Remedial Investigation/Feasibility Study
Work Plan
for the
Defense Reutilization and Marketing Office (DRMO)

Naval Air Station Jacksonville
Jacksonville, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0135

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WORK PLAN
FOR THE
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT

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ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
ASTs	Above Ground Storage Tanks
BEI	Bechtel Environmental, Inc.
bls	Below Land Surface
BRA	Baseline Risk Assessment
BTAGs	Baseline Toxicity Assessment Guidance
CERCLA	Comprehensive Environmental Response, Compensation Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPCs	Constituents of Potential Concern
cpm	Counts per Minute
CTO	Contract Task Order
DoD	Department of Defense
DPT	Direct-push Technology
DQOs	Data Quality Objectives
DRMO	Defense Reutilization Marketing Office
ERA	Ecological Risk Assessment
FDEP	Florida Department of Environmental Protection
FOL	Field Operations Leader
FS	Feasibility Study
FSWS	Florida Surface Water Standards
ft	feet
GCTLs	Groundwater Cleanup Target Levels
GGCs	Groundwater Guidance Concentrations
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HLA	Harding Lawson Associates
HSWA	Hazardous Solid Waste Amendment of 1984
IR	Installation Restoration
J.A. Jones	J.A. Jones Environmental Services
MCLs	Maximum Contaminant Level
mg/L	milligram per Liter
NASJAX	Naval Air Station Jacksonville
NAVFAC	Naval Facilities Engineering Command
NTP	Notice to Proceed
PA	Preliminary Assessment

ACRONYMS (Cont'd)

PCBs	Pesticides/Polychlorinated Biphenyls
PRG	Preliminary Remediation Goals
PSC	Potential Source of Contamination
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAD	Radiological
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments Reauthoriztion Act
SCTLs	Soil Cleanup Target Levels
SER	Sampling Event Report
SCGs	Soil Cleanup Goals
SI	Site Inspection
SOUTHNAVFACENGCOM	Southern Division Naval Facilities Engineering Command
SOUTHDIV	Southern Division
sq	Square
SQAGs	Sediment Quality Assessment Guidelines
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TtNUS	Tetra Tech NUS, Inc.
USACHPPM	United States Army Center for Health Promotion and Prevention Medicine
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds

FOREWORD

To meet its mission objectives, the United States Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense (DoD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program**.** This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA); the Resource Conservation and Recovery Act (RCRA); and the Hazardous and Solid Waste Amendments of 1984 (HSWA). These acts establish the means to assess and clean up hazardous waste sites for both private-sector and federal facilities.

The IR program is conducted in four stages as follows:

- The Preliminary Assessment (PA) identifies potential sites through record searches and interviews.
- The Site Inspection (SI) then confirms which areas contain contamination creating designated "sites".
- The Remedial Investigation and Feasibility Study (RI/FS) together determine the type and extent of contamination, establish criteria for cleanup, and identify and evaluate potential remedial action alternatives and their associated costs. As part of the RI/FS, a Risk Assessment identifies potential effects on human health and the environment to aid in evaluation of remedial action alternatives.
- The selected alternative is planned and implemented in the Remedial Design (RD) and Remedial Action (RA) stages. Monitoring then ensures the effectiveness of the effort.

This document is the RI/FS Work Plan outlining the requirements and procedures to be utilized in the collection, analysis, and evaluation of data central to this investigation.

The Southern Division (SOUTHDIV), Naval Facilities Engineering Command (NAVFAC) manages the IR program at the Naval Air Station Jacksonville (NASJAX) facility in Jacksonville, Florida. The United States Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP) oversee the IR program. The program's compliance with state and federal regulations is assured by the participation of these regulatory agencies.

Questions regarding the IR program at NASJAX should be addressed to Mr. Anthony Robinson, Remedial Project Manager at SOUTHDIV, at (843) 820-7339, or Mr. Tim Curtin at NASJAX, at (904) 542-2717, ext. 120.

1.0 INTRODUCTION

This RI/FS Work Plan for Potential Source of Contamination (PSC) 46, NASJAX, Jacksonville, Florida, has been prepared by Tetra Tech NUS, Inc., (TtNUS) for the SOUTHDIV NAVFAC under the Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0134. This Work Plan outlines the requirements and describes the procedures for performing the RI/FS at PSC 46, which consists of the Defense Reutilization and Marketing Office (DRMO).

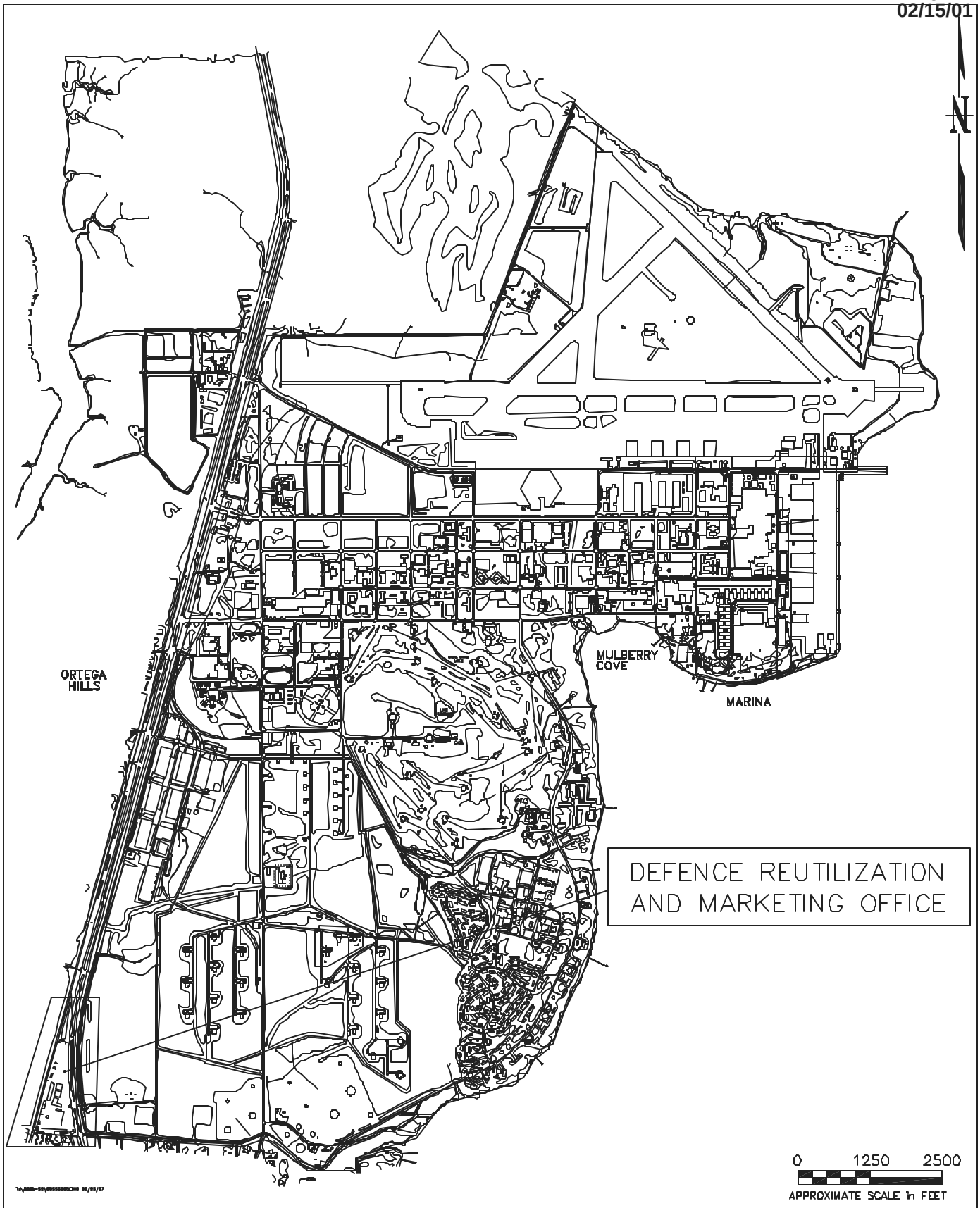
NASJAX is located in northeastern Florida in Jacksonville, Duval County on the west bank of the St. Johns River. The base occupies approximately 3,896 acres (history section NASJAX Internet site, 1999). A site location map is presented in Figure 1-1.

1.1 SCOPE AND OBJECTIVE

The scope of the project is to perform an RI/FS for PSC 46. This includes the preparation of a Sampling and Analysis Plan (SAP), Health and Safety Plan (HASP), and a Quality Assurance Project Plan (QAPP), which have been printed under separate cover, but are included herein as Appendices A, B, and C, respectively. In addition to preparation of these documents, the project will entail field investigative work and preparation of a RI Report, Baseline Risk Assessment (BRA), and Feasibility Study (FS). The objectives of the project are to verify the sources of contamination and to characterize and delineate the extent of constituents of potential concern (COPCs) in soil and groundwater where present. The data will be used in the BRA to determine risks and in the FS to evaluate alternatives for future courses of action.

The RI/FS field activities will address potential volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticide, inorganic metals, and radiological impacts to the surface soil, sediments, surface water, and groundwater at the DRMO site and surrounding areas. Data Quality Objectives (DQOs) for the site were developed and adopted by the NASJAX Partnering Team, which was comprised of representatives from the Navy at NASJAX and SOUTHDIV, the FDEP, the USEPA, the United States Geological Survey (USGS), TtNUS as the Navy CLEAN contractor, and J. A. Jones Environmental Services (J.A. Jones) as the Navy Remedial Action Contractor.

Data collected during this investigation will be used to assess the human health and ecological risks associated with potential migration of COPCs. Also, sampling is proposed to determine whether media contains COPCs at concentrations above applicable or relevant and appropriate requirements (ARARs). Natural attenuation sampling will also be performed to assess whether the site is conducive to natural



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CHECKED BY DATE		APPROVED BY DATE	
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SITE LOCATION MAP
DEFENSE REUTILIZATION AND MARKETING OFFICE
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

attenuation of COPCs detected at concentrations above ARARs. Based on this information, alternatives for remedial action will be evaluated.

1.2 SITE DESCRIPTION

The DRMO is a relatively flat fenced site that contains administrative and storage buildings. Its approximate dimensions are 650 feet (ft) wide on the southern edge, 1,500 ft long, and 120 ft wide on the northern edge. In map view, these dimensions approximate a wedge shaped tract oriented north to south. The site is almost entirely paved or covered with buildings. Site detail is provided in Figure 1-2.

Drainage ditches are located along the east, west, and south sides of the fenced yard. Approximately 250 ft of the southern perimeter ditch is concrete lined (eastern portion). These ditches only carry water during rain events, with the exception of the concrete lined area of the southern ditch, which usually contains standing water. Storm water runoff entering the eastern and western perimeter ditches flows to the south. The southern ditch receives outflow from the western ditch, flows eastward, and discharges to the eastern perimeter ditch at the southeast corner of the site. The eastern ditch parallels the west side of U.S. Highway 17. South of the site, the ditch receives runoff from the Highway 17, I-295 Interchange. During rain events, flow from DRMO is significantly diluted at this point, approximately 400 ft south of the DRMO. Near I-295, the ditch turns westward and shallows, becoming sheet flow into a wooded area. It appears runoff seeps into the ground in this area and does not continue to the west. Approximately 1.5 miles beyond (west of) this wooded area lies the Ortega River.

An Amtrak railroad line parallels the western boundary of the DRMO. A spur from this main line enters the DRMO along the west-central property boundary and provides rail access to the largest of the site structures, Building 178 (A and B).

Two above ground storage tanks (ASTs) and an underground oil-water separator are present at the southeast corner of the DRMO yard. Stormwater runoff from a large portion of the yard drains to the separator and is discharged into the concrete-lined portion of the south perimeter ditch. During heavy rain events, surface water runoff may bypass the oil-water separator and discharge directly into the drainage ditch.

1.3 DOCUMENT ORGANIZATION

The following sections of this RI/FS Work Plan provide a brief history of operations at PSC 46, and present a conceptual model and discussion of potential migration and human and ecological exposure pathways of contaminants previously reported. The document also presents the DQOs and provides the project schedule and reporting requirements. The SAP (Appendix A) includes

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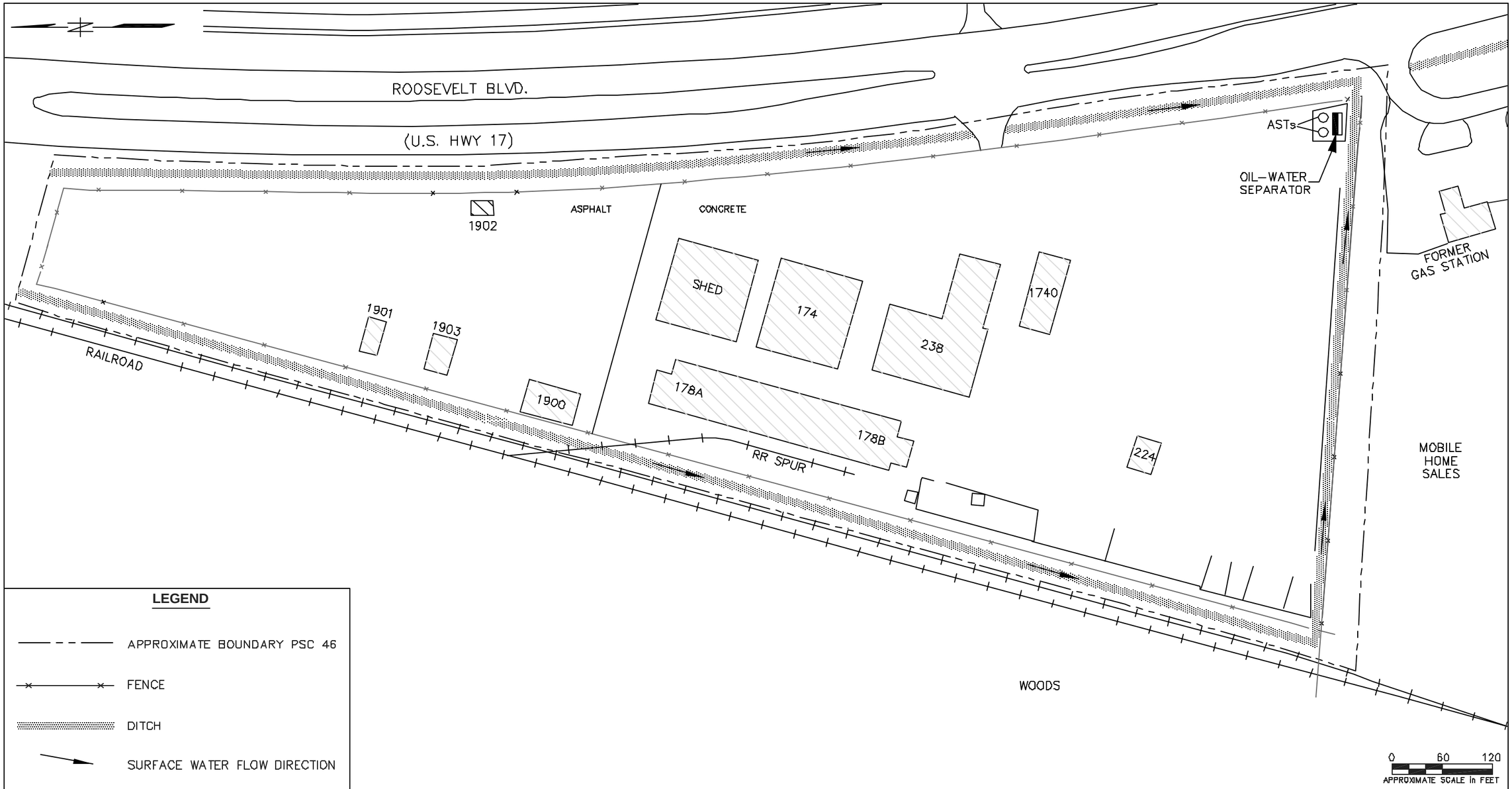

LEGEND

- APPROXIMATE BOUNDARY PSC 46
- FENCE
- DITCH
- SURFACE WATER FLOW DIRECTION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 5/23/00
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SITE PLAN
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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site-specific information to be used for sampling at PSC 46. The site-specific HASP is provided as Appendix B and the QAPP is presented as Appendix C.

