA
BENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOFORM	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 UJ	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-2GW30	WO-2GW31	WO-2GW32	WO-2GW45	WO-2GW76	/ /	/ /
COLLECTION DATE:	06/12/97	06/10/97	06/12/97	06/12/97	06/11/97		
LOCATION:	SITE 02	SITE 02	SITE 02	SITE 02	SITE 02		
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	1 U	2	1 U	1 U	NA	NA
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	NA	NA
DIBROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
METHYLENE CHLORIDE	2 U	2 U	3 U	2 U	2 U	NA	NA
STYRENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TETRACHLOROETHENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TOLUENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRICHLOROETHENE	3	1 U	81	2	1 U	NA	NA
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
XYLENES, TOTAL	1 U	1 U	1 U	1 U	1 U	NA	NA
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
1,2-DICHLOROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
1,3-DICHLOROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
1,4-DICHLOROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	6 UJ	8 U	5 UJ	5 UJ	5 U	NA	NA
2,4,5-TRICHLOROPHENOL	22 U	30 U	21 U	21 U	20 U	NA	NA
2,4,6-TRICHLOROPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
2,4-DICHLOROPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
2,4-DIMETHYLPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
2,4-DINITROPHENOL	22 U	30 U	21 U	21 U	20 U	NA	NA
2,4-DINITROTOLUENE	6 U	8 U	5 U	5 U	5 U	NA	NA
2,6-DINITROTOLUENE	6 U	8 U	5 U	5 U	5 U	NA	NA
2-CHLORONAPHTHALENE	6 U	8 U	5 U	5 U	5 U	NA	NA
2-CHLOROPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-2GW30	WO-2GW31	WO-2GW32	WO-2GW45	WO-2GW76	/ /	/ /
COLLECTION DATE:	06/12/97	06/10/97	06/12/97	06/12/97	06/11/97		
LOCATION:	SITE 02	SITE 02	SITE 02	SITE 02	SITE 02		
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	6 U	8 U	5 U	5 U	5 U	NA	NA
2-METHYLPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
2-NITROANILINE	22 U	30 U	21 U	21 U	20 U	NA	NA
2-NITROPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
3,3'-DICHLOROBENZIDINE	6 U	8 U	5 U	5 U	5 U	NA	NA
3-NITROANILINE	22 U	30 U	21 U	21 U	20 U	NA	NA
4,6-DINITRO-2-METHYLPHENOL	22 U	30 U	21 U	21 U	20 U	NA	NA
4-BROMOPHENYL PHENYL ETHER	6 U	8 U	5 U	5 U	5 U	NA	NA
4-CHLORO-3-METHYLPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
4-CHLOROANILINE	6 U	8 U	5 U	5 U	5 U	NA	NA
4-CHLOROPHENYL PHENYL ETHER	6 U	8 U	5 U	5 U	5 U	NA	NA
4-METHYLPHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
4-NITROANILINE	22 U	30 U	21 U	21 U	20 U	NA	NA
4-NITROPHENOL	22 U	30 U	21 U	21 U	20 U	NA	NA
ACENAPHTHENE	6 U	8 U	5 U	5 U	5 U	NA	NA
ACENAPHTHYLENE	6 U	8 U	5 U	5 U	5 U	NA	NA
ANTHRACENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BENZO(A)ANTHRACENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BENZO(A)PYRENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BENZO(B)FLUORANTHENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BENZO(G,H,I)PERYLENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BENZO(K)FLUORANTHENE	6 U	8 U	5 U	5 U	5 U	NA	NA
BIS(2-CHLOROETHOXY)METHANE	6 U	8 U	5 U	5 U	5 U	NA	NA
BIS(2-CHLOROETHYL)ETHER	6 U	8 U	5 U	5 U	5 U	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6 U	8 U	5 U	5 U	5 U	NA	NA
BUTYLBENZYL PHTHALATE	6 U	8 U	5 U	5 U	5 U	NA	NA
CARBAZOLE	6 U	8 U	5 U	5 U	5 U	NA	NA
CHRYSENE	6 U	8 U	5 U	5 U	5 U	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-2GW30	WO-2GW31	WO-2GW32	WO-2GW45	WO-2GW76	/ /	/ /
COLLECTION DATE:	06/12/97	06/10/97	06/12/97	06/12/97	06/11/97		
LOCATION:	SITE 02	SITE 02	SITE 02	SITE 02	SITE 02		
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	8 U	2 J	5 U	5 U	1 J	NA	NA
DI-N-OCTYL PHTHALATE	6 U	8 U	5 U	5 U	5 U	NA	NA
DIBENZO(A,H)ANTHRACENE	6 U	8 U	5 U	5 U	5 U	NA	NA
DIBENZOFURAN	6 U	8 U	5 U	5 U	5 U	NA	NA
DIETHYL PHTHALATE	6 U	8 U	5 U	5 U	5 U	NA	NA
DIMETHYL PHTHALATE	6 U	8 U	5 U	5 U	5 U	NA	NA
FLUORANTHENE	6 U	8 U	5 U	5 U	5 U	NA	NA
FLUORENE	6 U	8 U	5 U	5 U	5 U	NA	NA
HEXACHLOROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
HEXACHLOROBUTADIENE	6 U	8 U	5 U	5 U	5 U	NA	NA
HEXACHLOROCYCLOPENTADIENE	6 U	8 U	5 U	5 U	5 U	NA	NA
HEXACHLOROETHANE	6 U	8 U	5 U	5 U	5 U	NA	NA
INDENO(1,2,3-CD)PYRENE	6 U	8 U	5 U	5 U	5 U	NA	NA
ISOPHORONE	6 U	8 U	5 U	5 U	5 U	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	6 U	8 U	5 U	5 U	5 U	NA	NA
N-NITROSODIPHENYLAMINE	6 U	8 U	5 U	5 U	5 U	NA	NA
NAPHTHALENE	6 U	8 U	5 U	5 U	5 U	NA	NA
NITROBENZENE	6 U	8 U	5 U	5 U	5 U	NA	NA
PENTACHLOROPHENOL	22 U	30 U	21 U	21 U	20 U	NA	NA
PHENANTHRENE	6 U	8 U	5 U	5 U	5 U	NA	NA
PHENOL	6 U	8 U	5 U	5 U	5 U	NA	NA
PYRENE	6 U	8 U	5 U	5 U	5 U	NA	NA
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
1,3-DINITROBENZENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
2,4 DINITROTOLUENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
2,4,6-TRINITROTOLUENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
2,6 DINITROTOLUENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-2GW30 06/12/97 SITE 02	WO-2GW31 06/10/97 SITE 02	WO-2GW32 06/12/97 SITE 02	WO-2GW45 06/12/97 SITE 02	WO-2GW76 06/11/97 SITE 02	/ /	/ /
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
2-NITROTOLUENE	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	NA	NA
3-NITROTOLUENE	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	NA	NA
4-AMINO-2,6-DINITROTOLUENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
4-NITROTOLUENE	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	NA	NA
HMX	2.8	1.3 U	1.3 U	10.1	1.3 U	NA	NA
NITRO-BENZENE	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	NA	NA
RDX	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	NA	NA
TETRYL	1.3 UJ	1.3 UJ	1.3 UJ	1.3 UJ	1.3 UJ	NA	NA
METALS (µg/L)							
ALUMINUM	8790 J	8480	18800 J	552 J	1960	NA	NA
ANTIMONY	2 UL	2 U	2 UL	2 UL	2 U	NA	NA
ARSENIC	2.7	2.6 U	24.6	2.6 U	2.6 U	NA	NA
BARIUM	93.5 J	55.9	207 J	55.5 J	26	NA	NA
BERYLLIUM	0.3 U	1.1 U	9.9	0.3 U	0.76 U	NA	NA
CADMIUM	1.4 J	0.52 U	12 J	0.23 U	0.2 U	NA	NA
CALCIUM	62600 J	3840 K	193000 J	34200 J	3280 K	NA	NA
CHROMIUM	24.4	33	0.4 UL	1.3 L	5	NA	NA
COBALT	11.9 J	7.5	134 J	4.2 J	8	NA	NA
COPPER	34.6 J	25.2	83.7 J	12.5 J	13	NA	NA
CYANIDE	8.7	25.5	5 U	5 U	5 U	NA	NA
IRON	14000 J	14500 L	426 J	1370 J	2010 L	NA	NA
LEAD	12.8	5.4 L	21.5	1.1 U	2.9 L	NA	NA
MAGNESIUM	39100 J	3760 K	120000 J	17000 J	990 K	NA	NA
MANGANESE	5650 J	321	21300 J	463 J	333	NA	NA
MERCURY	0.34	0.16	0.52	0.21	0.14	NA	NA
NICKEL	35.1 J	33.5	171 J	0.9 UJ	7.3 U	NA	NA
POTASSIUM	7450 J	2740	45500 J	4000 J	2800	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 02

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-2GW30	WO 2GW31	WO-2GW32	WO-2GW45	WO-2GW76	/ /	/ /
COLLECTION DATE:	06/12/97	06/10/97	06/12/97	06/12/97	06/11/97		
LOCATION:	SITE 02	SITE 02	SITE 02	SITE 02	SITE 02		
FIELD DUPLICATE OF:							
METALS (µg/L)							
SELENIUM	2.5 U	1.6 U	1.6 UL	1.6 U	1.6 U	NA	NA
SILVER	0.5 U	0.5 U	0.59	0.5 U	0.62	NA	NA
SODIUM	262000	3020 L	6020000	209000	81700	NA	NA
THALLIUM	2.1 U	2.4 U	10.6 U	2.1 U	2.1 U	NA	NA
VANADIUM	19.2	10.6	0.6 UL	0.95	1.6	NA	NA
ZINC	41.8 J	113	442 J	68.9 J	48.4	NA	NA
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	NA	NA
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	1.11	0.58	17.4	1.42	0.05 U	NA	NA
ORTHOPHOSPHATE	0.5 UR	0.5 UL	50 UR	0.5 UR	0.5 UL	NA	NA
SULFATE	175 L	0.78	153 L	83.2 L	83.1	NA	NA

APPENDIX E

SITE 3 - HISTORICAL DATA

Phase I RI Summary Data
Phase II RI Summary Data
EM Survey Data
Test Pit Logs

Phase I RI Summary Data

TABLE 3-3
SITE 3 – PISTOL RANGE LANDFILL
SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations 3SD1	3SD2	3SD3	3SD6	3SL1	3SL2	Detection Limit	Units
TOTAL METALS:								
Cadmium	U	U	U	U	60.1	5.6	0.78	mg/kg
Chromium	33.9	12.0	6.3	16.8	83.0	34.2	0.70	mg/kg
Copper	9.9	3.3	6.6	8.9	2530	241	0.30	mg/kg
Lead	5.9	U	U	4.7	1460	141	3.60	mg/kg
Zinc	23.2	14.2	8.9	14.8	7300	544	0.50	mg/kg
Mercury	0.19	0.18	0.24	0.17	12.4	1.7	0.14	mg/kg
Chromium VI	U	U	U	U	U	U	10.0	ug/l
pH	7.21	7.42	7.23	7.21	--	--	--	su
TOC	2,580	1,735	3,400	1,310	--	--	100	mg/kg
TOX	19.8	19.2	16.2	10.2	--	--	10.0	mg/kg
SEMIVOLATILES:								
Phenanthrene	--	--	--	--	7,400	2,900	2,300	ug/kg
Anthracene	--	--	--	--	1,300 J	U	2,200	ug/kg
Di-n-Butylphthalate	--	--	--	--	15,000	7,200	2,300	ug/kg
Fluoranthene	--	--	--	--	14,000	5,400	2,300	ug/kg
Pyrene	--	--	--	--	9,600	4,000	2,300	ug/kg
Benzo(a)Anthracene	--	--	--	--	5,200	2,300	2,300	ug/kg
Chrysene	--	--	--	--	5,000	2,500	2,300	ug/kg
Benzo(b)Fluoranthene	--	--	--	--	4,700	2,700	2,300	ug/kg
Benzo(k)Fluoranthene	--	--	--	--	4,200	2,000 J	2,200	ug/kg
Benzo(a)Pyrene	--	--	--	--	4,800	2,600	2,200	ug/kg
Indeno(1,2,3-cd)Pyrene	--	--	--	--	2,600	1,200	1,100	ug/kg
Dibenz(a,h)Anthracene	--	--	--	--	1,100 JX	U	2,200	ug/kg
Benzo(g,h,i)Perylene	--	--	--	--	2,600	1,200	1,100	ug/kg

Notes: U – Not detected.
J – Compound is present but less than the detection limit.
X – EPA CLP criteria for confirmation not met but compound is present.

TABLE 3-5
SITE 3 - PISTOL RANGE LANDFILL
GROUNDWATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations 3GW17	3GW18	3GW19	3GW47	Detection Limit	Units
TOTAL METALS:						
Cadmium	U	U	U	U	5.0	ug/l
Chromium	14.8	69.9	56.9	259.0	5.0	ug/l
Copper	14.4	49.0	98.8	170.0	3.0	ug/l
Lead	U	U	53.4	91.1	28.0	ug/l
Mercury	U	0.33	0.24	U	0.20	ug/l
Zinc	34.1	137.0	122.0	275.0	3.0	ug/l
FILTERED METALS:						
Cadmium	U	U	U	U	5.0	ug/l
Chromium	U	U	5.6	U	5.0	ug/l
Copper	U	U	U	U	3.0	ug/l
Lead	U	U	U	64.3	28.0	ug/l
Mercury	U	U	U	U	0.20	ug/l
Zinc	21.3	106.0	39.0	283.0	3.0	ug/l
pH	6.20	6.10	6.30	5.80	--	su
TOC	5,790	36,400	38,200	34,200	500	ug/l
TOX	13.2	U	34.9	19.8	8	ug/l
TDS	48.0	138.0	208.0	262.0	20	mg/l
TSS	645	4,920	5,420	3,880	4	mg/l
VOLATILE ORGANICS:						
1,2-Dichloroethene (total)	U	8	38	U	5	ug/l
Trichloroethene	U	7	7	U	5	ug/l
Chlorobenzene	U	U	16	U	5	ug/l

Note: U - Not detected.

TABLE 3-5
SITE 3 - PISTOL RANGE LANDFILL
SURFACE WATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations				Detection Limit	Units
	3SW1	3SW2	3SW3	3SW4		
TOTAL METALS:						
Cadmium	U	U	U	U	5.0	ug/l
Chromium	U	8.8	U	U	7.0	ug/l
Copper	3.7	5.3	4.2	5.8	3.0	ug/l
Lead	31.4	U	U	U	28.0	ug/l
Zinc	14.5	28.3	19.7	26.7	3.0	ug/l
Mercury	U	U	U	0.22	0.20	ug/l
Chromium VI	U	U	U	U	10.0	ug/l
FILTERED METALS:						
Cadmium	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	7.0	ug/l
Copper	5.9	7.5	3.8	6.4	3.0	ug/l
Lead	U	U	U	U	28.0	ug/l
Zinc	42.2	26.2	30.8	19.1	3.0	ug/l
Mercury	U	U	0.41	U	0.20	ug/l
Chromium VI	U	U	U	U	10.0	ug/l
pH	7.38	7.57	7.33	7.69	—	su
TOC	4640	4620	4280	5240	500	ug/l
TOX	23.9	24.8	28.0	25.8	8	ug/l
TDS	212	165	206	177	20	mg/l
TSS	U	U	U	8	4	mg/l
VOLATILE ORGANICS:	U	U	U	U	—	ug/l

Note: U - Not detected.

Phase II RI Summary Data

TABLE 3-4
SITE 3 - PISTOL RANGE LANDFILL
SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations 3SD1	3SD2	3SD3	3SD6	3SL3	3SL4	Detection Limit	Units
TOTAL METALS:								
Cadmium	U	U	U	U	1.3	U	5	mg/kg
Chromium	8.3	3.5	8.7	7.4	28	12	10	mg/kg
Copper	4.2	5.9	U	U	16	22	25	mg/kg
Lead	4.4	4.5	2.0	0.8	92	20	3	mg/kg
Mercury	R	R	R	R	R	R	0.2	mg/kg
Zinc	8.7	14	13	8.8	20	38	20	mg/kg
VOLATILE ORGANICS:							(1)	
Acetone	--	--	--	--	36E	80E	--	ug/kg
Methylene Chloride	--	--	--	--	58E	48E	--	ug/kg
SEMIVOLATILES:							(1)	
Phenanthrene	--	--	--	--	UE	UE	--	ug/kg
Anthracene	--	--	--	--	UE	UE	--	ug/kg
Di-n-Butylphthalate	--	--	--	--	UE	UE	--	ug/kg
Fluoranthene	--	--	--	--	UE	UE	--	ug/kg
Pyrene	--	--	--	--	UE	UE	--	ug/kg
Benzo(a)Anthracene	--	--	--	--	UE	UE	--	ug/kg
Chrysene	--	--	--	--	UE	UE	--	ug/kg
Benzo(b)Fluoranthene	--	--	--	--	UE	UE	--	ug/kg
Benzo(k)Fluoranthene	--	--	--	--	UE	UE	--	ug/kg
Benzo(a)Pyrene	--	--	--	--	UE	UE	--	ug/kg
Indeno(1,2,3-cd)Pyrene	--	--	--	--	UE	UE	--	ug/kg
Dibenz(a,h)Anthracene	--	--	--	--	UE	UE	--	ug/kg
Benzo(g,h,i)Perylene	--	--	--	--	UE	UE	--	ug/kg

NOTES: (1) Detection limits are based on % moisture determination.
U - Not detected.
R - Quantitation Rejected
E - Quantitation Estimated

TABLE 3-6
SITE 3 – PISTOL RANGE LANDFILL
GROUNDWATER ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations							Detection Limit	Units
	3GW17	3GW18	3GW19	3GW47	3GW77	3GW78D	3GW78S		
TOTAL METALS:									
Cadmium	U	U	U	25	19	U	U	5.0	ug/l
Chromium	40	32	25	136	119	U	28	10	ug/l
Copper	86	25	U	543	186	U	54	25	ug/l
Lead	18	19	38	117	65	U	20	3	ug/l
Mercury	R	R	R	R	R	R	R	0.2	ug/l
Zinc	98	78	62	661	794	18	372	20	ug/l
FILTERED METALS:									
Cadmium	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	2.7	U	U	U	2.2	ug/l
Copper	33	25	26	30	U	U	U	11	ug/l
Lead	U	U	3.1	9.1	U	U	U	1.5	ug/l
Mercury	R	R	R	R	R	U	U	0.2	ug/l
Zinc	19	53	19	178	42	18	14	4.6	ug/l
PCBs (1)	U	U	U	U(2)	U	U	U	1.0	ug/l
VOLATILE ORGANICS:									
1,2-Dichloroethene (total)	U	U	120	U	U	U	U	5	ug/l
Trichloroethene	U	U	11	U	6	U	U	5	ug/l
Chlorobenzene	U	U	27	U	U	U	U	5	ug/l
Methylene Chloride	U	U	U	U	U	7	U	5	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.

(2) Quantitated from field duplicate

U – Not detected.

EM Survey Data

CALCULATION WORKSHEET

Order No. 19116 (01-91)

PAGE ____ OF ____

CLIENT: NSWC WHITECAK	JOB NUMBER: 2295
SUBJECT: EM SURVEY - SITE 23	
BASED ON:	DRAWING NUMBER:
BY: PLN	CHECKED BY: / APPROVED BY: / DATE:

NORTH - CENTRAL SECTION of GRID

TO SIK 4

	6 L6	L7	L8	L7	L6	L7	8 L7
280	6 L5	L6	L7	L6	L8	L8	(10) L6
270	L6	L5	L6	L6	L7	L7	4 L6 metal plate
260	5 L12	L8	L6	L7	L7	L6	8 L8
250	8 L6	L6	L5	L6	L6	L7	6 L7
240	6 L5	L6	L5	L6	L6	L7	8 L7
230	5 L3.5	L6	L6	L6	L7	L7	6 L6
220	6.2 L6.1	L6	7 L4	L8	L8	L7	6 L7
210	6 L7	7 L7	L6	L7	L7	L6	L7
200	5 L6	6 L7	L7	L6	L6	L7	9 L8
190	(22) L(1)	5 L6	L7	L7	L6	L7	8 L7
180	(21) L(13)	7 L6	L6	L6	L7	L7	7 L
170	(20) L(8)	6 L7	L6	L6	L6	L7	7.5 L8
160	L(2)	L4	L4	L7	L7	7 L7	6 L7
150	8 L6	7 L7	L6.5	L7	L7	L8	L(3)
140	SEE SOUTHERN SECTION	L	L	L	L	L	L

MANY MINE STAPLES

SCALE 10'

CULVERT

CALCULATION WORKSHEET

Order No. 19116 (01-91)

PAGE ____ OF ____

CLIENT: NSWC WHITECAK	JOB NUMBER: 2295
SUBJECT: EM SURVEY – SITE 23	
BASED ON:	DRAWING NUMBER:
BY: PLN	CHECKED BY: / APPROVED BY: / DATE:

SOUTHERN SECTION OF GRID

140	6 / 3	7	5.6	5	6.3	8	11.1 / 8
130	5 / 6	7 / 7	8 / 6	7	7	7	9 / 9
120	8.7 / 8.1	6 / 5.4	7 / 6.5	6	6	6	8.9 / 9
110	6.9 / 8.3	7.3 / (4)	3 / 0	6.0 / 4.7	6	6	7 / 7
100	(3) / (7.2)	(3.7) / 6.1	4.7 / 11.1	7.0	5.6	6.2	6.2 / 6.2
90	(13) / 23	(22) / (4.8)	5.7 / 6.5	6.2 / 7.3	7.3	7.7	9.1 / 8.2
80	17 / 11.8	4 / (2)	9.1 / 8.9	6.6	5.5	5.3	6.3 / 6.3
70	18 / 17	16 / 12	6.4 / 6.5	6.5	5.0	5.1	4.6 / 4.0
60	(1) / 2.5	10.2	8.8	6.4	6.1 / 5.5	5.5 / 5.0	4.4 / 4.0
50	(28.3) / (18)	(22) / (10)	3 / 0	7.2 / 7.3	8.0 / 8.0	5.8 / 6.3	4.8 / 4.1
40	(8.3) / (1.3)	(4.3) / (3.7)	2.2 / 2.8	9.0 / 9.2	5.4 / 5.0	4.5 / 4.6	4.0 / 4.7
30	(10) / 6.0	6.0 / 10.1	3.0) / 0.0	3.5 / 4.0	5.4 / 6.5	4.6 / 4.4	4.7 / 3.6
20	4.4	13.6	10.2	5.4	6.6	6.7	4.5
10	19.1 / 5.2	8.0 / 11.0	8.1 / 16	2.8 / 4.8	6.7 / 5.9	5.1 / 4.4	4.8 / 4.3
0	8.0 / 4.1	7.7 / 7.4	7.5 / 6.4	6.4 / 6.3	8.0 / 7.0	6.5 / 5.0	5.2 / 4.4

Scale: 10'

(X) = STAKED LOCAT

L EM READING at 2 CONTACT

Area of Anomalo Readings. (Metal)

y-DISTANCE

(0,0)

(60,0)

x-DISTANCE

CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: NSWC WHITEOAK	JOB NUMBER: 2295
SUBJECT: EM SURVEY - SITE 23	
BASED ON:	DRAWING NUMBER:
BY: RLN	CHECKED BY:
APPROVED BY:	DATE: 3/3/95

SOUTHERN SECTION OF GRID

140	6 / 3	7	5.6	5	6.3	8	11.1 / 8
130	5 / 6	7 / 7	8 / 6	7	7	7	9 / 9
120	8.7 / 8.1	6 / 5.4	7 / 6.5	6	6	6	8.9 / 8
110	6.9 / 8.3	7.3 / (4)	3 / 0	6.0 / 4.7	6	6	7
100	(3) / (7.2)	(3.7) / 6.1	4.7 / 11.1	7.0	5.6	6.2	6.2 / 6.2
90	(13) / 23	(22) / (4.8)	5.7 / 6.5	6.2 / 7.3	7.3	9.7	9.1 / 8.2
80	17 / 11.8	4 / (2)	9.1 / 8.9	6.6	5.5	5.3	6.3 / 6.3
70	18 / 17	16 / 12	6.4 / 6.5	6.5	5.0	5.1	4.6 / 4.0
60	(1) / 2.5	10.2	8.8	6.4	6.1 / 5.5	5.5 / 5.0	4.4 / 4.0
50	(28.8) / (18)	(22) / (10)	3 / 0	7.2 / 7.3	3.0 / 3.0	5.8 / 6.3	4.8 / 4.1
40	(8.3) / (1.3)	(4.3) / (8.7)	2.2 / 2.8	9.0 / 9.2	5.4 / 5.9	4.5 / 4.9	4.0 / 4.7
30	(10) / 6.0	6.9 / 10.7	(3.6) / 0.0	3.5 / 4.0	5.9 / 6.5	4.6 / 4.4	4.7 / 3.6
20	14.4	13.0	10.0	3.4	6.6	4.7	4.5
10	19.1 / 15.2	10.2 / 11.4	10.1 / 10.1	2.8 / 4.8	6.7 / 5.9	5.1 / 4.9	4.8 / 4.3
0	6.0 / 4.1	7.7 / 7.4	5.8 / 6.9	6.9 / 6.3	3.0 / 7.0	6.5 / 5.0	5.8 / 4.4

(0,0) (60,0)

Y-DISTANCE

X-DISTANCE: 0 10 20 30 40 50 60

SCALE 10'

(X) = STAKED LOCA

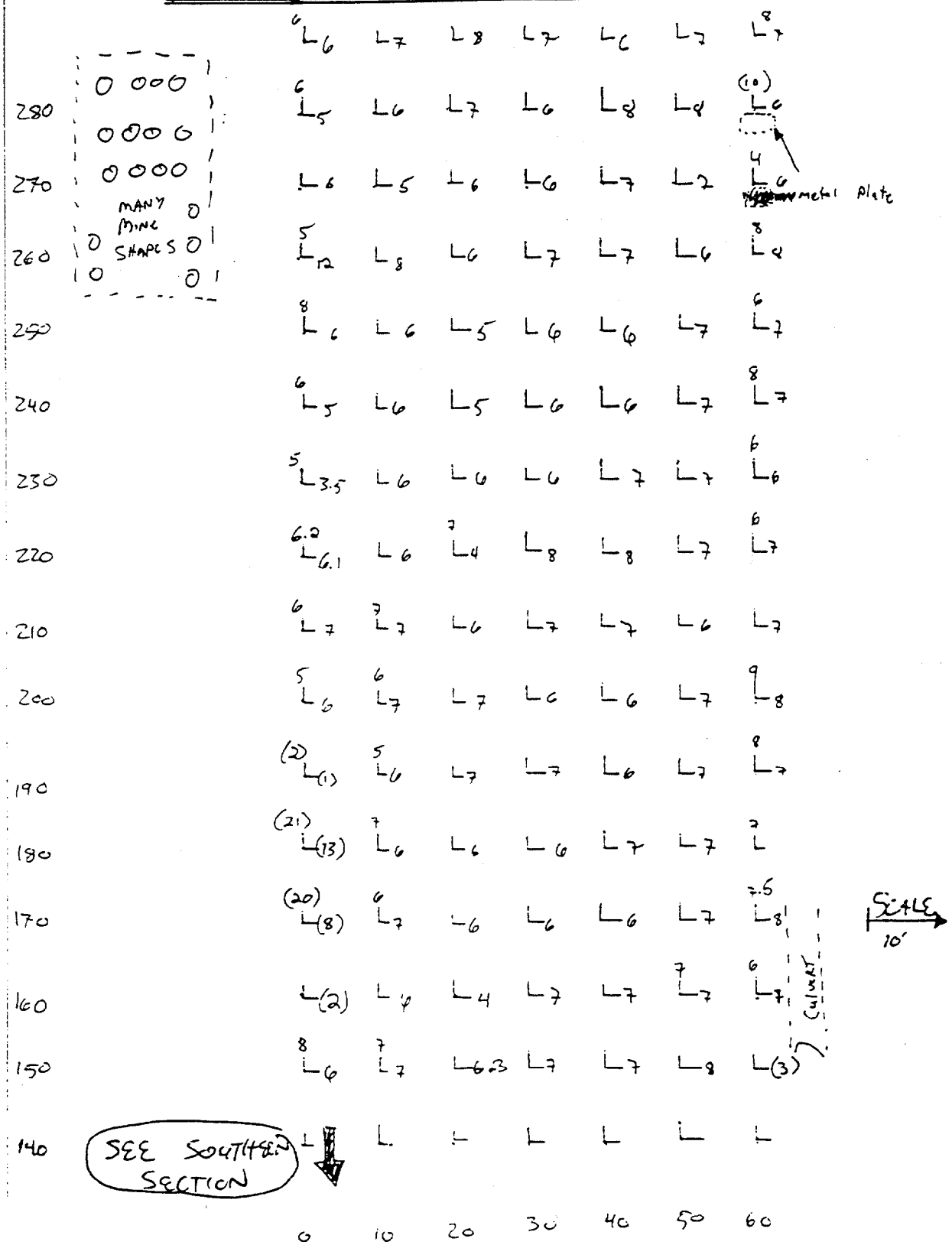
L EM READING a 2 ORIENTATIONS

CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: NSWC WHITEOAK	JOB NUMBER: 2295
SUBJECT: EM SURVEY - SITE ~~2~~ 3	
BASED ON:	DRAWING NUMBER:
BY: PLN	CHECKED BY:
APPROVED BY:	DATE: 3/3/95

NORTH - CENTRAL SECTION of GRID



Test Pit Logs

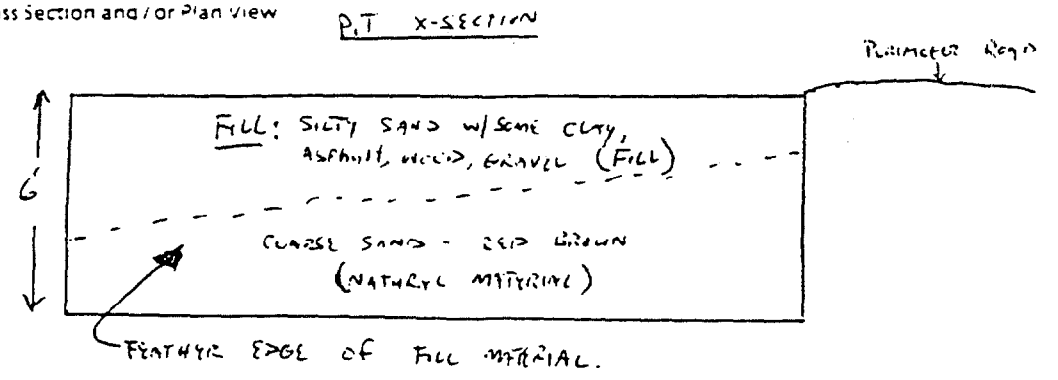
TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP1
PROJECT NO.: 2295 DATE: 3/6/95
LOCATION: Site 3 - Pistol Range Landfill, NE End
FIELD GEOLOGIST: P. Nammer / R. Willoughby

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Silty sand w/ clay. Black - Brown		Fill material
1.0		As above w/ some gravel.		
	Fill			
2.0	SM/GC	As above w/ black material including		Fill
		asphalt and wood.		
3.0		Red-Brn. ~~Coarse~~ Graded sand w/ some fine gravel.		Natural material. in analogic
				contact w/ fill.
4.0	Natural	As above.		
5.0	SP/SM	As above		
6.0		As above		
	TD = 6'			

Test Pit Cross Section and / or Plan View

P.T X-SECTION



REMARKS P.T 19.5' long x 3' wide x 6' deep

PHOTO LOG TEST PIT 3-TP1

PAGE 1 OF 1

TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP2

PROJECT NO.: 2295 DATE: 3/6/95

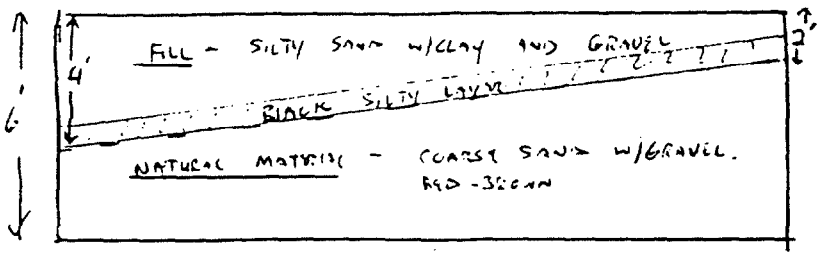
LOCATION: NE END of Site 3, along Perimeter Road.

FIELD GEOLOGIST: P. Nimmer / R. Willobe

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		SILTY SAND w/ CLAY AND GRAVEL. GREY -		FILL MATERIAL
1.0	GC	BROWN.		
	FILL			
2.0		AS ABOVE w/ BLACK ORGANIC MATERIAL		
3.0		RED-BRN COARSE SAND w/ GRAVEL		NATURAL MATERIAL
4.0	NATURAL	AS ABOVE		
5.0	SP/SM	AS ABOVE		
6.0				
	TD=6'			

Test Pit Cross Section and / or Plan View

PIT CROSS-SECTION



REMARKS Pit 25' long x 3' wide x 6' deep.

PHOTO LOG

TEST PIT

PAGE ..... OF

TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP3

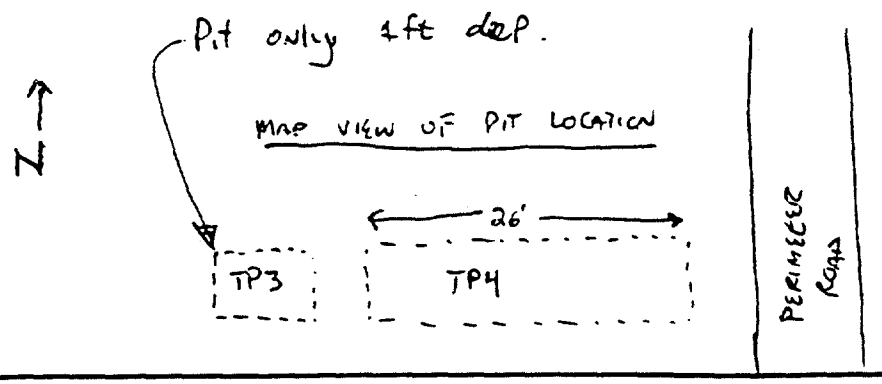
PROJECT NO.: 2295 DATE: 3/6/95

LOCATION: CENTER OF SITE 3 NEAR PERIMETER ROAD.

FIELD GEOLOGIST: P. NIMMER / R. WILLOWBY

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
	FILL	BLACK - BRN - RED SAND, SILT + COBBLES,		TRASH material, possibly burned.
1.0	GM	GLASS, metal, nails.		Included 3 potential UXO
	TD = 1'			Objects. 6" x 3" Cylinder
				2 more in Soil Pile.

Test Pit Cross Section and / or Plan View



REMARKS 9' Long x 3' wide x 1' deep.

5 UXO OBJECTS (BOMB FUSES) DISCOVERED.
ALL WERE TAKEN BY EOD PERSONNEL FROM SITE.

PHOTO LOG TEST PIT 3-TP3

PAGE 1 OF 1

TEST PIT LOG

HALLIBURTON NUS

PROJECT: WHITE OAK TEST PIT NO.: 3-TP4

PROJECT NO.: 2295 DATE: 3/6/95

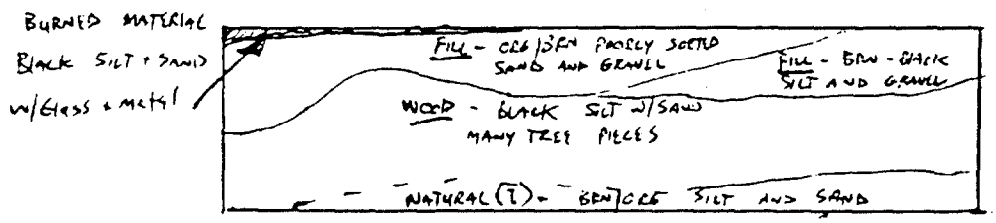
LOCATION: CENTER OF Site 3, NEAR Perimeter Road.

FIELD GEOLOGIST: P. Nimmer / R. Willowby

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
	GC	BRN - ORG GRADED SAND, GRAVEL AND SILT		POORLY SORTED
1.0		THIN LAYER (~6") OF TRASH AT WEST END.		SOME TRASH PRESENT.
2.0		BRN - BLACK SANDY SILT W/ GRAVEL		
3.0	WOOD	BLACK ORGANIC (TREE) MATERIAL		LAYER OF WOOD @ 3-5'
4.0		AS ABOVE		
5.0	SM	BRN - ORG SILT W/ SAND AND GRAVEL		POSSIBLE NATURAL MATERIAL
	TD=5'			

Test Pit Cross Section and / or Plan View

PIT CROSS-SECTION



REMARKS Metal + Trash AT Surface.

Pit 25' x 5' x 3' wide

PHOTO LOG

TEST PIT 3-TP4

PAGE 1 OF 1

TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP5
PROJECT NO.: 2295 DATE: 3/7/95
LOCATION: CENTER of S.k 3 NEAR PERIMETER RD.
FIELD GEOLOGIST: P. NIMMER / R. WILLOWBE

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
	GC	BRN SAND W/SILT AND GRAVEL		CLEAN FILL
1.0		BRN - GREY MOTTLED GRADED SAND		
		W/ GRAVEL		
2.0	GC			
		AS ABOVE.		BACKHOE GOT STUCK IN
3.0				AT COLLAPSED SIDES
	TD=3'			

Test Pit Cross Section and / or Plan View

CLEAN FILL, NO EVIDENCE OF TRASH OR METAL.