2.0 SITE HISTORY

2.1 1939 – LATE 1940'S

The DRMO site was developed in 1939 by the U. S. Army [Harding Lawson Associates (HLA), 1999]. The site first served as a decommissioning facility for used aircraft. The aircraft were drained of their fluids at PSC-51, located east of the DRMO site, and transported to the southern portion of the DRMO site. The aircraft were stripped of their various components and the components were staged at different locations on the yard. The aluminum components were smelted down into ingots near the south central portion of the yard, and stored on the west side of the property in storage bins where they awaited transport offsite by railcar. Other recoverable materials, such as leather, rubber and expendable materials from the aircraft were stockpiled on the northern side of the property. Based on review of a 1946 aerial photograph, the site was not paved. Some possible soil staining was noted in the south central and western portions of the property.

Historical activities may have resulted in impacts to the environment. These impacts could have resulted from releases of various contaminants to the ground surface through leaks, spills, and direct placement of waste materials on surface soils. Since the site was not paved, releases or spills likely resulted in seepage of contaminants directly into the subsurface soils. Potential subsurface COPCs include metals, solvents, and radiological components.

2.2 LATE 1940'S TO PRESENT

In the late 1940's, the site was developed for it's current use as the DRMO. The DRMO's mission is to provide a means for the disposal of surplus Navy equipment, supplies, and wastes. Materials are stored within the fenced yard prior to sale to the public. A wide array of surplus material has been dispensed to the public by DRMO including vehicles, appliances, electrical devices, transformers, batteries, scrap materials, various chemicals, furniture, storage vessels, and numerous other items. Some reconditioning and maintenance work has been performed on surplus materials at the site, but most of this activity has been conducted on a relatively small scale. The DRMO activities could have resulted in impacts to the environment. Chemicals such as pesticides, polychlorinated biphenyls (PCBs), metals, VOCs, SVOCs, and radiological components may be present.

Based on a comparison of current and historical aerial photos of the site, many of the original structures dating to the 1940s still exist and have been modified for current uses. Other buildings were demolished but foundations are still present. Further discussion of the site's current uses and historical practices is provided below.

2.3 SITE SCREENING – HLA

Site screening was performed by HLA at PSC 46 during the period of April 3 through July 31, 1997 to assess whether hazardous substances had been released to the environment. This action was initiated as a result of several events beginning in the early nineties. In 1991, NASJAX personnel observed that storage areas for lead acid batteries, hazardous materials, drums, and transformers drained into the western perimeter ditch, a pathway eventually leading offsite, as noted earlier. In 1994, a sludge sample from the first access hatch in the oil-water separator was reported to have a benzene toxicity characteristic leaching procedure (TCLP) level of 70 milligrams per liter (mg/L), exceeding the TCLP threshold of 0.5 mg/L. Consequently, the sludge had to be classified as a RCRA hazardous waste. Also in 1994 (April 22), HLA performed a site reconnaissance and observed oily water on the ground outside the opening to the oil-water separator and a “strong chemical odor” was said to be emanating from the southern perimeter ditch. A sheen was also observed on standing water in the eastern perimeter ditch near the oil-water separator. Other observations made by HLA during the April 1994 inspection included: soil staining where transformers were stored along the western fence; military-type vehicles leaking fluids onto the ground in the northern half of the PSC; and canisters of paint, cleaning compound, solvent, adhesive, sealant, containers of corrosive acids and bases, scrap metal, and empty drums. No figure with exact locations was available.

Details of the site screening performed by HLA in 1997 are documented in the Sampling Event Report (SER) (HLA,1999). Six micro wells were installed around the site perimeter and sampled to assess groundwater quality. Nine surface water, four surface soil, and five sediment samples were collected from the drainage ditches to assess impacts to those media. Samples were submitted to the laboratory for analysis of target compound list (TCL) VOCs, SVOCs, pesticides, PCBs, and target analyte list (TAL) inorganic compounds.

Detected values in groundwater samples were compared to USEPA maximum contaminant levels (MCLs) and FDEP groundwater guidance concentrations (GGCs). Values reported in surface water samples were compared to the Florida surface water standard (FSWS) for each compound. Surface soil analytical values were compared to FDEP residential soil cleanup goals (SCGs) and concentrations in sediment samples were compared to FDEP sediment quality assessment guidelines (SQAGs).

The following compounds were reported at values exceeding the federal and/or state criteria in at least one analyzed sample:

<u>Groundwater</u>: aluminum, antimony, iron, and manganese;

<u>Surface Water</u>: cadmium, mercury, and silver;

Surface Soil: benzo(a)pyrene, benzo(b)fluoranthene, aroclor-1260, aluminum, arsenic, chromium, copper, iron, and manganese;

Sediment: 13 SVOCs (including naphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, flouranthene, flourene, phenanthrene, and pyrene), 4,4'-DDD, 4,4'-DDT, arochlor-1260, dieldrin, alpha-chlordane, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc.

Other compounds were reported, but at concentrations below federal and state criteria. Exceedances reported in groundwater samples may be attributable to naturally suspended solids (HLA, 1999).

2.4 RADIOLOGICAL ASSESSMENT

On June 30, 1998, representatives from the U.S. Army Center for Health Promotion and Prevention Medicine (USACHPPM) conducted an industrial radiation survey at DRMO and identified areas with elevated radiation exposure readings. A follow-up study was conducted later in 1998 by Bechtel Environmental, Inc. (BEI), in which radiation readings were taken in three distinct areas within DRMO, based on USACHPPMs measurements. Maximum readings in counts per minute (cpm) ranged from 10 to 60 times average background readings in the specified areas. Radiological impacts are thought to have originated during airplane disassembly operations conducted at the DRMO site in the 1940s because paints used on these aircraft contained radium (BEI, 1998). Impact appears to have been confined to the western side of the DRMO yard, with three areas identified as potential candidates for clean up. The three sites are described in detail below:

Area 1 is an open storage area located on the northwest side of the property. The area is approximately 90 ft by 40 ft bordered by metal shelves on the north, equipment on the south, the roadway on the east and the edge of the facility on the west. According to the Army, an asphalt patch inside Area 1 was found to have elevated cpm readings. The report identified those "spots" within the area that contained cpm values more than two times background concentrations.

Area 2 is located to the west of Building 174 stretching to the edge of the western property boundary. The area is approximately 300 ft by 40 ft and is covered with dirt and concrete. An unused railroad spur is located in the dirt portion of this area. An area 240 ft by 40 ft [9600 square (sq) ft] from within Area 2 was found to exceed two times background concentrations.

Area 3 is located on the southwest side of the DRMO yard and is segregated from the remainder of the site by concrete barricades. This area was identified as containing elevated cpm values. The total surface area exceeding two times background concentrations was estimated at 2,800 sq ft.

All radiological (RAD) site information collected during the prior investigations was collected by field screening instrumentation. No laboratory analyses were performed for RAD parameters.

3.0 PRELIMINARY ASSESSMENT

This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways of contaminants from PSC 46. A detailed discussion of potential receptors, media of concern, and exposure routes is presented in Section 3.0 and Appendices A and B of the SAP (Appendix A).

3.1 SURFACE WATER

Surface water at the site consists primarily of stormwater runoff that collects in drainage ditches located on the west, south, and east side of the DRMO during rain events. During drier periods, standing water is only found in the south ditch on the east side of the DRMO where the channel has been lined with concrete. This area is near the oil-water separator located at the southeast corner of DRMO as shown in Figure 1-2.

Surface water samples will be collected from the drainage ditches and downgradient of the site, if surface water is present in these areas during field activities for the RI/FS. The samples will be tested for COPCs and RAD parameters as described in Section 4.0 of the SAP (Appendix A). The drainage ditch is a potential pathway for contaminant migration. If surface water is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in surface water by human receptors would be possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors would also be possible exposure pathways.

3.2 SEDIMENT

Sediment samples were collected from the drainage ditches during HLA's previous assessment activities. Laboratory analytical data indicated the presence of 13 SVOC compounds, five pesticide/PCB compounds and eight metals in concentrations exceeding SQAGs. As a result, sediment sampling will be conducted during the RI/FS to further define the extent of impacts to sediment. The sediment samples will be tested for COPCs and RAD parameters as described in Section 4.3 of the SAP (Appendix A). The data will be used to evaluate whether incidental ingestion of and/or dermal contact with contaminants in sediment by human receptors are possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (organisms living and/or feeding on the water bottom) would also be possible exposure pathways.

3.3 GROUNDWATER

Four inorganic compounds were reported at concentrations exceeding federal MCLs in groundwater samples collected by HLA (HLA,1999). HLA stated that these elevated values likely resulted from the presence of suspended solids since the samples were not filtered.

No groundwater data was collected from the interior portions of the site or from the area downgradient of the oil-water separator. As a result, additional monitoring wells will be installed as part of the RI/FS for the purpose of evaluating groundwater quality in these areas. Groundwater will tested for COPCs and RAD parameters as described in Section 4.5 of the SAP (Appendix A).

Only those personnel drilling and/or developing monitoring wells, sampling and/or analyzing groundwater collected from the wells, or disposing of purge water or development water derived from the wells would be at risk to exposure by ingestion, dermal contact, or inhalation. Groundwater in the surficial aquifer in this area is not used for drinking, so exposure to the general public is not likely. Exposure to ecological receptors is also unlikely since groundwater does not appear to typically discharge into drainage ditches, which border the site.

3.4 SOIL

Soil contamination previously reported at PSC 46 (HLA, 1999) was based upon limited sampling in dry portions of the drainage ditches. The RI/FS investigation will include an evaluation of surface soils from interior portions of the DRMO. The sampling strategy in the interior will include a combination of systematic grid-based sampling and biased sampling in suspected areas of impact based on historical documentation. Samples will be collected from various depths to determine vertical extent of impacts to soil. Soil samples will be tested for COPCs and RAD parameters as described in Section 4.2 of the SAP (Appendix A). The purpose of the soil sampling will be to evaluate whether incidental ingestion of and/or dermal contact with contaminants in soil by human receptors are possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors.

3.5 AIR

Potential impacts to air are limited by the presence of pavement or buildings, which cover virtually the entire site. However, there are potential impacts from RAD sources. Consequently, the air pathway will be considered significant to human or ecological risk only from the perspective of RAD contamination. Field screening of RAD levels will be conducted to determine current RAD levels in air. These results will be used to determine the location of confirmation soil sampling for RAD component speciation. The purpose of this sampling will be to evaluate the potential risks to ecological and human receptors.

4.0 DATA QUALITY OBJECTIVES

The sampling strategies detailed in the SAP (Appendix A) have been developed using the DQO Process. The DQO process is a systematic procedure, based on the scientific method, to define the criteria by which data collection activities are performed. The goal of the DQO process is to develop a strategy for the efficient collection of data that is of sufficient quality and quantity to support defensible decision-making, while eliminating excessive detail. The most efficient way to accomplish these goals is to establish criteria for defensible decision-making before the study begins and then develop a data collection design based on these criteria.

The complete DQO process consists of seven steps. A detailed description of the DQO process is beyond the scope of this document (USEPA guidance, 1999) however, the following is a brief description of each step in the DQO process:

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 existing data and determine the information and measurements needed 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 an alternative data collection design. Choose the most resource-effective design that meets all DQOs.

To ensure effective use of resources, SOUTHDIV NAVFAC has determined that it is appropriate to implement the DQO process during the planning stages of all studies that require data collection, before the data are collected. The DQO process applies to studies; however, the depth and detail of the process will vary with the complexity of the particular study. In addition, the DQO process is a flexible planning tool. For projects where the likelihood of making decision errors is small, where decision errors are not critical, or where prescriptive procedures/remedies are mandated, the DQO process can be used less intensively.

SOUTHDIV NAVFAC has identified several operational processes to aid and assist in the DQO process. These processes will be implemented for all SOUTHDIV NAVFAC projects. They are as follows:

- Preparation of a dynamic site-specific work plan that fully integrates the DQO process.
- Presentation of a DQO summary statement and logic flow diagram in the site-specific work plan that describes the decision-making process for data collection activities.
- Provision of “if-then” rules for reasonable deviations from the proposed plan.
- Involvement of multidiscipline teams in the decision-making process during the data collection activities.

4.1 STEP 1. STATE THE PROBLEM:

4.1.1 Planning Team Members

The following personnel were included as part of the planning team. Each member’s input was understood and evaluated during the DQO planning process.

- Anthony Robinson –SOUTHDIV NAVFAC
- Dana Gaskins - SOUTHDIV
- Tim Curtin – NASJAX
- Hal Davis –USGS
- Mark Peterson – TtNUS
- Ted Adams – B. Koh & Associates
- William Starkel – TtNUS
- Ronald Kotun – TtNUS
- Sam Ross – J.A. Jones

- Jorge Caspary –FDEP
- USEPA – this agency has been represented by both Brian Donaldson and John Grady during the planning process.

4.1.2 Decision Makers- NASJAX Tier I Partnering Team

The IR program for cleanup of the Navy sites has implemented a facilitated partnering team approach. Key members of this team are stakeholders with a vested interest and are considered decision makers for ongoing projects at NASJAX. These members are:

- Anthony Robinson – SOUTHDIV
- Dana Gaskins – SOUTHDIV
- Jorge Caspary – FDEP
- USEPA Representative- Previously was Brian Donaldson and is currently John Grady (interim member until permanent replacement is made)
- Tim Curtin – NASJAX
- Greg Roof – TtNUS
- Mike Halil – J.A. Jones

Each Partnering Team member listed above has participated in the development of the DQOs and has agreed with the results of the DQO evaluation. Note, Brian Donaldson of the USEPA left the NASJAX Partnering Team after the DQO process was completed. USEPA has assigned John Grady as an interim member until a permanent replacement is identified.

4.2 PROBLEM STATEMENT

Environmental site assessment work conducted at the DRMO to date has identified environmental impacts at the site. Chemicals of concern include VOCs, SVOCs, pesticides, PCBs, RAD components, and metal constituents found in excess of conservative screening criteria. Impacted media include surface water, sediment, soils, and groundwater. The extent of these impacts is unknown. No adverse physical effects have been observed in ecological or human receptors.

A RI/FS is to be conducted at the DRMO to identify and mitigate potential threats to human health and the environment. The RI/FS must adequately address the extent and potential threat posed by contaminated surface soils.

4.2.1 Available Resources and Deadlines

Completion of the RI/FS for the DRMO requires access to sufficient resources to carry out the planned activities. These resources include establishing a project team qualified by knowledge and experience to conduct the planned activities and to provide the project team with the budget, guidance, and a reasonable schedule to complete the process.

The DRMO Planning Team has been given the support necessary to complete the RI/FS. The Navy has agreed to provide the necessary funding. The project team is supported by the expertise of its members which includes extensive technical and regulatory experience. When necessary, the team can augment their capabilities through the inclusion of additional personnel with specialized expertise. Guidance for the RI/FS is provided by the DQO process (USEPA QA/G-4) and Data Quality Assessment (USEPA AQ/G-9).

4.2.2 Conceptual Model

The DRMO occupies a wedge shaped tract of land located at NASJAX. The facility has been used for multiple purposes since 1939, including the demolition of used aircraft, smelting operations, equipment maintenance and repair, transformer storage, and battery storage.

The DRMO activities have resulted in impacts to the environment. These impacts have resulted from releases of various contaminants to the ground surface through leaks, spills, and direct placement of waste materials on surface soils. Storm water runoff appears to have transported contaminants into drainage ditches located on the west, south, and east sides of the site.

Contaminants include radionuclides thought to have resulted from aircraft disassembly, principally from radium contained in paints used on aircraft. Other contaminants include petroleum hydrocarbons, chlorinated solvents, PCBs, pesticides, and heavy metals.

Confirmation sampling activities indicate that VOCs, SVOCs, pesticides, and metal constituents have impacted various media at the site. Radiological data has been limited to field screening methods (radioactivity counts) obtained during prior investigation activities.

4.3 STEP 2. IDENTIFY THE DECISION:

4.3.1 Principal Study Question

The principal study question is as follows. Are environmental media (surface water, sediment, groundwater, and soils) contaminated and do they pose a potential threat to ecological receptors or to human health? The alternative actions that could result from the resolution of the principal questions are no action or further action. Further action could entail a feasibility study, remedy selection, remedy implementation, and remedy monitoring.

4.3.2 Decision Statement

The decision that is required by the RI/FS is statement is to determine if COPCs meet or exceed selected screening levels. If COPCs are less than selected screening levels, conduct no further action. If COPC levels exceed selected screening levels, proceed with human health risk and ecological risk assessments. If COPCs exceed calculated risk-based thresholds or Florida Soil Cleanup Target Levels (SCTLs)/Groundwater Cleanup Target Levels (GCTLs)/Surface Water Standards two times background values, proceed with a FS.

4.4 STEP 3. IDENTIFY THE INPUTS TO THE DECISION:

4.4.1 Information Needed to Resolve the Decision

Several sources of information are required to resolve the decision statement. These sources of information include but are not limited to the following:

- Background Information and Existing Documents.
- Soil Data.
- Sediment Data.
- Surface Water Data.
- Groundwater Data.
- Receptor (Human and Ecological).
- Unacceptable risk level(s) or chemical concentrations.
- Unacceptable Hazard Index.
- Definition of “Extent”.
- Background Concentrations.

4.4.2 Sources of the Information Needed to Resolve the Decision

Existing information regarding the site can be found in several documents. Historical information is contained in part in prior assessment reports, historical aerial photographs, and DRMO records. The following existing documents have been identified as potential sources for this information and were reviewed in order to develop a better site understanding.

- ABB Environmental Services, Inc., 1994. Preliminary Characterization Summary Report, Operable Unit 1, Naval Air Station (NAS) Jacksonville, Jacksonville, Florida, Final Draft. Prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina.

- Bessent, Hammack and Ruckman, Inc., 1994. Separator Survey Report. Prepared for Navy Public Works Center, Jacksonville, FL.

- BEI Interoffice Memorandum, December 14, 1998. Radiological Survey of DRMO.

- HLA, 1999. Sampling Event Report, Potential Source of Contamination 46, Defense Reutilization and Marketing Office Yard, Naval Air Station Jacksonville, Jacksonville, Florida. July.

- Historical Aerial Photograph, April 2, 1946.

- Historical Aerial Photograph, 1979.

- USACHPPM, 1998. Industrial Radiation Survey No. 27-MH 84444-98. Defense Reutilization and Marketing Office. Jacksonville, FL. June 29-30.

In addition to the documents, site visits have been used to provide a better understanding of the facility. The initial site walk through was conducted in March of 2000 and subsequent site visits by TtNUS were conducted in order to develop a more thorough understanding of the site.

In addition, site knowledge gained from review of site documentation, existing analytical data from the sources referenced above has been used to identify the COPCs. Through the following analytical methods, the planning team needs to determine concentrations of TCL VOCs, PAHs, PCBs, TAL inorganics, and radiological nuclides levels in environmental media at the DRMO.

- TCL VOCs – SW-846 Methods 8260a/8260b
- PAHs – SW-846 Method 8270 single ion detection (SIM)
- TCL Pesticides & PCBs – SW846 Methods 8081/8081/a
- TAL Metals – SW846 Methods 6010a/6010b and 7000a series
- Radiological: gross alpha/beta (USEPA 900.0M/SW846-9310); isotopic radium (USEPA 901.1M); total radium (USEPA 903.0M); isotopic thorium (USEPA 907M); total thorium (calculation); isotopic uranium (USEPA 907M); total uranium (calculation)

The DRMO Planning Team has agreed that evaluation of this data will be conducted by direct comparison to background data (two times background concentrations) where appropriate and to selected screening/action levels. Statistical methods will only be used on a case by case basis and will be approved by the DRMO Planning Team.

4.4.3 Information Necessary for Establishing Action Levels

For the RI, screening levels will be used to evaluate the data. The selected screening levels were discussed and approved by the DRMO Planning Team. The screening levels for surface water and groundwater are derived from the following sources:

- Background Concentrations for NASJAX (OU-1 RI/FS),
- FDEP GCTLs, USEPA and FDEP MCLs,
- FDEP Surface Water Criteria, and NRC 10 CFR 20.

For soil and sediment the following sources may be used.

- Background Concentrations for NASJAX (OU-1 RI/FS).
- Florida SCTLs – Chapter 62-777, FAC, 1999.
- USEPA Region IX Preliminary Remediation Goals (PRGs).
- FDEP Criteria – FDEP Approach to the Assessment of Sediment Quality in Coastal Waters; Volume 1- Development and Evaluation of Sediment Quality Assessment Guidelines 1994a.
- Florida SQAGs, 1994.
- USEPA SQC - Fresh Water , USEPA ECO Update 1996.

- USEPA SQC- USEPA ECO Update 1996.
- REG III Baseline Toxicity Assessment Guidelines (BTAGs) – USEPA, Region III BTAG Screening Levels, 1995a.
- USEPA Region IV- USEPA Supplemental Guidance to RAGs; Region 4 Bulletins—Ecological Risk Assessment, 1995b.
- USEPA 40 CFR Part 192, "Health and Environmental Standards and Thorium Mill Tailings".
- EPA Region IX Preliminary Remediation Goals.

As necessary, corrective action levels will be defined by the human health risk and ecological risk assessment processes. Based on a decision adopted by the NASJAX Partnering Team, the risk assessment will evaluate the following exposure scenarios; residential, industrial worker, and construction/utility worker. Due to the configuration of the site (virtually 100% paved) and restricted access, it was decided that the trespasser exposure would not be evaluated.

Due to the limited presence of surface water at DRMO (intermittent occurrence in site drainage ditches) and lack of habitat, it is anticipated that ecological assessment will be completed at the screening step and that a detailed assessment will not be required. Soil criteria will take precedence over sediment criteria that will be used when soil criteria does not exist see Appendix A for details. Due to the lack of ecological receptors, it in also anticipated that should the sediment criteria be used, the probable effects level for the sediment criteria will be selected.

4.4.4 Measurement Methods for Analytical Data

The measurement methods have been selected based on the guidance criteria stated above. To adequately resolve the decision, method detection limits should be equal to or less than action levels. This will be ensured by supplying the selected action levels to the laboratory. In the event that it is not technically possible to achieve a low enough detection limit for a given parameter with the selected method, the Partnering Team will evaluate the results on a case-by-case basis, using frequency of detection in other samples to determine whether detected concentrations represent significant contamination. For parameters with no action levels, individual evaluation will be necessary.

4.5 STEP 4. DEFINE THE STUDY BOUNDARIES:

4.5.1 Characteristics that Define the Population of Interest

The population of interest is defined as environmental media that have been impacted by historical property uses such that they pose a potential threat to human health and the environment.

For the purpose of this assessment, surface water will be limited to the areas within the drainage ditches that border the DRMO site on the west, south, and east sides. In addition, surface water beyond the point of confluence at the southeast corner of DRMO will be evaluated during the RI/FS. If impacts to downstream receptors are identified, then those receptors may be included in the study.

Sediment is assumed to be a homogeneous layer beneath a water body. Therefore, sediment will be restricted to locations where surface water exists (i.e., the drainage ditches that border the west, south, and east sides of the DRMO). The water is temporal in nature, with the most continuous wet area located in the paved portion of the south ditch near the southeast corner of DRMO. Fate and transport of sediments will be evaluated.

Groundwater is defined as any occurrence of water below the earth's surface. For the purpose of this assessment, it is assumed that groundwater will include the uppermost occurrence of groundwater in the study area that may have been impacted by site activities.

Soil is assumed to be a homogeneous layer of the land surface. Therefore, soil typically will be found everywhere there is not an obstruction to the land surface such as a building, pavement or water. For the purposes of this study, soil extends down to the groundwater table, which is typically 3 to 6 ft below land surface (bls).

4.5.2 Spatial Boundary of the Decision Statement

The decision statement is bound by the spatial boundary of environmental media located at DRMO and adjacent areas. Environmental media are for the purposes of this study assumed to be homogeneous in nature. For the purposes of the study, five populations of environmental media area recognized; surface soils, subsurface soils, sediment, surface water, and groundwater. Soil is assumed to exist everywhere outside of the drainage ditches and within the drainage ditches where water is not commonly present. Surface soil is defined as soils within the upper foot of ground surface. Sediment is assumed to be confined to the drainage ditches and/or have resulted from the direct deposition from the movement of water. Land areas beneath persistent standing surface water will be referred to as sediment. Surface water is defined as water contained within the drainage ditches. Groundwater is defined as the occurrence of groundwater within the shallow aquifer beneath the site.

4.5.3 Temporal Boundary of the Decision Statement

The timeframe to which the decision applies consists of the time period necessary to complete the RI/FS.

4.5.4 Scale of the Decision Statement

The scale of the decision-making will be confined to the area of impact exceeding regulatory or risk-based thresholds.

4.5.5 Physical Constraints on Data Collection

Much of the area of potential impact to soils lies below buildings and paved surfaces of DRMO. The accessibility of environmental media will increase the cost of sampling, as specialized tools will be necessary to provide access.

Sediment is located beneath water bodies requiring specialized sampling equipment.

Impacted media may exist in offsite areas. Access to these areas may be required.

4.6 STEP 5. DEVELOP A DECISION RULE:

The DRMO Planning Team has approved a decision rule for the evaluation of analytical data. The decision rule states “if any chemical concentration in any sample is less than its respective screening level, then the soil/sediment sample will be considered not contaminated and no action will be taken. If any chemical concentration exceeds its screening level, further study of the soil/sediment will be considered, including evaluation of the potential ecological and human health risks.”

The project team will use direct comparison of VOC, PAHs, pesticides, PCBs, inorganics, and radiological parameters against selected screening and action levels.

Selected action levels for the study will be derived from background concentrations for NASJAX, the FDEP SCTLs and GCTLs, FDEP SQAGs, USEPA SQC, USEPA Region IX PRGs, and USEPA 40 CFR Part 192.

The rationale for selection of action levels will be as follows:

- Inorganics and Pesticides – Two times the background level or the most conservative of the regulatory screening levels, assuming a residential exposure scenario or probable effect level for sediments. Basewide background concentration, were established in the RI/FS for OU-1 [ABB Environmental Services (ABB), 1996].

- VOCs, SVOCs, PCBs – The most conservative of the regulatory screening levels, assuming residential exposure scenario or probable effect level for sediments.
- Radiological – Two times background and/or the most conservative of the regulatory screening levels, assuming a maximally exposed individual to soils/sediments, surface water, and groundwater.

4.7 STEP 6. SPECIFY TOLERABLE LIMITS ON DECISION ERRORS:

The systematic approach to evaluation of data includes a rationale for the effects of potential decision errors. Evaluation of the potential effects includes identification of the parameters of interest. The range of parameters is expected to be those with detected concentrations greater than the selected action levels.

In evaluation of the parameters which exceed the selected actions levels, the potential decision errors are: 1) identifying media as contaminated when it truly is not and 2) identifying media as not contaminated when it truly is. The potential consequence of the first error includes the expenditure of money and effort when they are really not necessary. The potential consequences of the second decision error includes potential exposure to receptors that may be adversely affected. Of these, the second decision error has more severe consequences since jeopardizing human health outweighs the consequences of additional expense.

The Null Hypothesis allows for the identification of the baseline condition at the site. At DRMO, the baseline condition is that environmental media has been impacted by historical site practices. The RI/FS has been designed with this as the basis of understanding. The alternative hypothesis is that environmental media has not been impacted by historical practices. A false positive to the Null Hypothesis would be that media at DRMO is contaminated when it truly is not A false positive for the alternative hypothesis would be that media is not contaminated when it truly is.

Statistical approaches allow for the establishing tolerance limits to decision errors. However, the DRMO Planning Team has determined that statistical analyses will not be utilized in evaluation of the data. As a result, statistical evaluation of the consequences of decision errors will not be conducted.