REMARKS Pit 36' long x 5' wide x 3' deep.

PHOTO LOG

TEST PIT 3-TP5

PAGE 1 OF 1

TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP6

PROJECT NO.: 2295 DATE: 3/7/95

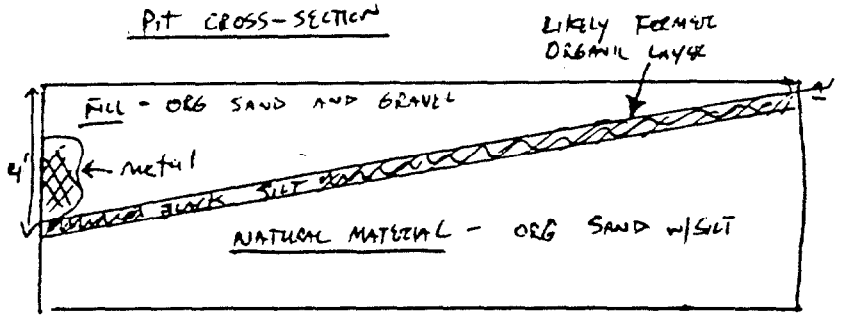
LOCATION: Southern Center area, towards

FIELD GEOLOGIST: P. NIMMER / R. Willowby

DEPTH (ft.)	LITHOLOGY CHANGE (Depth ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		ORG/BRN POORLY GRADED SAND w/ SILT + GRAVEL		FILL
1.0	SP/GC			
		BLACK SILT OVER GRAY CLAY		POSSIBLE ORGANIC (NATIVE) Zone
2.0				
3.0		ORG - GREY SAND w/cobbles		
4.0	SM	ORG SAND AND SILT - well GRADED		NATURAL MATERIAL
5.0		AS ABOVE		
	TD=5'			

Test Pit Cross Section and / or Plan View

PIT CROSS-SECTION



REMARKS Pit 21' LONG x 3' wide x 5' deep

PHOTO LOG

TEST PIT 3-TP6

PAGE 1 OF 1

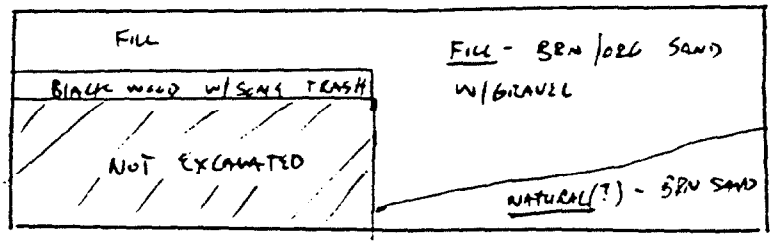
TEST PIT LOG **HALLIBURTON NUS**

PROJECT: WHITE OAK TEST PIT NO.: 3-TP7
PROJECT NO.: 2295 DATE: 3/9/95
LOCATION: Southern edge of site
FIELD GEOLOGIST: P. Nimmer / R. Willowby

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
1.0	SM	ORG-BRN GRADED SAND w/ MICA		LIKELY FILL
2.0				
		BLACK - ORGANIC - WOOD ZONE w/TRASH		SOME TRASH @ 25'
3.0	WOOD			
4.0				
	SM	ORG BRN - Sandy SILT		POSSIBLE NATURAL MATERIAL
5.0				
	TD=5'			

Test Pit Cross Section and / or Plan View

Pit CROSS-SECTION



REMARKS pit 25' long x 3' wide x 5' deep.

PHOTO LOG

TEST PIT 3-TP7

PAGE 1 OF 1

APPENDIX F

SITE 4 - HISTORICAL DATA

Phase I RI Summary Data
Phase II RI Summary Data
Design Verification Study - Soil Results
HREM Survey Results
Groundwater Sampling Analytical Results

Phase I RI Summary Data

TABLE 4-3
SITE 4 – CHEMICAL BURIAL SITE
SOIL BORING ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations						Detection Limit	Units
	4SB1A (4GW52)	4SB1B (4GW52)	4SB2A (4GW48)	4SB2B (4GW48)	4SB3A (4GW51S)	4SB3B (4GW51S)		
TOTAL METALS:								
Cadmium	U	U	U	U	U	0.57	0.50	mg/kg
Chromium	16.4	8.3	12.2	4.4	6.0	4.8	0.70	mg/kg
Copper	5.0	9.4	3.2	2.2	3.4	1.5	0.30	mg/kg
Lead	5.3	U	U	U	U	U	3.60	mg/kg
Zinc	2.6	0.90	5.6	1.8	1.4	1.7	0.50	mg/kg
Chromium VI	U	U	U	U	U	U	10.0	ug/l
pH	5.66	5.53	5.28	5.19	5.54	6.20	--	su
TOC	492	U	492	672	615	691	100	mg/kg
TOX	U	U	U	U	U	U	15	mg/kg
SEMIVOLATILE ORGANICS:								
bis(2-ethylhexyl)phthalate	--	--	150 J	U	U	86 JX	350	ug/kg

Notes: A - Sample collected above the water table.
B - Sample collected in the saturated zone.
U - Not detected.
J - Compound present but below detection limit.
X - EPA CLP criteria not met for confirmation but compound is present.

TABLE 4-5
SITE 4 – CHEMICAL BURIAL SITE
GROUNDWATER ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations												Detection Limit	Units
	4GW10	4GW11	4GW11A	4GW12	4GW13	4GW15	4GW48	4GW49S	4GW49D	4GW50	4GW51S	4GW52		
TOTAL METALS:														
Cadmium	U	7.4	12.6	U	0.1	2.2	2.1	U	U	U	U	8.4	2.0	ug/l
Chromium	93.9	204	1157	90.5	100	113	125	51.4	34.4	123	6.1	396	5.0	ug/l
Copper	45.7	408	780	56.3	143	46.3	236	23.5	40.2	209	4.3	259	3.0	ug/l
Lead	U	204	104	U	11.3	11.4	91.3	11.0	U	16.7	U	77.0	28.0	ug/l
Mercury	7.6	2.7	3.1	7.0	2.8	4.1	2.1	0.77	4.1	3.1	U	2.5	0.20	ug/l
Zinc	60.2	1150	2850	31.9	39.0	60.4	277	51.0	25.6	58.5	5.5	198	3.0	ug/l
Chromium VI	U	U	U	U	U	U	U	U	U	U	U	U	10.0	ug/l
FILTERED METALS:														
Cadmium	3.6	2.8	2.6	2.8	2.7	U	U	4.3	U	2.9	U	5.6	2.0	ug/l
Chromium	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Copper	U	U	18.6	U	U	U	U	U	U	U	U	U	3.0	ug/l
Lead	U	U	U	U	U	U	U	U	U	U	U	U	28.0	ug/l
Mercury	1.4	U	U	0.88	U	U	U	U	0.27	U	U	U	0.20	ug/l
Zinc	145	37.9	949	106	60.3	62.1	87.0	23.8	87.7	86.8	31.7	56.2	3.0	ug/l
Chromium VI	U	U	U	U	U	U	U	U	U	U	U	U	10.0	ug/l
pH	5.90	6.70	6.70	4.50	5.00	5.60	7.00	5.60	5.40	5.40	6.60	5.50	--	su
TOC	19.6	51.7	19.3	17.1	42.4	13.3	62.5	13.9	43.8	25.2	14.4	59.8	0.50	mg/l
TOX	47.2	17.0	17.3	23.6	87.2	89.8	140	U	17.6	21.0	39.6	472.0	8	ug/l
TDS	360	296	330	196	130	752	508	488	285	228	312	212	20	mg/l
TSS	4,990	23,900	924.0	7,140	4,320	9,810	20,600	7,550	5,360	16,220	536	31,500	4	mg/l
VOLATILE ORGANICS:														
Benzene	U	6	U	U	U	U	U	U	U	U	7	U	5	ug/l
Chloroform	U	U	U	U	6	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethene	U	U	U	U	7	U	U	U	U	U	U	170	5	ug/l
Methylene Chloride	4 J	4 J	U	U	U	U	21	U	U	U	U	U	5	ug/l
1,1,2,2-Tetrachloroethane	U	U	U	U	U	81	U	U	U	U	U	75	5	ug/l
Toluene	6	5 J	U	4 J	U	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	U	U	U	U	160	170	590	U	U	U	U	1000	5	ug/l
SEMIVOLATILES:														
Benzoic Acid	14 J	29 J	U	U	U	U	U	U	U	U	15 JX	U	50	ug/l
bis(2-Ethylhexyl)Phthalate	U	7 J	U	U	U	U	6 JX	U	U	U	14	8 JX	10	ug/l

Notes: U – Not detected.

J – Compound is present but less than the detection limit.

X – EPA CLP criteria for confirmation not met but compound is present.

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Phase II RI Summary Data

TABLE 4-4

SITE 4 - CHEMICAL BURIAL SITE

SURFACE SOIL ANALYTICAL RESULTS

(PHASE II - 1991)

Parameter	Sample Locations 4SL1	Sample Locations 4SL2	Detection Limit	Units
TOTAL METALS:				
Cadmium	U	U	5	mg/kg
Chromium	1.0	8.5	10	mg/kg
Copper	22	3.5	25	mg/kg
Lead	7.3	14	3	mg/kg
Zinc	34	9.5	20	mg/kg
VOLATILE ORGANICS:			(1)	
Acetone	48 E	59 E	—	ug/kg
Methylene Chloride	180 E	350 E	—	ug/kg
Trichloroethene	U E	8 E	—	ug/kg
Carbon Disulfide	5 E	U E	—	ug/kg
1,1,1-Trichloroethane	3 E	U E	—	ug/kg
m & p Xylene	3 E	U E	—	ug/kg
SEMIVOLATILE ORGANICS:			(1)	
bis(2-ethylhexyl)phthalate	U	U	—	ug/kg
pyrene	340 E	U	—	ug/kg

NOTES: (1) Detection limits are based on % moisture determination.
U - Not detected.
E - Quantitation Estimated

TABLE 4-6
SITE 4 - CHEMICAL BURIAL SITE
GROUNDWATER ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations												Detection Limit	Units
	4GW10	4GW11	4GW11A	4GW12	4GW13	4GW15	4GW48	4GW49D	4GW49S	4GW50	4GW51	4GW52		
TOTAL METALS:														
Cadmium	U	U	25	U	U	U	U	U	U	9.0	U	8.0	5.0	ug/l
Chromium	3.9	U	93	42	11	24	9.5	6.3	U	82	8.1	46	2.2	ug/l
Copper	U	U	1150	20	58	22	U	U	24	139	19	121	11	ug/l
Lead	3.2	2.3	96	22	9.9	19	2.4	2.8	3.6	19	U	30	1.5	ug/l
Mercury	PR	R	R	PR	PR	R	R	PR	R	PR	R	R	0.2	ug/l
Zinc	U	40	5310	12	21	46	45	6.0	37	52	71	56	4.6	ug/l
FILTERED METALS:														
Cadmium	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	U	U	U	U	U	U	U	U	2.2	ug/l
Copper	U	U	U	U	U	U	U	U	U	U	U	U	11	ug/l
Lead	U	U	U	U	U	U	U	U	U	U	U	U	1.5	ug/l
Mercury	R	R	PR	PR	R	R	R	R	R	R	R	R	0.2	ug/l
Zinc	6.0	18	418	41	22	8.0	104	16	42	46	18	25	4.6	ug/l
PCBs (1)	U	U	U	U	U	U	U	U	U	U	U	U		ug/l
VOLATILE ORGANICS:														
Benzene	U	U	U	U	2	U	U	U	U	U	3	U	5	ug/l
Chloroform	U	U	U	U	1	U	9	U	U	2	U	U	5	ug/l
Methylene Chloride	R	12	R	4	R	R	U	3	4	R	R	10	5	ug/l
1,1,2,2-Tetrachloroethane	U	U	U	U	3	U	U	U	U	10 E	U	U	5	ug/l
Tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Toluene	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	U	U	U	U	90	24	160	U	U	650	U	U	5	ug/l
Acetone	U	98 E	R	U	R	R	U	32 E	U	8	R	93 E	10	ug/l
1,1,1-Trichloroethane	U	U	U	U	2	2	U	U	U	5	U	U	5	ug/l
1,1,2-Trichloroethane	U	U	U	U	U	U	U	U	U	2	U	U	5	ug/l
1,2-Dichloroethene (Total)	U	U	U	U	50	U	U	U	U	54	U	U	5	ug/l
1,2-Dichloroethane	U	U	U	U	2	U	U	U	U	2	U	U	5	ug/l
Chlorobenzene	U	U	U	U	1	U	U	U	U	1	U	U	5	ug/l
Vinyl Chloride	U	U	U	U	11	U	U	U	U	U	U	U	10	ug/l
2-Butanone	U	U	U	U	U	U	U	U	U	U	40 E	U	10	ug/l
Ethylbenzene	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
m & p xylenes	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
o-xylene	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
SEMIVOLATILES:														
Benzoic Acid	U	R	R	R	U	R	U	U	R	U	R	U	50	ug/l
bis(2-Ethylhexyl)Phthalate	U	R	R	R	U	R	U	U	R	U	R	U	10	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.
U - Not detected.
E - Quantitation Estimated
R - Quantitation Rejected.

TABLE 4-6 (CONTINUED)
SITE 4 - CHEMICAL BURIAL SITE
GROUNDWATER ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations					Detection Limit	Units
	4PZ79(2)	4GW80	4GW81D	4GW81S	4GW82		
TOTAL METALS:							
Cadmium	U	U	U	U	7.0	5.0	ug/l
Chromium	U	26	2.3	270	45	2.2	ug/l
Copper	U	137	19	290	172	11	ug/l
Lead	U	12	U	32	34	1.5	ug/l
Mercury	P R	P R	P R	P R	U	0.2	ug/l
Zinc	32	79	14	167	666	4.6	ug/l
FILTERED METALS:							
Cadmium	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	U	2.2	ug/l
Copper	U	U	U	U	U	11	ug/l
Lead	U	U	U	U	U	1.5	ug/l
Mercury	R	R	R	R	U	0.2	ug/l
Zinc	74	26	42	44	45	4.6	ug/l
PCBs (1)	U	U	U	U	U	1.0	ug/l
VOLATILE ORGANICS:							
Benzene	U	U	U	U	U	5	ug/l
Chloroform	U	U	U	U	U	5	ug/l
Methylene Chloride	25	5 B	25	8 B	5	5	ug/l
1,1,2,2-Tetrachloroethane	3	U	3	10	U	5	ug/l
Tetrachloroethene	U	U	U	4	5	5	ug/l
Toluene	U	U	U	10	U	5	ug/l
Trichloroethene	39	34	2	4	U	5	ug/l
Acetone	7	12 B	13	5 B	12	10	ug/l
1,1,1-Trichloroethane	U	U	U	U	U	5	ug/l
1,1,2-Trichloroethane	U	U	U	U	U	5	ug/l
Vinyl Chloride	U	U	U	U	U	10	ug/l
1,2-Dichloroethane	U	U	U	U	U	5	ug/l
Chlorobenzene	U	U	U	U	U	5	ug/l
1,2,-Dichloroethene (Total)	U	U	U	U	U	5	ug/l
2-Butanone	U	U	U	U	U	10	ug/l
Ethylbenzene	U	U	U	U	2	5	ug/l
m & p xylenes	U	U	U	U	9	5	ug/l
o-xylene	U	U	U	U	4	5	ug/l
SEMIVOLATILES:							
Benzoic Acid	R	R	R	R	R	50	ug/l
bis(2-Ethylhexyl)Phthalate	R	R	R	R	R	10	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.
(2) Well damaged
U - Not detected.
E - Quantitation Estimated.
P - Present

F:\u\mullen.m\woreport\PHIII\tables\TABLE4-6.wk1 6-5-92

Design Verification Study - Soil Results

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CHEMI... ...URIAL AREA

DVSAP ANALYTICAL RESULTS

NSWC - WHITE OAK

PARAMETER	SB-01 04-SB01-1216		SB-02 04-SB02-1216		SB-03 04-SB03-1214		SB-04 04-SB04-1214		SB-05 04-SB05-0406		SB-06 04-SB06-0406		SB-07 04-SB07-1822		SB-08 04-SB08-0909		SB-08 04-SB08-0909-D		SB-09 04-SB09-0909		SB-10 04-SB10-0706		SB-11 04-SB11-0909
VOLATILES(ug/Kg)																							
METHYLENE CHLORIDE	8.15	B	11.0	B	9.20	B	2.00	B	14.9	B	6.71	B	2.04	B	6.59	B	5.84	B	6.86	B	6.61	B	9.63
ACETONE	ND		ND		ND		ND		ND		7.64	J	ND		ND		ND		ND		ND		ND
1,2-DICHLOROETHENE(TOTAL)	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
CHLOROFORM	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,2-DICHLOROETHANE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,1-TRICHLOROETHANE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
TRICHLOROETHENE	ND		ND		ND		ND		ND		ND		1.25	J	ND		ND		ND		ND		ND
1,1,2-TRICHLOROETHANE	ND		ND		ND		ND		ND		ND		ND		ND		ND		6.12	J	ND		ND
BENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		1.24	J	19.4
TETRACHLOROETHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
1,1,2,2-TETRACHLOROETHANE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
TOLUENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
CHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		5.71	J	45.8
ETHYLBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
XYLENES (TOTAL)	ND		ND		ND		3.17	J	ND		ND		ND		ND		ND		4.87	J	4.25	J	ND
SEMIVOLATILES(ug/Kg)																							
1,4-DICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
NAPHTHALENE	ND		ND		ND		ND		ND		ND		294.0	J	ND		ND		ND		40.2	J	3,200
2-METHYLNAPHTHALENE	ND		ND		ND		ND		ND		ND		2,100		ND		ND		ND		138	J	*18,000
PENTACHLOROPHENOL	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
DIETHYLPHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		1,300
PHENANTHRENE	ND		ND		ND		ND		ND		ND		1,120		ND		ND		ND		ND		*6,000
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		841
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		180
DI-n-BUTYLPHTHALATE	51.7	J	48.2	J	ND		35.9	J	ND		ND		ND		ND		109	J	ND		ND		ND
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		1,610
PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		1,430
BENZO(a)ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		554.0
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		800
BIS(2-ETHYLHEXYL)PHTHALATE	ND		53.0	B	ND		ND		ND		ND		ND		ND		ND		ND		ND		1,170
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		382
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		550
BENZO(a)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		566
INDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND
BEZO(g,h,i)PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		408
PESTICIDES/PCBS (ug/Kg)																							
AROCLOR 1260	NA		NA		NA		NA		NA		NA		NA		NA		NA		249		NA		NA
METALS(mg/Kg)																							
ALUMINUM	980		1,130		1,670		506		2,860		4,720		4,740		13,600		12,400		13,400		11,200		5,670
ANTIMONY	ND		1.68		ND		0.255	B	ND		0.356	B	ND		ND		ND		0.333		0.293		3.61
ARSENIC	0.513		3.89		0.642		0.339		1.54		0.647		1.17		2.48		2.79		1.98		1.99		1.66
BARIUM	2.31		3.86		3.31		3.73	B	8.78	B	9.83	B	8.74	B	28		28.2		44.7		55.6		49.7
BERYLIUM	0.198	B	0.349	B	0.252	B	0.364	B	0.530	B	0.457	B	0.500	B	0.371		0.328	B	0.425		0.440		0.259
CADMIUM	ND		ND		0.263		ND		ND		ND		ND		0.646		0.620		0.286		0.629		1.36
CALCIUM	ND		ND		ND		ND		ND		ND		53.8		141		142		109		371		51,200
CHROMIUM	2.15		16.3	B	4.06		2.51		8.20		10.1		6.35		16.4		16.2		17.7		14.9		15.5
COBALT	1.81	B	1.75		1.80	B	1.83	B	2.51	B	3.36	B	2.35	B	2.36		2.31		4.17		3.60		3.81
COPPER	1.03		21.7		1.98		1.59	B	3.00	B	3.63	B	3.60	B	14.1		10.0		13.6		8.50		130.0
IRON	1,010		5,280		2,110		588		6,770		6,270		4,880		17,800		19,800		17,800		12,300		12,500
LEAD	1.82		2.14		2.46		0.551		2.36		1.50		4.37		3.03		2.69		2.06		1.84		65.7
MAGNESIUM	6.05		53.4		22.2		ND		53.6		69.2		65.9		618		526		1,060		1,130		4,750
MANGANESE	1.47	B	ND		5.66		1.99		4.66		31.7		7.57		56.8		67.8		71.5		68.5		138
MERCURY	ND		0.106		ND		ND		0.061		0.064		ND		0.177		0.144		0.565		0.120		0.774
NICKEL	ND		ND		ND		2.90		ND		ND		ND		5.31		4.96		8.23		5.74		11.2
POTASSIUM	22.6		96.4		22.5		28.0		69.6		107		116		383		300		501		452		351
SELENIUM	ND		10.5		ND		ND		ND		ND		ND		1.14		1.07		0.488		0.451		ND
SILVER	ND		ND		ND		ND		ND		ND		0.440		ND		ND		ND		ND		2.41
SODIUM	30.4	B	ND		ND		20.2	B	59.2	B	43.2	B	59.2	B	56.3	B	56.7	B	46.0	B	57.9	B	82.9
VANADIUM	2.83	B	24.6		4.34	B	2.19		15.7		12.2		11.0		36.1		32.7		31.8		22.4		18.4
ZINC	1.66	B	1.78	B	2.14	B	ND		2.11		4.02		4.25		12.2		10.4		20.5		20.7		372
MISCELLANEOUS																							
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		2.28		ND		ND		2.13		ND		ND
TOTAL KJELDAHL NITROGEN (mg/Kg)	11.1		74.4		7.29		8.90		221		26.5		31.0		124		146		169		399		278
TOTAL ORGANIC CARBON (mg/Kg)	756		NA		NA		443		NA		NA		NA		NA		NA		NA		NA		NA
pH	4.06		4.33		3.83		5.10		4.61		4.47		5.40		4.95		5.04		5.71		5.90		6.75
PERCENT SOLIDS (%)	95.5		86.1		85.7		96.1		86.3		93.8		96.3		85.8		85.2		82.5		83.4		83.1
EXPLOSIVES - NO POSITIVES REPORTED																							

ND - Not Detected; NA - Not Analyzed

* - Result taken from dilution analysis

B - Positive result is considered false positive due to blank contamination

J - Positive result is considered an estimate

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CHEMICAL BURIAL AREA
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	SB-12 04-SB12-1012	SB-13 04-SB13-0506	SB-14 04-SB14-0506	SB-15 04-SB15-0812	SB-16 04-SB16-1012	SB-17 04-SB17-1214	SB-18 04-SB18-1012	SB-19 04-SB19-1012	SB-20 04-SB20-0607	SB-20 04-SB20-0607D	SB-21 0458-21
VOLATILES(ug/Kg)											
METHYLENE CHLORIDE	B 7.60	B ND	6.01 B	13.6 B	ND	40.1 B	5.33 B	3.76 B	38.4 B	40.0 B	NA
ACETONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
1,2-DICHLOROETHENE(TOTAL)	ND	ND	ND	ND	ND	41.8 J	ND	ND	ND	ND	NA
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	30.7 J	25.9 J	NA
1,2-DICHLOROETHANE	ND	ND	ND	ND	ND	133	ND	ND	ND	ND	NA
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	19.8 J	ND	ND	ND	ND	NA
TRICHLOROETHENE	1.13 J	1.87	ND	ND	2.90 J	*3,200	ND	45.7	*4,400	*2,600.0	NA
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	20.2 J	ND	ND	ND	ND	NA
BENZENE	J ND	ND	ND	ND	ND	31.4 J	ND	ND	ND	ND	NA
TETRACHLOROETHENE	ND	ND	ND	ND	ND	129	ND	ND	ND	6.19 J	NA
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	6.37 J	*13,000	ND	5.67 J	37.7 J	ND	NA
TOLUENE	ND	ND	ND	ND	ND	531	ND	ND	9.69 J	8.61 J	NA
CHLOROBENZENE	J ND	ND	ND	ND	ND	45.6 J	ND	ND	ND	ND	NA
ETHYLBENZENE	1.49 J	ND	ND	ND	ND	93.1	ND	ND	10.8 J	9.84 J	NA
XYLENES (TOTAL)	ND	ND	ND	ND	ND	789	ND	ND	93.2	101	NA
SEMIVOLATILES(ug/Kg)											
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	63.0 J
2-METHYLNAPHTHALENE	ND	ND	ND	ND	ND	483 J	ND	ND	787.0	566.0	516
PENTACHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	216 J
DIETHYLPHTHALATE	ND	ND	ND	*3,800	ND	ND	ND	ND	ND	ND	ND
FLUORENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PHENANTHRENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ANTHRACENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBAZOLE	J ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DI-n-BUTYLPHTHALATE	ND	107.0 B	58.0 J	47.3 J	79.5 B	119 B	ND	ND	ND	ND	49.0 J
FLUORANTHENE	ND	515.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
PYRENE	ND	510	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZO(a)ANTHRACENE	ND	313.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHRYSENE	ND	333.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	ND	ND	ND	ND	ND	ND	38.1 J	ND	ND	ND	ND
BENZO(b)FLUORANTHENE	J ND	247.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZO(k)FLUORANTHENE	ND	366.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZO(a)PYRENE	ND	343.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
INDENO(1,2,3-cd)PYRENE	ND	137.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
BEZO(g,h,i)PERYLENE	ND	221.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBS (ug/Kg)											
AROCLOR 1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS(mg/Kg)											
ALUMINUM	4,880	8,560	23,600	6,750	1,800	2,110	2,550	1,180	5,820	5,300	1,340
ANTIMONY	ND	3.19 B	0.587 B	0.369 B	.381 B	.322 B	ND	ND	0.316 B	ND	ND
ARSENIC	0.887	3.18 B	3.00	1.72	.776 B	1.04 B	ND	ND	1.87 B	1.74 B	ND
BARIUM	7.10	89.3	39.2	21.5	5.25 B	6.28	175.0	ND	11.1	10.8	3.14
BERYLIUM	B 0.114	B 0.539 B	1.14 B	0.964 B	.230 B	.310 B	ND	0.101 B	0.432 B	0.467 B	ND
CADMIUM	0.445	2.36 B	0.790	ND	ND	ND	0.606	0.373	ND	ND	ND
CALCIUM	42.4	11,500	ND	1,310	32.5 B	43.3 B	35.1	15.8	46.6 B	58.4 B	41.2
CHROMIUM	9.18	23.9	20.8	20.8	4.14	31.2	6.90	15.2	11.6	10.6	2.87
COBALT	ND	6.62	7.98 B	9.06 B	ND	ND	ND	ND	ND	ND	ND
COPPER	7.24	743	12.0	11.7	6.72 B	6.70 B	6.66	5.82	11.2 B	10.5 B	ND
IRON	4,730	23,300	20,800	9,010	2,020	2,170	3,380	1,410	6,670	5,360	1,050
LEAD	2.96	242	8.40	4.35	1.38 B	3.06	1.59	0.761	3.82	4.94	1.75
MAGNESIUM	149	2,300	462	290	103	35.7	172.0	40.4	136.0	133	51.5
MANGANESE	12.8	444	40.7	27.9	1.79	1.35	5.92	3.23	7.04	6.82	3.60
MERCURY	0.151	6.12	0.164	0.099	0.147 B	0.177 B	ND	ND	0.200 B	0.198 B	0.085
NICKEL	ND	17.4	6.86	9.90	ND	ND	ND	ND B	6.24	6.77	ND
POTASSIUM	160 B	753	397	233	63.0	79.9	135	67.7 B	188	234	120
SELENIUM	ND	ND	0.342	0.443	ND	ND	ND	ND	ND	ND	ND
SILVER	ND	7.15	ND	ND	ND	ND	ND	ND	0.172	ND	ND
SODIUM	B 52.6	B 30.1	70.8 B	68.2 B	ND	ND	53.4 B	30.3 B	ND	ND	ND
VANADIUM	11.7	20.3	41.4	20.6	5.22	23.3	6.96	4.98	41.5	48.2	ND
ZINC	3.80	517	14.2	9.10	ND	ND	2.91	3.23	3.91 B	3.75 B	4.24
MISCELLANEOUS											
TOTAL CYANIDE (mg/Kg)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
TOTAL KJELDAHL NITROGEN (mg/Kg)	66.6	235	50.6	40.3	12.8	31.7	19.1	41.8	73.8	57.8	NA
TOTAL ORGANIC CARBON (mg/Kg)	NA	NA	NA	NA	NA	NA	358	NA	NA	NA	NA
pH	5.53	7.48	4.91	5.49	6.06	4.66	5.93	4.64	4.61	4.61	5.12
PERCENT SOLIDS (%)	91.7	75.8	87.0	90.4	90.1	86.0	90.4	91.1	87.5	90.8	86.6
EXPLOSIVES - NO POSITIVES REPORTE											

ND - Not Detected; NA - Not Analyzed
* - Result taken from dilution analysis
B - Per[illegible] is considered false positive due to blank contamination
J - Pe[illegible] considered an estimate

[illegible]004 XLWJA

TABLE 2-4

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CHEMICAL BURIAL AREA
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	SB-22 04SB-22	SB-22 04SB-22-D	SB-23 04SB-23	SB-24 04SB-24	SB-25 04SB-25	SB-26 04SB-26	SB-26 04SB-26-D	SB-27 04SB-27	SB-28 04SB-28	SB-29 04SB-29
VOLATILES(ug/Kg)										
METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACETONE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROETHENE(TOTAL)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLOROFORM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRICHLOROETHENE	NA	NA	NA	NA	ND	107	2.96 J	ND	ND	ND
1,1,2-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOLUENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
XYLENES (TOTAL)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEMIVOLATILES(ug/Kg)										
1,4-DICHLOROBENZENE	ND	40.5 J	ND	ND	NA	NA	NA	NA	NA	NA
NAPHTHALENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
FLUORENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
PHENANTHRENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
ANTHRACENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
CARBAZOLE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
DI-n-BUTYLPHTHALATE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
FLUORANTHENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
PYRENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
BENZO(a)ANTHRACENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
CHRYSENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	ND	ND	52.6 J	ND	NA	NA	NA	NA	NA	NA
BENZO(b)FLUORANTHENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
BENZO(k)FLUORANTHENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
BENZO(a)PYRENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-cd)PYRENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
BEZO(g,h,i)PERYLENE	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
PESTICIDES/PCBS (ug/Kg)										
AROCLOR 1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS(mg/Kg)										
ALUMINUM	3,210	3,440	886	5,380	NA	NA	NA	NA	NA	NA
ANTIMONY	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
ARSENIC	0.352	ND	ND	0.633	NA	NA	NA	NA	NA	NA
BARIUM	4.42	5.15	ND	7.52	NA	NA	NA	NA	NA	NA
BERYLIUM	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
CADMIUM	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
CALCIUM	55.4	54.9	28.6	77.0	NA	NA	NA	NA	NA	NA
CHROMIUM	6.24	5.79	2.48	8.89	NA	NA	NA	NA	NA	NA
COBALT	1.49	ND	1.50	2.39	NA	NA	NA	NA	NA	NA
COPPER	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
IRON	3,480	3,800	1,370	5,690	NA	NA	NA	NA	NA	NA
LEAD	1.83	1.68	1.39	2.27	NA	NA	NA	NA	NA	NA
MAGNESIUM	84.8	92.4	33.7	125	NA	NA	NA	NA	NA	NA
MANGANESE	6.45	5.81	5.06	13.8	NA	NA	NA	NA	NA	NA
MERCURY	0.095	0.099	0.180	0.057	NA	NA	NA	NA	NA	NA
NICKEL	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
POTASSIUM	98.8	130	66.5	146	NA	NA	NA	NA	NA	NA
SELENIUM	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
SILVER	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
SODIUM	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA
VANADIUM	7.46	8.96	3.32	10.5	NA	NA	NA	NA	NA	NA
ZINC	2.28	1.96	ND	7.26	NA	NA	NA	NA	NA	NA
MISCELLANEOUS										
TOTAL CYANIDE (mg/Kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL KJELDAHL NITROGEN (mg/Kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (mg/Kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	5.06	5.43	4.88	4.77	NA	NA	NA	NA	NA	NA
PERCENT SOLIDS (%)	91.3	90.7	93.4	90.2	NA	NA	NA	NA	NA	NA
EXPLOSIVES - NO POSITIVES REPORTE										

ND - Not Detected; NA - Not Analyzed
* - Result taken from dilution analysis
B - Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

TABLE 2-5

SITE 4
CHEMICAL BURIAL AREA
DVSAP PCB FIELD SCREENING RESULTS
NSWC - WHITE OAK

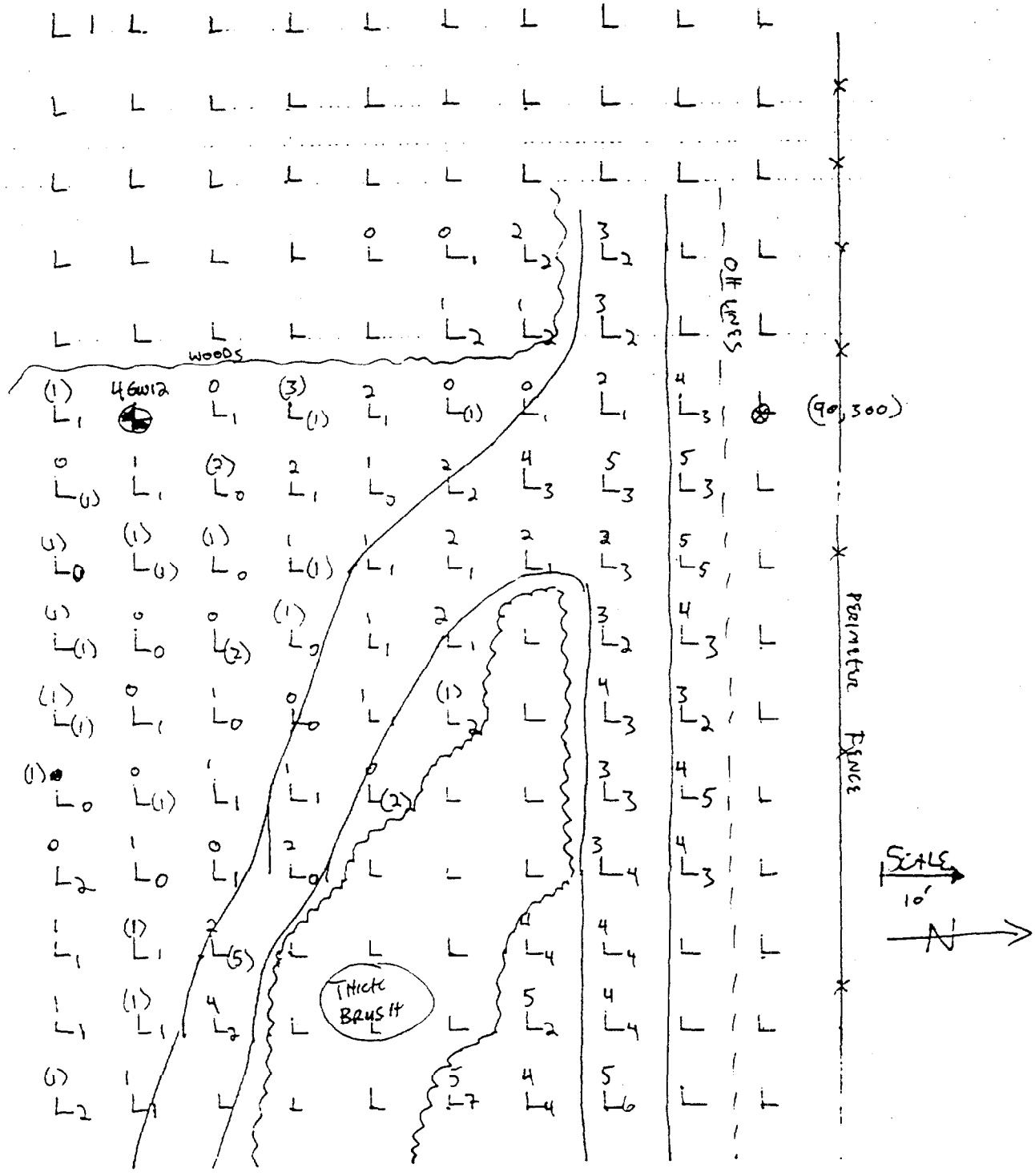
SUBSURFACE SAMPLES			
	Aroclor 1260	Aroclor 1260	Aroclor 1260
SAMPLE	< 0.4 ppm	> 0.4 ppm; < 4.0 ppm	> 4.0 ppm
04-SB01-1216	X		
04-SB03-1214	X		
04-SB04-1214	X		
04-SB07-1822	X		
04-SB08-0809	X		
04-SB09-0809	X		
04-SB10-0708		X	
04-SB11-0809			X
04-SB14-0506	X		
04-SB15-0812		X	
04-SB18-1012	X		
04-SB19-1012	X		

HREM Survey Results

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NSWC WHITEOAK	JOB NUMBER 2295
SUBJECT EM SURVEY - SITE 4	
BASED ON	DRAWING NUMBER
BY PLN / CHECKED BY	APPROVED BY / DATE 3/9/95

EM SURVEY - SITE 4 - WESTERN PORTION

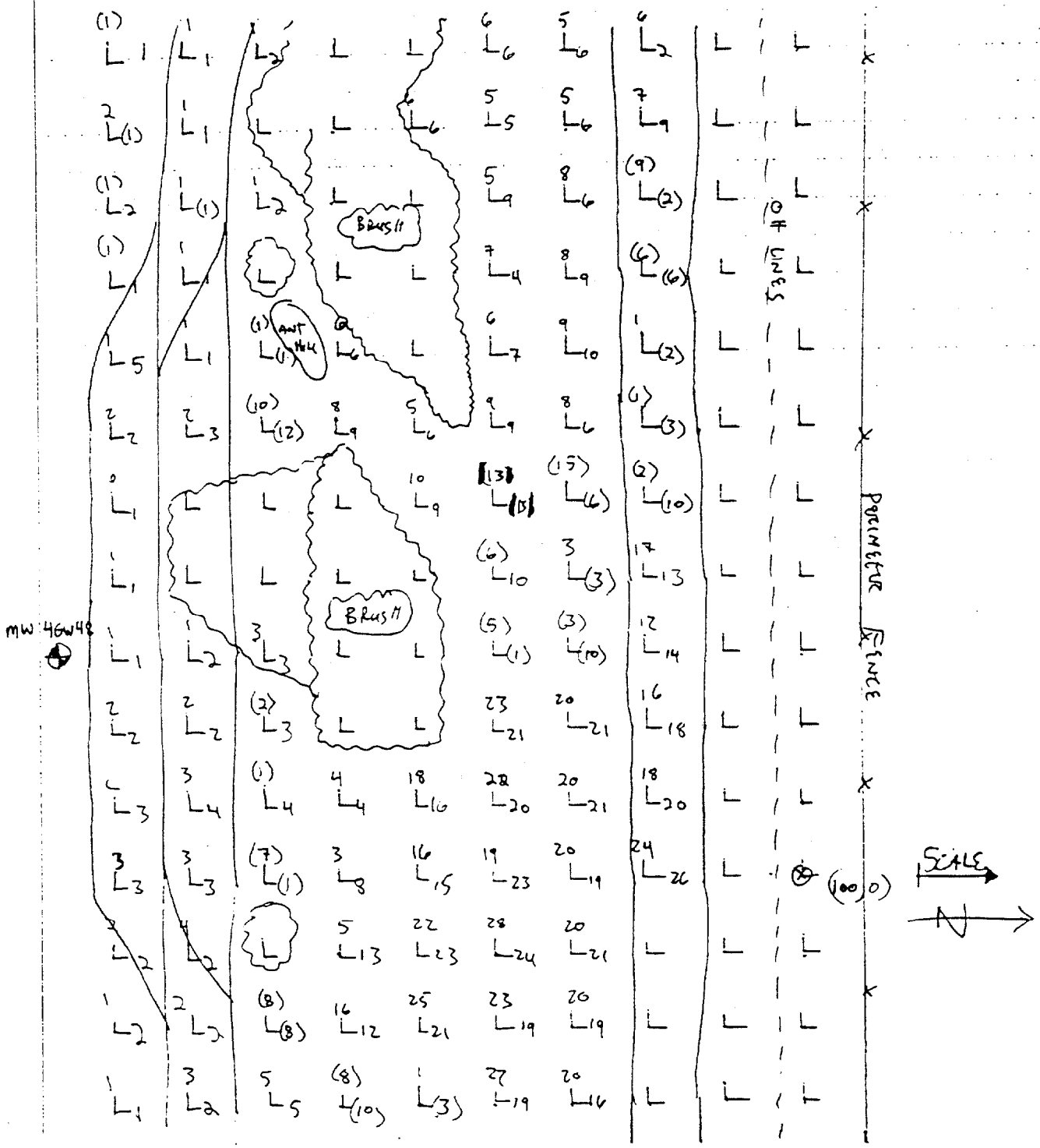


CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT NSWC WHITEOAK		JOB NUMBER 2295	
SUBJECT EM SURVEY - SITE 4			
BASED ON		DRAWING NUMBER	
BY PLN	CHECKED BY	APPROVED BY	DATE 3/9/95

EM Survey - Central Portion

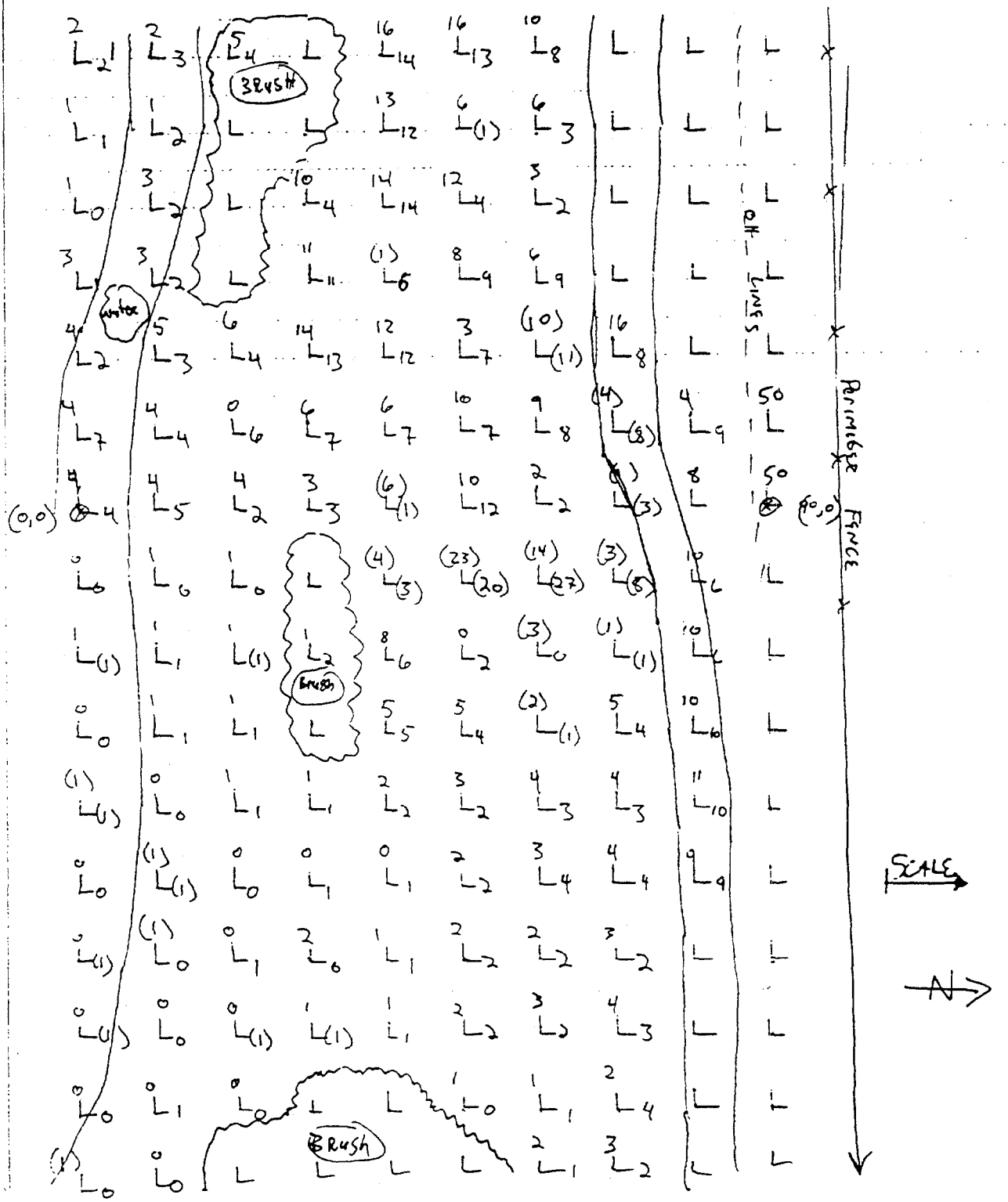


CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: NSWC WHITEOAK	JOB NUMBER: 3295
SUBJECT: EM SURVEY - SITE 4	
BASED ON:	DRAWING NUMBER:
BY: RLN	CHECKED BY: / APPROVED BY: / DATE: 3/9/95

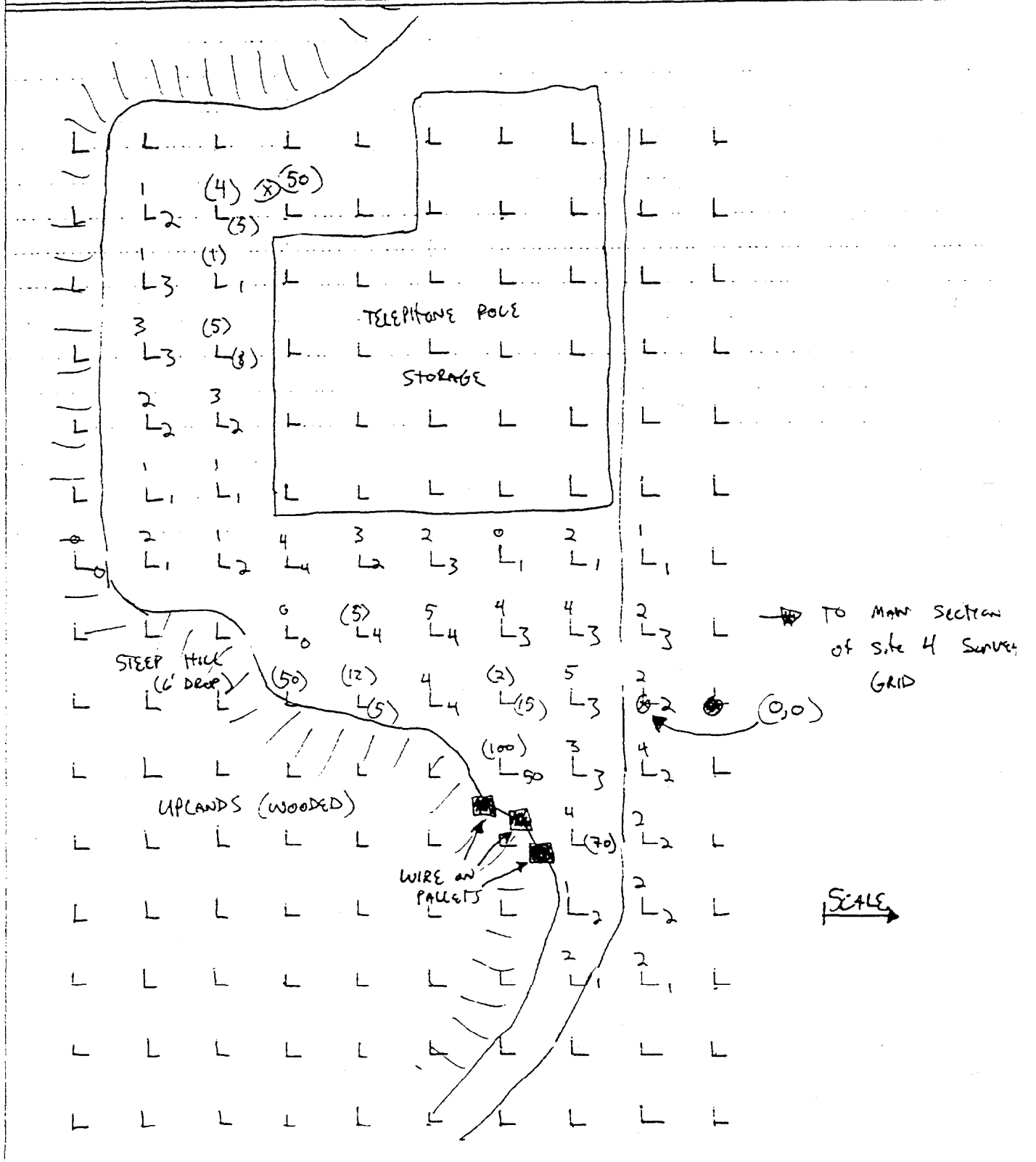
EM SURVEY - SITE 4 - WESTERN PORTION



CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE OF

CLIENT NSWC WHITEOAK	JOB NUMBER 2295
SUBJECT EM SURVEY - SITE 4 - TELEPHONE POLE STORAGE AREA	
BASED ON	DRAWING NUMBER
BY PLN / CHECKED BY	APPROVED BY / DATE 3/9/95



Groundwater Sampling Analytical Results

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW10	WO 4GW11	WO-4GW11A	WO-4GW12	WO-4GW13	WO-4GW15	WO-4GW48
COLLECTION DATE:	06/05/97	06/13/97	06/04/97	06/05/97	06/06/97	06/05/97	06/04/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1	1 U
1,1,2,2-TETRACHLOROETHANE	1 U	1 U	1 U	1 U	2	42	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4 TRICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	2	1 U
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	5 UR	7 J	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	8	1 U	1 U	1 U	1 U	1 U
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOFORM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	1 U	1	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U	1
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW10	WO-4GW11	WO-4GW11A	WO-4GW12	WO-4GW13	WO-4GW15	WO-4GW48
COLLECTION DATE:	06/05/97	06/13/97	06/04/97	06/05/97	06/06/97	06/05/97	06/04/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	9	1 U	1 U
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIBROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
STYRENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U	3
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	1 U	1 U	1 U	1 U	58	83	300
VINYL CHLORIDE	1 U	1 U	1 U	1 U	2	1 U	1 U
XYLENES, TOTAL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
1,2-DICHLOROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
1,3-DICHLOROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
1,4-DICHLOROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	6 UJ	6 U	5 U	5 U	5 U	6 U
2,4,5-TRICHLOROPHENOL	21 U	24 U	23 U	21 U	21 U	22 U	22 U
2,4,6-TRICHLOROPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2,4-DICHLOROPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2,4-DIMETHYLPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2,4-DINITROPHENOL	21 U	24 U	23 U	21 U	21 U	22 U	22 U
2,4-DINITROTOLUENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2,6-DINITROTOLUENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2-CHLORONAPHTHALENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2-CHLOROPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW10 06/05/97 SITE 04	WO-4GW11 06/13/97 SITE 04	WO-4GW11A 06/04/97 SITE 04	WO-4GW12 06/05/97 SITE 04	WO-4GW13 06/06/97 SITE 04	WO-4GW15 06/05/97 SITE 04	WO-4GW48 06/04/97 SITE 04
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2-METHYLPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
2-NITROANILINE	21 U	24 U	23 U	21 U	21 U	22 U	22 U
2-NITROPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
3,3'-DICHLOROBENZIDINE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
3-NITROANILINE	21 U	24 U	23 U	21 U	21 U	22 U	22 U
4,6-DINITRO-2-METHYLPHENOL	21 U	24 U	23 U	21 U	21 U	22 U	22 U
4-BROMOPHENYL PHENYL ETHER	5 U	6 U	6 U	5 U	5 U	5 U	6 U
4-CHLORO-3-METHYLPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
4-CHLOROANILINE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
4-CHLOROPHENYL PHENYL ETHER	5 U	6 U	6 U	5 U	5 U	5 U	6 U
4-METHYLPHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
4-NITROANILINE	21 U	24 U	23 U	21 U	21 U	22 U	22 U
4-NITROPHENOL	21 U	24 U	23 U	21 U	21 U	22 U	22 U
ACENAPHTHENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
ACENAPHTHYLENE	5 U	4 J	6 U	5 U	5 U	5 U	6 U
ANTHRACENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BENZO(A)ANTHRACENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BENZO(A)PYRENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BENZO(B)FLUORANTHENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BENZO(G,H,I)PERYLENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BENZO(K)FLUORANTHENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BIS(2-CHLOROETHOXY)METHANE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BIS(2-CHLOROETHYL)ETHER	5 U	6 U	6 U	5 U	5 U	5 U	6 U
BIS(2-ETHYLHEXYL)PHTHALATE	5 U	2 U	1 J	5 U	2 U	2 J	6 U
BUTYLBENZYL PHTHALATE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
CARBAZOLE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
CHRYSENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW10	WO-4GW11	WO-4GW11A	WO-4GW12	WO-4GW13	WO-4GW15	WO-4GW48
COLLECTION DATE:	06/05/97	06/13/97	06/04/97	06/05/97	06/06/97	06/05/97	06/04/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	6 U	6 U	7 U	5 U	2 U	8 U	8 U
DI-N-OCTYL PHTHALATE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
DIBENZO(A,H)ANTHRACENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
DIBENZOFURAN	5 U	6 U	6 U	5 U	5 U	5 U	6 U
DIETHYL PHTHALATE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
DIMETHYL PHTHALATE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
FLUORANTHENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
FLUORENE	5 U	2 J	6 U	5 U	5 U	5 U	6 U
HEXACHLOROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
HEXACHLOROBUTADIENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
HEXACHLOROCYCLOPENTADIENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
HEXACHLOROETHANE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
INDENO(1,2,3-CD)PYRENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
ISOPHORONE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
N-NITROSO-DI-N-PROPYLAMINE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
N-NITROSODIPHENYLAMINE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
NAPHTHALENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
NITROBENZENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
PENTACHLOROPHENOL	21 U	24 U	23 U	21 U	21 U	22 U	22 U
PHENANTHRENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
PHENOL	5 U	6 U	6 U	5 U	5 U	5 U	6 U
PYRENE	5 U	6 U	6 U	5 U	5 U	5 U	6 U
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
1,3-DINITROBENZENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
2,4 DINITROTOLUENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
2,4,6-TRINITROTOLUENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
2,6 DINITROTOLUENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW10	WO-4GW11	WO-4GW11A	WO-4GW12	WO-4GW13	WO-4GW15	WO-4GW48
COLLECTION DATE:	06/05/97	06/13/97	06/04/97	06/05/97	06/06/97	06/05/97	06/04/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
2-NITROTOLUENE	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
3-NITROTOLUENE	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
4-AMINO-2,6-DINITROTOLUENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
4-NITROTOLUENE	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
HMX	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
NITRO-BENZENE	0.6 U	NA	0.6 U	0.6 U	NA	0.6 U	0.6 U
RDX	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
TETRYL	1.3 U	NA	1.3 U	1.3 U	NA	1.3 U	1.3 U
METALS (µg/L)							
ALUMINUM	620 U	7430 J	2380 J	1090 J	1750 J	407 U	11500 J
ANTIMONY	2 U	5 L	6.5	2 U	2 U	2 U	2 U
ARSENIC	2.6 U	7.2	2.6 U	2.6 U	2.6 U	2.6 U	7.5
BARIUM	63.3 J	177 J	332 J	60.9 J	30.1 J	102 J	64.1 J
BERYLLIUM	0.3 UL	0.3 U	0.3 U	0.36 U	0.3 U	0.3 U	0.84 U
CADMIUM	0.42 U	1.9 J	6.1	0.69 U	1.7	0.53 U	1.2
CALCIUM	109000 J	76100 J	79100 J	11400 J	13500 J	44800 J	24400 J
CHROMIUM	7.3 J	10.1 L	50.8 J	8.6 J	6 J	4.8 J	51.2 J
COBALT	0.6 U	2 J	7.5	16.8	4.5	4	23.9
COPPER	4.3 U	24 J	107 J	7.5 U	6.9 U	5.4 U	26.5 J
CYANIDE	14.2	5 U	10.5	9.3	5.1	30.8	15.5
IRON	1280 K	51300	3340 K	11900 K	4500 K	502 K	24200 K
LEAD	1.1 U	12.6	10.2 J	2.9 J	2.6 J	1.2 J	15.6 J
MAGNESIUM	11500 J	13800 J	6630 J	9150 J	5350 J	13000 J	3380 J
MANGANESE	35.8 U	1260 J	370 J	941 J	457 J	219 J	281 J
MERCURY	0.43 U	0.19	0.72	3.7	2	0.6	0.36 U
NICKEL	2.2 U	0.9 UJ	76 J	6.2 U	6.5 U	6 U	29 J
POTASSIUM	3300 J	3660 J	4110 J	1720 J	1950 J	2930 J	2600 J

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW10	WO-4GW11	WO-4GW11A	WO-4GW12	WO-4GW13	WO-4GW15	WO-4GW48
COLLECTION DATE:	06/05/97	06/13/97	06/04/97	06/05/97	06/06/97	06/05/97	06/04/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
METALS (µg/L)							
SELENIUM	1.6 U	8.1 U	2.9 U	3.4 U	1.6 U	1.6 U	7.6 U
SILVER	0.5 U	0.5 U	2.9	0.5 U	0.5 U	0.5 U	0.86
SODIUM	4070 U	6180 L	3690	7150	4350	6340	3330
THALLIUM	2.1 U	3.7 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U
VANADIUM	1.7 L	26.7	7.3	3.6	7.5	1.5	48
ZINC	23 J	124 J	1120 J	22.3 J	5.5 U	30.3 J	36.6 J
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	1.85 J	0.07	0.49 J	0.2 J	0.25 J	1.09 J	0.33 J
ORTHOPHOSPHATE	0.5 UL	0.5 UR	0.5 UL	0.5 UL	2.5 UR	0.5 UL	0.5 UL
SULFATE	80.4 L	91.8 L	11.4 L	59.9 L	22.9	31.2 L	6.03 L

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW49D 06/03/97 SITE 04	WO-4GW49S 06/03/97 SITE 04	WO-4GW50 06/03/97 SITE 04	WO-4GW51S 06/06/97 SITE 04	WO-4GW52 06/06/97 SITE 04	WO-4GW79 06/04/97 SITE 04	WO-4GW80 06/05/97 SITE 04
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1 U	6	1 U	1 U	1 U	1 U
1,1,2,2-TETRACHLOROETHANE	1 U	1 U	59 J	1 U	1 U	41	6
1,1,2-TRICHLOROETHANE	1 U	1 U	1	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4 TRICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	1 U	1 U	2	1 U	1 U	1	1 U
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	5 U	5 U	5 UR	5 UR	5 UR	5 UR	5 UR
BENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOFORM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	1 U	1 U	2	1 U	1 U	1	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	1 U	1 U	2	1 U	1 U	1 U	2
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW49D	WO-4GW49S	WO-4GW50	WO-4GW51S	WO-4GW52	WO-4GW79	WO-4GW80
COLLECTION DATE:	06/03/97	06/03/97	06/03/97	06/06/97	06/06/97	06/04/97	06/05/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	1 U	80 J	1 U	1 U	8	5
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIBROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
STYRENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	5	1 U	1 U	1 U	2
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	1 U	1 U	1110	1 U	1 U	110	61
VINYL CHLORIDE	1 U	1 U	3	1 U	1 U	1 U	1 U
XYLENES, TOTAL	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,3-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,4-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4,5-TRICHLOROPHENOL	22 U	21 U	21 U	21 U	21 U	21 U	21 U
2,4,6-TRICHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4-DICHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4-DIMETHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4-DINITROPHENOL	22 U	21 U	21 U	21 U	21 U	21 U	21 U
2,4-DINITROTOLUENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,6-DINITROTOLUENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLORONAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW49D	WO-4GW49S	WO-4GW50	WO-4GW51S	WO-4GW52	WO-4GW79	WO-4GW80
COLLECTION DATE:	06/03/97	06/03/97	06/03/97	06/06/97	06/06/97	06/04/97	06/05/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-NITROANILINE	22 U	21 U	21 U	21 U	21 U	21 U	21 U
2-NITROPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
3,3'-DICHLOROBENZIDINE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
3-NITROANILINE	22 U	21 U	21 U	21 U	21 U	21 U	21 U
4,6-DINITRO-2-METHYLPHENOL	22 U	21 U	21 U	21 U	21 U	21 U	21 U
4-BROMOPHENYL PHENYL ETHER	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLORO-3-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROANILINE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROPHENYL PHENYL ETHER	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-NITROANILINE	22 U	21 U	21 U	21 U	21 U	21 U	21 U
4-NITROPHENOL	22 U	21 U	21 U	21 U	21 U	21 U	21 U
ACENAPHTHENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACENAPHTHYLENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ANTHRACENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZO(A)ANTHRACENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZO(A)PYRENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZO(B)FLUORANTHENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZO(G,H,I)PERYLENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZO(K)FLUORANTHENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BIS(2-CHLOROETHOXY)METHANE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BIS(2-CHLOROETHYL)ETHER	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BIS(2-ETHYLHEXYL)PHTHALATE	5 U	1 U	5 U	2 U	2 U	1 J	1 J
BUTYLBENZYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CARBAZOLE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHRYSENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW49D	WO-4GW49S	WO-4GW50	WO-4GW51S	WO-4GW52	WO-4GW79	WO-4GW80
COLLECTION DATE:	06/03/97	06/03/97	06/03/97	06/06/97	06/06/97	06/04/97	06/05/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	6 U	5 U	9 U	3 U	5 U	3 U	9 U
DI-N-OCTYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBENZO(A,H)ANTHRACENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBENZOFURAN	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIETHYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIMETHYL PHTHALATE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FLUORANTHENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FLUORENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEXACHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEXACHLOROBUTADIENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEXACHLOROCYCLOPENTADIENE	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U
HEXACHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
INDENO(1,2,3-CD)PYRENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ISOPHORONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
N-NITROSO-DI-N-PROPYLAMINE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
N-NITROSODIPHENYLAMINE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
NITROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
PENTACHLOROPHENOL	22 U	21 U	21 U	21 U	21 U	21 U	21 U
PHENANTHRENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
PHENOL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
PYRENE	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
1,3-DINITROBENZENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
2,4 DINITROTOLUENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
2,4,6-TRINITROTOLUENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
2,6 DINITROTOLUENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW49D	WO-4GW49S	WO-4GW50	WO-4GW51S	WO-4GW52	WO-4GW79	WO-4GW80
COLLECTION DATE:	06/03/97	06/03/97	06/03/97	06/06/97	06/06/97	06/04/97	06/05/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
2-NITROTOLUENE	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.3 U
3-NITROTOLUENE	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.3 U
4-AMINO-2,6-DINITROTOLUENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
4-NITROTOLUENE	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.3 U
HMX	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.4
NITRO-BENZENE	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U	0.6 U
RDX	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.3 U
TETRYL	1.3 U	1.3 U	1.3 U	NA	NA	1.3 U	1.3 U
METALS (µg/L)							
ALUMINUM	1350 J	166 J	1380	1730 J	667 J	11 U	704 J
ANTIMONY	2	2 U	2 U	2 U	2 U	2 U	2 U
ARSENIC	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U
BARIUM	61.2	28.4	21.8	69	68.2	52.3	68.4 J
BERYLLIUM	0.52 U	0.51 U	0.3 U	0.3 U	0.61 U	0.3 U	0.3 U
CADMIUM	2.7	0.68 U	0.22 U	0.87 U	1.9	0.2 U	0.76 U
CALCIUM	34800	4030 K	8530 J	32000 J	5240 J	20100 J	4640 J
CHROMIUM	14.7 J	5.5 K	11.3 J	15.5 J	78.7 J	0.86 U	7.8 J
COBALT	14.6	3.6 J	1.3 U	12.4	32.6	2.8 U	10.2
COPPER	10.6 J	11.2	8 J	10.1 J	15.9 J	6.6 J	8.1 U
CYANIDE	5 U	5 U	5.7 U	6.8 U	7.2 U	5 U	8.4
IRON	3040 J	173 J	2170 K	4380 K	3010 K	35.7 U	9670 K
LEAD	4 J	1.3 J	1.6 J	2.3 J	4.4 J	1.1 U	2.2 J
MAGNESIUM	12700	1450 K	4070 J	5310 J	5950 J	11800 J	3650 J
MANGANESE	527	13.6	28.5 J	174 J	147 J	315 J	193 J
MERCURY	3.3	1	0.54	1.8	4	4.4	1
NICKEL	13.5	11.6	11.3 J	14.3 J	85 J	6.2 U	29.2 J
POTASSIUM	5890 K	2670 K	1340 J	5090 J	2030 J	2040 J	2130 J

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW49D	WO-4GW49S	WO-4GW50	WO-4GW51S	WO-4GW52	WO-4GW79	WO-4GW80
COLLECTION DATE:	06/03/97	06/03/97	06/03/97	06/06/97	06/06/97	06/04/97	06/05/97
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04
FIELD DUPLICATE OF:							
METALS (µg/L)							
SELENIUM	4.6 J	1.6 U	1.6 U	5.8 U	6.2 U	1.6 U	3.1 U
SILVER	0.5 U	0.5 U	0.5 U	0.5 U	0.51	0.5 U	0.54
SODIUM	21600	12000	4350	12000	6240	12500	65200
THALLIUM	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U
VANADIUM	7.4 J	3.1 J	3.9	11.1	6.7	0.6 U	5.7
ZINC	32.9	80.4	26.3 J	10.1 U	12.6 U	16.7 J	22.1 J
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.08 U	0.08 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	0.19 L	0.79 L	0.08 J	0.5 J	0.5 J	0.52 J	0.54 J
ORTHOPHOSPHATE	0.5 UL	0.5 UL	0.5 UL	5 UR	5 UR	0.5 UL	0.5 UL
SULFATE	122 L	5.25 L	12.7 L	32.5	30.1	56 L	11.8 L

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW81D 06/02/97 SITE 04	WO-4GW81S 06/03/97 SITE 04	WO-4GW82 06/05/97 SITE 04	WO-4PZ89 06/11/97 SITE 04	WO-BGW16 06/10/97 SITE 04	/ /	/ /
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1,2,2-TETRACHLOROETHANE	8	19	1 U	8 J	1 U	NA	NA
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,1-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2,4 TRICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,3 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
1,4 DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	5 UR	NA	NA
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	NA	NA
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	NA	NA
ACETONE	5 U	5 U	5 UR	5 UR	5 UR	NA	NA
BENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOFORM	1 U	1 U	1 U	1 U	1 U	NA	NA
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
CHLOROFORM	1 U	1 U	1 U	1 U	6	NA	NA
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW81D	WO-4GW81S	WO-4GW82	WO-4PZ89	WO-BGW16	/ /	/ /
COLLECTION DATE:	06/02/97	06/03/97	06/05/97	06/11/97	06/10/97		
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04		
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	2	1 U	2	1 U	NA	NA
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	NA	NA
DIBROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	NA	NA
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	NA	NA
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	NA	NA
STYRENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TETRACHLOROETHENE	4	5	1 U	1 U	1 U	NA	NA
TOLUENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	NA	NA
TRICHLOROETHENE	2	6	1 U	65	1 U	NA	NA
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	NA	NA
XYLENES, TOTAL	1 U	1 U	1 U	1 U	1 U	NA	NA
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
1,2-DICHLOROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
1,3-DICHLOROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
1,4-DICHLOROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	5 U	6 U	5 UJ	5 U	NA	NA
2,4,5-TRICHLOROPHENOL	21 U	21 U	22 U	21 U	22 U	NA	NA
2,4,6-TRICHLOROPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
2,4-DICHLOROPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
2,4-DIMETHYLPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
2,4-DINITROPHENOL	21 U	21 U	22 U	21 U	22 U	NA	NA
2,4-DINITROTOLUENE	5 U	5 U	6 U	5 U	5 U	NA	NA
2,6-DINITROTOLUENE	5 U	5 U	6 U	5 U	5 U	NA	NA
2-CHLORONAPHTHALENE	5 U	5 U	6 U	5 U	5 U	NA	NA
2-CHLOROPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW81D 06/02/97 SITE 04	WO-4GW81S 06/03/97 SITE 04	WO-4GW82 06/05/97 SITE 04	WO-4PZ89 06/11/97 SITE 04	WO-BGW16 06/10/97 SITE 04	/ /	/ /
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	5 U	5 U	6 U	5 U	5 U	NA	NA
2-METHYLPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
2-NITROANILINE	21 U	21 U	22 U	21 U	22 U	NA	NA
2-NITROPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
3,3'-DICHLOROBENZIDINE	5 U	5 U	6 U	5 U	5 U	NA	NA
3-NITROANILINE	21 U	21 U	22 U	21 U	22 U	NA	NA
4,6-DINITRO-2-METHYLPHENOL	21 U	21 U	22 U	21 U	22 U	NA	NA
4-BROMOPHENYL PHENYL ETHER	5 U	5 U	6 U	5 U	5 U	NA	NA
4-CHLORO-3-METHYLPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
4-CHLOROANILINE	5 U	5 U	6 U	5 U	5 U	NA	NA
4-CHLOROPHENYL PHENYL ETHER	5 U	5 U	6 U	5 U	5 U	NA	NA
4-METHYLPHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
4-NITROANILINE	21 U	21 U	22 U	21 U	22 U	NA	NA
4-NITROPHENOL	21 U	21 U	22 U	21 U	22 U	NA	NA
ACENAPHTHENE	5 U	5 U	6 U	5 U	5 U	NA	NA
ACENAPHTHYLENE	5 U	5 U	6 U	5 U	5 U	NA	NA
ANTHRACENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BENZO(A)ANTHRACENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BENZO(A)PYRENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BENZO(B)FLUORANTHENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BENZO(G,H,I)PERYLENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BENZO(K)FLUORANTHENE	5 U	5 U	6 U	5 U	5 U	NA	NA
BIS(2-CHLOROETHOXY)METHANE	5 U	5 U	6 U	5 U	5 U	NA	NA
BIS(2-CHLOROETHYL)ETHER	5 U	5 U	6 U	5 U	5 U	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	1 U	5 U	3 U	5 U	5 U	NA	NA
BUTYLBENZYL PHTHALATE	5 U	5 U	6 U	5 U	5 U	NA	NA
CARBAZOLE	5 U	5 U	6 U	5 U	5 U	NA	NA
CHRYSENE	5 U	5 U	6 U	5 U	5 U	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW81D 06/02/97 SITE 04	WO-4GW81S 06/03/97 SITE 04	WO-4GW82 06/05/97 SITE 04	WO-4PZ89 06/11/97 SITE 04	WO-BGW16 06/10/97 SITE 04	/ /	/ /
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	8 U	6 U	2 U	11 U	5 U	NA	NA
DI-N-OCTYL PHTHALATE	5 U	5 U	6 U	5 U	5 U	NA	NA
DIBENZO(A,H)ANTHRACENE	5 U	5 U	6 U	5 U	5 U	NA	NA
DIBENZOFURAN	5 U	5 U	6 U	5 U	5 U	NA	NA
DIETHYL PHTHALATE	5 U	5 U	6 U	5 U	5 U	NA	NA
DIMETHYL PHTHALATE	5 U	5 U	6 U	5 U	5 U	NA	NA
FLUORANTHENE	5 U	5 U	6 U	5 U	5 U	NA	NA
FLUORENE	5 U	5 U	6 U	5 U	5 U	NA	NA
HEXACHLOROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
HEXACHLOROBUTADIENE	5 U	5 U	6 U	5 U	5 U	NA	NA
HEXACHLOROCYCLOPENTADIENE	5 UJ	5 UJ	6 U	5 U	5 U	NA	NA
HEXACHLOROETHANE	5 U	5 U	6 U	5 U	5 U	NA	NA
INDENO(1,2,3-CD)PYRENE	5 U	5 U	6 U	5 U	5 U	NA	NA
ISOPHORONE	5 U	5 U	6 U	5 U	5 U	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	5 U	5 U	6 U	5 U	5 U	NA	NA
N-NITROSODIPHENYLAMINE	5 U	5 U	6 U	5 U	5 U	NA	NA
NAPHTHALENE	5 U	5 U	6 U	5 U	5 U	NA	NA
NITROBENZENE	5 U	5 U	6 U	5 U	5 U	NA	NA
PENTACHLOROPHENOL	21 U	21 U	22 U	21 U	22 U	NA	NA
PHENANTHRENE	5 U	5 U	6 U	5 U	5 U	NA	NA
PHENOL	5 U	5 U	6 U	5 U	5 U	NA	NA
PYRENE	5 U	5 U	6 U	5 U	5 U	NA	NA
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
1,3-DINITROBENZENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
2,4 DINITROTOLUENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
2,4,6-TRINITROTOLUENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
2,6 DINITROTOLUENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA

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NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-4GW81D	WO-4GW81S	WO-4GW82	WO-4PZ89	WO-BGW16	/ /	/ /
COLLECTION DATE:	06/02/97	06/03/97	06/05/97	06/11/97	06/10/97		
LOCATION:	SITE 04	SITE 04	SITE 04	SITE 04	SITE 04		
FIELD DUPLICATE OF:							
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
2-NITROTOLUENE	1.3 U	1.3 U	NA	NA	1.3 U	NA	NA
3-NITROTOLUENE	1.3 U	1.3 U	NA	NA	1.3 U	NA	NA
4-AMINO-2,6-DINITROTOLUENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
4-NITROTOLUENE	1.3 U	1.3 U	NA	NA	1.3 U	NA	NA
HMX	2	2.1	NA	NA	1.3 U	NA	NA
NITRO-BENZENE	0.6 U	0.6 U	NA	NA	0.6 U	NA	NA
RDX	1.1 J	0.9 J	NA	NA	1.3 U	NA	NA
TETRYL	1.3 U	1.3 U	NA	NA	1.3 UJ	NA	NA
METALS (µg/L)							
ALUMINUM	174 J	152 J	1060 J	171 J	3430	NA	NA
ANTIMONY	2 U	2 U	2 U	2 UL	2 U	NA	NA
ARSENIC	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	NA	NA
BARIUM	78	76.8	44.6 J	31.4 J	40	NA	NA
BERYLLIUM	0.3 U	0.3 U	0.55 U	0.3 U	0.3 U	NA	NA
CADMIUM	0.27 U	0.36 U	0.32 U	0.2 J	0.2 U	NA	NA
CALCIUM	2790 K	2470 K	1240 J	5680 J	4530 K	NA	NA
CHROMIUM	2.3 U	5.7 J	8.2 J	0.85 L	17.4	NA	NA
COBALT	2.6 U	9.9	4.3	1.6 J	1.6 U	NA	NA
COPPER	9.1 J	12.5 J	15.2 J	5.4 U	9.4	NA	NA
CYANIDE	5 U	5 U	7.2	5 U	5 U	NA	NA
IRON	313 J	3430 J	2770 K	252 J	2140 L	NA	NA
LEAD	1.4 J	1.5 J	2.1 J	1.1 U	1.4 L	NA	NA
MAGNESIUM	5590 K	4340 K	2900 J	4310 J	5410 K	NA	NA
MANGANESE	70	125	73.4 J	64.2 J	23.8	NA	NA
MERCURY	5.4	1.7	0.26 U	3.4	0.1 U	NA	NA
NICKEL	10.6	25.7	35.2 J	0.9 UJ	13	NA	NA
POTASSIUM	1590 K	1660 K	2100 J	1200 J	1530	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 04

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-4GW81D 06/02/97 SITE 04	WO-4GW81S 06/03/97 SITE 04	WO-4GW82 06/05/97 SITE 04	WO-4PZ89 06/11/97 SITE 04	WO-BGW16 06/10/97 SITE 04	/ /	/ /
METALS (µg/L)							
SELENIUM	1.6 U	1.6 U	1.6 U	1.6 UL	2.4 K	NA	NA
SILVER	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA
SODIUM	8720	14600	16900	7570 L	6910 L	NA	NA
THALLIUM	2.1 U	2.1 U	2.1 U	2.1 U	2.6 U	NA	NA
VANADIUM	0.6 U	0.9 J	3.5	0.6 U	7.2	NA	NA
ZINC	22	29.5	38.6 J	6.6 J	33.8	NA	NA
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.08 U	0.08 U	0.07 U	0.07 U	0.07 U	NA	NA
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	0.29 L	0.36 L	0.58 J	0.94	0.8	NA	NA
ORTHOPHOSPHATE	0.5 UL	0.5 UL	0.5 UR	0.5 UR	0.5 UL	NA	NA
SULFATE	21.8 L	17.7 L	4.38	22.6 L	18.1	NA	NA

APPENDIX G

SITE 7 - HISTORICAL DATA

Phase I RI Summary Data
Phase II RI Summary Data
Groundwater Sampling Analytical Results

Phase I RI Summary Data

TABLE 5-3
SITE 7 - ORDNANCE BURN AREA
SOIL BORING ANALYTICAL RESULTS - NITROAROMATICS
(Phase I - 1989)

LOCATION	DETECTION LIMIT (ug/kg)	COMPOUNDS					
		HMX (ug/kg)	RDX (ug/kg)	1,3,5-TNB (ug/kg)	2,4,6-TNT (ug/kg)	2,6-DNT (ug/kg)	2,4-DNT (ug/kg)
7SL03A	20	30,000	8,300	U	U	U	U
7SL03B	19	360	1,100	U	U	U	U
7SL06A	20	1,500	270	U	2,100	U	U
7SL06B	20	710	U	U	910	U	U
7SL11A	20	3,000	U	U	U	U	U
7SL11B	20	520	250	U	450	U	U
7SL12A	20	74,000	1,300	U	230	U	U
7SL12B	20	51,000	470	U	450	U	U
7SL13A	20	6,000	1,000	U	210	U	U
7SL13B	19	5,800	850	U	380	U	U
7SL15A	20	1,300	740	U	330	U	U
7SL15B	20	980	380	U	410	U	U
7SL16A	19	51,000	1,300	U	120	U	U
7SL16B	190	17,000	930	U	130	U	U
7SL17A	20	13,000	220	U	U	U	U
7SL17B	20	16,000	760	U	230	U	U
7SL18A	20	19,000	3,500	U	15,000	U	U
7SL18B	19	16,000	5,100	U	34,000	U	U
7SL19A	19	160,000	430	U	U	U	U
7SL20A	19	3,100	U	U	380	U	U
7SL20B	20	4,900	260	U	490	U	U
7SL21A	19	46,000	700	U	600	U	U
7SL22A	20	8,400	U	U	U	U	U
7SL23A	20	820	U	U	U	U	U
7SL23B	19	370	U	U	U	U	U
7SL23C	20	250	U	U	U	U	U

Notes: U - Not detected.
A - Sample taken at depth of 0 to 1 foot.
B - Sample taken at depth of 4 to 5 feet.
C - Sample taken at depth of 3 feet.