4.8 STEP 7. OPTIMIZE THE DESIGN

The purpose of this step is to identify a resource-effective field investigation sampling design that generates data that are expected to satisfy the decision criteria previously specified in the DQO process. The design of the field investigation takes into account probabilistic sampling designs that account for

areas at the DRMO of known or suspected impact and areas without known impact. This probabilistic sampling design includes a non-biased systematic grid sampling approach combined with biased point sampling. The intent of the non-biased systematic grid sampling is to cost effectively evaluate the potential impacts of historical site activities on soils throughout the DRMO yard by providing sufficient data addressing a relatively large area while limiting the number of samples. Higher cost biased sampling will be conducted at areas previously identified by HLA's 1999 Sampling Event as having been impacted and areas that have a higher probability of impact identified through evaluation of historical records.

Systematic grid sampling will be used for the collection of shallow soil samples at the site via hand auger techniques. Biased sampling will be conducted by a variety of methods used for the collection of soil, sediment, surface water, and groundwater samples in and around the DRMO site. These methods include hand auger, simple scoop and dip methods, direct-push technology (DPT), and traditional monitoring well sampling methods. Each method used will be conducted in accordance with established protocol.

Analytical data will be generated both via field methods and in offsite laboratories. Field screening methods, detailed in the SAP in Appendix A, will be used to evaluate samples collected in the field and to select samples for laboratory testing. The intent of the screening method are to reduce the submittal of non-impacted media samples to the laboratory thereby reducing cost, both in the terms of direct analytical cost and by limiting the resource expenditure necessary to manage and evaluate laboratory data.

Laboratory analyses will be selected based on the sample location and known or suspected COPCs. In order to reduce the costs of extensive laboratory testing for every potential COPC, a percentage basis approach will be used for analyses of constituents not suspected as being primary COPCs. An example of this approach is as follows. VOCs were occasionally detected at relatively low levels in various environmental media in the HLA 1999 Sampling Event Report, but were not determined to be COPCs in soils or sediment at the DRMO. However, since the presence of VOCs cannot be ruled out, a percentage basis will be used to select samples for VOC analyses. The DRMO Planning Team has determined that 25 percent will be used as the percentage basis. Therefore in this example, a minimum of 25 percent of non-biased soil and sediment samples will be tested for VOCs, with the samples to be analyzed for VOCs selected based on the results of field screening. It should be noted that should field readings indicate a more widespread occurrence of VOCs than anticipated, then EPA and FDEP will be contacted to evaluate alternative criteria for VOC sampling and analysis which may include analysis of additional samples failing the field screening criteria.

Using these methods, the DRMO Planning Team has developed a sampling strategy that cost effectively fulfills the requirements of the DQO process. Additional information regarding the sampling strategy and approach are provided in the SAP in Appendix A.

5.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIRMENTS

The selection of screening/action levels is based on a determination of the appropriate regulatory criteria. As shown in Section 4.0, the DQO process has identified guidance that will be considered in the evaluation of data obtained during the RI/FS. In addition, a review of ARARs is required to evaluate other potential requirements that may have an affect on the implementation of the selected remedy. Table 5-1 provides a review of ARARs for the DRMO RI/FS.

Table 5-1
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal Chemical-Specific ARARs				
Safe Drinking Water Act (SDWA) Regulations, Maximum Contaminant Levels (MCLs)	40 CFR Part 141	Relevant and Appropriate	Establishes enforceable standards for potable water for specific contaminants that have been determined to adversely affect human health.	Would be used as protective levels for groundwater or surface waters that are current or potential drinking water sources.
SDWA Regulations, National Secondary Drinking Water Standards (SMCLs)	40 CFR Part 143	To Be Considered	Establishes welfare-based standards for public water systems for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water.	Would be used as protective levels for groundwater or surface waters that are current or potential drinking water sources.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
USEPA Office of Drinking Water, Health Advisories		Potential To Be Considered	Health advisories are estimates of non-carcinogenic risk due to consumption of contaminated drinking water.	These advisories would be considered for contaminants in surface water and groundwater that is or could be used as a potable water source.
Cancer Slope Factors (CSFs)		To Be Considered	CSFs are guidance value used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	CSFs would be considered for development of human health protection Preliminary Remediation Goals (PRGs) for soil and groundwater at this site.
Reference Doses (RFDs)		To Be Considered	RFDs are guidance values used to evaluate the potential noncarcinogenic hazard caused by exposure to contaminants.	RFDs would be considered for development of human health protection PRGs for soil and groundwater at this site.
State Chemical-Specific ARARs				
Florida Drinking Water Standards	FAC Chapter 62-550	Applicable	Rule adopts Federal primary and secondary drinking water standards and also creates additional rules to fulfill State and Federal requirements for community water distribution systems.	These regulations would be used to determine cleanup levels for groundwater that is a potential source of drinking water.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Surface Water Quality Standards	FAC Chapter 62-302	Potentially Applicable	Rule distinguishes surface water into five classes based on designated uses and establishes ambient water quality standards (called Florida Water Quality Standards) for listed pollutants.	Because these standards are specifically tailored to Florida waters, they should be used to establish cleanup levels rather than the Federal AWQC.
Florida Groundwater classes, Standards and Exemptions	FAC Chapter 62-520	Applicable	This rule designates the groundwater of the state into five classes and establishes minimum "free from" criteria. This rule also specifies that Classes I & II must meet the primary and secondary drinking water standards listed in Chapter 62-550.	These regulations would be used to determine cleanup levels for groundwater that is a potential source of drinking water.
Contaminant Cleanup Target Levels Rule	FAC Chapter 62-777	Applicable	This document provides guidance for soil, groundwater, and surface water cleanup levels that can be developed on a site-by-site basis.	These guidelines would be used in determining cleanup goals.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal Location-Specific ARARs				
Endangered Species Act Regulations	50 CFR Parts 81, 225, 402	Potentially Applicable	This act requires Federal agencies to act to avoid jeopardizing the continued existence of federally listed endangered or threatened species.	If a site investigation or remediation could potentially affect an endangered species, these regulations would apply.
Historic Sites Act Regulations	36 CFR Part 62	Potentially Applicable	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	The existence of Natural Landmarks would be identified prior to remedial activities onsite including remedial investigations.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Fish and Wildlife Coordination Act Regulations	33 CFR Subsection 320.3	Potentially Applicable	Requires that the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and related state agencies be consulted prior to structural modification of any body of water, including wetlands. If modifications must be conducted, the regulation requires that adequate protection be provided for fish and wildlife resources.	If a remedial alternative involves the alteration of a stream or wetland, these agencies would be consulted.
National Environmental Policy Act (NEPA) Regulations, Wetlands, Floodplains, etc.	40 CFR Subsection 6.302 [a]	Potentially Applicable	These regulations contain the procedures for complying with Executive Order 11990 on wetlands protection. Appendix A states that no remedial alternative adversely affect a wetland if another practicable alternative is available. If no alternative is available, impacts from implementing the chosen alternative must be mitigated.	If remedial action affects a wetland, these regulations would apply.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
NEPA Regulations, Floodplain Management, Executive Order 11988	40 CFR Part 6, Appendix A	Potentially Applicable	Appendix A describes the policy for carrying out the Executive Order regarding floodplains. If no practicable alternative exists to performing cleanup in a floodplain, potential harm must be mitigated and actions taken to preserve the beneficial value of the floodplain.	If removal actions take place in a floodplain, alternatives would be considered that would reduce the risk of flood loss and restore and preserve the floodplain.
Fish and Wildlife Conservation Act	40 CFR Section 6.302	Potentially Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers.	US Fish & Wildlife Service (USFWS) officials would be consulted on how to minimize impacts of any remedial activities on any wildlife.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal Action-Specific ARARs				
RCRA Regulations, Identification and Listing of Hazardous Wastes	40 CFR Part 261	Potentially Relevant and appropriate for on-site treatment, storage, and disposal (TSD) facility and Applicable for off-site TSD facility	Defines the listed and characteristic hazardous wastes subject to RCRA. Appendix II contains the Toxicity Characteristic Leaching Procedure (TCLP).	These regulations would apply when determining whether waste onsite is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
Clean Air Act (CAA) Regulations, National Ambient Air Quality Standards (NAAQSs)	40 CFR Part 50	Potentially Relevant and appropriate for on-site TSD facility and Applicable for off-site TSD facility	Establishes primary (health-based) and secondary (welfare-based) air quality standards for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides emitted from a major source of air emissions. The NAAQSs form the basis for all regulations promulgated under the CAA. However, the NAAQSs themselves are non-enforceable and are not ARARs themselves.	Site remediation activities must comply with NAAQS. The principal application of these standards is during remedial activities resulting in exposures through dust and vapors. In general, emissions from CERCLA activities are not expected to qualify as a major source, and are therefore, not expected to be applicable requirements. However, the requirements may be determined to be relevant and appropriate for non-major sources with significantly similar emissions.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, Land Disposal Restrictions (LDRs)	40 CFR Part 268	Potentially relevant and appropriate for on-site TSD facility and applicable for off-site TSD facility	This regulation prohibits the land disposal of untreated hazardous wastes and provides criteria for the treatment of hazardous waste prior to land disposal.	Remedial actions that involve excavating, treating, and redepositing hazardous soil would comply with LDRs.
Clean Water Act (CWA), National Pollution Discharge Elimination System (NPDES)	40 CFR Parts 122 through 125, and 131	Potentially Relevant and Appropriate	NPDES permits are required for any discharges to navigable waters. If remedial activities include such a discharge, the NPDES standards would be ARARs.	Any alternative which would discharge into any navigable water would require compliance with these regulations including treatment, if necessary.
CAA National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Potentially Applicable	NESHAPs are a set of emissions standards for specific chemicals from specific production activities.	Emissions of hazardous air pollutants would be minimized by fugitive dust control and off gas treatment from the thermal desorption facility.
RCRA, Treatment Standards for Hazardous Debris - Thermal Desorption	40 CFR 268.45	Potentially Applicable	Sets treatment standards for using thermal desorption.	Any thermal desorption unit would be operated in compliance with treatment standards.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
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Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Air/Superfund National Technical Guidance	EPA Guidance: EPA/450/1-89/001-EPA/450/1-89/004	Potential To Be Considered	This guidance describes methodologies for predicting risks due to air release at a Superfund site.	These guidance documents would be considered when risks due to air releases from fugitive dust and thermal desorption are being evaluated.
Federal Facilities Compliance Act of 1992	HR 2194	Potentially Relevant and Appropriate	This act amends the Solid Waste Disposal Act to clarify provisions concerning the application of certain requirements to federal facilities, such as providing a conditional exception to RCRA's domestic sewage exclusion for federally owned treatment works (FOTWs). In general, it allows state agencies and the USEPA to enforce hazardous waste laws at government sites.	This act expands the domestic sewage exclusion policy to FOTWs. In addition, when wastewater is considered a hazardous waste under RCRA, but is mixed with domestic waste as it flows through the sewer system to the FOTW, the FOTW would not be required to meet the additional regulatory requirements for a RCRA facility.
OSHA Regulations, General Industry Standards	29 CFR Part 1910	Applicable	Requires establishment of programs to assure worker health and safety at hazardous waste sites, including employee-training requirements.	These regulations would apply to all response activities.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
OSHA Regulations, Occupational Health and Safety Regulations	29 CFR Part 1910, Subpart Z	Potentially Applicable	Establishes permissible exposure limits for workplace exposure to a specific listing of chemicals.	Standards are applicable for worker exposure to OSHA hazardous chemicals during remedial activities.
OSHA Regulations, Recordkeeping, Reporting, and Related Regulations	29 CFR Part 1904	Potentially Applicable	Provides recordkeeping and reporting requirements applicable to remedial activities.	These requirements apply to all site contractors and subcontractors and must be followed during all site work.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
OSHA Regulations, Health and Safety Standards	29 CFR Part 1926	Potentially Applicable	Specifies the type of safety training, equipment, and procedures to be used during the site investigation and remediation.	All phases of the remedial response project would be executed in compliance with this regulation.
RCRA Regulations, Contingency Plan and Emergency Procedures	40 CFR 264, Subpart D	Potentially Relevant and Appropriate	Outlines requirements for emergency procedures to be followed in case of an emergency.	The administrative requirements established in this rule would be met for remedial actions involving the management of hazardous waste.
CAA Regulations, New Source Performance Standards (NSPS)	40 CFR Part 60	Potentially Relevant and Appropriate	This rule establishes NSPS for specified sources that are similar to a source that has established NSPSs (such as air stripping technologies). The NSPSs limit the emissions of a number of different pollutants, including the six criteria pollutants list (for which NAAQSs are established) as well fluorides, sulfuric acid mist, and total reduced sulfur (including hydrogen sulfide [H_2S]).	This rule may be a relevant and appropriate requirement for a new source that is similar to a source that has established NSPSs (such as air stripping technologies). If it is determined that the remedy would create potential air impacts, the response action or the equipment for the response action may qualify as a new source; therefore, these requirements would be met.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
CWA Regulations, National Pretreatment Standards	40 CFR Part 403	Potentially Relevant and Appropriate	Sets pretreatment standards through the National Categorical Standards of the General Pretreatment Regulations for the introduction of pollutants from non-domestic sources into Publicly Owned Treatment Works (POTWs) in order to control pollutants that pass through, cause interference, or are otherwise incompatible with treatment processes at a POTW.	If groundwater is discharged to a POTW or the Federally Owned Treatment Works (FOTW), the discharge must meet local limits imposed by the POTW. A discharge from a CERCLA site must meet the POTW's pretreatment standards in the effluent of the POTW. Discharge to a POTW is considered an offsite activity and is, therefore subject to both the substantive requirements of this rule.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, General Facility Standards	40 CFR Subpart B, 264.10-264.18	Potentially Relevant and Appropriate	Sets the general facility requirements including general waste analysis, security measures, inspections, and training requirements. Section 264.18 establishes that a facility located in a 100-year floodplain must be designed, constructed, and maintained to prevent washout of any hazardous wastes by a 100-year flood.	If the remedial action involves construction of an onsite treatment facility, such as a groundwater treatment facility, the substantive requirements of this rule would be applicable requirements. A permitted treatment facility must be selected for offsite treatment. These regulations do not apply to the above ground treatment or storage of hazardous waster before it is injected into underground. However, this rule may be an applicable requirement for alternatives that do not involve groundwater reinjection.
RCRA Regulations, Miscellaneous Units	40 CFR Part 264, Subpart X	Potentially Relevant and Appropriate	These standards are applicable to miscellaneous units not previously defined under existing RCRA regulations. Subpart X outlines performance requirements that miscellaneous units be designed, constructed, operated, and maintained to prevent releases to the subsurface, groundwater, and wetland that may have adverse effects on human health and the environment.	The design of proposed treatment alternatives, not specifically regulated under other subparts of RCRA, must prevent the release of hazardous constituents and future impacts on the environment. This subpart would apply to onsite construction of any treatment facility that is not previously defined under the RCRA regulation.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, Preparedness and Prevention	40 CFR Part 264, Subpart C	Potentially Relevant and Appropriate	Outlines requirements for safety equipment and spill control for hazardous waste facilities. Facilities must be designed, maintained, constructed, and operated to minimize the possibility of an unplanned release that could threaten human health or the environment.	Safety and communication equipment would be incorporated into all aspects of the remedial process and local authorities would be familiarized with site operations.
RCRA Regulations, Releases from Solid Waste Management Units (SWMUs)	40 CFR Part 264, Subpart F	Potentially Relevant and Appropriate	Establishes the requirements for SWMUs at RCRA regulated TSD facilities. The scope of the regulation encompasses groundwater protection standards, point of compliance, compliance period, and requirements for groundwater monitoring.	These regulations would be followed for the treatment of hazardous waste.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
RCRA Regulations, Standards for Owners and Operators of Hazardous Waste TSD Facilities	40 CFR Part 264	Potentially Relevant and Appropriate	Establishes minimum national standards defining the acceptable management of hazardous wastes for owners and operators of facilities that treat, store, or dispose of hazardous wastes.	If remedial actions involving management of RCRA wastes at an off-site TSD Facility or if RCRA wastes are managed onsite, the requirements of this rule would be followed.
RCRA Regulations, Use and Management of Containers	40 CFR Part 264, Subpart I	Potentially Relevant and Appropriate	Sets standards for the storage of containers of hazardous waste.	This requirement would apply if a remedial alternative involves the storage of a hazardous waste (i.e. contaminated groundwater) in containers, prior to treatment.
SWDA Regulations, Underground Injection Control Regulations	40 CFR Parts 144, 146, 147, and 1000	Potentially Relevant and Appropriate	Establishes minimum program and performance standards for underground injection programs. Technical criteria and standards for siting, operation, maintenance, reporting, and recordkeeping are included in Part 146. Also requires protection of underground sources of drinking water.	Discharge of treated groundwater, by well injection, would be in accordance with all criteria and standards in these regulations, as well as meet all State Underground Injection Control Program requirements. Treated groundwater would meet all SWDA standards for reinjection prior to well injection.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State Action-Specific ARARs				
Florida Hazardous Waste Rules-October, 1993	FAC Chapter 62-730	Potentially Applicable	Adopts by reference sections of the Federal hazardous waste regulations and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation and disposal of hazardous wastes.	These regulations would apply if waste onsite were deemed hazardous and needed to be stored, transported, or disposed of properly.
Florida Drinking Water Standards	FAC Chapter 62-550	Potentially Applicable	This rule adopts Federal primary and secondary drinking water standards.	These regulations would apply to remedial activities that involve discharges to potential sources of drinking water.
Florida Wetland Application Regulations-November, 1989	FAC Chapter 62-611	Potentially Applicable	Sets requirements for discharge of domestic wastewater to wetland. This rule mainly addresses the discharge of domestic wastewater to wetlands. Discharge limits are established for biological oxygen demand (BOD), total suspended solids (TSS), nitrogen, and phosphorous.	This rule would be considered for remedial alternatives that would result in discharges to wetlands where these limits may be approached.
Florida Wastewater Facility Permits	FAC Chapter 62-620	Potentially Applicable	This rule establishes requirements for wastewater permits. It was published in November 1994; however, it is not effective until Florida is recognized as a "delegated" state.	Upon delegation, facilities in Florida requiring a wastewater permit will meet the permitting requirements of this rule.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Air Pollution Rules – October, 1992	FAC Chapter 62-2	Potentially Relevant and Appropriate	Establishes permitting requirements for owners of operators of any source that emits any air pollutant.	These requirements are appropriate for remedial action that could result in a release of regulated contaminants to the atmosphere, such as may occur during air stripping or excavation.
Florida Regulation of Stormwater Discharge – May 1993	FAC Chapter 62-25	Potentially Relevant and Appropriate	Establishes requirements for discharges of untreated stormwater to ensure protection of the surface water of the state.	Remedial actions would consider the impact of the discharge of untreated storm water.
Florida Underground Injection Control Regulations – April, 1989	FAC Chapter 62-28	Potentially Applicable	Establishes a State Underground Injection Control Program consistent with federal requirements and appropriate to the hydrogeology of Florida.	These regulations would be considered if remedial actions involve underground injection.
Florida Ambient Air Quality Standards – December, 1994	FAC Chapter 62-272	Potentially Applicable	Establishes ambient air quality standards to protect human health and public welfare.	These ambient air quality standards would be met for remedial actions involving the possible release exposure of contaminants to the atmosphere.
Air pollution Episodes – September, 1994	FAC Chapter 62-273	Potentially Relevant and Appropriate	This rule classifies an air episode as an air alert, warning or emergency and establishes criteria for determining the level of the air episode. It also establishes response requirements for each level.	These regulations would be adhered to if remedial actions involve air emissions.

Table 5-1 (Cont'd)
Synopsis of Federal and State ARARs and Guidance Materials for PSC 46

Remedial Investigation and Feasibility Study Work Plan for PSC 46
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Groundwater Permitting and Monitoring Requirments – April, 1994	FAC Chapter 62-522	Potentially Applicable	Establishes permitting and monitoring requirements for installations discharging to groundwater.	The substantive requirement for permitting would be met when discharge to groundwater is a possible remedial action. If these requirements are met under another permit, a separate discharge permit may not be required.
Florida Water Well Permitting and Construction Requirements – March 1992	FAC Chapter 62-736	Applicable	Establishes minimum standards for the location, construction, repair, and abandonment of water wells. Permitting requirements and procedures are established.	The substantive requirements for permitting would be met if remedial actions involve the construction, repair, or abandonment of monitoring, extraction, or injection wells.
Florida Rules on Hazardous Waste Warning Signs – July, 1991	FAC Chapter 62-736	Applicable	Requires warning signs at NPL and FDEP identified hazardous waste sites to inform the public of the presence of potentially harmful conditions.	This requirement will be met.
Florida Rules on Permits-November, 1994	FAC Chapter 62-4	Potentially Applicable	Establishes procedures for obtaining permits for sources of pollution.	These substantive requirements would be met during remediation.

6.0 SCHEDULE AND REPORTING

The notice to proceed (NTP) for the RI/FS will be based on the final approval of the RI/FS Work Plan and receipt of funding for its implementation. The following provides the planned duration for each task followed by the implementation schedule based on the NTP.

- RI field work – 60-day duration, to begin 30 days after NTP.
- Laboratory Analyses and Data Management – 60 day duration, beginning 90 days after NTP.
- Human Health and Ecological Risk Assessments – 30 day duration, beginning150 days after NTP.
- Prepare Draft RI, Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) Report for Partnering Team Review – 25 days, beginning 180 days after NTP
- Partnering Team Review – 30 days, beginning 205 days after NTP
- Conduct FS – 30 days, beginning 245 days after NTP
- Partnering Team Review of FS – 30 days, beginning 275 days after NTP
- Prepare Draft RI/FS Report – 30 days, beginning 305 days after NTP
- Partnering Team Review of Draft RI/FS Report – 30 days, beginning 335 days after NTP
- Submit Final RI/FS Report – beginning 365 days after NTP

The NASJAX Partnering Team has adopted a streamlined approach to the RI/FS reporting requirements. Based on this agreement, the results of the RI, HHRA, and ERA will be presented to the NASJAX Partnering Team at a regularly scheduled Partnering Team Meeting. The Partnering Team will provide comment based on this presentation. Based on this input from the Partnering Team, the FS will be conducted. A formal Draft-Final RI/FS Report will the be prepared for formal Team review. No formal draft reports will be submitted for review prior to completion of the FS.

7.0 SUMMARY

An RI/FS is planned for the DRMO at NASJAX. This work is to be conducted in general accordance with this RI/FS Work Plan. The RI/FS Work Plan summarizes site use history which has resulted in impacts to environmental media at the DRMO, documents the DQOs for the RI/FS, evaluates potential ARARs that may effect the evaluation of potential remedies, provides a schedule for the planned activities, and via incorporation of supporting work plans documents the methods, procedures, quality assurance/quality control, and health and safety requirements for the implementation of the RI/FS activities.

Appended to this document are the supporting work plans. These work plans have been developed as stand alone documents and have been approved by the NASJAX Partnering Team. These documents include Sampling and Analysis Plan (Appendix A), the Health and Safety Plan (Appendix B), and the Quality Assurance Project Plan (Appendix C).

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ABB Environmental Services (ABB), 1996. Remedial Investigation and Feasibility Study, Operable Unit 1, Naval Air Station Jacksonville, Jacksonville, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

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U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), 1998. Industrial Radiation Survey No. 27-MH 84444-98, Defense Reutilization and Marketing Office, Jacksonville, FL, June.

USEPA, 1994. Data Quality Objectives Process for Hazardous Waste Site Investigations. EPA QA/G-4HW. Peer Review Draft. June.

Historical Aerial Photograph, April 2, 1946.

APPENDIX A

Remedial Investigation/Feasibility Study Sampling and Analysis Plan for the Defense Reutilization and Marketing Office, Naval Air Station Jacksonville, Jacksonville, Florida, February 2001

Remedial Investigation/Feasibility Study
Sampling and Analysis Plan
for the
Defense Reutilization and Marketing Office (DRMO)

Naval Air Station Jacksonville
Jacksonville, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0135

February 2001

01JAX0050

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
SAMPLING AND ANALYSIS PLAN
FOR THE
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
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CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0135

FEBRUARY 2001

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ACRONYMS

AST	Above Ground Storage Tank
bgs	Below Ground Surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
COCs	Chemicals of Concern
CompQAP	Comprehensive Quality Assurance Plan
COPCs	Chemicals of Potential Concern
CTO	Contract Task Order
°C	Degree Celsius
DQOs	Data Quality Objectives
DOT	Department of Transportation
DPT	Direct-push Technology
DRMO	Defense Reutilization and Marketing Office
FDEP	Florida Department of Environmental Protection
FID	Flame Ionization Detector
FOL	Field Operations Leader
ft	foot/feet
HHRA	Human Health Risk Assessment
HLA	Harding Lawson Associates
IDW	Investigative-derived Waste
IRP	Installation Restoration Program
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NASJAX	Naval Air Station Jacksonville
NAVFAC	Naval Facilities Engineering Command
NFESC	Naval Facilities Engineering Service Center
NIRP	Naval Installation Restoration Program
NSF	National Sanitation Foundation
uohms/cm	Ohms per Centimeter
ORP	Oxidation Reduction Potential
PCBs	Polychlorinated Biphenyls
PSC	Potential Source of Contamination
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RAD	Radiological
RBCs	Risk-based Concentrations

ACRONYMS (CONT'D)

RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling Analysis Plan
SOP	Standard Operating Procedures
SOUTHDIV	Southern Division
SVOCs	Semi-volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOA	Volatile Organic Aromatic
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) Sampling and Analysis Plan (SAP) for Potential Source of Contamination (PSC) 46, Naval Air Station Jacksonville (NASJAX), Jacksonville, Florida, has been prepared by Tetra Tech NUS, Inc., (TtNUS) for the Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under the Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0134. This SAP outlines the requirements and describes the procedures for performing the field investigation for the Remedial Investigation (RI) at PSC 46, which includes the Defense Reutilization and Marketing Office (DRMO) at NASJAX.

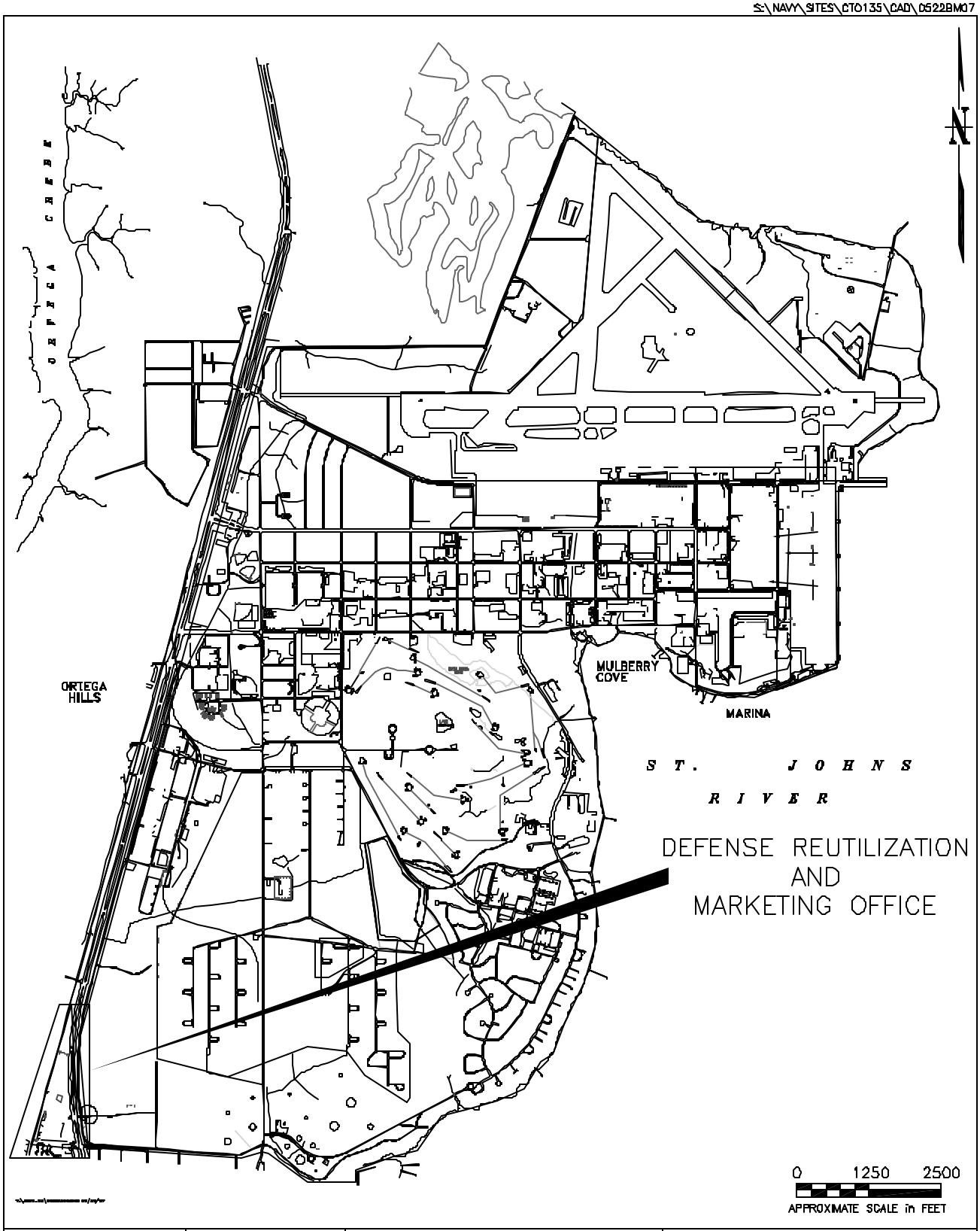
1.1 GENERAL SITE LOCATION

NASJAX is located in northeastern Florida in Jacksonville, Duval County on the west bank of the St. Johns River. It occupies about 3,896 acres (history section NASJAX Internet site, 2000). It is bounded to the west by U.S. Highway 17 and to the east by the St. Johns River. The DRMO is located west of U.S. Highway 17, which separates it from the remainder of NASJAX. The DRMO consists of a relatively flat fenced yard that contains administrative and storage buildings. A site location map that shows the general location of the DRMO is provided as Figure 1-1. A more detailed map depicting the DRMO and surrounding area is included on the DRMO site map, presented as Figure 1-2.