TABLE 5-5
SITE 7 – ORDNANCE BURN AREA
GROUNDWATER ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations 7GW8	7GW41	7GW43	Detection Limit	Units
TOTAL METALS:					
Cadmium	U	6.1	5.2	5.0	ug/l
Chromium	211.0	315.0	476.0	7.0	ug/l
Copper	190.0	753.0	513.0	3.0	ug/l
Lead	43.8	71.9	55.7	28.0	ug/l
Mercury	2.1	2.6	1.4	0.20	ug/l
Zinc	68.2	250.0	145.0	3.0	ug/l
FILTERED METALS:					
Cadmium	U	6.2	U	5.0	ug/l
Chromium	U	U	U	7.0	ug/l
Copper	12.7	14.7	21.5	3.0	ug/l
Lead	U	U	U	28.0	ug/l
Mercury	U	U	U	0.20	ug/l
Zinc	11.7	60.2	24.2	3.0	ug/l
pH	4.3	5.1	5.8	--	su
TOC	12.1	56.1	39.7	0.50	mg/l
TOX	13.0	32.3	128.0	8	ug/l
TDS	U	U	244.0	20	mg/l
TSS	22,800	19,300	11,400	4	mg/l
NITROAROMATICS:					
HMX	190.0	U	U	10.0	ug/l
RDX	700.0	U	U	10.0	ug/l
1,3,5-trinitrobenzene	U	U	U	10.0	ug/l
2,4,6-trinitrotoluene	U	U	U	10.0	ug/l
2,6-dinitrotoluene	U	U	U	10.0	ug/l
2,4-dinitrotoluene	U	U	U	10.0	ug/l

Note: U – Not detected.

Phase II RI Summary Data

TABLE 5-4
SITE 7 – ORDNANCE BURN AREA
SOIL BORING ANALYTICAL RESULTS- NITROAROMATICS
(PHASE II - 1991)

Compound	Sample Location						Detection Limit	Units
	7SB28A	7SB28B	7SB28C	7SB29A	7SB29B	7SB29C		
HMX	U	0.400	150.0	U	U	U	0.470	ug/g
RDX	0.350	1.100	U	U	U	U	0.180	ug/g
1,3,5-TNB	U	U	U	U	U	U	0.270	ug/g
2,4,6-TNT	1.30	U	U	U	U	U	0.660	ug/g
2,6-DNT	U	U	U	U	U	U	0.360	ug/g
2,4-DNT	U	U	U	U	U	U	0.530	ug/g
1,3-DNB	U	U	U	U	U	U	0.200	ug/g
Nitrobenzene	U	U	U	U	U	U	0.570	ug/g
Tetryl	U	U	U	U	U	U	4.00	ug/g

NOTES: A – Sample taken at depth of 5 feet.
B – Sample taken at depth of 10 feet.
C – Sample taken at depth of 15 feet.
U – Not detected.

TABLE 5-6

SITE 7 - ORDNANCE BURN AREA

GROUNDWATER ANALYTICAL RESULTS

(PHASE II - 1991)

Parameter	Sample Locations			Detection Limit	Units
	7GW8	7GW41	7GW43		
TOTAL METALS:					
Cadmium	U	U	U	5.0	ug/l
Chromium	U	12	5.2	10	ug/l
Copper	23	121	34	25	ug/l
Lead	U	3.8	3.8	3	ug/l
Mercury	R	R	R	0.2	ug/l
Zinc	312	34	10	20	ug/l
FILTERED METALS:					
Cadmium	U	U	U	5.0	ug/l
Chromium	U	U	U	10	ug/l
Copper	20	45	15	25	ug/l
Lead	3.8	U	U	3	ug/l
Mercury	R	R	R	0.2	ug/l
Zinc	15	5350	44	20	ug/l
VOLATILE ORGANICS:					
Methylene Chloride	U	U	U	5	ug/l
cis-1,2-Dichloroethene	U	6	U	5	ug/l
Trichloroethene	U	33	U	5	ug/l
1,1,2,2-Tetrachloroethane	U	6	U	5	ug/l
Acetone	U	U	17E	10	ug/l
NITROAROMATICS:					
HMX	470.0	U	U	4.200	ug/l
RDX	2300	U	U	1.600	ug/l
1,3,5-Trinitrobenzene	31.10	U	1.10	0.200	ug/l
2,4,6-Trinitrotoluene	1900	U	U	0.940	ug/l
2,6-Dinitrotoluene	3.20	U	U	0.500	ug/l
2,4-Dinitrotoluene	3.10	U	U	0.500	ug/l
1,3-Dinitrobenzene	10.30	U	U	2.600	ug/l
Nitrobenzene	U	U	U	1.500	ug/l
Tetryl	U	13.30	U	3.700	ug/l

NOTES: U - Not detected.
R - Quantitation Rejected
E - Quantitation Estimated

Groundwater Sampling Analytical Results

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-7GW08	WO-7GW41	WO-7GW43	WO-7PZ42	/ /	/ /	/ /
COLLECTION DATE:	06/04/97	06/04/97	06/04/97	06/06/97			
LOCATION:	SITE 07	SITE 07	SITE 07	SITE 07			
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1	1 U	1 U	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	1 U	61 J	3	1	NA	NA	NA
1,1,2-TRICHLOROETHANE	1 U	2	1 U	1 U	NA	NA	NA
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
1,1-DICHLOROETHENE	1 U	2	1 U	1 U	NA	NA	NA
1,2 DICHLOROBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
1,2,4 TRICHLOROBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-DICHLOROETHANE	1 U	1	1 U	1 U	NA	NA	NA
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	NA	NA	NA
1,3 DICHLOROBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
1,4 DICHLOROBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
2-BUTANONE	5 UR	5 UR	5 UR	5 UR	NA	NA	NA
2-HEXANONE	5 U	5 U	5 U	5 U	NA	NA	NA
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	NA	NA	NA
ACETONE	5 UR	5 UR	5 UR	5 UR	NA	NA	NA
BENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
BROMOFORM	1 U	1 U	1 U	1 U	NA	NA	NA
BROMOMETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
CARBON DISULFIDE	1 U	1 U	1 U	1 U	NA	NA	NA
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	NA	NA	NA
CHLOROBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
CHLOROETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
CHLOROFORM	1 U	1 U	1 U	1 U	NA	NA	NA
CHLOROMETHANE	1 U	1 U	1 U	1 U	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-7GW08	WO-7GW41	WO-7GW43	WO-7PZ42	/ /	/ /	/ /
COLLECTION DATE:	06/04/97	06/04/97	06/04/97	06/06/97			
LOCATION:	SITE 07	SITE 07	SITE 07	SITE 07			
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	74 J	6	1 U	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	NA	NA	NA
DIBROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	NA	NA	NA
ETHYLBENZENE	1 U	1 U	1 U	1 U	NA	NA	NA
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	NA	NA	NA
STYRENE	1 U	1 U	1 U	1 U	NA	NA	NA
TETRACHLOROETHENE	1 U	1 U	1 U	1 U	NA	NA	NA
TOLUENE	1 U	1 U	1 U	1 U	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	NA	NA	NA
TRICHLOROETHENE	1 U	400	74	4	NA	NA	NA
VINYL CHLORIDE	1 U	3	1 U	1 U	NA	NA	NA
XYLENES, TOTAL	1 U	1 U	1 U	1 U	NA	NA	NA
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
1,2-DICHLOROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
1,3-DICHLOROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
1,4-DICHLOROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	6 U	6 U	5 U	NA	NA	NA
2,4,5-TRICHLOROPHENOL	22 U	23 U	22 U	22 U	NA	NA	NA
2,4,6-TRICHLOROPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
2,4-DICHLOROPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
2,4-DIMETHYLPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
2,4-DINITROPHENOL	22 U	23 U	22 U	22 U	NA	NA	NA
2,4-DINITROTOLUENE	5 U	6 U	6 U	5 U	NA	NA	NA
2,6-DINITROTOLUENE	5 U	6 U	6 U	5 U	NA	NA	NA
2-CHLORONAPHTHALENE	5 U	6 U	6 U	5 U	NA	NA	NA
2-CHLOROPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-7GW08	WO-7GW41	WO-7GW43	WO-7PZ42	/ /	/ /	/ /
COLLECTION DATE:	06/04/97	06/04/97	06/04/97	06/06/97			
LOCATION:	SITE 07	SITE 07	SITE 07	SITE 07			
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	5 U	6 U	6 U	5 U	NA	NA	NA
2-METHYLPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
2-NITROANILINE	22 U	23 U	22 U	22 U	NA	NA	NA
2-NITROPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
3,3'-DICHLOROBENZIDINE	5 U	6 U	6 U	5 U	NA	NA	NA
3-NITROANILINE	22 U	23 U	22 U	22 U	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	22 U	23 U	22 U	22 U	NA	NA	NA
4-BROMOPHENYL PHENYL ETHER	5 U	6 U	6 U	5 U	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
4-CHLOROANILINE	5 U	6 U	6 U	5 U	NA	NA	NA
4-CHLOROPHENYL PHENYL ETHER	5 U	6 U	6 U	5 U	NA	NA	NA
4-METHYLPHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
4-NITROANILINE	22 U	23 U	22 U	22 U	NA	NA	NA
4-NITROPHENOL	22 U	23 U	22 U	22 U	NA	NA	NA
ACENAPHTHENE	5 U	6 U	6 U	5 U	NA	NA	NA
ACENAPHTHYLENE	5 U	6 U	6 U	5 U	NA	NA	NA
ANTHRACENE	5 U	6 U	6 U	5 U	NA	NA	NA
BENZO(A)ANTHRACENE	5 U	6 U	6 U	5 U	NA	NA	NA
BENZO(A)PYRENE	5 U	6 U	6 U	5 U	NA	NA	NA
BENZO(B)FLUORANTHENE	5 U	6 U	6 U	5 U	NA	NA	NA
BENZO(G,H,I)PERYLENE	5 U	6 U	6 U	5 U	NA	NA	NA
BENZO(K)FLUORANTHENE	5 U	6 U	6 U	5 U	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	5 U	6 U	6 U	5 U	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	5 U	6 U	6 U	5 U	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	5 U	6 U	6 U	2 U	NA	NA	NA
BUTYLBENZYL PHTHALATE	5 U	6 U	6 U	5 U	NA	NA	NA
CARBAZOLE	5 U	6 U	6 U	5 U	NA	NA	NA
CHRYSENE	5 U	6 U	6 U	5 U	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-7GW08 06/04/97 SITE 07	WO-7GW41 06/04/97 SITE 07	WO-7GW43 06/04/97 SITE 07	WO-7PZ42 06/06/97 SITE 07	/ /	/ /	/ /
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	5 U	5 U	6 U	3 U	NA	NA	NA
DI-N-OCTYL PHTHALATE	5 U	6 U	6 U	5 U	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	5 U	6 U	6 U	5 U	NA	NA	NA
DIBENZOFURAN	5 U	6 U	6 U	5 U	NA	NA	NA
DIETHYL PHTHALATE	5 U	6 U	6 U	5 U	NA	NA	NA
DIMETHYL PHTHALATE	5 U	6 U	6 U	5 U	NA	NA	NA
FLUORANTHENE	5 U	6 U	6 U	5 U	NA	NA	NA
FLUORENE	5 U	6 U	6 U	5 U	NA	NA	NA
HEXACHLOROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
HEXACHLOROBUTADIENE	5 U	6 U	6 U	5 U	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	5 U	6 U	6 U	5 U	NA	NA	NA
HEXACHLOROETHANE	5 U	6 U	6 U	5 U	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	5 U	6 U	6 U	5 U	NA	NA	NA
ISOPHORONE	5 U	6 U	6 U	5 U	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	5 U	6 U	6 U	5 U	NA	NA	NA
N-NITROSODIPHENYLAMINE	5 U	6 U	6 U	5 U	NA	NA	NA
NAPHTHALENE	5 U	6 U	6 U	5 U	NA	NA	NA
NITROBENZENE	5 U	6 U	6 U	5 U	NA	NA	NA
PENTACHLOROPHENOL	22 U	23 U	22 U	22 U	NA	NA	NA
PHENANTHRENE	5 U	6 U	6 U	5 U	NA	NA	NA
PHENOL	5 U	6 U	6 U	5 U	NA	NA	NA
PYRENE	5 U	6 U	6 U	5 U	NA	NA	NA
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA
1,3-DINITROBENZENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA
2,4 DINITROTOLUENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA
2,4,6-TRINITROTOLUENE	47	0.6 U	0.6 U	0.6 U	NA	NA	NA
2,6 DINITROTOLUENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-7GW08	WO-7GW41	WO-7GW43	WO-7PZ42	/ /	/ /	/ /
COLLECTION DATE:	06/04/97	06/04/97	06/04/97	06/06/97			
LOCATION:	SITE 07	SITE 07	SITE 07	SITE 07			
FIELD DUPLICATE OF:							
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	44	0.6 U	0.6 U	0.6 U	NA	NA	NA
2-NITROTOLUENE	6.5 U	1.3 U	1.3 U	1.3 U	NA	NA	NA
3-NITROTOLUENE	6.5 U	1.3 U	1.3 U	1.3 U	NA	NA	NA
4-AMINO-2,6-DINITROTOLUENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA
4-NITROTOLUENE	6.5 U	1.3 U	1.3 U	1.3 U	NA	NA	NA
HMX	61	1.3 U	1.3 U	1.3 U	NA	NA	NA
NITRO-BENZENE	3.2 U	0.6 U	0.6 U	0.6 U	NA	NA	NA
RDX	170	1.3 U	1.3 U	1.3 U	NA	NA	NA
TETRYL	6.5 U	1.3 U	1.3 U	1.3 U	NA	NA	NA
METALS (µg/L)							
ALUMINUM	32600 J	562 J	184 U	693 J	NA	NA	NA
ANTIMONY	2 U	2 U	2 U	2 U	NA	NA	NA
ARSENIC	21.4	2.6 U	2.6 U	2.6 U	NA	NA	NA
BARIUM	150 J	61.3 J	49.1 J	40.8 J	NA	NA	NA
BERYLLIUM	1.3 U	0.34 U	0.35 U	0.4 U	NA	NA	NA
CADMIUM	0.69 U	0.39 U	0.49 U	0.44 U	NA	NA	NA
CALCIUM	6720 J	20900 J	5490 J	5070 J	NA	NA	NA
CHROMIUM	153 J	3.6 U	1.7 U	6 J	NA	NA	NA
COBALT	3.3 U	3.2 U	6.1	5.7	NA	NA	NA
COPPER	87.8 J	5.8 U	3.4 U	6.1 U	NA	NA	NA
CYANIDE	10.1	5 U	50.7	20.9	NA	NA	NA
IRON	49300 K	1450 K	1040 K	1050 K	NA	NA	NA
LEAD	21.9 J	4.5 J	7.2 J	1.5 J	NA	NA	NA
MAGNESIUM	6150 J	11300 J	5480 J	4600 J	NA	NA	NA
MANGANESE	91.3 J	147 J	77.8 J	61.2 J	NA	NA	NA
MERCURY	1.2	0.32 U	1.2	2.8	NA	NA	NA
NICKEL	49.1 J	7.9 U	3.3 U	5.6 U	NA	NA	NA
POTASSIUM	4060 J	1670 J	2280 U	1230 J	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - SITE 07

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-7GW08 06/04/97 SITE 07	WO-7GW41 06/04/97 SITE 07	WO-7GW43 06/04/97 SITE 07	WO-7PZ42 06/06/97 SITE 07	/ /	/ /	/ /
METALS (µg/L)							
SELENIUM	70.7	1.6 U	2.4 U	3.7	NA	NA	NA
SILVER	0.5 U	0.5 U	0.5 U	1.3	NA	NA	NA
SODIUM	4200	9730	31500	8030	NA	NA	NA
THALLIUM	3.5 U	2.1 U	2.1 U	2.1 U	NA	NA	NA
VANADIUM	237	2	1.1	3.1	NA	NA	NA
ZINC	21.1 J	10 J	5.2 U	6.2 U	NA	NA	NA
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.07 U	0.07 U	0.07 U	0.07 U	NA	NA	NA
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	3 J	0.47 J	0.93 J	0.97 J	NA	NA	NA
ORTHOPHOSPHATE	0.5 UL	0.5 UL	0.5 UL	2.5 UR	NA	NA	NA
SULFATE	15.3 L	50.8 L	10.9 L	26.2	NA	NA	NA

APPENDIX H

SITE 8 - HISTORICAL DATA

Phase III RI Groundwater Analytical Results
HREM Survey Results

Phase III RI Groundwater Analytical Results

TABLE 3-2
SUMMARY OF ORGANIC ANALYTICAL RESULTS (ug/L)
SITE 8, NSWCWODET
White Oak, Maryland

Parameter	MCL	MDL	8GW33	8GW34	8GW35	8GW36	8GW53	8GW54#	GWTB
Volatile Organics									
Choroform	100*	0.7	3 J	U	12	U	U	U	U
1,1,2-Trichloroethane	5	1.2	U	U	U	43	U	40	U
Methylene Chloride	5	1.8	U	3 B	U	U	U	U	2 J
Acetone	NA	7.1	U	8 B	8 B	U	U	U	15
Semivolatile Organics									
1,3-Dichlorobenzene	NA	0.6	2 J	1 J	U	2 J	2 J	2 J	---
Di-n-butylphthalate	NA	2.5	U	U	U	0.6 J	U	U	---
Bis(2-ethylhexyl)phthalate	6	1.9	3 B	1 B	4 B	3 B	6 B	3 B	---

MCL = Maximum Contaminant Level
MDL = Method Detection Limit
* = MCL for total trihalomethanes, including chloroform.
\# = Duplicate of Sample 8GW36
J = Positive result, below contract-required quantitation
B = Blank contaminant; not considered present
U = Nondetect
--- = Not Analyzed

TABLE 3-3
SUMMARY OF TOTAL INORGANIC ANALYTICAL RESULTS (ug/L)
SITE 8, NSWCWODET
White Oak, Maryland

Parameter	MCL	SMCL	IDL	8GW33	8GW34	8GW35	8GW36	8GW53	8GW54#
Aluminum	NA	50-200	34	11300	5750	5160	1460	4750	1870
Antimony	6	NA	16	25.8 L(m)	U	U	U	U	U
Arsenic	50	NA	2	U	2.1 L(m,p)	U	U	U	U
Barium	2000	NA	9	219.0	64.0	136.0	44.2	81.7	44.7
Beryllium	4	NA	1	1.8 L(n)	U	1.5 L(n)	U	U	U
Cadmium	5	NA	3	U	U	U	U	3.6	U
Calcium		NA	230	5000	1670	3450	2520	5540	2570
Chromium	100	NA	6	19.9	11.6	9.0	U	10.8	U
Cobalt	NA	NA	6	13.8	8.5	29.7	10.7	23.4	9.2
Copper	1300+	1000	2	38.2	12.9	14.4	5.1	19.3	3.9
Iron	NA	300	8	22000 L(n)	9840 L(n)	4030 L(n)	1570 L(n)	7230 L(n)	2380 L(n)
Lead	15+	NA	2	14.2	8.0	8.0	3.0	10.1	4.6
Magnesium	NA	NA	193	6240	3580	5390	1950	2880	2100
Manganese	NA	50	2	910.0 L(n)	409.0 L(n)	1090.0 L(n)	383.0 L(n)	1340.0 L(n)	388.0 L(n)
Mercury	2	NA	0.2	U	U	U	U	U	U
Nickel	100	NA	27	32.6	U	U	U	U	U
Potassium	NA	NA	743	6940	4320	2760	1650	3100	1690
Selenium	50	NA	1	U	U	U	U	U	U
Silver	NA	100	2	U	3.2 B	U	U	3.4 B	U
Sodium	NA	NA	252	4050	2700	7740	4140	2630	4420
Thallium	2	NA	3	U	U	U	U	U	U
Vanadium		NA	6	23.5	8.8	15.8	U	7.7	U
Zinc	NA	5000	2	74.1	40.4	38.3	21.8	390.0	30.6

MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
IDL = Instrument Detection Limits
+ = Action level for tap water
# = Duplicate of Sample 8GW36
U = Value is a nondetect as reported by the laboratory
B = Positive result is considered to be an artifact of blank contamination, and should not be considered present
L(m,p) = Positive result is biased low due to low matrix spike and low PDS recovery
L (n) = Positive result is biased low due to negative concentrations reported in the laboratory blanks
L(m) = Positive result is biased low due to low matrix spike re

TABLE 3-4
SUMMARY OF DISSOLVED INORGANIC ANALYTICAL RESULTS (ug/L)
SITE 8, NSWCWODET
White Oak, Maryland

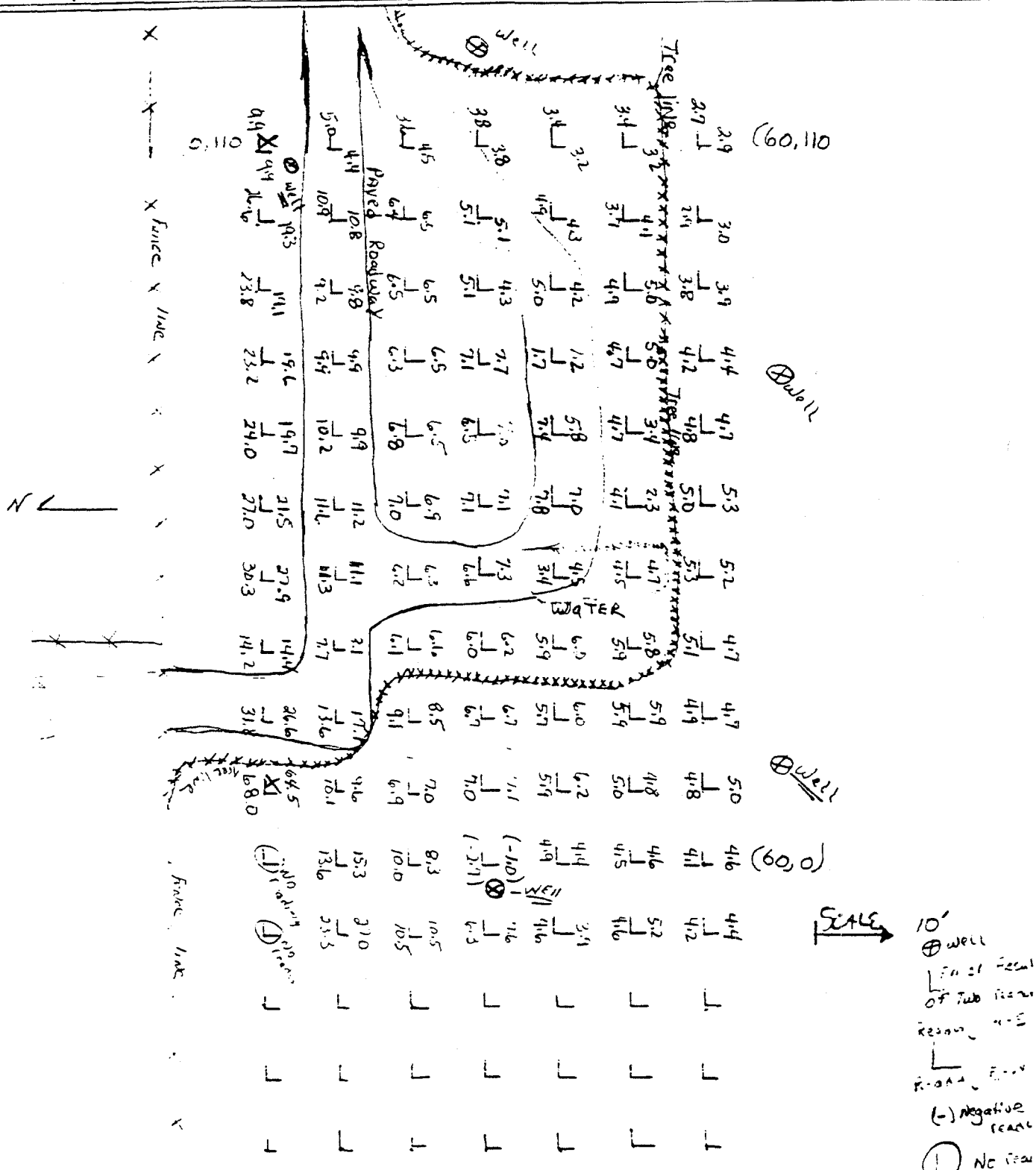
Parameter	MCL	SMCL	IDL	8GW33DS	8GW34DS	8GW35DS	8GW36DS	8GW53DS	8GW54DS
Aluminum	NA	50-200	34	230	216	272	211	183	220
Antimony	6	NA	16	U	U	U	U	U	U
Arsenic	50	NA	2	U	U	U	U	U	U
Barium	2000	NA	9	9.1	9.1	31.6	22.0	15.5	22.8
Beryllium	4	NA	1	U	U	U	U	U	U
Cadmium	5	NA	3	U	U	U	U	U	U
Calcium	NA	NA	230	1600	1230	1510	2250	2520	2230
Chromium	100	NA	6	U	U	U	U	U	U
Cobalt	NA	NA	6	U	U	U	U	U	U
Copper	1300	1000	2	U	U	U	9.8	U	U
Iron	NA	300	8	9.6 L(n)	U	9.8 L(n)	20.4 L(n)	U	U
Lead	15+	NA	2	U	U	1.1	U	U	U
Magnesium	NA	NA	193	980	842	2570	1520	883	1520
Manganese	NA	50	2	49.7 L(n)	17.3 L(n)	95.8 L(n)	83.4 L(n)	187.0 L(n)	88.9 L(n)
Mercury	2	NA	0.2	U	U	U	U	U	U
Nickel	100	NA	27	U	U	U	U	U	U
Potassium		NA	743	1550	1460	U	1270	1150	1160
Selenium	50	NA	1	U	U	U	U	U	U
Silver	NA	100	2	U	U	U	U	U	U
Sodium	NA	NA	252	3510	2620	7730	4570	2270	4390
Thallium	2	NA	3	U	U	U	U	U	U
Vanadium	NA	NA	6	U	U	U	U	U	U
Zinc	NA	5000	2	6.1	6.6	14.3	13.3	223.0	9.0

MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
IDL = Instrument Detection Limits
+ = Action level for tap water
# = Duplicate of Sample 8GW36
U = Value is a nondetect as reported by the laboratory
B = Positive result is considered to be an artifact of blank contamination,.and should not be considered present
L(m,p) = *Positive result is biased low due to low matrix spike and low PDS recovery*
L (n) = Positive result is biased low due to negative concentrations reported in the laboratory blanks
L(m) = Positive result is biased low due to low matrix spike recovery

HREM Survey Results

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NSWC WHITEOAK	JOB NUMBER 2295
SUBJECT EM SURVEY - SITE 8 - Chemical Burial Area	
BASED ON	DRAWING NUMBER
BY PLN	CHECKED BY / APPROVED BY / DATE 3-95



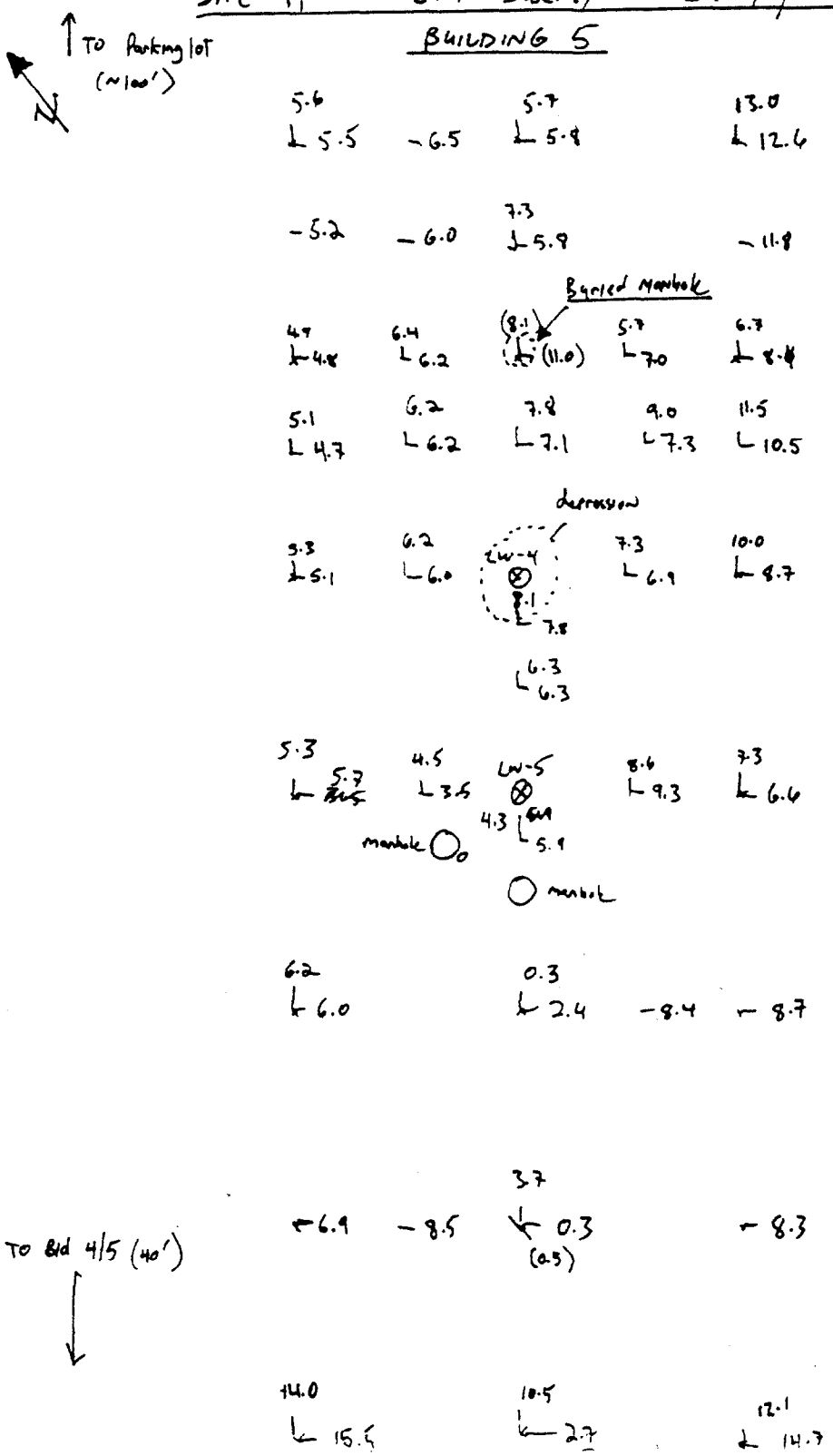
CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: White Oak	JOB NUMBER:
SUBJECT: EM Survey - Site 11 - Near LW-4 / LW-5	
BASED ON:	DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
PLN			3/2/95

Site 11 EM Survey LW-4 / LW-5 Area

Building 5



Note: Buried manhole discovered - assumed to be leaching well. Flag LW-4 moved to this location.

SCALE: 4'

APPENDIX I

SITE 9 - HISTORICAL DATA

Phase I RI Summary Data
Phase II RI Summary Data
Design Verification Study - Summary of Analytical Data

Phase I RI Summary Data

TABLE 7-3
SITE 9 – INDUSTRIAL WASTEWATER DISPOSAL AREA 300
SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations												Detection Limit	Units
	9SD2	9SD3	9SD7	9SD9	9SD10	9SD11	9SD13	9SD16	9SD17	9SD18	9SL1	9SL2		
TOTAL METALS:														
Cadmium	0.83	1.3	U	U	U	U	U	U	U	0.82	U	U	0.78	mg/kg
Chromium	14.6	12.0	16.8	16.8	10.6	15.3	10.6	14.6	31.1	5.0	14.3	10.8	0.70	mg/kg
Copper	9.3	68.9	5.6	42.7	9.8	16.7	9.0	9.0	18.4	4.0	273.0	9.3	0.30	mg/kg
Lead	54.2	40.3	15.9	37.3	19.9	71.8	18.8	10.9	10.9	U	65.0	24.0	3.60	mg/kg
Zinc	36.1	118.0	85.2	43.7	31.6	44.8	20.3	26.9	37.4	17.7	298.0	46.5	0.50	mg/kg
pH	4.83	6.40	8.16	6.54	7.51	4.93	6.62	7.41	7.52	7.26	--	--	--	su
TOC	29,100	28,700	5,760	20,600	5,400	22,000	9,030	5,420	5,870	2,660	--	--	100	mg/kg
TOX	33.8	18.8	11.8	24.8	U	34.3	12.6	11.2	32.8	U	--	--	10	mg/kg
SEMIVOLATILE ORGANICS:														
Benzoic Acid	--	--	--	--	--	--	--	--	--	U	310 JX	U	2,400	ug/kg
Phenanthrene	--	--	--	--	--	--	--	--	--	U	400 J	U	490	ug/kg
Fluoranthene	--	--	--	--	--	--	--	--	--	U	650	U	490	ug/kg
Pyrene	--	--	--	--	--	--	--	--	--	U	520	U	490	ug/kg
Benzo(a)anthracene	--	--	--	--	--	--	--	--	--	U	320 J	U	490	ug/kg
Chrysene	--	--	--	--	--	--	--	--	--	U	400 J	U	490	ug/kg
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	U	370 J	U	490	ug/kg
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	U	250 J	U	490	ug/kg
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	U	320 J	U	490	ug/kg
Hexadecanoic Acid	--	--	--	--	--	--	--	--	--	U	1,600 J	1,700 J	2,400	ug/kg
Octodecanoic Acid	--	--	--	--	--	--	--	--	--	U	U	380 J	490	ug/kg

Notes: U – Not detected.
J – Compound is present but less than the detection limit.
X – EPA CLP criteria for confirmation not met but compound is present.

TABLE 7–5
SITE 9 – INDUSTRIAL WASTEWATER DISPOSAL AREA 300
GROUNDWATER ANALYTICAL RESULTS
(Phase I – 1989)

Parameter	Sample Locations													Detection Limit	Units
	9GW1	9GW2	9GW3	9GW4	9GW5	9GW6	9GW7	9GW57S	9GW57D	9GW58	9GW59	9GW74	9GW75		
TOTAL METALS:															
Cadmium	U	U	4.4	U	U	U	U	5.2	U	U	U	U	U	2.0	ug/l
Chromium	30.8	152.0	94.2	9.9	106.0	159.0	130.0	224.0	U	61.2	29.0	222.0	90.1	5.0	ug/l
Copper	42.9	175.0	151.0	7.9	129.0	223.0	138.0	173.0	9.4	56.8	44.4	223.0	60.3	3.0	ug/l
Lead	U	66.2	32.4	U	U	48.2	U	130.0	U	U	U	108.0	U	28.0	ug/l
Mercury	U	1.1	U	U	5.2	3.2	3.7	0.48	U	3.2	0.24	U	0.43	0.20	ug/l
Zinc	59.7	531.0	132.0	11.8	78.2	51.0	121.0	241.0	22.8	18.4	22.7	652.0	27.0	3.0	ug/l
FILTERED METALS:															
Cadmium	U	4.3	5 J	U	U	U	U	U	U	U	U	U	U	2.0	ug/l
Chromium	U	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Copper	U	28.3	18.2	U	U	U	U	U	U	U	U	U	U	3.0	ug/l
Lead	U	U	U	U	U	U	U	U	U	U	U	U	U	28.0	ug/l
Mercury	U	U	U	U	U	U	U	U	U	0.24	U	U	U	0.20	ug/l
Zinc	33.3	220.0	72.3	14.5	17.9	37.8	16.3	34.1	21.9	22.6	32.4	45.1	23.9	3.0	ug/l
pH	5.10	5.50	4.90	5.70	4.60	4.30	4.70	5.30	5.40	5.60	5.50	5.10	5.40	--	su
TOC	15.7	7.7	14.0	5.29	10.3	16.5	32.7	45.2	4.7	37.7	38.5	11.1	17.5	0.50	mg/l
TOX	35.5	24.9	16.8	15.2	14.4	343.0	U	19.1	89.6	12.8	18.0	15.5	20.8	8	ug/l
TDS	48	50	124	28	U	U	U	40	55	U	38	104	76	20	mg/l
TSS	674	3,980	5,070	309	13,900	9,280	19,400	5,730	144	9,640	4,040	5,410	7,890	4	mg/l
NITROAROMATICS:															
HMX	U	U	14	U	U	U	U	25	U	U	U	U	U	10	ug/l
RDX	130	U	U	U	U	U	U	U	U	U	U	U	U	10	ug/l
2,6-dinitrotoluene	U	U	U	U	U	U	U	U	U	24	U	U	U	10	ug/l
VOLATILES:															
Chloroform	6	7	U	7	16	20	8	U	4 J	3 J	2 J	6	U	5	ug/l
1,2-Dichloroethene	4 J	U	U	U	U	U	U	3 J	19	U	U	U	U	5	ug/l
Tetrachloroethene	U	8	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Toluene	4 J	U	U	2 J	U	U	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	67	17	29	U	U	U	U	31	100	U	U	U	U	5	ug/l
Trichlorofluoromethane	8 J	5 J	U	U	U	U	U	20 J	57 J	U	U	U	U	--	ug/l
3-Methylpentane	U	U	U	U	U	U	U	U	U	U	U	U	7 J		ug/l
SEMIVOLATILES:	U	--	--	--	--	--	--	--	--	--	--	--	--		ug/l

Notes: U – Not detected.

J – Compound is present but less than the detection limit.

Y – EPA CLP criteria for confirmation not met but compound is present.

TABLE 7-7
SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300,
SURFACE WATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations 9SW1	9SW2	9SW3	Detection Limit	Units
TOTAL METALS:					
Cadmium	7.3	6.6	U	5.0	ug/l
Chromium	U	U	U	7.0	ug/l
Copper	4.8	5.8	5.3	3.0	ug/l
Lead	U	U	28.1	28.0	ug/l
Zinc	13.6	17.8	20.7	3.0	ug/l
FILTERED METALS:					
Cadmium	U	U	U	5.0	ug/l
Chromium	U	U	U	7.0	ug/l
Copper	U	4.2	U	3.0	ug/l
Lead	U	U	U	28.0	ug/l
Zinc	10.5	13.8	9.3	3.0	ug/l
pH	7.30	7.40	7.30	--	su
TOC	3,900	5,500	5,200	500	ug/l
TOX	35	18	17	8	ug/l
TDS	88	68	66	20	mg/l
TSS	43	43	37	4	mg/l
VOLATILE ORGANICS:					
Acetone	34 B	4 JB	U	5	ug/l

Notes: U - Not detected.
B - Compound also detected in blank sample.
J - Compound is present but less than the detection limit.

Phase II RI Summary Data

TABLE 7-4

SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300

SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS

(PHASE II - 1991)

Parameter	Sample Locations										Detection Limit	Units
	9SD2	9SD3	9SD7	9SD9	9SD10	9SD11	9SD13	9SD16	9SD17	9SD18		
TOTAL METALS:												
Cadmium	U	U	U	U	U	U	U	U	U	U	5	mg/kg
Chromium	13	9.8	21	13	19	15	14	5.9	7.4	U	10	mg/kg
Copper	11	13	3.8	4.7	4.2	8.2	8.7	9.5	3.6	4.6	25	mg/kg
Lead	58	26	10	8.2	5.3	30	14	5.4	1.1	0.68	3	mg/kg
Zinc	41	74	24	6.8	28	26	14	72	16	4.6	20	mg/kg
VOLATILE ORGANICS:												
Methylene Chloride	95 B	32	23	13	R	R	R	37	7	5	5	ug/kg
Acetone	39 E	>200	>200	U	810	R	R	39 E	59 E	16 E	10	ug/kg
Carbon Disulfide	10 E	3	U	U	U	4	U	3	3	U	5	ug/kg
2-Butanone	U	9 E	U	U	U	34 E	U	U	U	U	10	ug/kg
1,1,1-Trichloroethane	9 E	U	U	U	U	U	U	U	U	U	5	ug/kg
NITROAROMATICS:												
1,3,5 Trinitrobenzene	U	U	U	U	U	0.94	U	U	U	U	0.2	ug/kg
2,4,6 Trinitrotoluene	U	U	U	U	U	1.20	U	U	U	U	0.94	ug/kg
HMX	U	U	U	U	U	2.70	U	U	U	U	4.2	ug/kg
RDX	U	U	U	U	U	1.80	U	U	U	U	1.6	ug/kg
Tetryl	U	U	U	U	U	15.00	U	U	U	U	3.7	ug/kg

NOTES: U - Not detected.
R - Quantitation Rejected
E - Quantitation Estimated.

TABLE 7–6
SITE 9 – INDUSTRIAL WASTEWATER DISPOSAL AREA 300
GROUNDWATER ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations													Detection Limit	Units
	9GW1	9GW2	9GW3	9GW4	9GW5	9GW6	9GW7	9GW57D	9GW57S	9GW59	9GW74	9GW75	9GW83		
TOTAL METALS:															
Cadmium	U	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Chromium	3.3	U	11	U	8.9	3.4	2.5	U	4.7	U	U	U	3.7	10	ug/l
Copper	57	27	31	U	U	U	27	U	16	13	20	U	U	25	ug/l
Lead	9.1	13	9.3	3.6	6.9	7.6	4.7	U	11	U	5.1	U	11	3	ug/l
Mercury	R	R	R	R	R	R	R	R	R	R	R	R	R	0.2	ug/l
Zinc	30	91	70	12	16	12	40	6.0	7.0	13	76	13	70	20	ug/l
FILTERED METALS:															
Cadmium	U	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	3.9	U	U	U	U	U	U	U	U	10	ug/l
Copper	U	U	U	U	15	17	13	U	U	19	U	U	U	25	ug/l
Lead	U	U	U	U	U	U	U	4.6	5.0	U	U	U	2.1	3	ug/l
Mercury	R	R	R	R	R	R	R	R	R	R	R	R	R	0.2	ug/l
Zinc	25	11	35	6.0	10	10	16	8.0	7.0	44	21	16	38	20	ug/l
PCBs (1)	U	U	U	U	U	U	U	U	U	U	U	U	U	1.0	ug/l
NITROAROMATICS:															
HMX	10.60	U	U	U	U	U	U	1.60 E	2.00 E	U	U	U	3.10 E	4.2	ug/l
RDX	21.0	U	U	11.00	U	U	U	12.30	12.10	U	U	U	11.00	1.6	ug/l
Nitrobenzene	U	U	U	1.5	U	U	U	U	U	U	U	U	U	1.5	ug/l
2,6–Dinitrotoluene	U	U	U	U	U	U	U	U	U	U	U	U	U	0.5	ug/l
1,3,5 Trinitrobenzene	U	R	R	R	R	R	R	U	U	R	R	U	R	0.2	ug/l
VOLATILE ORGANICS:															
Chloroform	8	3 E	2 E	7	8	3 E	7	4 E	3 E	3 E	U	2 E	U	5	ug/l
Carbon Tetrachloride	U	2 E	U	U	2 E	U	U	U	U	U	U	U	U	5	ug/l
1,2–Dichloroethene	2 E	U	U	U	U	U	U	20	11	U	U	U	U	5	ug/l
Tetrachloroethene	U	7	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Toluene	U	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	49	14	7	U	14	7	U	180	83	U	2 E	U	U	5	ug/l
1,1,2,2–Tetrachloroethane	U	U	U	U	2 E	U	U	U	U	U	U	U	U	5	ug/l
Methylene Chloride	12	R	R	R	R	R	R	R	R	R	R	R	5 E	5	ug/l
Acetone	U	R	R	R	U	U	U	R	R	U	R	R	7 E	10	ug/l
1,2–Dichloroethane	U	U	U	3 E	U	2 E	U	U	U	U	U	U	U	5	ug/l

NOTES: (1) The PCB compound for which values are given here is AR1260.
U – Not detected.
R – Quantitation Rejected.
E – Quantitation Estimated

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TABLE 7-8

SITE 9 - INDUSTRIAL WASTEWATER DISPOSAL AREA 300

SURFACE WATER ANALYTICAL RESULTS

(PHASE II - 1991)

Parameter	Sample Locations			Detection Limit	Units
	9SW1	9SW2	9SW3		
TOTAL METALS:					
Cadmium	U	U	U	5	ug/l
Chromium	U	U	U	10	ug/l
Copper	U	U	U	25	ug/l
Lead	4.5	U	Not Reported	3	ug/l
Zinc	12	U	U	20	ug/l
FILTERED METALS:					
Cadmium	U	U	U	5	ug/l
Chromium	U	U	U	10	ug/l
Copper	U	12	U	25	ug/l
Lead	U	U	U	3	ug/l
Zinc	U	7.0	14	20	ug/l
VOLATILE ORGANICS:					
Acetone	U	14 E	31 E	10	ug/l
Methylene Chloride	5	U	6	5	ug/l
NITROAROMATICS:					
1,3,5 Trinitrobenzene	Not Reported	R	U	0.2	ug/l

NOTES: U - Not detected.
E - Quantitation Estimated.
R - Quantitation Rejected

Design Verification Study - Summary of Analytical Data

9

INDUSTRIAL WAST[illegible]ER DISPOSAL AREA 300

DVSAP ANALYTICAL RESULTS

NSWC - WHITE OAK

PARAMETER	LW-01 09-LW-01		LW-02 09-SB02-1012		LW-03 09-SB03-CUT		LW-04 09-SB04-1012		LW-05 09-SB05-1012		LW-06 09-SB06-1214		LW-07 09-SB07-1012		LW-08 09-SB08-1214		LW-9 09-LW-09	
VOLATILES (ug/Kg)																		
METHYLENE CHLORIDE	10.4	B	62.0		18.7	B	4.6	B	5.96	B	5.87	B	ND		2.19	B	15.2	B
ACETONE	ND		ND		11.7		ND		ND		11.4	B	ND		4.67	B	ND	
2-BUTANONE	7.36	J	ND		ND		ND		ND		ND		ND		ND		ND	
TRICHLOROETHENE	ND		ND		ND		ND		ND		ND		1.28	J	3.20	J	ND	
4-METHYL-2-PENTANONE	ND		ND		ND		1.18	J	1.3	J	ND		ND		ND		ND	
ETHYLBENZENE	ND		ND		ND		ND		ND		ND		1.42	J	ND		ND	
XYLENES (TOTAL)	ND		ND		ND		ND		ND		ND		5.84	J	ND		ND	
SEMIVOLATILES (ug/Kg)																		
NAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND		*3900	
2-METHYLNAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND		998	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND		*4900	
DIBENZOFURAN	ND		ND		ND		ND		ND		ND		ND		ND		2890	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND		*4800	
PHENANTHRENE	ND		ND		193	J	ND		ND		ND		ND		ND		*33,000	
ANTHRACENE	ND		ND		61	J	ND		ND		ND		ND		ND		*9900	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND		*4700	
DI-n-BUTYLPHTHALATE	ND		ND		ND		110	B	69.2	B	81.2	B	117	B	50.3	B	ND	
FLUORANTHENE	ND		ND		173	J	ND		ND		ND		ND		ND		*34,000	
PYRENE	ND		ND		193	J	ND		ND		ND		ND		ND		*29,000	
BENZO[a]ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		*15,000	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND		*13,000	
BIS(2-ETHYLHEXYL)PHTHALATE	109	J	ND		ND		ND		ND		ND		ND		ND		500	
BENZO[b]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		*9100	
BENZO[k]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		*11,000	
BENZO[a]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		*10,700	
IDENO[1,2,3-cd]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		*6100	
BENZO[g,h,i]PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND		*6400	
METALS (mg/Kg)																		
ALUMINUM	3800		3790		2250		14,600		13,500		15,900		8,650		3,830		6720	
ANTIMONY	1.89		1.1	B	ND		0.352		ND		ND		0.455	B	0.346	B	0.606	
ARSENIC	2.22		1.74		0.867		4.73		0.858		0.271		4.23	B	1.44	B	3.56	
BARIUM	102		3.6		6.72		20.0		60.6		78.2		18.4		5.58	B	40.4	
BERYLLIUM	0.198		ND		ND		0.439		1.94		1.88		0.528	B	0.311	B	0.228	
CADMIUM	1.48	B	ND		ND		ND		ND		1.14		ND		1.12	B	2.79	
CALCIUM	626		19.7	B	282		ND		916		738		35.5	B	17.8	B	3740	
CHROMIUM	17.0		12.5		7.76		24.7		20.9		23.8		15.9		6.83		12	
COBALT	5.51		ND		1.91		ND		10.9		16.9		3.16		ND		2.92	B
COPPER	30.0	B	9.0		8.67		9.94	B	14.8	B	46.7		16.0	B	14.7	B	95.3	
IRON	67,100		15,800		5260		21,500		50,500		50,500		18,100		5,020		88,200	
LEAD	90.1		3.47		3.69		9.32		5.43		5.59		6.31		1.38	B	120	
MAGNESIUM	147		120		107		219		4520		5570		191.0		90.2		306	
MANGANESE	17.8		1.3		19.6		17.0		847		1120		16.5		6.47		33.9	
MERCURY	11.9		0.063		0.186		0.244		0.888		0.367		0.150	B	0.112	B	66.0	
NICKEL	14.3		ND		ND		4.97		16.9		18.0		4.70		ND		7.89	
POTASSIUM	202		75.5		130		322	B	3950		3650		182		90.2		171	
SELENIUM	ND		ND		ND		0.34		ND		ND		0.544		0.620		4.55	
SILVER	42.3		ND		ND		ND		ND		ND		ND		ND		35.3	
SODIUM	ND		ND		ND		26.4	B	92.1	B	86.6	B	ND		ND		24.6	B
THALLIUM	ND		ND		ND		ND		ND		0.602		ND		ND		ND	
VANADIUM	19.9		19.4		10.1		41.2		40.4		37.7		56.7		12.8		22	
ZINC	184		ND		3.22		9.13	B	58.5		76.1		4.77	B	9.68		147	
MISCELLANEOUS																		
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	92.1		38.3		56.8		15.2		20.5		14.9		22.7		19.4		155	
pH	8.20		4.91		6.78		4.41		4.76		5.22		4.85		4.75		7.79	
PERCENT SOLIDS (%)	84.0		88.4		88.5		88.5		82.3		87.3		90.2		89.5		87.8	
EXPLOSIVES - NO POSITIVES REPORTED																		

ND - Not Detected

NA - Not Analyzed

* - Result taken from dilution analysis

B - Positive result is considered false positive due to blank contamination

J - Positive result is considered an estimate

JCTO18009.XLW/A

INDUSTRIAL WASTEWATER DISPOSAL AREA 300
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-9 09-SB09A-1012		LW-9 09-SB09A-1214		LW-9 09-SB09A-1618		LW-9 09-SB09B-1012		LW-9 09-SB09B-1214		LW-9 09-SB09B-1416		LW-9 09-SB09C-0810		LW-9 09-SB09C-1012	
VOLATILES (ug/Kg)																
METHYLENE CHLORIDE	NA		NA		NA		NA		NA		NA		NA		NA	
ACETONE	NA		NA		NA		NA		NA		NA		NA		NA	
2-BUTANONE	NA		NA		NA		NA		NA		NA		NA		NA	
TRICHLOROETHENE	NA		NA		NA		NA		NA		NA		NA		NA	
4-METHYL-2-PENTANONE	NA		NA		NA		NA		NA		NA		NA		NA	
ETHYLBENZENE	NA		NA		NA		NA		NA		NA		NA		NA	
XYLENES (TOTAL)	NA		NA		NA		NA		NA		NA		NA		NA	
SEMIVOLATILES (ug/Kg)																
NAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
2-METHYLNAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
DIBENZOFURAN	ND		ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	43.9	J	ND		93.8	J	ND		40.8	J	63.2	J	290	J	94.4	J
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(a)ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		ND		ND		ND		37.7	B	ND		ND		ND	
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(a)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
IDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(g,h,i)PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)																
ALUMINUM	NA		NA		NA		NA		NA		NA		NA		NA	
ANTIMONY	NA		NA		NA		NA		NA		NA		NA		NA	
ARSENIC	NA		NA		NA		NA		NA		NA		NA		NA	
BARIUM	NA		NA		NA		NA		NA		NA		NA		NA	
BERYLLIUM	NA		NA		NA		NA		NA		NA		NA		NA	
CADMIUM	NA		NA		NA		NA		NA		NA		NA		NA	
CALCIUM	NA		NA		NA		NA		NA		NA		NA		NA	
CHROMIUM	NA		NA		NA		NA		NA		NA		NA		NA	
COBALT	NA		NA		NA		NA		NA		NA		NA		NA	
COPPER	NA		NA		NA		NA		NA		NA		NA		NA	
IRON	NA		NA		NA		NA		NA		NA		NA		NA	
LEAD	NA		NA		NA		NA		NA		NA		NA		NA	
MAGNESIUM	NA		NA		NA		NA		NA		NA		NA		NA	
MANGANESE	NA		NA		NA		NA		NA		NA		NA		NA	
MERCURY	NA		NA		NA		NA		NA		NA		NA		NA	
NICKEL	NA		NA		NA		NA		NA		NA		NA		NA	
POTASSIUM	NA		NA		NA		NA		NA		NA		NA		NA	
SELENIUM	NA		NA		NA		NA		NA		NA		NA		NA	
SILVER	NA		NA		NA		NA		NA		NA		NA		NA	
SODIUM	NA		NA		NA		NA		NA		NA		NA		NA	
THALLIUM	NA		NA		NA		NA		NA		NA		NA		NA	
VANADIUM	NA		NA		NA		NA		NA		NA		NA		NA	
ZINC	NA		NA		NA		NA		NA		NA		NA		NA	
MISCELLANEOUS																
TOTAL CYANIDE (mg/Kg)	NA		NA		NA		NA		NA		NA		NA		NA	
TOTAL KJELDAHL NITROGEN (mg/Kg)	NA		NA		NA		NA		NA		NA		NA		NA	
pH	NA		NA		NA		NA		NA		NA		NA		NA	
PERCENT SOLIDS (%)	91.3		91.6		89.2		93.9		94.0		93.1		87.7		90.2	
EXPLOSIVES - NO POSITIVES REPORTED																

ND - Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B - Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

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TABLE 2-6

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INDUSTRIAL WASTEWATER DISPOSAL AREA 300

DVSAP ANALYTICAL RESULTS

NSWC - WHITE OAK

PARAMETER	LW-9 09-SB09C-1618		LW-9 09-SB09D-0810		LW-9 09-SB09D-1012		LW-9 09-SB09D-1214		LW-10 09-SB10-1214		LW-11 09-SB11-1012		LW-12 09-SB12-1012		LW-13 09-SB13-0810	
VOLATILES (ug/Kg)																
METHYLENE CHLORIDE	NA		NA		NA		NA		6.55	B	6.35	B	5.93	B	13.3	B
ACETONE	NA		NA		NA		NA		ND		ND		7.43	B	6.85	J
2-BUTANONE	NA		NA		NA		NA		ND		ND		ND		ND	
TRICHLOROETHENE	NA		NA		NA		NA		ND		ND		ND		ND	
4-METHYL-2-PENTANONE	NA		NA		NA		NA		ND		ND		1.9	J	ND	
ETHYLBENZENE	NA		NA		NA		NA		ND		ND		ND		ND	
XYLENES (TOTAL)	NA		NA		NA		NA		ND		ND		ND		ND	
SEMIVOLATILES (ug/Kg)																
NAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
2-METHYLNAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
DIBENZOFURAN	ND		ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	ND		ND		ND		ND		40.2	B	ND		ND		117	B
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[a]ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[b]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[k]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[a]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
IDENO[1,2,3-cd]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[g,h,i]PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)																
ALUMINUM	NA		NA		NA		NA		7160		506.0		3190		10,100	
ANTIMONY	NA		NA		NA		NA		ND		ND		ND		ND	
ARSENIC	NA		NA		NA		NA		2.76		0.626		2.62		2.40	
BARIUM	NA		NA		NA		NA		14.7		1.45		3.36		17.5	
BERYLLIUM	NA		NA		NA		NA		0.275		0.114		0.271	B	0.162	B
CADMIUM	NA		NA		NA		NA		ND		ND		ND		0.979	B
CALCIUM	NA		NA		NA		NA		ND		13.2		ND		33.6	
CHROMIUM	NA		NA		NA		NA		9.27		2.88		20.5		16.6	
COBALT	NA		NA		NA		NA		3.49	B	2.72	B	ND		2.6	
COPPER	NA		NA		NA		NA		7.88		12.0		7.1	B	8.19	
IRON	NA		NA		NA		NA		61,400		23,600		10,700		18,300	
LEAD	NA		NA		NA		NA		5.60		1.44		4.7		5.58	
MAGNESIUM	NA		NA		NA		NA		159		16.4		46		586	
MANGANESE	NA		NA		NA		NA		12.2		1.98	B	6.81		73.1	
MERCURY	NA		NA		NA		NA		0.158		ND		0.338		0.882	
NICKEL	NA		NA		NA		NA		4.38		2.72		ND		4.14	
POTASSIUM	NA		NA		NA		NA		111		ND		158	B	405	
SELENIUM	NA		NA		NA		NA		0.529		0.553		ND		ND	
SILVER	NA		NA		NA		NA		ND		ND		ND		ND	
SODIUM	NA		NA		NA		NA		ND		ND		27.2	B	ND	
THALLIUM	NA		NA		NA		NA		ND		ND		ND		ND	
VANADIUM	NA		NA		NA		NA		18.6		7.12		26.3		26.4	
ZINC	NA		NA		NA		NA		5.40	B	4.5	B	4.26	B	10.8	
MISCELLANEOUS																
TOTAL CYANIDE (mg/Kg)	NA		NA		NA		NA		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	NA		NA		NA		NA		24.8		9.23		30.5		248	
pH	NA		NA		NA		NA		5.04		7.05		4.74		4.68	
PERCENT SOLIDS (%)	88.9		90.6		89.2		90.4		90.8		93.6		84.0		87.0	
EXPLOSIVES - NO POSITIVES REPORTED																

ND - Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B - Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

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INDUSTRIAL WASTEWATER DISPOSAL AREA 300
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-14 09-SB14-1012		LW-15 09-SB15-1214		LW-15 09-SB15-1214D		LW-16 09-SB16-1012		LW-17 09-SB17-1416		LW-18 09-SB18-1012		LW-19 09-SB19-1012		LW-20 09-SB20-1416	
VOLATILES (ug/Kg)																
METHYLENE CHLORIDE	18.1	B	21	B	22.4	B	6.17	B	8.85	B	7.59	B	2.62	B	6.57	B
ACETONE	ND		ND		ND		ND		5.2	J	ND		ND		ND	
2-BUTANONE	ND		ND		ND		ND		ND		ND		ND		ND	
TRICHLOROETHENE	ND		ND		ND		ND		ND		ND		5.26	J	ND	
4-METHYL-2-PENTANONE	ND		ND		ND		ND		ND		ND		ND		ND	
ETHYLBENZENE	ND		ND		ND		ND		ND		ND		ND		ND	
XYLENES (TOTAL)	ND		ND		ND		ND		ND		ND		ND		ND	
SEMIVOLATILES (ug/Kg)																
NAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
2-METHYLNAPHTHALENE	ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
DIBENZOFURAN	ND		ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	47.8	B	70.2	B	ND		ND		ND		56.9	B	78.2	B	ND	
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[a]ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		ND		ND		ND		38.4	J	87.1	J	ND		ND	
BENZO[b]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[k]FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[a]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
IDENO[1,2,3-cd]PYRENE	ND		ND		ND		ND		ND		ND		ND		ND	
BENZO[g,h,i]PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)																
ALUMINUM	3100		1930		897		1900		3520		5860		5,440.0		3740	
ANTIMONY	ND		0.742		ND		1.42		ND		ND		0.756	B	ND	
ARSENIC	1.18		0.767		1.74		1.86		2.55		2.39		2.20	B	1.9	
BARIUM	1.63		4.9		3.31		4.44		4.23		11.8		4.05	B	5.81	
BERYLLIUM	ND		ND		ND		0.221		ND		0.227		.452	B	ND	
CADMIUM	0.408	B	ND		ND		0.437	B	0.49	B	0.393	B	1.29	B	ND	
CALCIUM	ND		18.6		12.1		ND		ND		9.39		61.0	B	32.1	
CHROMIUM	7.19		11.4		2.25		6.79		10.6		11.9		34.2		7.09	
COBALT	ND		ND		ND		2.88	B	2.6	B	2.1	B	ND		2.57	B
COPPER	7.58		18.1		1.84		5.54	B	7.5		9.45		35.1		6.74	B
IRON	11,800		3930		412		74,800		69,600		95,400		24,800		67,800	
LEAD	2.76		1.72		2.37		2.63		2.29		3.93		2.16		2.7	
MAGNESIUM	22.8		96.6		103		44.6		36.3		105		68.4		57.6	
MANGANESE	2.84		ND		ND		3.22	B	3.51	B	8.84		11.2		5.15	B
MERCURY	0.146		0.321		0.243		0.165		0.390		0.179		0.318	B	0.199	
NICKEL	ND		ND		ND		3.57		ND		ND		ND		2.8	
POTASSIUM	88.9		191		103		ND		ND		89		109.0		34.2	
SELENIUM	ND		0.635		1.22		ND		ND		0.975		ND		0.335	
SILVER	ND		ND		ND		ND		ND		ND		ND		1.04	
SODIUM	ND		ND		ND		ND		ND		ND		ND		ND	
THALLIUM	ND		ND		ND		ND		ND		ND		ND		ND	
VANADIUM	17.4		20.5		3.6		20.8		28.5		32.6		45.9		23.1	
ZINC	1.48		ND		ND		3.31	B	3.73	B	6.22	B	12.6		4.24	B
MISCELLANEOUS																
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	79.0		45.2		38.8		15.5		17.8		29.8		29.5		18.9	
pH	4.66		5.02		4.78		5.80		5.35		5.23		5.17		4.82	
PERCENT SOLIDS (%)	86.8		90.0		93.4		90.2		92.0		90.0		85.2		92.0	
EXPLOSIVES - NO POSITIVES REPORTED																

ND - Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B - Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

(CTO18009.XLW)A

APPENDIX J

SITE 11 - HISTORICAL DATA

Phase I RI Summary Data
Phase II RI Summary Data
EM Survey Data
Design Verification Study - Summary of Analytical Data

Phase I RI Summary Data

TABLE 8-3

SITE 11 – INDUSTRIAL WASTEWATER DISPOSAL AREA 100

SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS

(Phase I – 1989)

Parameter	Sample Locations 11SD1	11SD2	11SD3	11SL1	11SL2	Detection Limit	Units
TOTAL METALS:							
Cadmium	4.3	U	U	0.85	U	0.78	mg/kg
Chromium	133.0	12.8	14.1	18.0	17.7	0.70	mg/kg
Copper	135.0	12.4	8.5	16.0	8.8	0.30	mg/kg
Lead	139.0	40.5	9.2	46.4	28.9	3.60	mg/kg
Mercury	1.9	U	0.21	--	--	0.14	mg/kg
Zinc	789.0	62.3	26.6	59.2	28.1	0.20	mg/kg
pH	7.31	6.23	7.21	--	--	--	su
TOC	64,600	5,880	4,885	--	--	100	mg/kg
TOX	266	20.2	18.3	--	--	15.0	mg/kg
SEMIVOLATILES:	(Note 1)						
Phenanthrene	U	670	U	U	U	450	ug/kg
Anthracene	U	U	U	U	U	450	ug/kg
Di-n-Butylphthalate	U	U	U	U	U	450	ug/kg
Fluoranthene	30,000 J	780	U	440 J	U	450	ug/kg
Pyrene	22,000 JX	670 X	U	340 JX	U	450	ug/kg
Benzo(a)Anthracene	U	410 J	U	U	U	450	ug/kg
Chrysene	31,000 J	540	U	280 JX	U	450	ug/kg
bis(2-ethylhexyl)phthalate	23,000 J	190 JX	U	150 JX	U	450	ug/kg
Benzo(b)Fluoranthene	32,000 JX	400 JX	U	240 JX	U	450	ug/kg
Benzo(k)Fluoranthene	24,000 JX	400 JX	U	230 JX	U	450	ug/kg
Benzo(a)Pyrene	22,000 JX	420 JX	U	250 JX	U	450	ug/kg
Indeno(1,2,3-cd)Pyrene	20,000 JX	U	U	U	U	450	ug/kg
Dibenz(a,h)Anthracene	U	U	U	U	U	450	ug/kg
Benzo(g,h,i)Perylene	U	360 JX	U	U	U	450	ug/kg

Notes: (1) The detection limit for this sample was 100 times greater than the limit listed on this sheet.
U – Not detected.
J – Compound is present but less than the detection limit.
X – EPA CLP criteria for confirmation not met but compound is present.

TABLE 8-5
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
GROUNDWATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations								Detection Limit	Units
	11GW22	11GW23	11GW24	11GW25	11GW26	11GW27	11GW28	11GW29		
TOTAL METALS:										
Cadmium	U	U	U	U	U	3.8	U	U	2.0	ug/l
Chromium	176.0	153.0	109.0	574.0	62.8	2,100.0	111.0	236.0	5.0	ug/l
Copper	250.0	226.0	108.0	516.0	80.8	4,880.0	144.0	226.0	3.0	ug/l
Lead	66.2	128.0	U	305.0	41.4	151.0	27.1	86.6	28.0	ug/l
Mercury	0.61	U	U	U	0.98	0.46	0.42	0.28	0.20	ug/l
Zinc	630.0	668.0	283.0	1,420.0	250.0	791.0	343.0	496	3.0	ug/l
FILTERED METALS:										
Cadmium	U	4.4	U	U	U	U	U	U	2.0	ug/l
Chromium	U	U	U	U	U	1,460.0	U	U	5.0	ug/l
Copper	U	U	U	U	U	4,150.0	U	U	3.0	ug/l
Lead	U	U	U	U	U	U	U	U	28.0	ug/l
Mercury	0.70	U	U	U	U	U	U	U	0.20	ug/l
Zinc	18.1	8.5	52.0	36.4	11.9	95.4	18.1	19.5	3.0	ug/l
pH	5.20	5.40	4.36	4.55	6.20	4.50	4.80	6.30	—	
TOC	1.6	1.2	1.8	—	2.1	—	1.5	10.8	0.50	mg/l
TOX	480	—	59	11	14	17	47	—	8	ug/l
TDS	U	U	132	136	138	U	U	172	20	mg/l
TSS	4,040	5,490	5,160	9,610	1,520	5,270	3,120	3,960	4	mg/l
VOLATILE ORGANICS:										
Acetone	U	U	7 BJ	U	U	U	—	—	10	ug/l
Benzene	U	U	6	U	U	U	—	—	5	ug/l
Chloroform	23	U	58	4 J	U	U	—	—	5	ug/l
1,1-Dichloroethane	6 X	U	U	U	U	U	—	—	5	ug/l
1,2-Dichloroethane	6 X	U	10	U	U	U	—	—	5	ug/l
1,2-Dichloroethene	1000 D	U	U	U	U	U	—	—	5	ug/l
1,2-Dichloro-1,1,2-Tri-chloroethane	64 J	U	U	U	U	U	—	—	—	ug/l
Tetrachloroethene	10	U	U	U	U	U	—	—	5	ug/l
Tetrahydrofuran	U	U	12 J	U	19	U	—	—	—	ug/l
Trichloroethene	110 D	U	U	U	U	U	—	—	5	ug/l
Trichlorofluoromethane	U	13 J	U	U	U	U	—	—	—	ug/l

Notes: U - Not detected.
J - Compound is present but less than the detection limit.
X - EPA CLP criteria for confirmation not met but compound is present.
D - Concentration was calculated from a dilution.
B - Compound is present in blank.

TABLE 8-5 (CONTINUED)
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
GROUNDWATER ANALYTICAL RESULTS
(Phase I - 1989)

Parameter	Sample Locations								Detection Limit	Units
	11GW66	11GW67	11GW68	11GW69	11GW70D	11GW71	11GW72	11GW73		
TOTAL METALS:										
Cadmium	U	6.1	U	U	U	U	U	U	2.0	ug/l
Chromium	440.0	93.5	1,260.0	343.0	53.4	46.0	105.0	60.2	5.0	ug/l
Copper	456.0	149.0	3,460.0	355.0	56.9	40.8	124.0	82.1	3.0	ug/l
Lead	31.5	106.0	569.0	212.0	44.1	U	29.4	U	28.0	ug/l
Mercury	U	U	0.38	U	0.43	U	U	U	0.20	ug/l
Zinc	780.0	179.0	2,900.0	728.0	283.0	117.0	89.2	51.2	3.0	ug/l
FILTERED METALS:										
Cadmium	U	U	U	U	U	U	U	U	2.0	ug/l
Chromium	U	U	U	U	U	U	U	U	5.0	ug/l
Copper	U	U	U	U	U	U	U	U	3.0	ug/l
Lead	U	U	U	U	U	U	U	U	28.0	ug/l
Mercury	U	U	U	U	U	U	U	U	0.20	ug/l
Zinc	61.1	33.5	19.2	40.4	35.9	72.3	17.2	37.8	3.0	ug/l
pH	8.20	6.25	5.61	4.87	6.69	6.56	11.24	5.49	—	su
TOC	2.1	—	7.1	2.6	1.5	1.1	0.70	U	0.50	mg/l
TOX	11	29	10	U	U	U	11	9	8	ug/l
TDS	U	112	106	198	210	U	72	86	20	mg/l
TSS	5,980	3,540	30,500	9,520	6,380	1,720	5,980	3,120	4	mg/l
VOLATILE ORGANICS:										
Acetone	13	U	U	U	U	12	U	16 B	10	ug/l
Benzene	U	U	U	U	U	U	U	U	5	ug/l
Chloroform	U	4 J	U	U	U	U	U	4 J	5	ug/l
1,1-Dichloroethane	U	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethane	U	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethene	8	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloro-1,1,2-Tri-chloroethane	U	U	U	U	U	U	U	U	—	ug/l
Tetrachloroethene	U	U	U	U	U	U	U	U	5	ug/
Tetrahydrofuran	U	U	U	U	U	U	U	U	—	ug/
Trichloroethene	6	U	U	U	U	U	U	U	5	ug/
Trichlorofluoromethane	U	U	U	U	U	U	U	U	—	ug/

Notes: U - Not detected.
J - Compound is present but less than the detection limit.
X - EPA CLP criteria for confirmation not met but compound is present.
D - Concentration was calculated from a dilution.
B - Compound is present in blank.

Phase II RI Summary Data

TABLE 8-4
SITE 11 – INDUSTRIAL WASTEWATER DISPOSAL AREA 100
SEDIMENT/SURFICIAL SOIL ANALYTICAL RESULTS
(PHASE II – 1991)

Parameter	Sample Locations			Detection Limit	Units
	11SD1	11SD2	11SD3		
TOTAL METALS:					
Cadmium	2.6	U	U	5.0	mg/kg
Chromium	24	7.1	13	10	mg/kg
Copper	66	5.2	5.8	25	mg/kg
Lead	48	8.2	24	3	mg/kg
Zinc	696	40	50	20	mg/kg

NOTES: U – Not detected.