1.2 SITE HISTORY AND PRIOR INVESTIGATIONS

The DRMO site was assessed as part of the Installation Restoration Program (IRP) at NAS JAX. This assessment was conducted by Harding Lawson Associates (HLA) with the results summarized in two documents: 1) “Sampling Event Report”, Potential Source of Contamination 46 Defense Reutilization and Marketing Office Yard, July 1999; and 2) Potential Source of Contamination 46 “Further Remedial Action Decision Report,” an attachment to Appendix D/Volume 2 of the Naval Installation Restoration Program (NIRP) Plan. As a result of this investigation, the DRMO was designated as PSC 46 in the NAS Jacksonville NIRP.

A detailed description of the site history and prior investigation results is provided in the RI/FS Work Plan and is briefly summarized below.



DRAWN BY CW DATE 10/23/00		CONTRACT NO. N0522	
CHECKED BY DATE	SITE LOCATION MAP DEFENSE REUTILIZATION AND MARKETING OFFICE NAS JACKSONVILLE JACKSONVILLE, FLORIDA	APPROVED BY DATE	
COST/SCHED–AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 1–1	REV. 0

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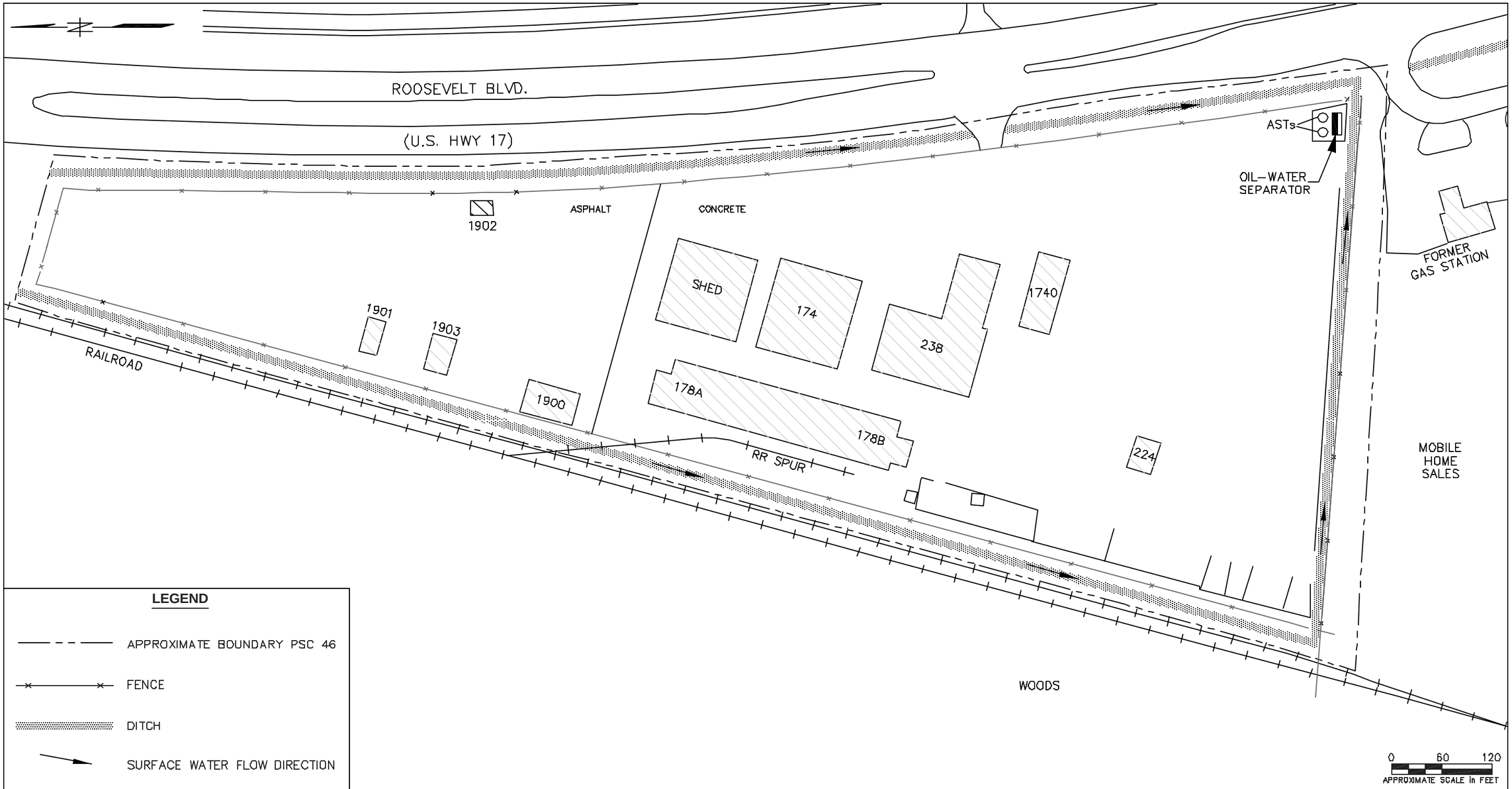

LEGEND

- APPROXIMATE BOUNDARY PSC 46
- FENCE
- DITCH
- SURFACE WATER FLOW DIRECTION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 5/23/00
CHECKED BY DATE
COST/SCHED–AREA
SCALE AS NOTED

SITE PLAN
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1–2 REV. 0

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

In the 1930's to the mid 1940's, the site was utilized by the U.S. Army for the dismantling and smelting of surplus aircraft. From the late 1940's to present, the facility has been used for the temporary storage, refurbishing, and resale of surplus Navy equipment to the general public. These activities may have resulted in impacts to various media at the DRMO including surficial soils, subsurface soils, groundwater, surface water, and sediments. Chemicals of Concern (COCs) identified in assessment work conducted by HLA include various volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and radiological compounds.

1.3 OBJECTIVE

This SAP comprises one element of a RI/FS to be performed at PSC 46. The objective of the RI supported by this SAP is to characterize the nature of contaminant impacts to soil, sediment, surface water and groundwater resulting from past operations at the site so that threats to human health and the environment can be adequately assessed and strategies for remedial action elucidated, as required.

Field elements of the SAP include the following activities:

- Surface soil/sediment and soil Investigation to identify source area, magnitude, and extent of previously reported COCs.

- Surface water and groundwater monitoring to determine if these media have been impacted by past operations at the DRMO.

- Radiological survey to determine if radiological contamination is present, and if so, characterization of the nature and extent of impact to environmental media at the DRMO.

The data collected during at the DRMO during this investigation will be used to support human health and ecological risk assessments of DRMO and any subsequent feasibility studies.

The strategy used to characterize the nature and extent of COCs at the DRMO was evaluated during the development of Data Quality Objectives (DQOs) that were subsequently approved by the NASJAX Partnering Team. The DQOs for the RI/FS are presented in the RI/FS Work Plan.

1.4 DOCUMENT ORGANIZATION

This SAP includes the site-specific information to be used for sampling at PSC 46. The project scope and objectives, background and site history are presented in Sections 1.0 and 2.0. Human health and ecological risk assessment procedures are discussed in Section 3.0. The proposed sampling plan, site-specific field and sampling procedures, and quality assurance/control measures are detailed in Section 4.0. The proposed laboratory analyses is presented in Section 5.0. The proposed project schedule and reporting are discussed in sections 6.0 and 7.0.

2.0 SITE DESCRIPTION

The DRMO is a relatively flat fenced site that contains administrative and storage buildings. Its approximate dimensions are 650 feet (ft) wide on the southern edge, 1,500 ft long, and 120 ft wide on the northern edge. In map view, these dimensions approximate a wedge shaped tract elongated north to south. The site is almost entirely paved or covered with buildings. Site detail is provided in Figure 1-2.

Drainage ditches are located along the east, west, and south sides of the fenced yard. Approximately 250 feet of the southern perimeter ditch is concrete lined (eastern portion). These ditches typically carry water only during rain events, with the exception of the concrete lined area of the southern ditch, which usually contains standing water. Runoff in the eastern and western perimeter ditches is to the south. The southern ditch receives outflow from the western ditch, flows eastward, and discharges to the eastern perimeter ditch at the southeast corner of the PSC. The eastern ditch parallels the west side of U.S. Highway 17. Approximately 400 ft south of the site, the ditch receives runoff from the Highway 17, I-295 Interchange. During rain events, flow from DRMO should be greatly diluted at this point. Near I-295, the ditch turns westward and shallows, allowing runoff flows to sheet flow into a wooded area. Runoff apparently seeps into the ground in this area and does not continue to the west. Approximately 1.5 miles beyond this wooded area lies the Ortega River.

An Amtrak railroad line parallels the western boundary of the DRMO. A spur from this main line enters the DRMO along the west-central property boundary and provides rail access to the largest of the site structures, Building 178 (A and B).

Two aboveground storage tanks (ASTs) and an oil-water separator are present at the southeast corner of the DRMO yard. Stormwater runoff from a large portion of the yard drains to the separator and is discharged into the concrete-lined portion of the south perimeter ditch. During heavy rain events, surface water runoff bypasses the oil water separator and discharges directly into the drainage ditch.

In order to address historical site practices, a Confirmation Sampling Event was conducted at the DRMO. As part of this investigation, a review of historical practices was performed. Interviews with knowledgeable parties and historical documents were relied upon by HLA to develop a sampling protocol. Detail regarding site use history is provided in the RI/FS Work Plan.

The Confirmation Sampling Report (HLA, 1999) documents the results of this investigation. Based on the data obtained, impacts to surface soil, subsurface soil, sediment, surface water, and groundwater were identified. Based on these results, the DRMO site was designated in the IRP as requiring further

evaluation via the RI/FS process to determine if the site poses a threat to human health and the environment, and to select proper remedies, if appropriate.

3.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The primary objective of the RI/FS is to ensure protection of human health and the environment. In order to achieve these objectives, the SAP is designed to provide the data necessary to conduct both human health and ecological risk assessments. The following two sections briefly describe the human health and ecological risk assessment process that will be conducted for PSC 46.

3.1 HUMAN HEALTH RISK ASSESSMENT

A human health risk assessment (HHRA) will be performed based upon surface soil, subsurface soil, groundwater, surface water, and sediment quality at the site. Analytical data generated during the upcoming event and data from previous investigations will be examined to determine whether reported chemical concentrations pose a significant threat to human receptors. The general methodologies, which will be used to assess human health risks, are described in Appendix A. United States Environmental Protection Agency (USEPA) Region III Risk-based concentrations (RBCs) (1998) and Florida Department of Environmental Protection (FDEP) soil, surface water, and groundwater criteria will be used to identify site- and media-specific chemicals of potential concern (COPCs) at the site.

In the DQO process, it was agreed by the NASJAX Partnering Team to limit the HHRA to the following potential receptor groups.

- Site Maintenance Workers
  - Surface Soil: ingestion, dermal contact, and inhalation of particulates
  - Groundwater: ingestion
  - Surface Water: ingestion and dermal contact

- Excavation Workers
  - Surface and Subsurface Soil: ingestion, dermal contact, and inhalation of particulates
  - Groundwater: ingestion and dermal contact

- Occupational Workers
  - Surface Soil: ingestion, dermal contact, and inhalation of particulates

- Future Residents (Adult and Children)
  - Surface Soil: ingestion, dermal contact, and inhalation of particulates
  - Groundwater: ingestion and inhalation (showering – adults only)
  - Surface Water: ingestion and dermal contact

- Sediment: ingestion and dermal contact

Additional details on receptors and complete exposure pathways to be considered in the development of the HHRA are provided in Appendix A.

3.2 ECOLOGICAL RISK

A quantitative ecological risk assessment will be performed at PSC 46. Media to be considered in the ecological risk assessment are soil, groundwater, surface water, and sediment. Analytical data generated under this SAP and previously reported data will be used to determine if measured chemical concentrations pose a significant threat to potential ecological receptors. The general methodologies, which will be used to assess risks to ecological receptors, are described in Appendix B.

The ecological risk assessment approach consists of eight steps in accordance with USEPA (1997) and Navy (1999) guidance. Based on evaluation of the existing site data conducted during the DQO process, it is believed that risk to ecological receptors may be limited to ecological screening (through step 3a of Navy guidance).

Initial screening activities include identification and selection of COPCs, which will be accomplished by comparing maximum detected site concentrations to USEPA Region IV screening values and FDEP concentrations. The ecological risk assessment will include a “preliminary problem formulation” step, including review of historical documents, COPCs, site characteristics, photographs, maps, and notes from site visits. Media of concern include soil, sediment, groundwater and surface water. Receptors may be exposed to contaminants through direct contact, inhalation and/or ingestion. Preliminary receptors of concern at PSC 46 may be:

- Terrestrial invertebrates,
- Terrestrial vertebrates,
- Aquatic life, and
- Benthic invertebrates.

These may change because pathways may be incomplete for all these of receptors. The problem formulation step will include the development of a conceptual exposure model.

The latter part of the screening assessment will include an evaluation of ecological effects, which will establish screening threshold levels for contaminant concentrations in exposure media, and if needed, for contaminant ingestion rates. A screening exposure assessment will entail the compilation of maximum

contaminant concentrations in exposure media. If necessary, maximum ingestion rates for indicator species will be calculated. The risk calculations will be in the form of ratios, the exposure levels to be divided by the threshold values.

4.0 SAMPLING PLAN

The proposed Sampling Plan for the RI includes the following tasks. Task detail is provided in subsequent sections.

Radiological Survey: This activity will be conducted by a subcontractor, B. Koh & Associates, Inc. The survey will be restricted to the western property boundary extending from south of the previously reported radiological (RAD) areas to north of Building 1901. Location of the proposed radiological survey is shown on Figure 4-1.

Soil Sampling: This activity will include collection of one soil sample each from 17 non-biased grid locations and collection of two soil samples each from 20 biased locations. Locations of the proposed soil samples and those collected by HLA in 1997 are shown on Figure 4-2.