TABLE 8-6
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100
GROUNDWATER ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations														Detection Limit	Units
	11GW22	11GW23	11GW24	11GW25	11GW26	11GW27	11GW28	11GW29	11GW66	11GW67	11GW68	11GW69	11GW70D	11GW71		
TOTAL METALS:																
Cadmium	11	11	U	14	10	U	8.0	13	18	U	U	U	U	U	5.0	ug/l
Chromium	65	24	14	146	72	326	104	81	264	U	5.6	U	3.7	20	10	ug/l
Copper	315	179	37	326	207	1160	184	208	485	U	28	23	18	42	25	ug/l
Lead	73	42	5.9	73	132	134	61	45	122	U	12	2.9	19	5.5	3	ug/l
Mercury	R	R	R	R	R	R	R	R	R	R	R	R	R	R	0.2	ug/l
Zinc	774	530	53	859	622	230	520	587	1030	17	19	49	109	69	20	ug/l
FILTERED METALS:																
Cadmium	U	U	U	U	U	U	U	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	3.9	U	3.2	U	492	U	U	U	U	U	6.1	U	U	10	ug/l
Copper	22	U	U	22	15	634	18	19	15	U	U	U	U	22	25	ug/l
Lead	U	U	U	U	U	U	U	U	U	U	1.8	NA	U	U	3	ug/l
Mercury	R	R	R	R	R	R	R	R	R	R	R	R	R	R	0.2	ug/l
Zinc	32	43	23	31	20	84	U	92	38	34	16	66	42	23	20	ug/l
VOLATILE ORGANICS:																
Acetone	R	24 B	R	R	R	R	R	U	U	U	U	U	R	U	10	ug/l
Chloroform	21	U	29	R	U	U	U	U	U	U	U	U	U	U	5	ug/l
1,1-Dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
1,1-Dichloroethane	5	U	2	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethane	6	U	5	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
cis-1,2-Dichloroethene	U	U	U	U	U	U	2	U	2	U	U	U	U	U	5	ug/l
Tetrachloroethene	9	U	U	U	U	U	77	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	150	U	U	U	U	U	9	U	5	U	U	U	U	U	5	ug/l
Methylene Chloride	U	7	3	U	3	5	4	2	4	R	R	R	R	R	5	ug/l
1,1,1-Trichloroethane	U	U	1	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Carbon Tetrachloride	U	U	1	U	U	U	U	U	U	U	U	U	U	U	5	ug/l
Benzene	U	U	2	U	U	U	U	U	U	U	U	U	U	U	5	ug/l

NOTES: U - Not detected.
E - Quantitation Estimated
R - Quantitation Rejected
NA - Not analyzed (Digested alloquot lost by laboratory)

TABLE 8-6 (CONTINUED)
SITE 11 – INDUSTRIAL WASTEWATER DISPOSAL AREA 100
GROUNDWATER ANALYTICAL RESULTS
(PHASE II - 1991)

Parameter	Sample Locations							Detection Limit	Units
	11GW72	11GW73	11GW84	11GW85	11GW86	11GW87	11GW88		
TOTAL METALS:									
Cadmium	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	3.2 B	18	5.0	U	14	10	ug/l
Copper	33	U	U	142	15	U	49	25	ug/l
Lead	U	U	6.0	163	U	U	35	3	ug/l
Mercury	R	R	R	R	R	R	R	0.2	ug/l
Zinc	338	U	27	270	66	40	133	20	ug/l
FILTERED METALS:									
Cadmium	U	U	U	U	U	U	U	5.0	ug/l
Chromium	U	U	U	U	U	U	U	10	ug/l
Copper	U	U	U	U	U	U	U	25	ug/l
Lead	U	U	U	1.5	1.9	U	U	3	ug/l
Mercury	R	R	R	R	R	R	R	0.2	ug/l
Zinc	8.0	21	16 B	34	29	47	33	20	ug/l
VOLATILE ORGANICS:									
Acetone	R	U	U	6 E	6 E	10	U	10	ug/l
Chloroform	U	U	U	U	U	U	U	5	ug/l
1,1-Dichloroethene	U	U	U	U	U	U	U	5	ug/l
1,1-Dichloroethane	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethane	U	U	U	U	U	U	U	5	ug/l
cis-1,2-Dichlroethene	U	U	U	U	U	U	U	5	ug/l
Tetrachloroethene	U	U	U	U	U	U	U	5	ug/l
Trichloroethene	U	U	U	U	U	2	U	5	ug/l
Methylene Chloride	R	R	U	7 E	U	20	6 E	5	ug/l
1,1,1-Trichloroethane	U	U	U	U	U	U	U	5	ug/l
Carbon Tetrachloride	U	U	U	U	U	U	U	5	ug/l
Benzene	U	U	U	U	U	U	U	5	ug/l
1,2-Dichloroethene (Total)	U	U	U	U	U	2	U	5	ug/l

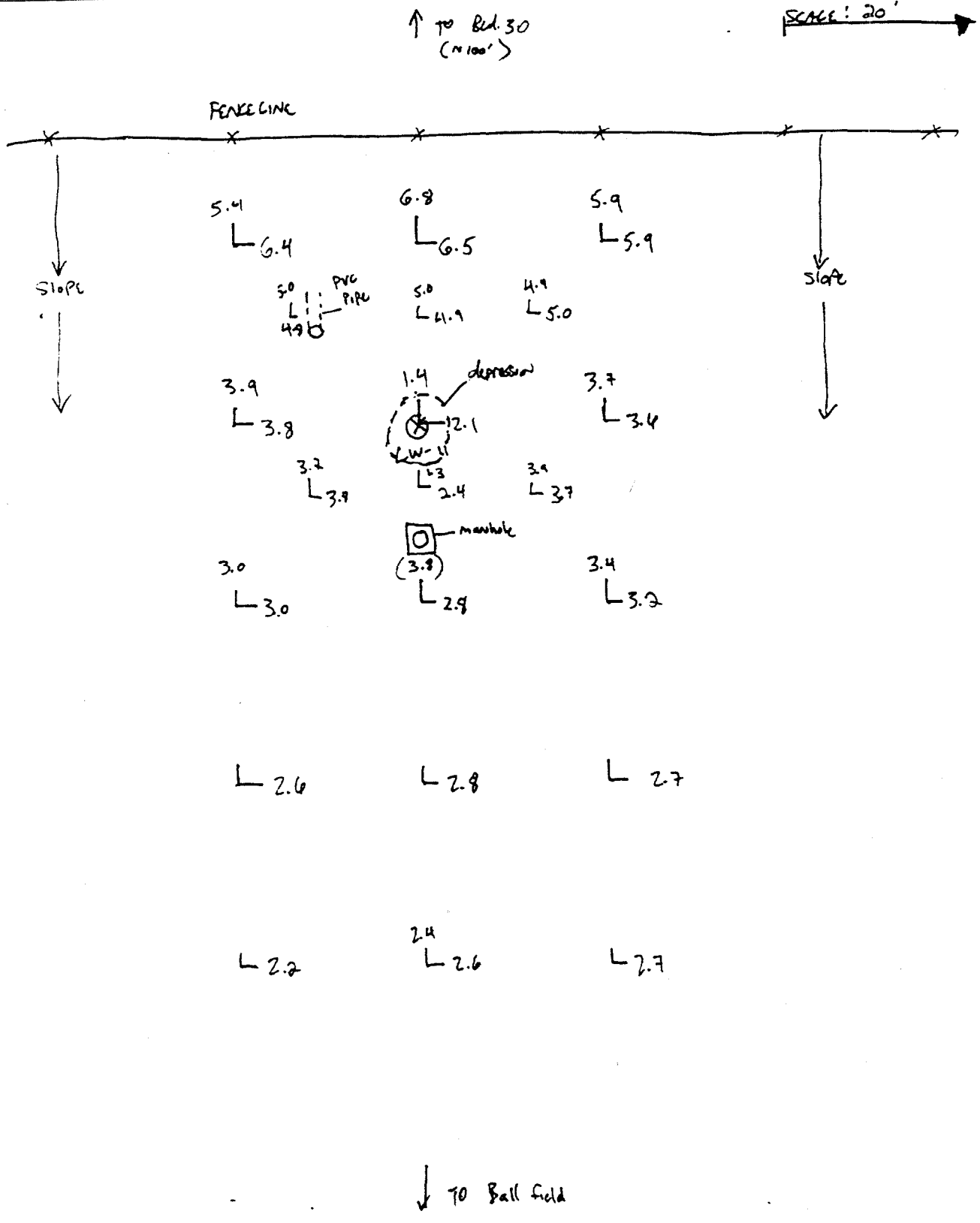
NOTES: U – Not detected.
E – Quantitation Estimated
R – Quantitation Rejected
B – Present in blank

EM Survey Data

CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: White Oak	JOB NUMBER:
SUBJECT: Site 11 EM Survey - Near Bld. 30	
BASED ON:	DRAWING NUMBER:
BY: DJN	CHECKED BY:
APPROVED BY:	DATE: 3/2/95

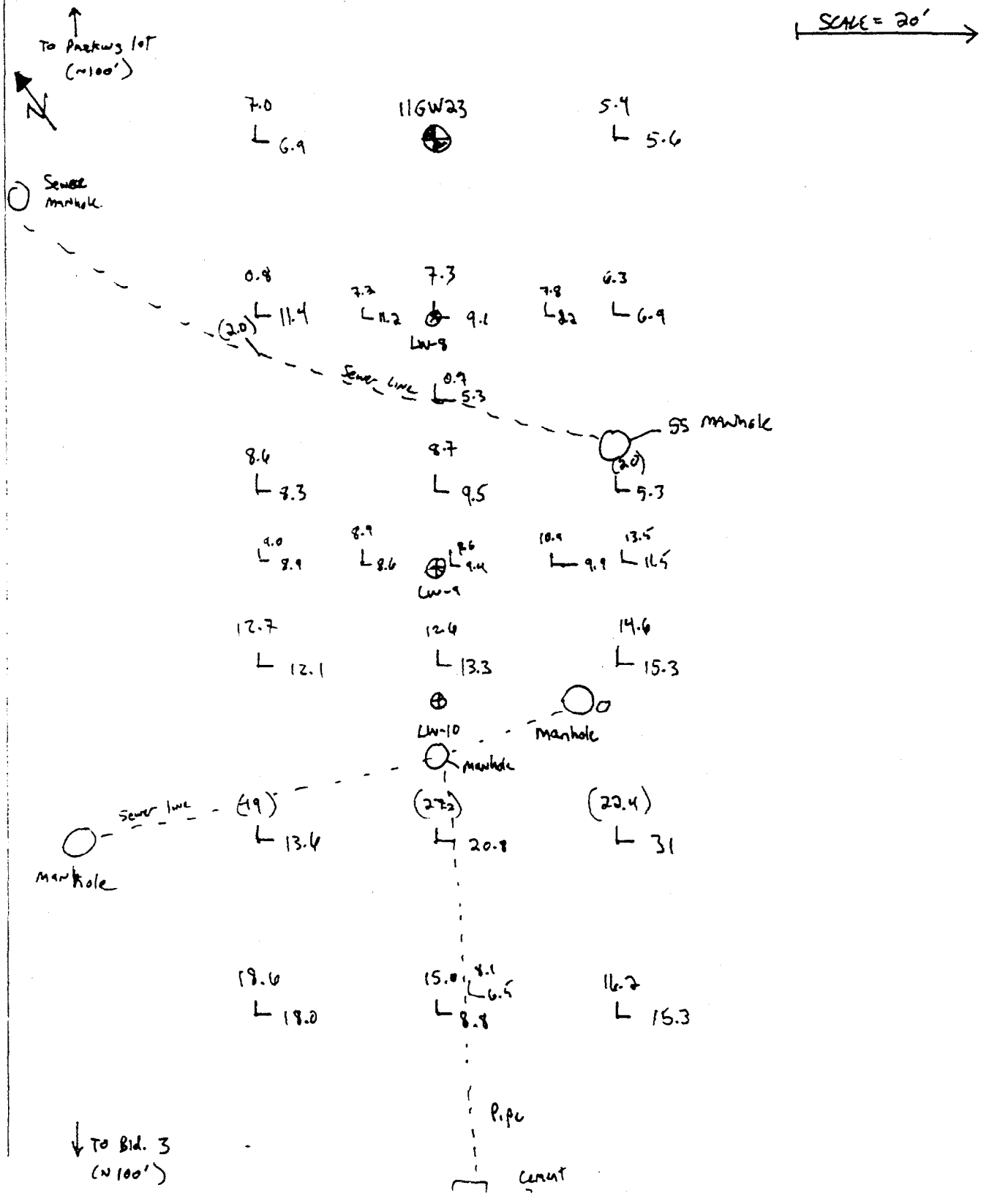


CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: White Oak	JOB NUMBER:
SUBJECT: Site 11 EM Survey - Near Bld. 3	
BASED ON:	DRAWING NUMBER:

BY	CHECKED BY	APPROVED BY	DATE
PLN			3/2/95



Design Verification Study - Summary of Analytical Data

TAL

SITE 11
INDUSTRIAL WASTEWATER DISPOSAL AREA 100
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-01 11-SB01-1418		LW-02 11-LW-02		LW-02 11-SB02A-0304		LW-02 11-SB02A-0506		LW-02 11-SB02A-0910		LW-02 11-SB02B-0204		LW-02 11-SB02B-0406		LW-02 11-SB02B-0608		LW-02 11-SB02C-0204		LW-02 11-SB02C-0608	
VOLATILES (ug/Kg)																				
METHYLENE CHLORIDE	6.13	B	3.64	B	NA		NA		NA		NA		NA		NA		NA		NA	
ACETONE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
CARBON DISULFIDE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
2-BUTANONE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
BENZENE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
TOLUENE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
CHLOROBENZENE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
ETHYLBENZENE	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
XYLENES (TOTAL)	ND		ND		NA		NA		NA		NA		NA		NA		NA		NA	
SEMIVOLATILES (ug/Kg)																				
1,2-DICHLOROBENZENE	ND		2380		ND		ND		ND		ND		ND		ND		ND		ND	
1,2,4-TRICHLOROBENZENE	ND		2540		ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
HEXACHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		40.9	J	ND		ND		45.6	J	ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	47.8	B	109	J	ND		ND		ND		ND		ND		ND		ND		ND	
FLUORANTHENE	ND		241	B	67.7	J	ND		ND		51.7	J	ND		ND		ND		ND	
PYRENE	ND		190	J	94.9	J	ND		ND		68.3	J	ND		ND		ND		ND	
BUTYL BENZYL PHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(A)ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		154	J	47.2	J	ND		ND		ND		ND		ND		ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		2690		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(a)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
IDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(g,h,i)PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)																				
ALUMINUM	9430		5150		3720		8030		7930		5470		17,400		9210		7150		7020	
ANTIMONY	ND		24.4		0.380		ND		ND		ND		ND		ND		ND		0.492	
ARSENIC	0.501		5.42		1.04		1.17		6.09		0.786		2.14		1.26		0.849		2.17	
BARIUM	22.9		195		16.0		123		41.4		24.2		47.3		51.8		33.1		18.5	
BERYLLIUM	1.07		ND		0.152		0.285		0.191		0.246		0.316		0.331		0.194		0.290	
CADMIUM	ND		7.63		0.706		1.44		2.23		1.03		6.68		1.17		1.92		1.80	
CALCIUM	287		5720		284		591		560		322		656		739		275		175	
CHROMIUM	20.7		396		10.3		15.4		77.3		11.8		40.7		22.0		34.8		30.4	
COBALT	19.2		75.7		2.25		15.0		2.07		ND		2.81		2.93		ND		2.46	
COPPER	30.7		3320		5.14		15.2		5.96		12.8		6.63		10.3		3.04		8.24	
IRON	63,800		35,300		6790		18,000		30,100		12,700		91,000		14,000		22,800		20,800	
LEAD	22.7		2420		12.7		13.1		6.12		9.65		9.47		11.2		6.09		4.47	
MAGNESIUM	2000		899		870		358		185		222		355		442		243		270	
MANGANESE	200		64.4		46.3		910		18.0		81.9		98.6		98.6		21.1		50.0	
MERCURY	0.609		64.2		ND		ND		ND		ND		ND		ND		ND		ND	
NICKEL	19.2		ND		25.2		5.77		3.41		3.11		4.78		6.70		ND		4.30	
POTASSIUM	2050		215		180		292		187		251		402		421		359		318	
SELENIUM	ND		3.54		ND		ND		0.367		ND		ND		ND		ND		ND	
SILVER	ND		492		ND		ND		ND		ND		ND		ND		ND		ND	
SODIUM	72.6	B	39.6	B	65.5		54.5		28.8		27.4		84.4		27.1		28.0		40.9	
THALLIUM	0.431		ND		ND		ND		ND		ND		ND		ND		ND		ND	
VANADIUM	24.7		34.3		11.0		17.8		32.5		12.8		48.7		23.5		34.6		35.1	
ZINC	81.1		496		7.90		14.4		4.43		9.13		10.6		16.7		4.61		8.40	
MISC																				
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	5.60		88.2		NA		NA		NA		NA		NA		NA		NA		NA	
pH	5.23		4.34		6.36		5.14		4.96		5.04		4.74		4.72		4.54		4.57	
PERCENT SOLIDS (%)	84.8		80.0		84.3		81.9		81.2		85.4		78.0		86.3		83.8		83.1	
EXPLOSIVES (ug/Kg) NO POSITIVES REPORTED																				

ND- Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B- Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

TABL

SITE 11
INDUSTRIAL WASTEWATER DISPOSAL AREA 100
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-02 11-SB02C-0610		LW-02 11-SB02D-0002		LW-02 11-SB02D-0204		LW-02 11-SB02D-0204D		LW-02 11-SB02D-0610		LW-03 11-LW-03		LW-04 11-LW-04		LW-05 11-SB05-1416		LW-06 11-LW-06		LW-07 11-SB07-0607		LW-08 11-SB08-1416	
VOLATILES (ug/Kg)																						
METHYLENE CHLORIDE	NA		NA		NA		NA		NA		2.37	B	3.4	B	6.53	B	8.5	B	7.39	B	13.3	B
ACETONE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
CARBON DISULFIDE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
2-BUTANONE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
BENZENE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
TOLUENE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
CHLOROBENZENE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
ETHYLBENZENE	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
XYLENES (TOTAL)	NA		NA		NA		NA		NA		ND		ND		ND		ND		ND		ND	
SEMIVOLATILES (ug/Kg)																						
1,2-DICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
1,2,4-TRICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
HEXACHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		83.6	J	ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	ND		ND		ND		69.1	B	42.1	B	ND		70.5	B	ND		80.4	B	ND		68.7	B
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		106	J	ND	
PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		89.3	J	ND	
BUTYL BENZYL PHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(A)ANTHRACENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		49.6	J	ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(a)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
IDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(g,h,i)PERYLENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)																						
ALUMINUM	6450		6170		7450		5630		10,200		5080		1150		2860		3860		10,600		7740	
ANTIMONY	ND		0.428		ND		ND		ND		0.745		ND		ND		ND		0.308	B	ND	
ARSENIC	0.691		0.315		2.62		7.03		0.757		0.994		0.309		ND		ND		2.54		ND	
BARIUM	10.4		24.9		22.2		19.6		22.0		17		ND		6.34		12		30.5		2.52	
BERYLLIUM	0.361		0.242		0.312		0.212		0.294		0.568		ND		0.263		0.326	B	0.518	B	0.807	B
CADMIUM	1.79		1.02		1.49		1.22		1.81		1.27	B	ND		ND		2.31		0.709		ND	
CALCIUM	311		450		228		367		54.4		496		57.4	B	41	B	702		305		172	
CHROMIUM	12.8		17.9		23.1		23.1		22.8		14.9		5.32		3.41		8.66		20.1		ND	
COBALT	2.68		2.80		1.98		1.76		3.44		4.37	B	ND		ND		ND		4.16	B	ND	
COPPER	18.5		8.10		10.6		8.80		13.5		44.2		9.27		8.28		15.9		9.73		ND	
IRON	22,000		12,200		18,900		13,500		19,000		107,000		4140		4620		5480		20,400		2520	
LEAD	17.1		26.7		4.33		8.06		8.52		103		44		4.56		24.1		6.72		4.46	
MAGNESIUM	588		288		295		293		431		414		ND		347		203		479		126	
MANGANESE	59.3		83.6		65.2		65.7		61.6		63.4		4.28		16.6		31.4		38.9		2.21	B
MERCURY	ND		ND		ND		ND		ND		1.60		0.644		0.174		0.585		0.230		ND	
NICKEL	4.56		3.53		3.54		3.88		4.72		7.45		ND		2.18		2.61		4.65		ND	
POTASSIUM	843		232		287		236		426		466		ND		939		268		317		52.2	B
SELENIUM	ND		ND		ND		ND		0.537		ND		ND		ND		ND		ND		ND	
SILVER	ND		ND		ND		ND		ND		19.3		1.4		ND		2.5		ND		ND	
SODIUM	41.0		28.8		40.9		40.1		27.6		133	B	31.7	B	121	B	20.3	B	34.4	B	ND	
THALLIUM	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
VANADIUM	26.3		17.7		24.4		25.8		27.5		13.4		3.94		9.26		20.4		30.8		ND	
ZINC	20.8		10.7		11.2		21.3		10.8		79.5		3.38	B	6.45		61		10.2	B	3.38	B
MISC																						
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		53.0		ND		NA		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	NA		NA		NA		NA		NA		73.6		232		9.20		34.8		189		8.24	
pH	4.20		6.23		4.78		4.91		4.55		8.80		6.82		5.55		6.16		4.32		4.87	
PERCENT SOLIDS (%)	82.9		81.8		83.2		84.9		84.6		63.0		75.0		81.8		87.2		84.3		81.3	
EXPLOSIVES (ug/Kg) NO POSITIVES REPORTED																						

ND- Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B- Positive result is considered false positive due to blank contamination
J - Positive result [illegible] tered an estimate

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SITE 11
INDUSTRIAL WASTEWATER DISPOSAL AREA 100
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-09 11-SB09-1416		LW-10 11-SB10-1012		LW-11 11-SB11-1214		LW-12 11-LW-12		LW-13 11-LW-13		LW13 11-SB13A-1012		LW-13 11-SB13A-1416		LW-13 11-SB13A-2223		LW-13 11-SB13B-1012		LW-13 11-SB13B-1618		LW-13 11-SB13B-2224	
VOLATILES (ug/Kg)																						
METHYLENE CHLORIDE	5.17	B	4.59	B	5.38	B	2.98	B	2.55	B	NA		NA		NA		NA		NA		NA	
ACETONE	ND		213		ND		82.5		ND		NA		NA		NA		NA		NA		NA	
CARBON DISULFIDE	ND		ND		7.43	J	48.1		ND		NA		NA		NA		NA		NA		NA	
2-BUTANONE	ND		ND		2.68	J	21		ND		NA		NA		NA		NA		NA		NA	
BENZENE	ND		7.15	J	ND		ND		ND		NA		NA		NA		NA		NA		NA	
TOLUENE	ND		3.03	J	ND		ND		ND		NA		NA		NA		NA		NA		NA	
CHLOROBENZENE	ND		11.4	J	ND		ND		ND		NA		NA		NA		NA		NA		NA	
ETHYLBENZENE	ND		20.1		ND		4.67	J	ND		NA		NA		NA		NA		NA		NA	
XYLENES (TOTAL)	ND		127		ND		8.18	J	ND		NA		NA		NA		NA		NA		NA	
SEMIVOLATILES (ug/Kg)																						
1,2-DICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
1,2,4-TRICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		80.5	J	ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		84.2	J	ND		ND		ND		ND		ND		ND	
HEXACHLOROBENZENE	ND		192	J	ND		ND		ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		642		ND		ND		ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		112	J	ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		74.3	J	ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	50.6	B	66.8	B	65.7	B	56.6	B	44.3	B	ND		41.8	B	ND		ND		ND		ND	
FLUORANTHENE	ND		ND		ND		87.5	J	989		ND		ND		ND		85.3	J	ND		ND	
PYRENE	ND		ND		ND		ND		812		ND		ND		ND		167	J	ND		ND	
BUTYL BENZYL PHTHALATE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
BENZO(A)ANTHRACENE	ND		ND		ND		ND		422		ND		ND		ND		70.3	J	ND		ND	
CHRYSENE	ND		ND		ND		ND		466		ND		ND		ND		116	J	ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	ND		335	J	ND		ND		205	J	ND		ND		ND		ND		ND		ND	
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		606		ND		ND		ND		125	J	ND		ND	
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		752		ND		ND		ND		116	J	ND		ND	
BENZO(a)PYRENE	ND		ND		ND		ND		354	J	ND		ND		ND		157	J	ND		ND	
IDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		661		ND		ND		ND		120	J	ND		ND	
BENZO(g,h,i)PERYLENE	ND		ND		ND		ND		784		ND		ND		ND		227	J	ND		ND	
METALS (mg/Kg)																						
ALUMINUM	5310		2940		1340		12,500		10,100		15,700		13,100		14,800		15,200		22,800		16,000	
ANTIMONY	ND		1.58		ND		ND		ND		ND		0.255		ND		ND		ND		0.398	
ARSENIC	ND		ND		0.601		1.16		3.07		1.15		ND		ND		0.560		0.313		0.384	
BARIUM	ND		26.0		ND		30.6		26.1		28.1		20.1		34.6		24.4		96.6		51.0	
BERYLLIUM	0.816	B	0.318	B	ND		0.388		0.261		0.490		0.571		1.65		0.999		1.73		1.69	
CADMIUM	3.76		25.6		1.07		49.2		1.24		2.50		1.15		1.85		1.90		2.11		1.85	
CALCIUM	250		301		99.2		1680		804		635		ND		ND		88.6		ND		ND	
CHROMIUM	12.4		34.2		4.75		177		40.6		63.3		13.8		12.8		24.5		20.0		13.0	
COBALT	ND		4.1		9.91		ND		5.37		3.09		9.21		14.8		9.58		14.1		17.4	
COPPER	11.0		121		18.9		187		19.4		23.2		12.0		28.1		21.5		14.5		13.0	
IRON	16,600		3780		9120		27,100		23,700		34,600		15,600		26,700		22,800		22,800		23,200	
LEAD	4.69		12.1		77.5		58.3		109		11.5		3.99		5.42		6.19		7.11		6.50	
MAGNESIUM	ND		79.5		ND		636		5160		435		2200		3420		2100		4270		2680	
MANGANESE	41.5		13.9		9.59		71		51.6		75.9		278		420		183		514		735	
MERCURY	0.092		2.22		3.37		9.4		2.21		ND		ND		ND		ND		ND		ND	
NICKEL	ND		13.1		3.6		23.8		78.4		10.4		13.3		19.3		13.3		27.5		27.6	
POTASSIUM	ND		ND		ND		707		632		495		2530		3550		2480		4210		2860	
SELENIUM	ND		ND		ND		ND		ND		ND		0.469		ND		0.524		ND		ND	
SILVER	ND		1.16		ND		306		17.6		ND		ND		ND		ND		ND		ND	
SODIUM	ND		ND		28.2	B	179	B	77	B	561		142		95.5		51.4		122		99.1	
THALLIUM	ND		ND		ND		ND		ND		ND		ND		0.324		ND		ND		ND	
VANADIUM	19.5		13.0		5.91		25.4		39.1		35.9		12.5		13.7		16.9		25.3		15.7	
ZINC	35		200		11.3		403		63.6		16.7		38.4		67.8		43.1		88.5		80.3	
MISC																						
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		20.2		8.06		ND		ND		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	41.1		35.7		16.4		897		263		NA		NA		NA		NA		NA		NA	
pH	4.87		5.60		5.43		7.65		6.39		5.22		4.84		5.34		5.10		4.79		5.06	
PERCENT SOLIDS (%)	87.0		86.4		90.7		76.7		79.9		83.5		91.4		91.1		86.9		88.5		87.8	
EXPLOSIVES (ug/Kg) NO POSITIVES REPORTED																						

ND- Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B- Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

TAB.

SITE 11
INDUSTRIAL WASTEWATER DISPOSAL AREA 100
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK

PARAMETER	LW-13 11-SB13C-1214		LW-13 11-SB13C-1214D		LW-13 11-SB13C-1416		LW-13 11-SB13C-1618		LW-13 11-SB13D-1012		LW-13 11-SB13D-1214		LW-13 11-SB13D-1416	
VOLATILES (ug/Kg)														
METHYLENE CHLORIDE	NA		NA		NA		NA		NA		NA		NA	
ACETONE	NA		NA		NA		NA		NA		NA		NA	
CARBON DISULFIDE	NA		NA		NA		NA		NA		NA		NA	
2-BUTANONE	NA		NA		NA		NA		NA		NA		NA	
BENZENE	NA		NA		NA		NA		NA		NA		NA	
TOLUENE	NA		NA		NA		NA		NA		NA		NA	
CHLOROBENZENE	NA		NA		NA		NA		NA		NA		NA	
ETHYLBENZENE	NA		NA		NA		NA		NA		NA		NA	
XYLENES (TOTAL)	NA		NA		NA		NA		NA		NA		NA	
SEMIVOLATILES (ug/Kg)														
1,2-DICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND	
1,2,4-TRICHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND	
ACENAPHTHENE	ND		ND		ND		ND		ND		ND		ND	
FLUORENE	ND		ND		ND		ND		ND		ND		ND	
HEXACHLOROBENZENE	ND		ND		ND		ND		ND		ND		ND	
PHENANTHRENE	ND		ND		ND		ND		ND		ND		ND	
ANTHRACENE	ND		ND		ND		ND		ND		ND		ND	
CARBAZOLE	ND		ND		ND		ND		ND		ND		ND	
DI-n-BUTYLPHTHALATE	63.3	B	62.9	B	56.7	B	43.0	B	ND		55.2	B	ND	
FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND	
PYRENE	ND		ND		ND		ND		ND		ND		ND	
BUTYL BENZYL PHTHALATE	60.6	J	ND		ND		ND		ND		ND		ND	
BENZO(A)ANTHRACENE	ND		ND		ND		ND		ND		ND		ND	
CHRYSENE	ND		ND		ND		ND		ND		ND		ND	
BIS(2-ETHYLHEXYL)PHTHALATE	86.1	J	ND		ND		ND		ND		* 2900		39.4	J
BENZO(b)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND	
BENZO(k)FLUORANTHENE	ND		ND		ND		ND		ND		ND		ND	
BENZO(a)PYRENE	ND		ND		ND		ND		ND		ND		ND	
IDENO(1,2,3-cd)PYRENE	ND		ND		ND		ND		ND		ND		ND	
BENZO(g,h,i)PERYLENE	ND		ND		ND		ND		ND		ND		ND	
METALS (mg/Kg)														
ALUMINUM	16,600		20,100		16,000		14,400		24,800		20,000		20,800	
ANTIMONY	ND		ND		ND		ND		0.317		ND		ND	
ARSENIC	0.731		0.909		0.547		0.588		1.32		0.202		0.640	
BARIUM	15.6		16.2		14.4		23.8		27.2		35.4		61.8	
BERYLLIUM	1.28		1.15		1.10		0.808		1.12		1.20		1.39	
CADMIUM	2.36		2.82		2.21		1.90		3.01		2.84		2.69	
CALCIUM	38.1		55.8		41.2		ND		306		68		42.5	
CHROMIUM	18.2		21.5		27		14.0		31		22.8		19.1	
COBALT	8.86		10.4		7.52		10.9		19.4		38.2		64.7	
COPPER	26.8		26.4		22.7		18.6		30.1		36		30.6	
IRON	28,600		36,400		30,700		26,700		40,200		35,700		29,800	
LEAD	9.99		9.06		9.27		7.28		8.30		9.09		9.86	
MAGNESIUM	1740		1790		1020		1600		1290		2800		2220	
MANGANESE	260		316		166		350		193		859		2720	
MERCURY	ND		ND		ND		ND		ND		ND		ND	
NICKEL	11.9		13.1		11.5		12.6		15.7		27.9		52.2	
POTASSIUM	1720		1810		1170		1930		1300		2580		1890	
SELENIUM	ND		0.349		0.504		0.329		ND		ND		ND	
SILVER	ND		ND		ND		ND		ND		ND		ND	
SODIUM	73.8		73.8		49.4		49.2		131		122		168	
THALLIUM	ND		ND		ND		ND		ND		0.497		0.417	
VANADIUM	18.0		20.0		14.8		11.5		32.1		22.8		18.4	
ZINC	40.5		44.2		28.8		40.2		39.2		71.8		73.5	
MISC														
TOTAL CYANIDE (mg/Kg)	ND		ND		ND		ND		ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	NA		NA		NA		NA		NA		NA		NA	
pH	4.92		4.81		4.66		4.75		5.42		5.13		5.16	
PERCENT SOLIDS (%)	89.2		89.2		90.4		90.7		82.7		88.4		89.6	
EXPLOSIVES (ug/Kg) NO POSITIVES REPORTED														

ND- Not Detected
NA - Not Analyzed
* - Result taken from dilution analysis
B- Positive result is considered false positive due to blank contamination
J - Positive result is considered an estimate

APPENDIX K

BACKGROUND SAMPLING - HISTORICAL DATA

Analytical Data - Surface Soil
Analytical Data - Subsurface Soil
Analytical Data - Surface Water
Analytical Data - Sediment
Analytical Data - Groundwater

Analytical Data - Surface Soil

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DATE:	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97
LOCATION:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DEPTH:							
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	370 UJ	360 UJ	58 J	75 J	360 UJ	370 UJ	350 UJ
ACENAPHTHYLENE	370 UJ	360 UJ	360 UJ	360 UJ	360 UJ	370 UJ	350 UJ
ANTHRACENE	370 UJ	360 UJ	96 J	120 J	360 UJ	370 UJ	350 UJ
BENZO(A)ANTHRACENE	44 J	360 UJ	310 J	370 J	360 UJ	370 UJ	350 UJ
BENZO(A)PYRENE	44 J	360 UJ	260 J	270 J	360 UJ	370 UJ	350 UJ
BENZO(B)FLUORANTHENE	53 J	360 UJ	290 J	260 J	360 UJ	370 UJ	350 UJ
BENZO(G,H,I)PERYLENE	48 J	360 UJ	220 J	220 J	360 UJ	370 UJ	350 UJ
BENZO(K)FLUORANTHENE	51 J	360 UJ	310 J	360 J	360 UJ	370 UJ	350 UJ
CHRYSENE	67 J	360 UJ	390 J	410 J	360 UJ	370 UJ	350 UJ
DIBENZO(A,H)ANTHRACENE	370 UJ	360 UJ	92 J	98 J	360 UJ	370 UJ	350 UJ
FLUORANTHENE	94 J	360 UJ	750 J	850 J	46 J	370 UJ	350 UJ
FLUORENE	370 UJ	360 UJ	56 J	78 J	360 UJ	370 UJ	350 UJ
INDENO(1,2,3-CD)PYRENE	43 J	360 UJ	190 J	210 J	360 UJ	370 UJ	350 UJ
NAPHTHALENE	370 UJ	360 UJ	360 UJ	360 UJ	360 UJ	370 UJ	350 UJ
PHENANTHRENE	53 J	360 UJ	500 J	640 J	360 UJ	370 UJ	350 UJ
PYRENE	89 J	360 UJ	620 J	640 J	41 J	370 UJ	350 UJ
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	9.2 J	3.6 UJ	2.8 J	2.1 J	3.6 UJ	3.7 UJ	0.51 J
4,4'-DDE	81 J	0.59 J	8.8 J	7.8 J	0.33 J	3.7 UJ	0.69 J
4,4'-DDT	49 J	3.6 UJ	11 J	9.2 J	3.6 UJ	3.7 UJ	2.9 J
ALDRIN	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
ALPHA-BHC	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
ALPHA-CHLORDANE	2.6 J	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
AROCLOR-1016	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ
AROCLOR-1221	73 UJ	73 UJ	72 UJ	72 UJ	72 UJ	75 UJ	72 UJ
AROCLOR-1232	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ
AROCLOR-1242	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ
AROCLOR-1248	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DATE:	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97
LOCATION:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DEPTH:							
PESTICIDES/PCBs (µg/kg)							
AROCLOR-1254	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ
AROCLOR-1260	37 UJ	36 UJ	36 UJ	36 UJ	36 UJ	37 UJ	35 UJ
BETA-BHC	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
DELTA-BHC	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
DIELDRIN	8.8 J	0.43 J	2 J	1.9 J	1.3 J	3.7 UJ	3.5 UJ
ENDOSULFAN I	1.8 UJ	0.71 J	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
ENDOSULFAN II	3.7 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 UJ	3.5 UJ
ENDOSULFAN SULFATE	3.7 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 UJ	3.5 UJ
ENDRIN	3.7 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 UJ	3.5 UJ
ENDRIN ALDEHYDE	3.7 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 UJ	3.5 UJ
ENDRIN KETONE	3.7 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 UJ	3.5 UJ
GAMMA-BHC (LINDANE)	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
GAMMA-CHLORDANE	1.5 J	0.49 J	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
HEPTACHLOR	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.8 UJ	1.9 UJ	1.8 UJ
HEPTACHLOR EPOXIDE	2.4 J	1.8 UJ	2.2 J	2 J	1.8 UJ	1.9 UJ	1.8 UJ
METHOXYCHLOR	18 UJ	18 UJ	18 UJ	18 UJ	18 UJ	19 UJ	18 UJ
TOXAPHENE	180 UJ	180 UJ	180 UJ	180 UJ	180 UJ	190 UJ	180 UJ
METALS (mg/kg)							
ALUMINUM	8540	10400	7610	6530	9510	12300	9560
ANTIMONY	0.57 UL	0.56 UL	0.56 UL	0.56 UL	0.55 UL	0.58 UL	0.54 UL
ARSENIC	3.1	4.2	2.2	2.1	4.2	4.6	2.3
BARIUM	41.8	52.8	48.9	42.7	40.6	76.5	56.5
BERYLLIUM	0.06 B	0.19	0.02 B	0.02 B	0.16	0.05 B	0.04 B
CADMIUM	0.07 U	0.06 U	0.12 B	0.11 B	0.06 U	0.08 B	0.06 U
CALCIUM	92.6 B	169 B	383 K	299 K	260 B	1050 K	130 B
CHROMIUM	11.8	20.6	11.7	10.3	12.7	55.9	12.3
COBALT	7.1	13.8	3.5	2.8	3	6.3	3.6
COPPER	4.8	9.4	18.8	16.8	5.5	13.2	5