Soil/Sediment Sampling in Perimeter Ditches: This activity will include collection of 17 soil (where ditch is dry) or sediment (where water is present in ditch) samples from the perimeter ditches. Locations of the proposed soil/sediment samples and those collected by HLA in 1997 are shown on Figure 4-3.

Surface Water Sampling: This activity will include collection of seven surface water samples from the southern and eastern perimeter ditches. Locations of the proposed surface water samples are shown on Figure 4-3.

Groundwater Sampling: This activity will include a single groundwater sampling event from six proposed micro wells at PSC 46. Proposed micro well locations are shown on Figure 4-4.

Laboratory Analyses: Table 4-1 provides the proposed analytical methods to be utilized during the RI. The range of analyses to be conducted is dependent on the location and purpose of the sample. Laboratory methods for each media and identified area of concern were chosen based on historical characterization data and on the nature of each potential concern. The analytical programs for each area of concern were approved by the NASJAX Partnering Team and are documented in the DQOs for this project (see Section 4.0 of the Work Plan for information on the DQOs). Specific laboratory analyses to be performed on the various media are presented in the following sections.

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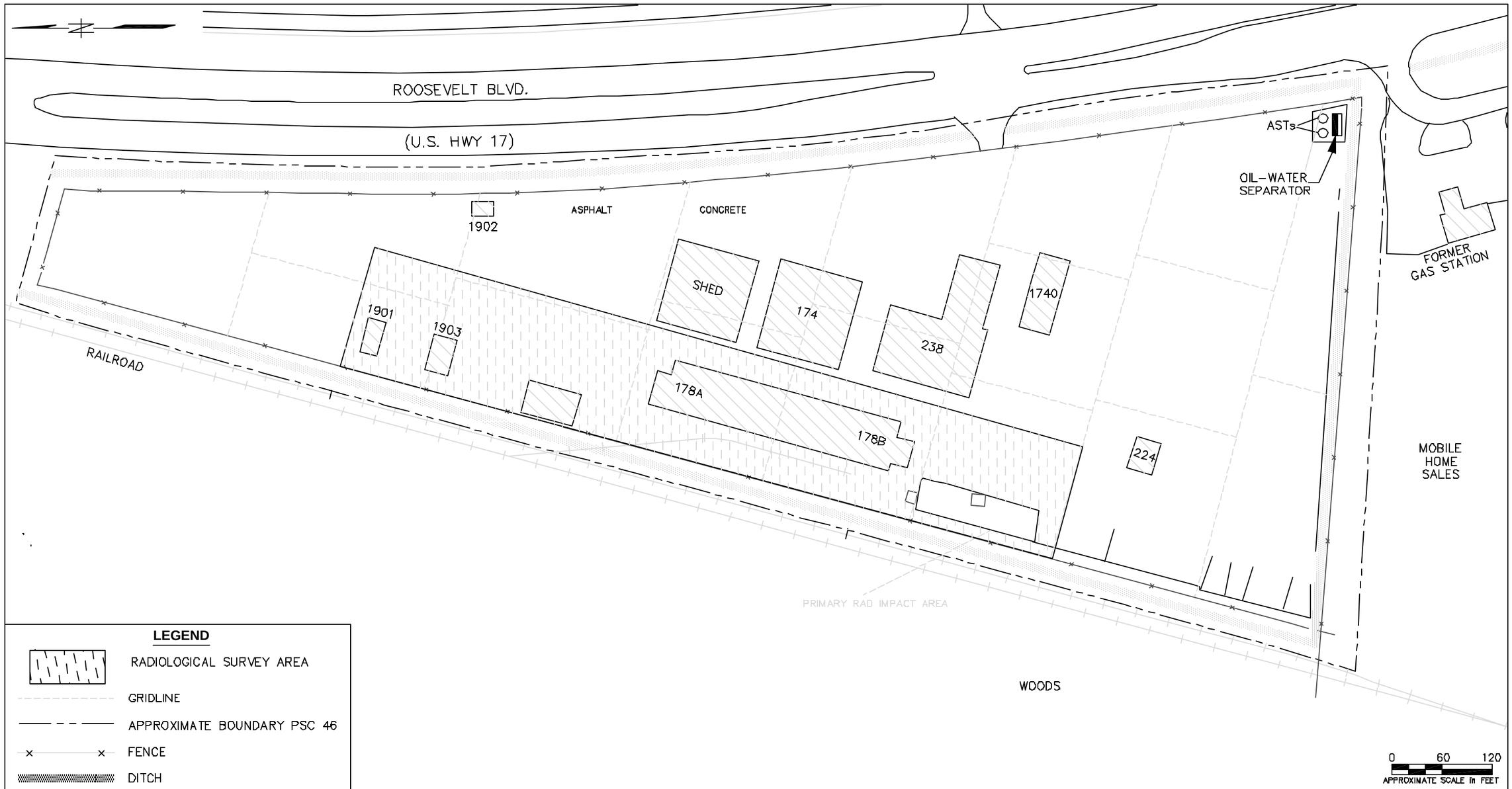

LEGEND

- RADIOLOGICAL SURVEY AREA
- GRIDLINE
- APPROXIMATE BOUNDARY PSC 46
- FENCE
- DITCH

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/27/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PROPOSED RADIOLOGICAL SURVEY LOCATION MAP
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-1 REV. 0

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

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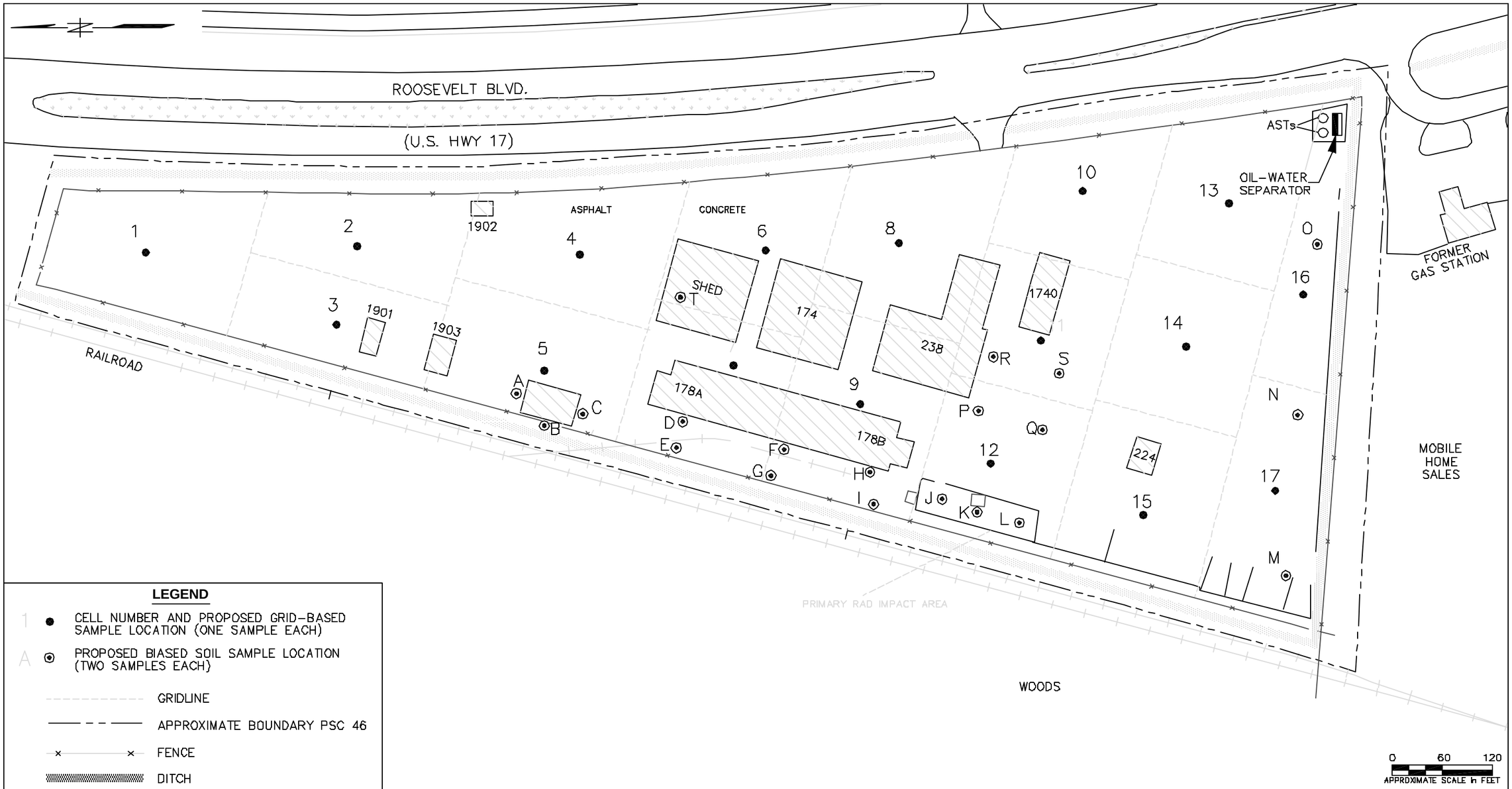

LEGEND

- 1 ● CELL NUMBER AND PROPOSED GRID-BASED SAMPLE LOCATION (ONE SAMPLE EACH)
- A ⊙ PROPOSED BIASED SOIL SAMPLE LOCATION (TWO SAMPLES EACH)
- GRIDLINE
- APPROXIMATE BOUNDARY PSC 46
- FENCE
- DITCH

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/27/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PROPOSED SOIL SAMPLE LOCATIONS
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-2 REV. 0

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

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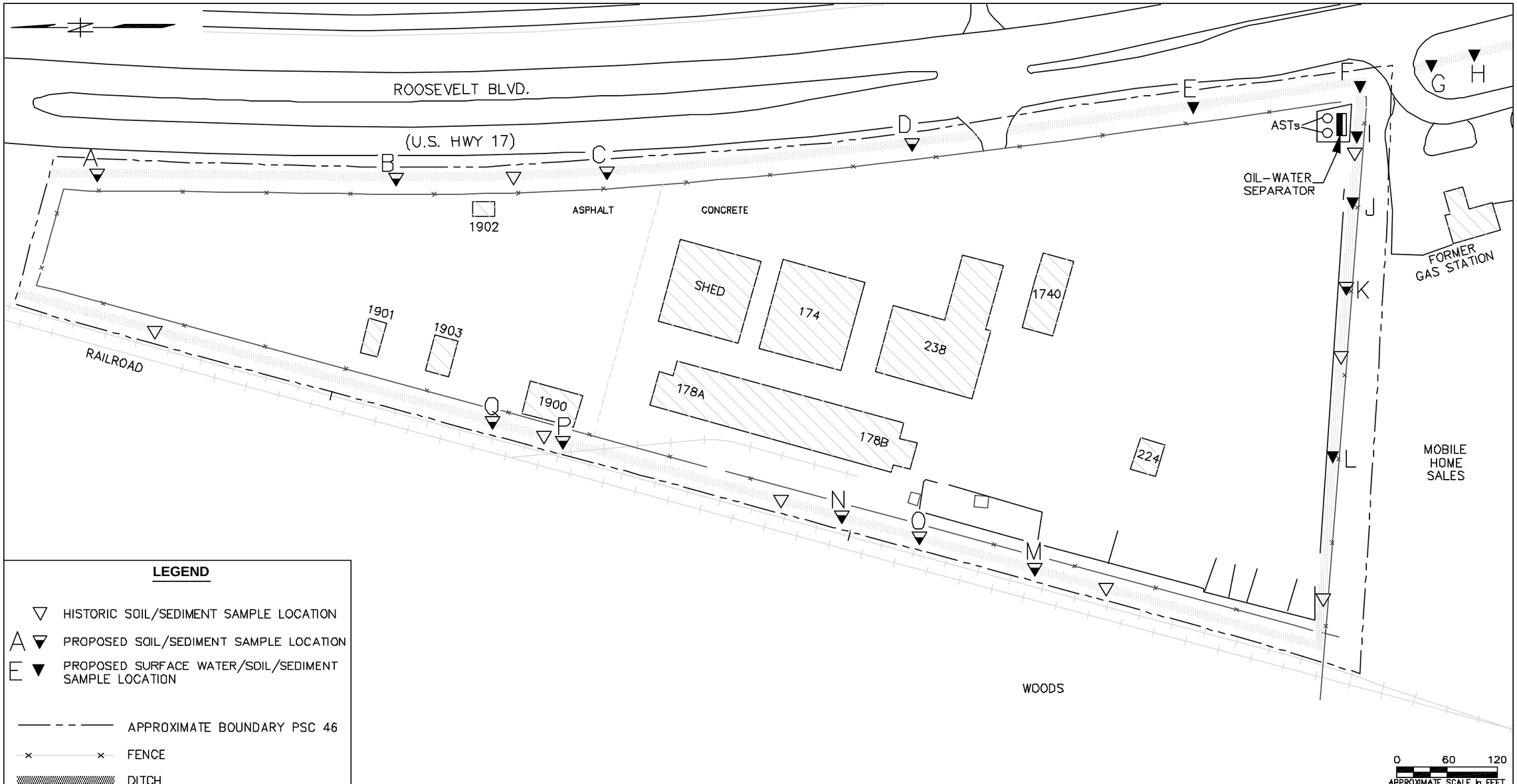

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/27/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PROPOSED DITCH SAMPLE LOCATIONS
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4–3 REV. 0