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DATE:	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97	10/07/97
LOCATION:	BG-04-SS	BG-05-SS	BG-06-SS	BG-101-SS	BG-07-SS	BG-10-SS	BG-12-SS
SAMPLE DEPTH:							
METALS (mg/kg)							
IRON	10600	16400	9620	8700	10300	15700	10900
LEAD	28.2	25.1	42.4	35.7	18.2	31.3	133
MAGNESIUM	649 K	922 K	366 K	308 K	773 K	1180 K	926 K
MANGANESE	242	304	73.9	55.4	150	490	97.4
MERCURY	0.07	0.06	0.21	0.18	0.04	0.11	0.06
NICKEL	4.9 K	8 K	6.5 K	5.4 K	6.4 K	28.6	7 K
POTASSIUM	314	541	357	295	358	859	376
SELENIUM	0.61 U	0.61 U	0.62 K	0.74 K	0.59 U	0.65 K	0.59 U
SILVER	0.17 U	0.17 U	1.3	0.99	0.17 U	0.18 U	0.17 U
SODIUM	43.6 U	43.3 U	77.3 B	58.3 B	42.3 U	64.9 B	41.9 U
THALLIUM	0.63 U	0.63 U	0.63 U	0.62 U	0.61 U	0.65 U	0.61 U
VANADIUM	26	23 U	30.5	26.6	22.4	28.1	18.5
ZINC	18.9	26.4	23.3	18.2	19.8	43.5	26.1
RADIONUCLIDES (PCI/G)							
BISMUTH-214	1.23	0.96	1.1	0.496	0.84	0.76	0.91
LEAD-214	1.37	0.88	1.42	0.91	0.86	0.92	0.76
RADIUM-226	0.1 U	6.38	-1.75 U	3.51	1.74	1.51 U	2.98
MISCELLANEOUS PARAMETERS ()							
PH	4.11	4.76	4.58	4.61	4.1	5.79	4.57

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102	/ /	/ /	/ /
SAMPLE DATE:	10/10/97	11/04/97	11/06/97	11/05/97			
LOCATION:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102			
SAMPLE DEPTH:							
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	360 U	400 UJ	390 UJ	400 UJ			
ACENAPHTHYLENE	360 U	400 UJ	390 UJ	400 UJ			
ANTHRACENE	360 U	400 UJ	390 UJ	400 UJ			
BENZO(A)ANTHRACENE	360 U	400 UJ	390 UJ	400 UJ			
BENZO(A)PYRENE	360 U	400 UJ	390 UJ	400 UJ			
BENZO(B)FLUORANTHENE	360 U	400 UJ	390 UJ	400 UJ			
BENZO(G,H,I)PERYLENE	360 U	400 UJ	390 UJ	400 UJ			
BENZO(K)FLUORANTHENE	360 U	400 UJ	390 UJ	400 UJ			
CHRYSENE	360 U	400 UJ	390 UJ	400 UJ			
DIBENZO(A,H)ANTHRACENE	360 U	400 UJ	390 UJ	400 UJ			
FLUORANTHENE	360 U	400 UJ	390 UJ	400 UJ			
FLUORENE	360 U	400 UJ	390 UJ	400 UJ			
INDENO(1,2,3-CD)PYRENE	360 U	400 UJ	390 UJ	400 UJ			
NAPHTHALENE	360 U	400 UJ	390 UJ	400 UJ			
PHENANTHRENE	360 U	400 UJ	390 UJ	400 UJ			
PYRENE	360 U	400 UJ	390 UJ	400 UJ			
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
4,4'-DDE	0.21 J	3.1 J	3.9 UJ	4 UJ			
4,4'-DDT	3.6 UJ	1.4 J	3.9 UJ	4 UJ			
ALDRIN	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
ALPHA-BHC	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
ALPHA-CHLORDANE	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
AROCLOR-1016	36 UJ	40 UJ	39 UJ	40 UJ			
AROCLOR-1221	73 UJ	79 UJ	78 UJ	79 UJ			
AROCLOR-1232	36 UJ	40 UJ	39 UJ	40 UJ			
AROCLOR-1242	36 UJ	40 UJ	39 UJ	40 UJ			
AROCLOR-1248	36 UJ	40 UJ	39 UJ	40 UJ			

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102	/ /	/ /	/ /
SAMPLE DATE:	10/10/97	11/04/97	11/06/97	11/05/97			
LOCATION:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102			
SAMPLE DEPTH:							
PESTICIDES/PCBs (µg/kg)							
AROCLOR-1254	36 UJ	40 UJ	39 UJ	40 UJ			
AROCLOR-1260	36 UJ	40 UJ	39 UJ	40 UJ			
BETA-BHC	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
DELTA-BHC	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
DIELDRIN	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
ENDOSULFAN I	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
ENDOSULFAN II	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
ENDOSULFAN SULFATE	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
ENDRIN	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
ENDRIN ALDEHYDE	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
ENDRIN KETONE	3.6 UJ	4 UJ	3.9 UJ	4 UJ			
GAMMA-BHC (LINDANE)	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
GAMMA-CHLORDANE	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
HEPTACHLOR	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
HEPTACHLOR EPOXIDE	1.8 UJ	2 UJ	1.9 UJ	2 UJ			
METHOXYCHLOR	18 UJ	20 UJ	19 UJ	20 UJ			
TOXAPHENE	180 UJ	200 UJ	190 UJ	200 UJ			
METALS (mg/kg)							
ALUMINUM	12200	16500	20900	5150			
ANTIMONY	0.57 UJ	0.66 UL	0.64 UL	0.66 UL			
ARSENIC	3.3 B	5.2 L	6.7	2.5 L			
BARIUM	73.9 J	42.6	49.2	19.9			
BERYLLIUM	0.08	0.02 U	0.02 UL	0.02 U			
CADMIUM	0.07 UJ	0.36 B	0.59 B	0.15 B			
CALCIUM	533 K	283 J	87.6 B	83.1 B			
CHROMIUM	15.6 K	19.2 K	27.3	8.4 K			
COBALT	6.5	7.3	3.7 K	0.79			
COPPER	6.9	11.9	11 J	3.4 B			

CTO 273 - WHITE OAK
BACKGROUND SURFACE SOIL DATA

SAMPLE NUMBER:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102			
SAMPLE DATE:	10/10/97	11/04/97	11/06/97	11/05/97	/ /	/ /	/ /
LOCATION:	BG-13-SS	BG-SS-09	BG-SS-100	BG-SS-102			
SAMPLE DEPTH:							
METALS (mg/kg)							
IRON	15800	19200	25500 J	6030			
LEAD	10.6 L	13 K	11.8 J	17.5 K			
MAGNESIUM	1360 J	1690 K	1150 K	323 K			
MANGANESE	196 J	176 L	72.3 J	20.2 L			
MERCURY	0.03	0.04	0.02 UL	0.05			
NICKEL	9.9 K	10.4	7.5 J	2.8			
POTASSIUM	596	998	1020 K	236			
SELENIUM	0.61 UJ	0.55 UL	0.73 B	0.54 UL			
SILVER	0.17 UL	0.21 U	0.21 U	0.21 U			
SODIUM	43.5 UJ	116 B	126 B	30.6 U			
THALLIUM	0.63 UL	0.55 U	0.53 U	0.54 U			
VANADIUM	24.4	31.9	42.8	14.4			
ZINC	31.8	30.7	26.2 J	7.8			
RADIONUCLIDES (PCI/G)							
BISMUTH-214	1.09	0.64	0.53	0.74			
LEAD-214	0.87	0.25	0.85	1.35			
RADIUM-226	2.36	0.34 U	1.77 U	3.85			
MISCELLANEOUS PARAMETERS ()							
PH	4.92	5.02	4.48	4.13			

Analytical Data - Subsurface Soil

BACKGROUND SAMPLES
DVSAP ANALYTICAL RESULTS
NSWC - WHITE OAK, MARYLAND

PARAMETER	BG-01-0506		BG-02-0506		BG-03-0506	
VOLATILES (ug/Kg)						
METHYLENE CHLORIDE	6.00	J	5.00	J	5.00	J
SEMIVOLATILES (ug/Kg)						
DI-n-BUTYLPHTHALATE	76.0	J	55.6	J	50.3	J
PCBs (ug/Kg)						
AROCLOR 1260	13.0	J	53.0		56.0	
METALS (mg/Kg)						
ALUMINUM	14,100		734		8,000	
ANTIMONY	0.409		0.420		0.394	
ARSENIC	2.55		0.690		ND	
BARIUM	32.9		4.77		20.6	
BERYLLIUM	0.671		0.467		2.37	
CADMIUM	ND		ND		ND	
CALCIUM	ND		ND		299	
CHROMIUM	15.1		7.89		3.90	
COBALT	3.96		2.27		15.3	
COPPER	7.83		4.34		8.11	
IRON	15,300		2,680		4,700	
LEAD	5.00		2.37		3.02	
MAGNESIUM	532		ND		763	
MANGANESE	14.1		2.15		209	
MERCURY	0.055		ND		ND	
NICKEL	5.70		ND		3.58	
POTASSIUM	348		31.1		954	
SELENIUM	ND		ND		ND	
SILVER	ND		ND		ND	
SODIUM	69.4		46.8		52.4	
VANADIUM	27.0		14.8		5.53	
ZINC	11.8		0.815		15.5	
MISC						
TOTAL CYANIDE (mg/Kg)	ND		ND		ND	
TOTAL KJELDAHL NITROGEN (mg/Kg)	84.6		ND		11.1	
pH	5.02		4.16		5.11	
PERCENT SOLIDS (%)	88.8		86.5		77.3	
EXPLOSIVES (ug/Kg)	NO POSITIVES REPORTED					

ND - Not Detected
J- Positive result is considered an esitmate

CTO 273 - WHITE OAK
BACKGROUND SUBSURFACE SOIL DATA

SAMPLE NUMBER:	BG-04-SB	BG-04-SB(6)	BG-05-SB	BG-05-SB(6)	BG-06-SB	BG-06-SB(6)	BG-07-SB(6)
SAMPLE DATE:	10/08/97	10/08/97	10/07/97	10/07/97	10/07/97	10/07/97	10/23/97
LOCATION:	BG-04-SB	BG-04-SB(6)	BG-05-SB	BG-05-SB(6)	BG-06-SB	BG-06-SB(6)	BG-07-SB(6)
SAMPLE DEPTH:							
METALS (mg/kg)							
ALUMINUM	21800		10600		5780		22000
ANTIMONY	0.58 UL		0.56 UL		0.56 UL		0.59 UL
ARSENIC	9.2 K		0.76 K		1.8 K		12.7 K
BARIUM	38.2		31.7		14.1		23.9
BERYLLIUM	0.07 B		0.04 B		0.02 U		0.02 UL
CADMIUM	0.07 U		0.06 U		0.06 U		0.36 B
CALCIUM	64.1 B		75.4 B		73.9 B		117 B
CHROMIUM	40.3		15.7		11.2		45.8 K
COBALT	6.2		10.5		5.7		1.5 B
COPPER	11		13.3		22.7		20.2 J
IRON	36000		25200		28800		30900
LEAD	14.4		8.6		11.3		9 K
MAGNESIUM	699 K		1690 K		103 K		506 K
MANGANESE	46.1		219		503		22
MERCURY	0.08		0.03		0.04		0.03
NICKEL	6 K		14 K		2.1 K		5 J
POTASSIUM	437		1780		191		546 K
SELENIUM	0.63 UL		0.6 UL		0.6 UL		1.7 J
SILVER	0.18 U		0.17 U		0.17 U		0.19 U
SODIUM	46.7 B		42.8 U		43.1 U		44.2 B
THALLIUM	0.65 UL		0.62 UL		0.62 UL		0.49 UJ
VANADIUM	70.9		24.6		31.9		54.8 K
ZINC	14.3		57.7		5.4 B		11.1 J
RADIONUCLIDES (PCI/G)							
BISMUTH-214		0.84		1.06		1.13	0.65
LEAD-214		0.74		0.82		1.35	0.91
RADIUM-226		-4.23 U		1.43 U		2.55	2.76

CTO 273 - WHITE OAK
BACKGROUND SUBSURFACE SOIL DATA

SAMPLE NUMBER:	BG-10-SB(6)	BG-12-SB(3)	BG-13-SB(6)	BG-SB-09(7)	BG-SB-100(7)	BG-SB-102(7)	
SAMPLE DATE:	10/23/97	10/10/97	10/23/97	11/04/97	11/07/97	11/05/97	/ /
LOCATION:	BG-10-SB(6)	BG-12-SB(3)	BG-13-SB(6)	BG-SB-09(7)	BG-SB-100(7)	BG-SB-102(7)	
SAMPLE DEPTH:							
METALS (mg/kg)							
ALUMINUM	40700	9900	22900			8100	
ANTIMONY	0.63 UL	0.54 UJ	0.74 B			0.59 UL	
ARSENIC	4.3 K	2.9 B	7.7 K			3.2 L	
BARIUM	61.7	46.8 J	27			10.5	
BERYLLIUM	0.73 J	0.04	0.02 UL			0.02 U	
CADMIUM	0.49 B	0.06 UJ	0.32 B			0.25 B	
CALCIUM	363 J	96.3 B	149 B			47.3 B	
CHROMIUM	41.1 K	15.8	29.4 K			18.3 K	
COBALT	16.6	4.5	1.6 B			0.65	
COPPER	40.5 J	5.5	14.7 J			9.1	
IRON	48600	12500	24500			12500	
LEAD	18.7 K	41 L	8.1 K			5 K	
MAGNESIUM	3710	799 J	470 K			161 K	
MANGANESE	288	74.8 J	25.6			10.7 L	
MERCURY	0.05	0.03	0.04			0.03	
NICKEL	26.7 J	8.2 K	4.9 J			2.7	
POTASSIUM	2930	403	369 K			230	
SELENIUM	0.91 J	0.93 J	1.4 J			3.1 J	
SILVER	0.2 U	0.17 UL	0.19 U			0.19 U	
SODIUM	190 B	41.6 UJ	91 B			40.5 B	
THALLIUM	0.52 UJ	0.6 UL	0.49 UJ			0.49 U	
VANADIUM	54.3 K	21.3	44.7 K			22.2	
ZINC	84.2 J	21.4	10.8 J			41.4	
RADIONUCLIDES (PCI/G)							
BISMUTH-214	1.47	0.33	0.84	0.3	0.55	0.27	
LEAD-214	1.52	0.68	0.64	0.49	0.61	0.26	
RADIUM-226	2.87	2.71	-2.78 U	0.28 U	1.98	2.54	

Analytical Data - Surface Water

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
COLLECTION DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
SEMIVOLATILES (µg/L)							
ACENAPHTHENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
ACENAPHTHYLENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
ANTHRACENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
BENZO(A)ANTHRACENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
BENZO(A)PYRENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
BENZO(B)FLUORANTHENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
BENZO(G,H,I)PERYLENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
BENZO(K)FLUORANTHENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
CHRYSENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
DIBENZO(A,H)ANTHRACENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
FLUORANTHENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
FLUORENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
INDENO(1,2,3-CD)PYRENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
NAPHTHALENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
PHENANTHRENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
PYRENE	11 U	11 U	10 U	10 U	11 U	10 U	11 U
PESTICIDES/PCBs (µg/L)							
4,4'-DDD	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
4,4'-DDE	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
4,4'-DDT	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ALDRIN	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
ALPHA-BHC	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
ALPHA-CHLORDANE	0.053 U	0.053 U	0.052 U	0.006 J	0.052 U	0.053 UJ	0.052 U
AROCLOR-1016	1.1 U	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 U
AROCLOR-1221	2.1 U	2.1 U	2.1 U	2.2 UJ	2.1 U	2.1 UJ	2.1 U
AROCLOR-1232	1.1 U	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 U
AROCLOR-1242	1.1 U	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 U
AROCLOR-1248	1.1 U	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 U

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
COLLECTION DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
PESTICIDES/PCBs (µg/L)							
AROCLOR-1254	1.1 U	1.1 U	1 U	1.1 UJ	1 U	1.1 UJ	1 U
AROCLOR-1260	1.1 U	1.1 U	0.14 J	1.1 UJ	1 U	1.1 UJ	1 U
BETA-BHC	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
DELTA-BHC	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
DIELDRIN	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ENDOSULFAN I	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
ENDOSULFAN II	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ENDOSULFAN SULFATE	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ENDRIN	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ENDRIN ALDEHYDE	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
ENDRIN KETONE	0.11 U	0.11 U	0.1 U	0.11 UJ	0.1 U	0.11 UJ	0.1 U
GAMMA-BHC (LINDANE)	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
GAMMA-CHLORDANE	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
HEPTACHLOR	0.053 U	0.053 U	0.052 U	0.056 UJ	0.052 U	0.053 UJ	0.052 U
HEPTACHLOR EPOXIDE	0.053 U	0.053 U	0.052 U	0.018 UR	0.052 U	0.053 UJ	0.052 U
METHOXYCHLOR	0.53 U	0.53 U	0.52 U	0.56 UJ	0.52 U	0.53 UJ	0.52 U
TOXAPHENE	5.3 U	5.3 U	5.2 U	5.6 UJ	5.2 U	5.3 UJ	5.2 U
METALS (µg/L)							
ALUMINUM	20 U	58.4 K	104 B	671	19 U	85 K	20 U
ANTIMONY	2.6 U	2.6 U	2.8 U	2.8 U	2.8 U	2.6 U	2.6 U
ARSENIC	3.3 U	3.3 U	3 U	3 U	3 U	3.3 U	3.3 U
BARIUM	25.6	51.2	71.5	32.5	37.8	25.2	25.1
BERYLLIUM	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
CADMIUM	0.3 U	0.3 U	0.3 U	0.56 B	0.3 U	0.3 U	0.3 U
CALCIUM	11000	13400	10700	5670 K	12800	10400	10700
CHROMIUM	0.5 U	0.5 U	0.5 U	2.2 B	0.75 B	0.5 U	0.5 U
COBALT	0.4 U	0.4 U	0.6 U	0.6 U	0.6 U	0.4 U	0.4 U
COPPER	8.8 B	2.1 B	2.9 B	11.6 B	28.4 J	3.4 B	7.3 B

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
COLLECTION DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SW-100	BG-SW-01	BG-SW-02	BG-SW-03	BG-SW-04	BG-SW-05	BG-SW-06
METALS (µg/L)							
IRON	36.6 B	679	77.2 B	966	52 B	214	27.6 B
LEAD	1 U	1.1 K	1.6 B	29.3	3.7 B	1 K	1 U
MAGNESIUM	3730 J	6020 J	5790 K	2810 K	4560 K	3190 J	3660 J
MANGANESE	9.4 B	40.2	40.2	50.2	4.3 B	17.2 B	8.3 B
MERCURY	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NICKEL	1.6 K	1.7 K	6.3 B	2.8 B	2.6 B	1.3 K	1.1 U
POTASSIUM	2420	3000	3180	2560 K	3350 K	2790	2370
SELENIUM	2.8 U	2.8 U	2.3 U	2.3 U	2.3 U	2.8 U	2.8 U
SILVER	0.8 U	0.8 U	0.9 U	0.9 U	0.9 U	0.8 U	0.8 U
SODIUM	10700	23200	20700	7820 J	3030 B	10600	11200
THALLIUM	2.9 UL	2.9 UL	4.2 B	2.3 U	2.3 U	2.9 UL	2.9 UL
VANADIUM	1.1 U	1.1 U	1 U	1.5 B	1 U	1.1 U	1.1 U
ZINC	9.1 B	4.7 B	11.8 B	10.2 B	9.2 B	5.1 B	7.4 B
MISCELLANEOUS PARAMETERS ()							
PH	7.88	6.86		6.27	6.73	7.23	7.43

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BG-SW-07 10/10/97 BG-SW-07	BG-SW-08 10/15/97 BG-SW-08	BG-SW-09 11/11/97 BG-SW-09	BG-SW-10 10/14/97 BG-SW-10	BG-SW-11 10/14/97 BG-SW-11	BG-SW-101 10/14/97 BG-SW-101	BG-SW-12 10/16/97 BG-SW-12
SEMIVOLATILES (µg/L)							
ACENAPHTHENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
ACENAPHTHYLENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
ANTHRACENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
BENZO(A)ANTHRACENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
BENZO(A)PYRENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
BENZO(B)FLUORANTHENE	11 U	11 U	12 U	10 U	11 U	6 J	11 U
BENZO(G,H,I)PERYLENE	11 U	11 U	12 U	10 U	2 J	2 J	11 U
BENZO(K)FLUORANTHENE	11 U	11 U	12 U	10 U	11 U	2 J	11 U
CHRYSENE	11 U	11 U	12 U	10 U	3 J	2 J	11 U
DIBENZO(A,H)ANTHRACENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
FLUORANTHENE	11 U	11 U	12 U	10 U	6 J	10 U	11 U
FLUORENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
INDENO(1,2,3-CD)PYRENE	11 U	11 U	12 U	10 U	2 J	2 J	11 U
NAPHTHALENE	11 U	11 U	12 U	10 U	11 U	10 U	11 U
PHENANTHRENE	11 U	11 U	12 U	10 U	2 J	1 J	11 U
PYRENE	11 U	11 U	12 U	10 U	3 J	2 J	11 U
PESTICIDES/PCBs (µg/L)							
4,4'-DDD	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.016 J
4,4'-DDE	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
4,4'-DDT	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ALDRIN	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
ALPHA-BHC	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
ALPHA-CHLORDANE	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
AROCLOR-1016	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U
AROCLOR-1221	2.1 U	2.2 U	2.1 U	2 U	2.1 U	2.2 U	2.1 U
AROCLOR-1232	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U
AROCLOR-1242	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U
AROCLOR-1248	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER:	BG-SW-07	BG-SW-08	BG-SW-09	BG-SW-10	BG-SW-11	BG-SW-101	BG-SW-12
COLLECTION DATE:	10/10/97	10/15/97	11/11/97	10/14/97	10/14/97	10/14/97	10/16/97
LOCATION:	BG-SW-07	BG-SW-08	BG-SW-09	BG-SW-10	BG-SW-11	BG-SW-101	BG-SW-12
PESTICIDES/PCBs (µg/L)							
AROCLOR-1254	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U
AROCLOR-1260	1 U	1.1 U	1.1 U	1 U	1 U	1.1 U	1.1 U
BETA-BHC	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
DELTA-BHC	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
DIELDRIN	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ENDOSULFAN I	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
ENDOSULFAN II	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ENDOSULFAN SULFATE	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ENDRIN	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ENDRIN ALDEHYDE	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
ENDRIN KETONE	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
GAMMA-BHC (LINDANE)	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
GAMMA-CHLORDANE	0.052 U	0.055 U	0.053 U	0.05 U	0.052 U	0.055 U	0.053 U
HEPTACHLOR	0.052 U	0.055 U	0.088 R	0.05 U	0.052 U	0.055 U	0.053 U
HEPTACHLOR EPOXIDE	0.052 U	0.055 U	0.011 R	0.008 J	0.052 U	0.055 U	0.012 J
METHOXYCHLOR	0.52 U	0.55 U	0.53 U	0.5 U	0.52 U	0.55 U	0.53 U
TOXAPHENE	5.2 U	5.5 U	5.3 U	5 U	5.2 U	5.5 U	5.3 U
METALS (µg/L)							
ALUMINUM	20 U	93.8 K	21.4 B	35 K	2270	772	156 B
ANTIMONY	2.6 U	2.6 U	2.8 U	2.6 U	4.1	3	2.6 U
ARSENIC	3.3 U	3.3 U	3 UL	3.3 U	14.7 B	11.4 B	3.3 U
BARIUM	50	42.5	43.4 B	41.2	135	81.9	54.1 J
BERYLLIUM	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
CADMIUM	0.3 U	0.3 U	0.3 U	0.3 U	4.4	2.3	0.3 U
CALCIUM	39300	24600	18100	12900	51600	49400	22500
CHROMIUM	0.5 U	0.5 U	0.5 U	0.5 U	24.1	11.1 K	0.5 U
COBALT	0.51 B	1.7 B	0.6 U	0.4 U	6.4	5.5	0.4 U
COPPER	5.2 B	2.3 B	6.5 B	2.7 B	98.8	45	16.6 K

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BG-SW-07 10/10/97 BG-SW-07	BG-SW-08 10/15/97 BG-SW-08	BG-SW-09 11/11/97 BG-SW-09	BG-SW-10 10/14/97 BG-SW-10	BG-SW-11 10/14/97 BG-SW-11	BG-SW-101 10/14/97 BG-SW-101	BG-SW-12 10/16/97 BG-SW-12
METALS (µg/L)							
IRON	64.3 B	916	51.8 B	58.9 B	7230	5110	10 U
LEAD	1 U	2 K	1 U	1 U	35.4	14.4	1 U
MAGNESIUM	14500	9890 J	5000 K	7210 J	13900	12200	10200
MANGANESE	21.5	318	7.5 B	9.2 B	507	617	6 K
MERCURY	0.1 U	0.1	0.1 U	0.1 U	0.69	0.31	0.1 U
NICKEL	2.4 K	8.5 K	1.6 B	8.9 K	52.3 K	33.8 K	5.5 K
POTASSIUM	7920	4510	1910 K	2470	8480	8300	3160 K
SELENIUM	2.8 U	2.8 U	2.3 U	2.8 U	2.8 U	2.8 U	2.8 UJ
SILVER	0.92 B	0.8 U	0.9 U	0.8 U	0.8 U	0.8 U	0.8 U
SODIUM	22800	18700	13700	13800	14400	14300	11500
THALLIUM	2.9 UL	2.9 UL	2.3 U	2.9 UL	2.9 UL	2.9 UL	2.9 UL
VANADIUM	1.1 U	1.1 U	1 U	1.1 U	10.7	6.3	1.1 U
ZINC	3.8 B	12.8 B	12.6 B	9 B	1070	549	36.6 K
MISCELLANEOUS PARAMETERS ()							
PH	7.51	7.17		7.32	6.84	6.8	6.98

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BG-SW-13 10/16/97 BG-SW-13	BG-SW-14 10/16/97 BG-SW-14	BG-SW-15 10/16/97 BG-SW-15	BG-SW-16 10/17/97 BG-SW-16	/ /	/ /	/ /
SEMIVOLATILES (µg/L)							
ACENAPHTHENE	11 U	11 U	12 U	11 U			
ACENAPHTHYLENE	11 U	11 U	12 U	11 U			
ANTHRACENE	11 U	11 U	12 U	11 U			
BENZO(A)ANTHRACENE	11 U	11 U	12 U	11 U			
BENZO(A)PYRENE	11 U	11 U	12 U	11 U			
BENZO(B)FLUORANTHENE	11 U	11 U	12 U	11 U			
BENZO(G,H,I)PERYLENE	11 U	11 U	12 U	11 U			
BENZO(K)FLUORANTHENE	11 U	11 U	12 U	11 U			
CHRYSENE	11 U	11 U	12 U	11 U			
DIBENZO(A,H)ANTHRACENE	11 U	11 U	12 U	11 U			
FLUORANTHENE	11 U	11 U	12 U	11 U			
FLUORENE	11 U	11 U	12 U	11 U			
INDENO(1,2,3-CD)PYRENE	11 U	11 U	12 U	11 U			
NAPHTHALENE	11 U	11 U	12 U	11 U			
PHENANTHRENE	11 U	11 U	12 U	11 U			
PYRENE	11 U	11 U	12 U	11 U			
PESTICIDES/PCBs (µg/L)							
4,4'-DDD	0.1 U	0.11 U	0.12 U	0.11 U			
4,4'-DDE	0.1 U	0.11 U	0.12 U	0.11 U			
4,4'-DDT	0.1 U	0.11 U	0.12 U	0.11 U			
ALDRIN	0.052 U	0.053 U	0.062 U	0.053 U			
ALPHA-BHC	0.052 U	0.053 U	0.062 U	0.053 U			
ALPHA-CHLORDANE	0.052 U	0.053 U	0.062 U	0.053 U			
AROCLOR-1016	1 U	1.1 U	1.2 U	1.1 U			
AROCLOR-1221	2.1 U	2.1 U	2.5 U	2.1 U			
AROCLOR-1232	1 U	1.1 U	1.2 U	1.1 U			
AROCLOR-1242	1 U	1.1 U	1.2 U	1.1 U			
AROCLOR-1248	1 U	1.1 U	1.2 U	1.1 U			

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BG-SW-13 10/16/97 BG-SW-13	BG-SW-14 10/16/97 BG-SW-14	BG-SW-15 10/16/97 BG-SW-15	BG-SW-16 10/17/97 BG-SW-16	/ /	/ /	/ /
PESTICIDES/PCBs (µg/L)							
AROCLOR-1254	1 U	1.1 U	1.2 U	1.1 U			
AROCLOR-1260	1 U	1.1 U	1.2 U	1.1 U			
BETA-BHC	0.052 U	0.053 U	0.062 U	0.053 U			
DELTA-BHC	0.052 U	0.053 U	0.062 U	0.053 U			
DIELDRIN	0.1 U	0.11 U	0.12 U	0.01 J			
ENDOSULFAN I	0.052 U	0.053 U	0.062 U	0.053 U			
ENDOSULFAN II	0.1 U	0.11 U	0.12 U	0.11 U			
ENDOSULFAN SULFATE	0.1 U	0.11 U	0.12 U	0.11 U			
ENDRIN	0.1 U	0.11 U	0.12 U	0.11 U			
ENDRIN ALDEHYDE	0.1 U	0.11 U	0.12 U	0.11 U			
ENDRIN KETONE	0.1 U	0.11 U	0.12 U	0.11 U			
GAMMA-BHC (LINDANE)	0.052 U	0.053 U	0.062 U	0.053 U			
GAMMA-CHLORDANE	0.052 U	0.053 U	0.062 U	0.053 U			
HEPTACHLOR	0.052 U	0.053 U	0.062 U	0.053 U			
HEPTACHLOR EPOXIDE	0.052 U	0.053 U	0.062 U	0.018 J			
METHOXYCHLOR	0.52 U	0.53 U	0.62 U	0.53 U			
TOXAPHENE	5.2 U	5.3 U	6.2 U	5.3 U			
METALS (µg/L)							
ALUMINUM	62.6 B	80.8 B	26.4 B	20 U			
ANTIMONY	2.6 U	2.6 U	2.6 U	2.6 U			
ARSENIC	3.3 U	3.3 U	3.3 U	3.3 U			
BARIUM	22 J	22.8 J	28.4 J	41.5 J			
BERYLLIUM	0.1 U	0.1 U	0.1 U	0.1 U			
CADMIUM	0.3 U	0.3 U	0.3 U	0.3 U			
CALCIUM	7840 K	10500	6720 K	7670 K			
CHROMIUM	0.5 U	1.9 B	0.5 U	0.5 U			
COBALT	0.42 B	0.6 B	0.4 U	0.4 U			
COPPER	2.7 B	2.5 B	12.6 K	12.4 K			

CTO 273 - WHITE OAK
BACKGROUND SURFACE WATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BG-SW-13 10/16/97 BG-SW-13	BG-SW-14 10/16/97 BG-SW-14	BG-SW-15 10/16/97 BG-SW-15	BG-SW-16 10/17/97 BG-SW-16	/ /	/ /	/ /
METALS (µg/L)							
IRON	444	1220	121 K	46.4 B			
LEAD	1.2 K	1 U	1 U	1 U			
MAGNESIUM	1890 K	2070 K	3010 K	3110 K			
MANGANESE	60.6	591	20.5 K	8.5 K			
MERCURY	0.1 U	0.1 U	0.1 U	0.1 U			
NICKEL	1.1 U	30 K	4.7 K	1.1 K			
POTASSIUM	2880 K	2120 K	2190 K	1900 K			
SELENIUM	2.8 UJ	2.8 UJ	2.8 UJ	2.8 UJ			
SILVER	0.8 U	0.8 U	0.8 U	0.8 U			
SODIUM	4430 J	3920 J	6260 J	20800			
THALLIUM	2.9 UL	2.9 UL	2.9 UL	2.9 UL			
VANADIUM	1.1 U	1.1 U	1.1 U	1.1 U			
ZINC	4.5 K	4.3 K	3.8 K	5.2 K			
MISCELLANEOUS PARAMETERS ()							
PH	6.99	6.59	6.76	6.67			

Analytical Data - Sediment

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DEPTH:							
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	430 U	450 U	480 UJ	470 UJ	470 UJ	450 UJ	430 U
ACENAPHTHYLENE	430 U	450 U	480 UJ	470 UJ	470 UJ	450 UJ	430 U
ANTHRACENE	430 U	450 U	77 J	470 UJ	470 UJ	450 UJ	430 U
BENZO(A)ANTHRACENE	430 U	450 U	220 J	470 UJ	470 UJ	90 UJ	80 J
BENZO(A)PYRENE	430 U	450 U	180 J	470 UJ	470 UJ	100 UJ	87 J
BENZO(B)FLUORANTHENE	430 U	450 U	210 J	470 UJ	470 UJ	150 UJ	140 J
BENZO(G,H,I)PERYLENE	430 U	450 U	120 J	470 UJ	470 UJ	450 UJ	76 J
BENZO(K)FLUORANTHENE	430 U	450 U	150 J	470 UJ	470 UJ	55 UJ	91 J
CHRYSENE	430 U	450 U	210 J	470 UJ	470 UJ	110 UJ	110 J
DIBENZO(A,H)ANTHRACENE	430 U	450 U	480 UJ	470 UJ	470 UJ	450 UJ	430 U
FLUORANTHENE	68 J	450 U	490 J	470 UJ	470 UJ	250 UJ	240 J
FLUORENE	430 U	450 U	480 UJ	470 UJ	470 UJ	450 UJ	430 U
INDENO(1,2,3-CD)PYRENE	430 U	450 U	110 J	470 UJ	470 UJ	450 UJ	71 J
NAPHTHALENE	430 U	450 U	480 UJ	470 UJ	470 UJ	450 UJ	430 U
PHENANTHRENE	430 U	450 U	320 J	470 UJ	470 UJ	120 UJ	150 J
PYRENE	53 J	450 U	310 J	470 UJ	470 UJ	220 UJ	180 J
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
4,4'-DDE	4.3 UJ	4.5 U	4.7 UJ	0.18 J	4.7 UJ	4.5 UJ	3.6 UJ
4,4'-DDT	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ALDRIN	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
ALPHA-BHC	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
ALPHA-CHLORDANE	0.3 J	2.2 U	2.4 UJ	1.1 J	2.4 UJ	2.3 UJ	0.23 J
AROCLOR-1016	43 UJ	45 U	47 UJ	36 UJ	47 UJ	45 UJ	36 UJ
AROCLOR-1221	85 UJ	90 U	95 UJ	71 UJ	94 UJ	90 UJ	72 UJ
AROCLOR-1232	43 UJ	45 U	47 UJ	36 UJ	47 UJ	45 UJ	36 UJ
AROCLOR-1242	43 UJ	45 U	47 UJ	36 UJ	47 UJ	45 UJ	36 UJ
AROCLOR-1248	43 UJ	45 U	47 UJ	36 UJ	47 UJ	45 UJ	36 UJ

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DEPTH:							
PESTICIDES/PCBs (µg/kg)							
AROCLOR-1254	43 UJ	45 U	47 UJ	36 UJ	47 UJ	45 UJ	36 UJ
AROCLOR-1260	6 J	45 U	3000 J	36 UJ	97 J	45 UJ	7.7 J
BETA-BHC	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
DELTA-BHC	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
DIELDRIN	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ENDOSULFAN I	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
ENDOSULFAN II	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ENDOSULFAN SULFATE	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ENDRIN	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ENDRIN ALDEHYDE	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
ENDRIN KETONE	4.3 UJ	4.5 U	4.7 UJ	3.6 UJ	4.7 UJ	4.5 UJ	3.6 UJ
GAMMA-BHC (LINDANE)	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
GAMMA-CHLORDANE	0.3 J	2.2 U	2.4 UJ	0.64 J	2.4 UJ	2.3 UJ	0.21 J
HEPTACHLOR	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
HEPTACHLOR EPOXIDE	2.1 UJ	2.2 U	2.4 UJ	1.8 UJ	2.4 UJ	2.3 UJ	1.8 UJ
METHOXYCHLOR	21 UJ	22 U	24 UJ	18 UJ	24 UJ	23 UJ	18 UJ
TOXAPHENE	210 UJ	220 U	240 UJ	180 UJ	240 UJ	230 UJ	180 UJ
METALS (mg/kg)							
ALUMINUM	1340	4260	3690	3990	5210	2190	1890
ANTIMONY	0.66 UJ	0.69 UJ	0.79 UL	0.77 U	0.79 U	0.7 UJ	0.67 UJ
ARSENIC	0.84 UJ	1.5 B	0.85 U	0.82 U	0.85 U	0.89 UJ	0.85 UJ
BARIUM	8.8 J	29.6 J	23.2	21.2	34.4	14.4 J	11.6 J
BERYLLIUM	0.03	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.04
CADMIUM	0.1 B	0.18 B	0.38 B	0.24 B	0.45 B	0.14 B	0.08 UJ
CALCIUM	122 B	365 K	266 B	210 B	397 K	222 K	153 B
CHROMIUM	4.7	26.4	16.8 J	7 K	10.9 K	8	8.3
COBALT	1.8	5.7	4.4	3.7	5.1	2.9	2.2
COPPER	3 B	7	8 J	8.2 J	12.6 J	4.6	4.8

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DATE:	10/10/97	10/14/97	10/28/97	10/27/97	10/27/97	10/15/97	10/10/97
LOCATION:	BG-SD-100	BG-SD-01	BG-SD-02	BG-SD-03	BG-SD-04	BG-SD-05	BG-SD-06
SAMPLE DEPTH:							
METALS (mg/kg)							
IRON	5950	12500	8640	8220	12100	9550	6060
LEAD	2.7 L	8.3 L	6.4 J	16.3 K	7.1 K	4.4 L	3.5 L
MAGNESIUM	466 J	3040 J	1940 J	1040 K	1760 K	783 J	620 J
MANGANESE	81.9 J	270 J	203 J	178	292	134 J	119 J
MERCURY	0.02 U	0.02 U	0.1	0.02 U	0.04	0.02 U	0.02 U
NICKEL	3.6 K	40.4	17	6.9 K	11.6 K	5.6 K	5.6 K
POTASSIUM	281	1030	705 J	852 K	1240 K	502	384
SELENIUM	0.71 UJ	0.74 UJ	0.85 K	0.63 U	0.65 U	0.76 UJ	0.72 UJ
SILVER	0.2 UL	0.21 UL	0.25 U	0.25 U	1.3 B	0.22 UL	0.21 UL
SODIUM	50.7 UJ	73 B	91.9 B	55.7 B	79.5 B	54.1 UJ	51.5 UJ
THALLIUM	0.74 UL	0.77 UL	0.65 U	0.63 U	0.65 U	0.78 UL	0.75 UL
VANADIUM	5.8	11	8	8.2	11.3	11.2	6.2
ZINC	12.3	39.6	32.7 J	24.8 K	49.6 K	16.5	15.2
MISCELLANEOUS PARAMETERS ()							
PH	7.26	7.35		6.31	6.38	6.89	7.19
TOTAL ORGANIC CARBON (mg/Kg)	550	2030	7530	2740	1510	1490	1290

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DATE:	10/10/97	10/15/97	11/03/97	10/14/97	10/14/97	10/14/97	10/16/97
LOCATION:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DEPTH:							
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	400 U	370 UJ	450 UJ	410 U	680 J	630 J	470 UJ
ACENAPHTHYLENE	400 U	370 UJ	450 UJ	410 U	4400 U	4200 U	470 UJ
ANTHRACENE	400 U	370 UJ	450 UJ	120 J	3000 J	3100 J	470 UJ
BENZO(A)ANTHRACENE	400 U	370 UJ	450 UJ	710	20000	24000	470 UJ
BENZO(A)PYRENE	400 U	370 UJ	450 UJ	750	23000	26000	470 UJ
BENZO(B)FLUORANTHENE	400 U	370 UJ	450 UJ	1300	28000	38000	470 UJ
BENZO(G,H,I)PERYLENE	400 U	370 UJ	450 UJ	650	19000	22000	470 UJ
BENZO(K)FLUORANTHENE	400 U	370 UJ	450 UJ	640	15000	19000	470 UJ
CHRYSENE	400 U	370 UJ	450 UJ	1000	26000	31000	470 UJ
DIBENZO(A,H)ANTHRACENE	400 U	370 UJ	450 UJ	230 J	6500	7400	470 UJ
FLUORANTHENE	400 U	370 UJ	82 J	2100	53000	57000	470 UJ
FLUORENE	400 U	370 UJ	450 UJ	47 J	1200 J	1200 J	470 UJ
INDENO(1,2,3-CD)PYRENE	400 U	370 UJ	450 UJ	580	18000	19000	470 UJ
NAPHTHALENE	400 U	370 UJ	450 UJ	410 U	4400 U	4200 U	470 UJ
PHENANTHRENE	40 J	370 UJ	50 J	880	21000	21000	470 UJ
PYRENE	58 J	370 UJ	72 J	1600	33000	45000	470 UJ
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	3.9 UJ	0.32 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
4,4'-DDE	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
4,4'-DDT	3.9 UJ	0.27 UJ	4.5 UJ	4.1 U	4.4 UJ	8.7 J	4.7 UR
ALDRIN	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
ALPHA-BHC	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
ALPHA-CHLORDANE	2 UJ	1.1 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
AROCLOR-1016	39 UJ	37 UJ	45 UJ	41 U	44 UJ	42 UJ	47 UR
AROCLOR-1221	79 UJ	75 UJ	90 UJ	82 U	87 UJ	85 UJ	94 UR
AROCLOR-1232	39 UJ	37 UJ	45 UJ	41 U	44 UJ	42 UJ	47 UR
AROCLOR-1242	39 UJ	37 UJ	45 UJ	41 U	44 UJ	42 UJ	47 UR
AROCLOR-1248	39 UJ	37 UJ	45 UJ	41 U	44 UJ	42 UJ	47 UR

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DATE:	10/10/97	10/15/97	11/03/97	10/14/97	10/14/97	10/14/97	10/16/97
LOCATION:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DEPTH:							
PESTICIDES/PCBs (µg/kg)							
AROCLOR-1254	44	37 UJ	55 J	41 U	44 UJ	42 UJ	47 UR
AROCLOR-1260	39 UJ	37 UJ	45 UJ	41 U	44 UJ	42 UJ	47 UR
BETA-BHC	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
DELTA-BHC	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
DIELDRIN	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
ENDOSULFAN I	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
ENDOSULFAN II	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	46 R	26 R	4.7 UR
ENDOSULFAN SULFATE	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
ENDRIN	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
ENDRIN ALDEHYDE	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
ENDRIN KETONE	3.9 UJ	3.7 UJ	4.5 UJ	4.1 U	4.4 UJ	4.2 UJ	4.7 UR
GAMMA-BHC (LINDANE)	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
GAMMA-CHLORDANE	2 UJ	0.96 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
HEPTACHLOR	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
HEPTACHLOR EPOXIDE	2 UJ	1.9 UJ	2.3 UJ	2.1 U	2.2 UJ	2.1 UJ	2.3 UR
METHOXYCHLOR	20 UJ	19 UJ	23 UJ	21 U	22 UJ	21 UJ	23 UR
TOXAPHENE	200 UJ	190 UJ	230 UJ	210 U	220 UJ	210 UJ	230 UR
METALS (mg/kg)							
ALUMINUM	918	1580	3750	738	4100	2410	5130
ANTIMONY	0.62 UJ	0.56 UJ	0.76 UL	0.62 UJ	0.67 UJ	0.66 UJ	0.73 UL
ARSENIC	0.78 UJ	1.7 B	0.82 L	0.79 UJ	7.4 J	3.4 B	1.2 B
BARIUM	6.3 J	9.6 J	25.7	9 J	11.9 J	12.7 J	35.4
BERYLLIUM	0.02 U	0.02 U	0.03 U	0.02 U	0.03 U	0.05	0.03 U
CADMIUM	0.09 B	0.1 B	0.27 B	0.16 B	0.62 J	0.62 J	0.08 U
CALCIUM	168 B	225 K	529 J	337 K	30800	34600	574 K
CHROMIUM	3.3 K	6.7	10.8 K	2.3 K	116	80	7.7 J
COBALT	0.63 B	6.2	5.9	1.3	21.7	16.1	5.1
COPPER	4.2	3.2 B	9.8	3.6 B	64.7	58.9	11.4 B

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DATE:	10/10/97	10/15/97	11/03/97	10/14/97	10/14/97	10/14/97	10/16/97
LOCATION:	BG-SD-07	BG-SD-08	BG-SD-09	BG-SD-10	BG-SD-11	BG-SD-101	BG-SD-12
SAMPLE DEPTH:							
METALS (mg/kg)							
IRON	3850	6320	7460	2830	11900	10600	11300
LEAD	2.2 L	2.9 L	10.8 K	3.5 L	8.9 L	18.5 L	10 L
MAGNESIUM	245 J	346 J	1910 K	392 J	35100 J	30700 J	1860 K
MANGANESE	51.8 J	428 J	199 L	95.9 J	174 J	209 J	205 J
MERCURY	0.02	0.02	0.33	0.02 U	0.08	0.07	0.02 UR
NICKEL	2.4 K	3.3 K	14.7	8.6 K	376	281	13.5 K
POTASSIUM	189	225	844	219	949	242	1360 K
SELENIUM	0.66 UJ	0.6 UJ	0.62 UL	0.67 UJ	0.72 UJ	0.71 UJ	0.79 UJ
SILVER	0.19 UL	0.17 UL	0.24 U	0.19 UL	0.21 UL	2.8 L	0.23 U
SODIUM	47.4 UJ	43.1 UJ	123 B	47.9 UJ	82.2 B	101 B	64.6 J
THALLIUM	0.69 UL	0.62 UL	0.62 U	0.69 UL	0.74 UL	0.74 UL	0.82 UL
VANADIUM	8.1	5.8	9.9	4.2	16.4	7.7	12.5 J
ZINC	7.1	13.1	40.2	14.6	238	235	60.8 J
MISCELLANEOUS PARAMETERS ()							
PH	7.12	7.28	7.28	7.16	7.96	7.8	7.26
TOTAL ORGANIC CARBON (mg/Kg)	481	1230	2600	424	3800	3410	3070

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16	/ /	/ /	/ /
SAMPLE DATE:	10/16/97	10/16/97	10/16/97	10/17/97			
LOCATION:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16			
SAMPLE DEPTH:							
SEMIVOLATILES (µg/kg)							
ACENAPHTHENE	470 UJ	430 UJ	460 UJ	510 UJ			
ACENAPHTHYLENE	470 UJ	430 UJ	460 UJ	510 UJ			
ANTHRACENE	470 UJ	430 UJ	460 UJ	510 UJ			
BENZO(A)ANTHRACENE	470 UJ	430 UJ	460 UJ	230 UJ			
BENZO(A)PYRENE	470 UJ	430 UJ	460 UJ	210 UJ			
BENZO(B)FLUORANTHENE	470 UJ	430 UJ	460 UJ	200 UJ			
BENZO(G,H,I)PERYLENE	470 UJ	430 UJ	460 UJ	240 UJ			
BENZO(K)FLUORANTHENE	470 UJ	430 UJ	460 UJ	250 UJ			
CHRYSENE	470 UJ	430 UJ	460 UJ	250 UJ			
DIBENZO(A,H)ANTHRACENE	470 UJ	430 UJ	460 UJ	510 UJ			
FLUORANTHENE	470 UJ	430 UJ	460 UJ	390 UJ			
FLUORENE	470 UJ	430 UJ	460 UJ	510 UJ			
INDENO(1,2,3-CD)PYRENE	470 UJ	430 UJ	460 UJ	200 UJ			
NAPHTHALENE	470 UJ	430 UJ	460 UJ	510 UJ			
PHENANTHRENE	470 UJ	430 UJ	460 UJ	150 UJ			
PYRENE	470 UJ	44 UJ	460 UJ	430 UJ			
PESTICIDES/PCBs (µg/kg)							
4,4'-DDD	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
4,4'-DDE	0.93 J	4.3 UJ	0.23 J	5 UJ			
4,4'-DDT	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
ALDRIN	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
ALPHA-BHC	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
ALPHA-CHLORDANE	0.7 J	2.1 UJ	0.23 J	3.4 J			
AROCLOR-1016	47 UJ	43 UJ	47 UJ	50 UJ			
AROCLOR-1221	93 UJ	86 UJ	93 UJ	100 UJ			
AROCLOR-1232	47 UJ	43 UJ	47 UJ	50 UJ			
AROCLOR-1242	47 UJ	43 UJ	47 UJ	50 UJ			
AROCLOR-1248	47 UJ	43 UJ	47 UJ	50 UJ			

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16	/ /	/ /	/ /
SAMPLE DATE:	10/16/97	10/16/97	10/16/97	10/17/97			
LOCATION:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16			
SAMPLE DEPTH:							
PESTICIDES/PCBs (µg/kg)							
AROCLOR-1254	47 UJ	43 UJ	47 UJ	50 UJ			
AROCLOR-1260	47 UJ	43 UJ	47 UJ	50 UJ			
BETA-BHC	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
DELTA-BHC	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
DIELDRIN	4.7 UJ	4.3 UJ	0.15 J	2.4 J			
ENDOSULFAN I	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
ENDOSULFAN II	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
ENDOSULFAN SULFATE	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
ENDRIN	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
ENDRIN ALDEHYDE	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
ENDRIN KETONE	4.7 UJ	4.3 UJ	4.7 UJ	5 UJ			
GAMMA-BHC (LINDANE)	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
GAMMA-CHLORDANE	0.6 J	2.1 UJ	0.25 J	3.4 J			
HEPTACHLOR	2.3 UJ	2.1 UJ	2.3 UJ	2.5 UJ			
HEPTACHLOR EPOXIDE	2.3 UJ	2.1 UJ	2.3 UJ	3.2 J			
METHOXYCHLOR	23 UJ	21 UJ	23 UJ	25 UJ			
TOXAPHENE	230 UJ	210 UJ	230 UJ	250 UJ			
METALS (mg/kg)							
ALUMINUM	5960	13200	5740	4230			
ANTIMONY	0.71 UL	0.65 UL	0.71 UL	0.76 UL			
ARSENIC	1.6 B	2.5 B	2.5 B	1.4 B			
BARIUM	36.6	89.9	39.4	29.8			
BERYLLIUM	0.03 U	0.69	0.21	0.92			
CADMIUM	0.08 U	0.07 U	0.08 U	0.09 U			
CALCIUM	1560 K	381 K	910 K	321 K			
CHROMIUM	13.1 J	14.4 J	23.7 J	25.3 J			
COBALT	5.1	11.7	6.1	11.6			
COPPER	10.8 B	33 J	10.4 B	14.8 B			

CTO 273 - WHITE OAK
BACKGROUND SEDIMENT DATA

SAMPLE NUMBER:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16			
SAMPLE DATE:	10/16/97	10/16/97	10/16/97	10/17/97	/ /	/ /	/ /
LOCATION:	BG-SD-13	BG-SD-14	BG-SD-15	BG-SD-16			
SAMPLE DEPTH:							
METALS (mg/kg)							
IRON	12600	21300	14000	17400			
LEAD	13.3 L	9 L	10.7 L	29.5 L			
MAGNESIUM	1040 K	3410	1220 K	1610 K			
MANGANESE	157 J	317 J	273 J	573 J			
MERCURY	0.03 L	0.02 UR	0.02 UR	0.31 L			
NICKEL	7.5 K	18.6	18.1	19.4			
POTASSIUM	838 K	2960	592 K	343 K			
SELENIUM	0.77 UJ	0.7 UJ	0.76 UJ	0.82 UJ			
SILVER	0.22 U	0.2 U	0.22 U	0.23 U			
SODIUM	97 J	101 J	73.6 J	88.8 J			
THALLIUM	0.8 UL	0.72 UL	0.79 UL	0.85 UL			
VANADIUM	17.4 J	20.5 J	15.5 J	12.7 J			
ZINC	46.5 J	72.5 J	30.2 J	45 J			
MISCELLANEOUS PARAMETERS ()							
PH	6.85	6.59	6.74	7.01			
TOTAL ORGANIC CARBON (mg/Kg)	14400	4360	2450	4940			

Analytical Data - Groundwater

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-BGW16 06/10/97 SITE 04	WO BGW40 06/11/97 SITE 11	/ /	/ /	/ /	/ /	/ /
VOLATILES (µg/L)							
1,1,1-TRICHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	1 U	1 U	NA	NA	NA	NA	NA
1,2 DICHLOROBENZENE	1 U	1 U	NA	NA	NA	NA	NA
1,2,4 TRICHLOROBENZENE	1 U	1 U	NA	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	NA	NA	NA	NA	NA
1,2-DIBROMOETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
1,2-DICHLOROPROPANE	1 U	1 U	NA	NA	NA	NA	NA
1,3 DICHLOROBENZENE	1 U	1 U	NA	NA	NA	NA	NA
1,4 DICHLOROBENZENE	1 U	1 U	NA	NA	NA	NA	NA
2-BUTANONE	5 UR	5 UR	NA	NA	NA	NA	NA
2-HEXANONE	5 U	5 U	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	5 U	5 U	NA	NA	NA	NA	NA
ACETONE	5 UR	5 UR	NA	NA	NA	NA	NA
BENZENE	1 U	1 U	NA	NA	NA	NA	NA
BROMOCHLOROMETHANE	1 U	1 U	NA	NA	NA	NA	NA
BROMODICHLOROMETHANE	1 U	1 U	NA	NA	NA	NA	NA
BROMOFORM	1 U	1 U	NA	NA	NA	NA	NA
BROMOMETHANE	1 U	1 U	NA	NA	NA	NA	NA
CARBON DISULFIDE	1 U	1 U	NA	NA	NA	NA	NA
CARBON TETRACHLORIDE	1 U	1 U	NA	NA	NA	NA	NA
CHLOROBENZENE	1 U	1 U	NA	NA	NA	NA	NA
CHLOROETHANE	1 U	1 U	NA	NA	NA	NA	NA
CHLOROFORM	6	1 U	NA	NA	NA	NA	NA
CHLOROMETHANE	1 U	1 U	NA	NA	NA	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-BGW16	WO-BGW40	/ /	/ /	/ /	/ /	/ /
COLLECTION DATE:	06/10/97	06/11/97					
LOCATION:	SITE 04	SITE 11					
FIELD DUPLICATE OF:							
VOLATILES (µg/L)							
CIS-1,2-DICHLOROETHENE	1 U	1 U	NA	NA	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	1 U	1 U	NA	NA	NA	NA	NA
DIBROMOCHLOROMETHANE	1 U	1 U	NA	NA	NA	NA	NA
ETHYLBENZENE	1 U	1 U	NA	NA	NA	NA	NA
METHYLENE CHLORIDE	2 U	2 U	NA	NA	NA	NA	NA
STYRENE	1 U	1 U	NA	NA	NA	NA	NA
TETRACHLOROETHENE	1 U	1 U	NA	NA	NA	NA	NA
TOLUENE	1 U	1 U	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	1 U	1 U	NA	NA	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	NA	NA	NA	NA	NA
TRICHLOROETHENE	1 U	1 U	NA	NA	NA	NA	NA
VINYL CHLORIDE	1 U	1 U	NA	NA	NA	NA	NA
XYLENES, TOTAL	1 U	1 U	NA	NA	NA	NA	NA
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	5 U	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	22 U	22 U	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	5 U	5 U	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	5 U	5 U	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	5 U	5 U	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	22 U	22 U	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	5 U	5 U	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	5 U	5 U	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	5 U	5 U	NA	NA	NA	NA	NA
2-CHLOROPHENOL	5 U	5 U	NA	NA	NA	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-BGW16	WO-BGW40	/ /	/ /	/ /	/ /	/ /
COLLECTION DATE:	06/10/97	06/11/97					
LOCATION:	SITE 04	SITE 11					
FIELD DUPLICATE OF:							
SEMIVOLATILES (µg/L)							
2-METHYLNAPHTHALENE	5 U	5 U	NA	NA	NA	NA	NA
2-METHYLPHENOL	5 U	5 U	NA	NA	NA	NA	NA
2-NITROANILINE	22 U	22 U	NA	NA	NA	NA	NA
2-NITROPHENOL	5 U	5 U	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	5 U	5 U	NA	NA	NA	NA	NA
3-NITROANILINE	22 U	22 U	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	22 U	22 U	NA	NA	NA	NA	NA
4-BROMOPHENYL PHENYL ETHER	5 U	5 U	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	5 U	5 U	NA	NA	NA	NA	NA
4-CHLOROANILINE	5 U	5 U	NA	NA	NA	NA	NA
4-CHLOROPHENYL PHENYL ETHER	5 U	5 U	NA	NA	NA	NA	NA
4-METHYLPHENOL	5 U	5 U	NA	NA	NA	NA	NA
4-NITROANILINE	22 U	22 U	NA	NA	NA	NA	NA
4-NITROPHENOL	22 U	22 U	NA	NA	NA	NA	NA
ACENAPHTHENE	5 U	5 U	NA	NA	NA	NA	NA
ACENAPHTHYLENE	5 U	5 U	NA	NA	NA	NA	NA
ANTHRACENE	5 U	5 U	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	5 U	5 U	NA	NA	NA	NA	NA
BENZO(A)PYRENE	5 U	5 U	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	5 U	5 U	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	5 U	5 U	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	5 U	5 U	NA	NA	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	5 U	5 U	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	5 U	5 U	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	5 U	2 J	NA	NA	NA	NA	NA
BUTYLBENZYL PHTHALATE	5 U	5 U	NA	NA	NA	NA	NA
CARBAZOLE	5 U	5 U	NA	NA	NA	NA	NA
CHRYSENE	5 U	5 U	NA	NA	NA	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO-BGW16 06/10/97 SITE 04	WO-BGW40 06/11/97 SITE 11	/ /	/ /	/ /	/ /	/ /
SEMIVOLATILES (µg/L)							
DI-N-BUTYL PHTHALATE	5 U	1 J	NA	NA	NA	NA	NA
DI-N-OCTYL PHTHALATE	5 U	5 U	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	5 U	5 U	NA	NA	NA	NA	NA
DIBENZOFURAN	5 U	5 U	NA	NA	NA	NA	NA
DIETHYL PHTHALATE	5 U	5 U	NA	NA	NA	NA	NA
DIMETHYL PHTHALATE	5 U	5 U	NA	NA	NA	NA	NA
FLUORANTHENE	5 U	5 U	NA	NA	NA	NA	NA
FLUORENE	5 U	5 U	NA	NA	NA	NA	NA
HEXACHLOROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	5 U	5 U	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	5 U	5 U	NA	NA	NA	NA	NA
HEXACHLOROETHANE	5 U	5 U	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	5 U	5 U	NA	NA	NA	NA	NA
ISOPHORONE	5 U	5 U	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	5 U	5 U	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE	5 U	5 U	NA	NA	NA	NA	NA
NAPHTHALENE	5 U	5 U	NA	NA	NA	NA	NA
NITROBENZENE	5 U	5 U	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	22 U	22 U	NA	NA	NA	NA	NA
PHENANTHRENE	5 U	5 U	NA	NA	NA	NA	NA
PHENOL	5 U	5 U	NA	NA	NA	NA	NA
PYRENE	5 U	5 U	NA	NA	NA	NA	NA
ENERGETICS (µg/L)							
1,3,5-TRINITROBENZENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
1,3-DINITROBENZENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
2,4 DINITROTOLUENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
2,4,6-TRINITROTOLUENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
2,6 DINITROTOLUENE	0.6 U	0.6 U	NA	NA	NA	NA	NA

CTO 273
NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND
UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION: FIELD DUPLICATE OF:	WO BGW16 06/10/97 SITE 04	WO BGW40 06/11/97 SITE 11	/ /	/ /	/ /	/ /	/ /
ENERGETICS (µg/L)							
2-AMINO-4,6-DINITROTOLUENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
2-NITROTOLUENE	1.3 U	1.3 U	NA	NA	NA	NA	NA
3-NITROTOLUENE	1.3 U	1.3 U	NA	NA	NA	NA	NA
4-AMINO-2,6-DINITROTOLUENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
4-NITROTOLUENE	1.3 U	1.3 U	NA	NA	NA	NA	NA
HMX	1.3 U	1.3 U	NA	NA	NA	NA	NA
NITRO-BENZENE	0.6 U	0.6 U	NA	NA	NA	NA	NA
RDX	1.3 U	1.3 U	NA	NA	NA	NA	NA
TETRYL	1.3 UJ	1.3 UJ	NA	NA	NA	NA	NA
METALS (µg/L)							
ALUMINUM	3430	280 K	NA	NA	NA	NA	NA
ANTIMONY	2 U	2 U	NA	NA	NA	NA	NA
ARSENIC	2.6 U	2.6 U	NA	NA	NA	NA	NA
BARIUM	40	32.2	NA	NA	NA	NA	NA
BERYLLIUM	0.3 U	0.46 U	NA	NA	NA	NA	NA
CADMIUM	0.2 U	0.2 U	NA	NA	NA	NA	NA
CALCIUM	4530 K	3460 K	NA	NA	NA	NA	NA
CHROMIUM	17.4	3.9	NA	NA	NA	NA	NA
COBALT	1.6 U	4.1	NA	NA	NA	NA	NA
COPPER	9.4	14.2	NA	NA	NA	NA	NA
CYANIDE	5 U	5 U	NA	NA	NA	NA	NA
IRON	2140 L	513 L	NA	NA	NA	NA	NA
LEAD	1.4 L	1.1 UL	NA	NA	NA	NA	NA
MAGNESIUM	5410 K	2370 K	NA	NA	NA	NA	NA
MANGANESE	23.8	48.6	NA	NA	NA	NA	NA
MERCURY	0.1 U	0.1 U	NA	NA	NA	NA	NA
NICKEL	13	10.4	NA	NA	NA	NA	NA
POTASSIUM	1530	411	NA	NA	NA	NA	NA

CTO 273

NSWC WHITE OAK, MD: SITE SCREENING PROCESS - BACKGROUND

UNFILTERED GROUNDWATER DATA

SAMPLE NUMBER:	WO-BGW16	WO-BGW40	/ /	/ /	/ /	/ /	/ /
COLLECTION DATE:	06/10/97	06/11/97					
LOCATION:	SITE 04	SITE 11					
FIELD DUPLICATE OF:							
METALS (µg/L)							
SELENIUM	2.4 K	1.6 U	NA	NA	NA	NA	NA
SILVER	0.5 U	0.5 U	NA	NA	NA	NA	NA
SODIUM	6910 L	7250 L	NA	NA	NA	NA	NA
THALLIUM	2.6 U	2.7 U	NA	NA	NA	NA	NA
VANADIUM	7.2	0.69	NA	NA	NA	NA	NA
ZINC	33.8	38.7	NA	NA	NA	NA	NA
RCRA CHARACTERISTICS (mg/L)							
REACTIVE SULFIDE	0.07 U	0.07 U	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (mg/L)							
NITRATE	0.8	4.59	NA	NA	NA	NA	NA
ORTHOPHOSPHATE	0.5 UL	0.5 UL	NA	NA	NA	NA	NA
SULFATE	18.1	0.49	NA	NA	NA	NA	NA

CTO 273 - WHITE OAK
BACKGROUND GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BGW-100 11/21/97 BGW-100	BGW-101 11/21/97 BGW-101	BGW-102 11/21/97 BGW-102	BGW-16 10/21/97 BGW-16	BGW-40 10/21/97 BGW-40	GW-100 10/21/97 GW-100	/ /
SEMIVOLATILES (µg/L)							
1,2,4-TRICHLOROBENZENE	11 U	11 U	11 U				
1,2-DICHLOROBENZENE	11 U	11 U	11 U				
1,3-DICHLOROBENZENE	11 U	11 U	11 U				
1,4-DICHLOROBENZENE	11 U	11 U	11 U				
2,2'-OXYBIS(1-CHLOROPROPANE)	11 UJ	11 UJ	11 UJ				
2,4,5-TRICHLOROPHENOL	28 U	28 U	28 U				
2,4,6-TRICHLOROPHENOL	11 U	11 U	11 U				
2,4-DICHLOROPHENOL	11 U	11 U	11 U				
2,4-DIMETHYLPHENOL	11 U	11 U	11 U				
2,4-DINITROPHENOL	28 U	28 U	28 U				
2,4-DINITROTOLUENE	11 U	11 U	11 U				
2,6-DINITROTOLUENE	11 U	11 U	11 U				
2-CHLORONAPHTHALENE	11 U	11 U	11 U				
2-CHLOROPHENOL	11 U	11 U	11 U				
2-METHYLNAPHTHALENE	11 U	11 U	11 U				
2-METHYLPHENOL	11 U	11 U	11 U				
2-NITROANILINE	28 U	28 U	28 U				
2-NITROPHENOL	11 U	11 U	11 U				
3,3'-DICHLOROBENZIDINE	11 U	11 U	11 U				
3-NITROANILINE	28 U	28 U	28 U				
4,6-DINITRO-2-METHYLPHENOL	28 U	28 U	28 U				
4-BROMOPHENYL PHENYL ETHER	11 U	11 U	11 U				
4-CHLORO-3-METHYLPHENOL	11 U	11 U	11 U				
4-CHLOROANILINE	11 U	11 U	11 U				
4-CHLOROPHENYL PHENYL ETHER	11 U	11 U	11 U				
4-METHYLPHENOL	11 U	11 U	11 U				
4-NITROANILINE	28 U	28 U	28 U				
4-NITROPHENOL	28 U	28 U	28 U				

CTO 273 - WHITE OAK
BACKGROUND GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BGW-100 11/21/97 BGW-100	BGW-101 11/21/97 BGW-101	BGW-102 11/21/97 BGW-102	BGW-16 10/21/97 BGW-16	BGW-40 10/21/97 BGW-40	GW-100 10/21/97 GW-100	/ /
SEMIVOLATILES (µg/L)							
ACENAPHTHENE	11 U	11 U	11 U	5 U	5 U	5 U	
ACENAPHTHYLENE	11 U	11 U	11 U	5 U	5 U	5 U	
ANTHRACENE	11 U	11 U	11 U	5 U	5 U	5 U	
BENZO(A)ANTHRACENE	11 U	11 U	11 U	5 U	5 U	5 U	
BENZO(A)PYRENE	11 U	11 U	11 U	5 U	5 U	5 U	
BENZO(B)FLUORANTHENE	11 U	11 U	11 U	5 U	5 U	5 U	
BENZO(G,H,I)PERYLENE	11 U	11 U	11 U	5 U	5 U	5 U	
BENZO(K)FLUORANTHENE	11 U	11 U	11 U	5 U	5 U	5 U	
BIS(2-CHLOROETHOXY)METHANE	11 U	11 U	11 U				
BIS(2-CHLOROETHYL)ETHER	11 U	11 U	11 U				
BIS(2-ETHYLHEXYL)PHTHALATE	11 U	11 U	1 B				
BUTYLBENZYL PHTHALATE	11 U	11 U	11 U				
CARBAZOLE	11 U	11 U	11 U				
CHRYSENE	11 U	11 U	11 U	5 U	5 U	5 U	
DI-N-BUTYL PHTHALATE	11 U	11 U	11 U				
DI-N-OCTYL PHTHALATE	11 U	11 U	11 U				
DIBENZO(A,H)ANTHRACENE	11 U	11 U	11 U	5 U	5 U	5 U	
DIBENZOFURAN	11 U	11 U	11 U				
DIETHYL PHTHALATE	11 U	2 J	11 U				
DIMETHYL PHTHALATE	11 U	11 U	11 U				
FLUORANTHENE	11 U	11 U	11 U	5 U	5 U	5 U	
FLUORENE	11 U	11 U	11 U	5 U	5 U	5 U	
HEXACHLOROBENZENE	11 U	11 U	11 U				
HEXACHLOROBUTADIENE	11 U	11 U	11 U				
HEXACHLOROCYCLOPENTADIENE	11 U	11 U	11 U				
HEXACHLOROETHANE	11 U	11 U	11 U				
INDENO(1,2,3-CD)PYRENE	11 U	11 U	11 U	5 U	5 U	5 U	
ISOPHORONE	11 U	11 U	11 U				

CTO 273 - WHITE OAK
BACKGROUND GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BGW-100 11/21/97 BGW-100	BGW-101 11/21/97 BGW-101	BGW-102 11/21/97 BGW-102	BGW-16 10/21/97 BGW-16	BGW-40 10/21/97 BGW-40	GW-100 10/21/97 GW-100	/ /
SEMIVOLATILES (µg/L)							
N-NITROSO-DI-N-PROPYLAMINE	11 U	11 U	11 U				
N-NITROSODIPHENYLAMINE	11 U	11 U	11 U				
NAPHTHALENE	11 U	11 U	11 U	5 U	5 U	5 U	
NITROBENZENE	11 U	11 U	11 U				
PENTACHLOROPHENOL	28 U	28 U	28 U				
PHENANTHRENE	11 U	11 U	11 U	5 U	5 U	5 U	
PHENOL	11 U	11 U	11 U				
PYRENE	11 U	11 U	11 U	5 U	5 U	5 U	
PESTICIDES/PCBs (µg/L)							
4,4'-DDD	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
4,4'-DDE	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
4,4'-DDT	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
ALDRIN	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
ALPHA-BHC	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
ALPHA-CHLORDANE	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
AROCLOR-1016	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
AROCLOR-1221	2.2 U	2.2 U	2.2 U	2.3 U	2.2 U	2.3 U	
AROCLOR-1232	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
AROCLOR-1242	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
AROCLOR-1248	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
AROCLOR-1254	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
AROCLOR-1260	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	
BETA-BHC	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
DELTA-BHC	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
DIELDRIN	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
ENDOSULFAN I	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
ENDOSULFAN II	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
ENDOSULFAN SULFATE	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	

CTO 273 - WHITE OAK
BACKGROUND GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BGW-100 11/21/97 BGW-100	BGW-101 11/21/97 BGW-101	BGW-102 11/21/97 BGW-102	BGW-16 10/21/97 BGW-16	BGW-40 10/21/97 BGW-40	GW-100 10/21/97 GW-100	/ /
PESTICIDES/PCBs (µg/L)							
ENDRIN	0.11 UJ	0.11 UJ	0.11 UJ	0.11 U	0.11 U	0.11 U	
ENDRIN ALDEHYDE	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
ENDRIN KETONE	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	
GAMMA-BHC (LINDANE)	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
GAMMA-CHLORDANE	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
HEPTACHLOR	0.056 U	0.056 U	0.056 U	0.057 U	0.055 U	0.057 U	
HEPTACHLOR EPOXIDE	0.015 J	0.014 J	0.015 J	0.057 U	0.055 U	0.057 U	
METHOXYCHLOR	0.56 U	0.56 U	0.56 U	0.57 U	0.55 U	0.57 U	
TOXAPHENE	5.6 U	5.6 U	5.6 U	5.7 U	5.5 U	5.7 U	
METALS (µg/L)							
ALUMINUM	11800	190 B	657	1490	106	95.7 B	
ANTIMONY	2.8 U	2.8 U	2.8 U	2.6 U	2.6 U	2.6 U	
ARSENIC	3 U	3 U	3 U	3.3 UL	3.3 UL	3.3 UL	
BARIUM	404	49.5	65.7	96.3 J	30.4 J	30.6 J	
BERYLLIUM	22.1	0.16 B	0.42 B	0.1 U	0.21 B	0.2 B	
CADMIUM	0.3 U	0.4 B	0.3 U	0.54 B	0.3 U	0.3 U	
CALCIUM	30900	5410 K	2350 K	7430 K	3270 K	3260 K	
CHROMIUM	42.7	5.6	1.6	19.3	5.8	5	
COBALT	38.1	15.4	21.2	2.8 B	2.7 B	3 B	
COPPER	22.9	10.2 B	9.1 B	10.4	12.4	13	
IRON	147000	360	498	1090 J	124 J	87 B	
LEAD	6.8 B	1.5 B	13	3.3 L	4.8 L	5.3 L	
MAGNESIUM	26000	4240 K	1660 K	11400	2180 J	2180 J	
MANGANESE	7000	217	464	55.3	39.2	39.3	
MERCURY	0.1 U	0.1 U	0.1 U	0.28 U	0.1 U	0.1 U	
NICKEL	177	24.2	15.8	26.8 K	12.7 K	12.7 K	
POTASSIUM	25500 J	9460 J	3120 J	2290	390	401	
SELENIUM	2.3 UL	2.3 UL	2.3 UL	5.8 J	2.8 U	2.8 U	

CTO 273 - WHITE OAK
BACKGROUND GROUNDWATER DATA

SAMPLE NUMBER: COLLECTION DATE: LOCATION:	BGW-100 11/21/97 BGW-100	BGW-101 11/21/97 BGW-101	BGW-102 11/21/97 BGW-102	BGW-16 10/21/97 BGW-16	BGW-40 10/21/97 BGW-40	GW-100 10/21/97 GW-100	/ /
METALS (µg/L)							
SILVER	0.9 U	3	0.9 U	0.8 U	0.8 U	0.8 U	
SODIUM	10700	32900	6100 B	9560 J	6630 J	6740 J	
THALLIUM	4.7 B	2.9 B	2.3 U	2.9 U	2.9 U	2.9 U	
VANADIUM	36.5	1.2	1 U	4.1	1.1 U	1.1 U	
ZINC	257	28.3	41.1	12.9 B	24.8 B	29.9 B	
RADIONUCLIDES (PCI/L)							
RADIUM-226	11.3	0.78	15.6	1.7	0.35	0.35	
MISCELLANEOUS PARAMETERS (mg/L)							
PH	7.2	5.86	5.67	4.98	4.93	4.85	
TOTAL DISSOLVED SOLIDS	197	136	280	10	10 U	10 U	

APPENDIX L

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APPENDIX L : RI TABLE OF CONTENTS

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