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

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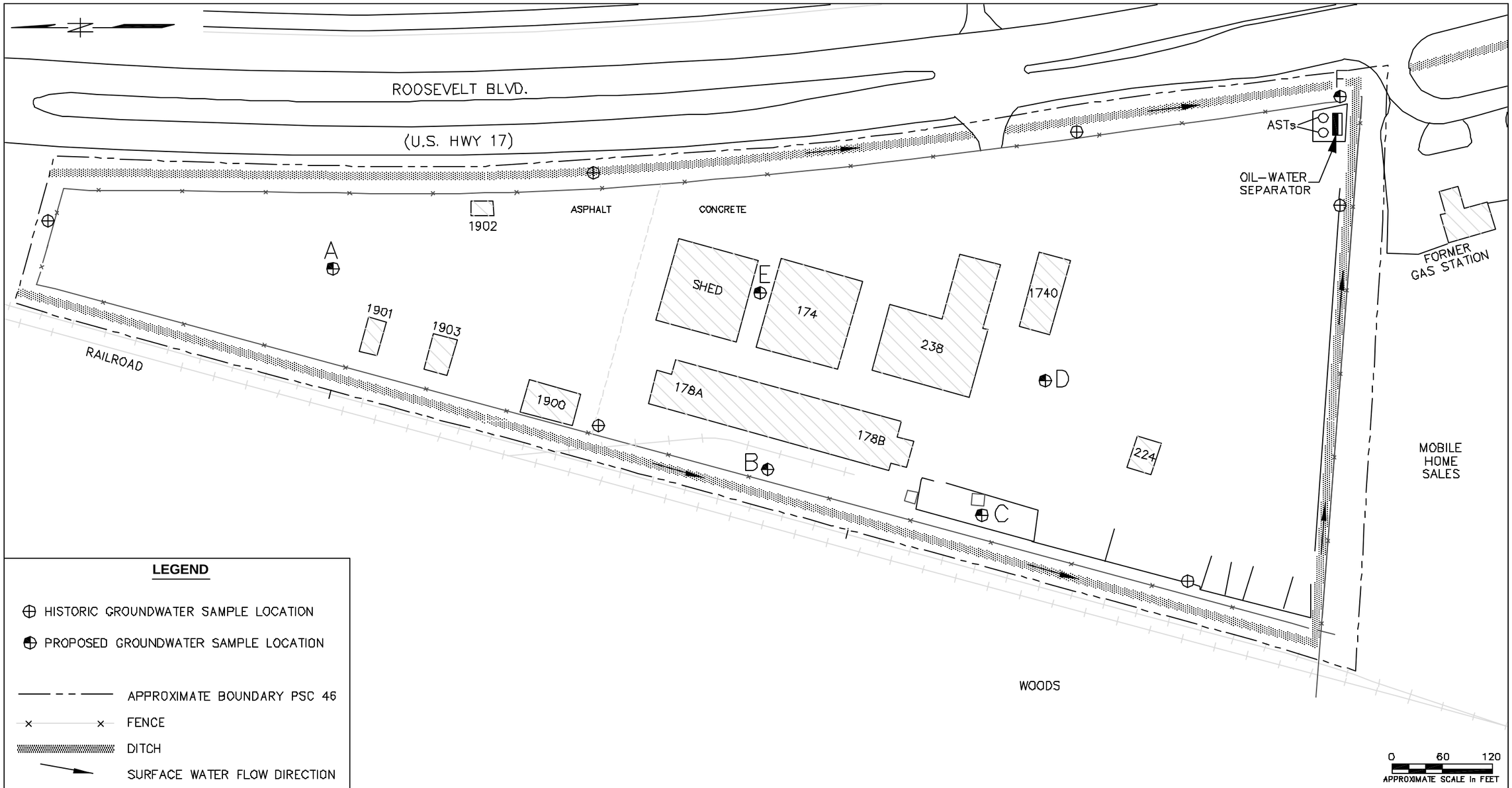

LEGEND

- ⊕ HISTORIC GROUNDWATER SAMPLE LOCATION
- ⊕ PROPOSED GROUNDWATER SAMPLE LOCATION
- APPROXIMATE BOUNDARY PSC 46
- FENCE
- DITCH
- SURFACE WATER FLOW DIRECTION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/27/00
CHECKED BY DATE
COST/SCHED–AREA
SCALE AS NOTED

PROPOSED MONITORING WELL LOCATIONS
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4–4 REV. 0

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

Table 4-1
Sampling Parameters and Standards

Sampling Analysis Plan
Defense Reutilization and Marketing Office
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Test Method
Chemical Constituents	
TCL Volatiles	SW-846 8260B
TCL SVOCs	SW-846 8270C
TCL Pesticides & PCBs	SW-846 8081
TAL Metals	SW-846 6010/7000
Radiological Speciation Analyses	
Gross alpha/beta	EPA 900.0, SW-846-9010
Radium 226	EPA 900.0, SW-846-9315
Radium 228	EPA 900.0, SW-846-9320
Radium 226/228	EPA 901.1M
Thorium (228,230,232)	LANL ER 200M
Total Uranium	ASTM-D 3972-90M, EPA 901.1M ASTM-D-5174-91
Uranium (234,235,238)	ASTM-D 3972-90M
Gamma Emitting Nuclides	EPA 901.1M

Notes:
TAL = Target Analyte List
TCL = Target Compound List
SVOCs = Semi-volatile Organic Compounds
PCBs = Polychlorinated biphenyls
EPA = Environmental Protection Agency
SW = Solid Waste
ASTM = American Society of Testing Methods

This section describes in detail the activities to be performed for each of the above items.

4.1 DRMO RADIOLOGICAL SCREENING SURVEY

B. Koh and Associates, a radiological specialty contractor will perform the RAD screening survey. The screening survey will be conducted over the west side of the DRMO in the area indicated in Figure 4-1. The purpose of the screening survey will be to determine/verify the areas of impact, and to provide data for the selection of biased sample locations showing RAD impact. The methods and procedures are described as follows.

A 100 percent walkover radiation survey will be performed using a Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 44-10 Gamma Scintillation (2-inch by 2-inch NaI) Detector (or equivalent). Areas exhibiting elevated radiation levels, i.e., twice background, will be recorded and marked for sampling.

4.2 SOIL SAMPLING

A total of 57 soil samples will be collected from inside the fenced area at the locations shown on Figure 4-2. Soil samples will be collected either by hand auger methods or by direct push technology (DPT) methods. Soil sampling methods will be conducted in accordance with TtNUS approved Comprehensive Quality Assurance Plan (CompQAP) (#980038) and by our Standard Operating Procedures (SOP) provided in Appendix C.

4.2.1 Grid Based Soil Sampling

Grid based soil sampling will be conducted to determine if shallow soils in the site interior have been impacted by historical practices. This nonbiased approach will consist of establishing a grid with 17 cells as shown on Figure 4-2. A single sample location will be established near the center of each cell. A concrete/asphalt-coring machine will be used to penetrate pavement where necessary. A hang auger will be used to collect shallow soil samples beneath the pavement. The samples will be collected from the uppermost non-fill materials from the 0-12” interval for analyses. A second sample will be collected from the 24-36” interval and held. The soil samples will be field screened for the presence of organic vapors using a flame ionization detector (FID).

Shallow interval (0-12”) grid based samples will be tested in the laboratory for Target Analyte List (TAL) metals, pesticides, and PCBs by the methods detailed in Table 4-1.

Approximately 25 percent (four total) of the soil samples will be tested for VOCs. The samples to be selected for VOC analyses will be chosen based on FID screening results. If all FID results are non-detects, samples selected for VOC analyses will be field selected based on proximity to potential sources of contamination. If VOCs are encountered frequently, additional sampling may be warranted. The need for additional sampling will be determined by the appropriate Partnering Team members.

In addition, three grid based soil samples will be tested for SVOCs. The three samples will be collected from three cells ranging from cells 6-17 and will be selected based on the FID results. The surface in cells 1-5 is paved with asphalt, which is a potential source of SVOC constituents. Therefore, only grid areas covered by concrete (6-17) will be candidates for SVOC analyses.

The deep interval samples (24-26") will be held for potential future analyses. The samples will only be tested should results from shallow interval analyses indicate the need for depth delineation of COPCs.

4.2.2 Biased Soil Sampling

Biased soil sampling will be conducted to evaluate if shallow and deeper soils in the interior portion of the DRMO have been impacted by historical practices. The biased sampling approach will consist of establishing approximately 22 boring locations in previously identified areas of impact or areas suspected to have a higher probability of impact based on proximity to historical operations. For planning purposes, the locations of these borings are provided (Letters A through M) on Figure 4-2. It should be noted that biased soil sample locations from the west side of the site may be adjusted based on the results of the radiological screening survey.

Two soil samples will be collected from each biased sample location using DPT methods. Soil samples will be screened with a FID in non-RAD areas and by both FID and a Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 44-9 Pancake Geiger-Muller (G-M) Detector (or equivalent) within RAD impact areas. An exposure rate measurement will be obtained at each soil sample location using a Ludlum Model 19 Micro R Survey Meter (or equivalent). Base wide background radiation for NASJAX has been established in the RI/FS for Operable Unit 1 (March, 1996).

All biased samples will be tested in the laboratory for TAL metals, pesticides, and PCBs by the methods detailed in Table 4-1.

Approximately 25 percent (10 total) of the soil samples will be tested for VOCs. The samples to be selected for VOC analyses will be chosen based on FID screening results. If all FID results are non-detect, samples selected for VOC analyses will be field selected based on proximity to potential sources of contamination.

In addition, eight biased soil samples will be tested for SVOCs. The eight samples will be collected from biased samples located beneath concrete. Biased soil sample locations on the north side of the site are not candidates for SVOC analyses since presence of these constituents may be attributable to direct contact with or leaching of the asphalt pavement.

Twenty five percent (approximately nine) of the soil samples collected from the RAD impact areas will be submitted for RAD speciation analyses (Table 4-1) which include the following: radium 226; radium 228; radium 226/228; thorium 228, 230, and 232; total uranium; uranium 234, 235, and 238; gross alpha/beta; and gamma emitting nuclides. The samples chosen for these analyses will be selected based on the RAD field screening results.

4.3 DRAINAGE DITCH SAMPLING

4.3.1 Soil/Sediment Sampling

Seventeen (17) soil or sediment samples will be collected from the upper 0–2 ft interval from the perimeter ditches at locations shown on Figure 4-3. All soil/sediment samples will be collected by trowel method and field screened for RAD impact.

A total of 17 samples will be tested for SVOCs, metals, pesticides, and PCBs. Four of the samples will be tested for soil RAD components as described in the previous section. Since the perimeter ditches on the east and west side of DRMO are dry except during rain events, it is estimated that roughly half of these samples will be collected from dry parts of the ditch and classified as “soil” and the other half from areas of the ditch containing water, and classified as “sediment.” Sediment samples from the concrete lined portion of the ditch will be collected from transient sediment on top of the concrete.

In addition, a representative sample will be tested for Total Organic Carbon and grain size analyses. The sample will be collected from the vicinity of the out-fall of the southern drainage ditch.

4.3.2 Surface Water Sampling

Seven (7) surface water samples will be taken from the eastern and southern perimeter drainage ditches at the locations shown on Figure 4-3. Samples will be collected by the dip method using the dedicated pre-cleaned bottleware supplied by the laboratory and analyzed for TAL metals. Two of the samples, collected closest to the RAD impacted areas, will be tested for water RAD components as previously described.

4.4 WELL INSTALLATION

4.4.1 "Micro" Monitoring Well Installation

Four "micro" monitoring wells will be installed to an estimated depth of 15 ft below ground surface (bgs) using DPT drilling methods. Pre-packed monitoring well borings shall be advanced using DPT drilling techniques. The wells are intended to assess groundwater quality in the shallow aquifer. Based on historical data, it is estimated that the wells will be approximately 15 ft deep and will be designed to screen the water table. The pre-packed screens consist of 3-foot sections and have outside diameters of 1.5 inches and an inside diameter of 0.5 inches. The inner component of the screen is 0.5-inch Schedule 40 PVC with 0.01-inch slots. The outer component of the screen is stainless steel wire mesh with a pore size of 0.011 inches. The screens are pre-packed with a 20-40 grade silica sand. Each section of well casing and screen shall be National Sanitation Foundation (NSF) approved. The total well screen length for water table wells will generally be 9 ft, but may be longer or shorter based on sub-surface conditions encountered.

Pre-packed wells will be installed through the DPT rods upon completion of each well boring. A minimum 2-foot thick 30-65 grade clean silica sand seal will be installed above the sand pack. The depths of backfill materials will be constantly monitored during well installation using a weighted, stainless steel or fiberglass tape measure. The remaining annulus above the choke sand seal will be backfilled with a 20:1 cement/bentonite grout to the surface using a tremie pipe.

The geologist will arrange for access to drilling locations and arrange for subsurface utility clearance approval. The subcontractor, however, will be required to hand dig, using a post-hole digger or other appropriate method, from the surface to a minimum of 4 ft bgs at each location to ensure that utilities are not present.

4.4.2 Monitoring Well Installation

Two 2-inch monitoring wells will be installed to an estimated depth of 15 feet bgs. The purpose is to provide sufficient well design for performing step draw down tests requested by the U. S. Geological Survey (USGS). Permanent monitoring wells will be installed using the hollow stem auger drilling techniques. Monitoring wells will be constructed of 2-inch diameter Schedule 40, flush-joint PVC riser and flush-joint 0.01-inch factory-slotted well screen. Shallow monitoring well screen sections will be 10 feet in length and positioned to intersect the water table. After the borings are drilled to the desired depth, the well will be installed through the augers. A completed monitoring well log will be recorded for each well installed.

The monitoring wells will be developed no sooner than 24 hours after installation to remove fine sediment material from around the screened interval. Wells will be developed by bailing and surging, or by pumping, as determined by the field geologist. Temperature, pH, and specific conductance measurements will be recorded on the development water. Wells will be developed up to a maximum of one hour or until these measurements stabilize and the development water is visibly clear. Water quality stabilization will be determined using the following criteria: temperature +/-1.0 degree Celsius (°C), pH +/-0.1standard unit, and specific conductivity +/-10 micro ohms per centimeter (*uohms*/cm).

4.5 GROUNDWATER SAMPLING

Six groundwater samples will be collected and tested for TCL VOCs, SVOCs, pesticides, PCBs, TAL metals and radiological constituents (total and isotopic uranium, total and isotopic thorium, total and isotopic radium, and gross alpha and gross beta). In addition, groundwater will be tested for natural attenuation parameters: nitrate, nitrite, sulfate, chloride, methane/ethane/ethene, total iron, total organic carbon (TOC), sulfide, ammonia, and total kjeldahl nitrogen (TKN). Groundwater samples, collected during the sampling event will be collected in accordance with TtNUS' FDEP-approved CompQAP (# 980038). Prior to obtaining samples from any of the wells, water levels and total well depths will be measured and recorded. Prior to sampling, each well will be purged using a peristaltic pump. Three to five well volumes will be purged. If wells are purged dry with less than three well volumes removed, the water level in the well will be allowed to recover at least 80 percent, then a sample will be collected. Field measurements of pH, temperature, specific conductance, turbidity, dissolved oxygen and oxidation/reduction potential (ORP) will be taken after each volume of water is purged. If these parameters do not stabilize after three volumes, up to five volumes will be removed. Natural attenuation parameters for dissolved oxygen, alkalinity, carbon dioxide, sulfide, sulfate, ferrous iron, and hydrogen sulfide will be taken in the field immediately after purging.

Samples will be obtained using a peristaltic pump and a low flow quiescent sampling technique. The samples will be transferred directly into the appropriate (pre-preserved if necessary) sample bottles for analysis. If required, samples to be analyzed for volatile constituents shall be taken first and immediately sealed in the vial so that no headspace exists.

4.6 EQUIPMENT DECONTAMINATION – SAMPLING EQUIPMENT

The equipment involved in field sampling activities will be decontaminated prior to and during sampling activities in accordance with TtNUS's SOP and CompQAP. All equipment used for collecting samples will

be decontaminated prior to beginning field sampling and between sample locations. The following decontamination steps will be taken:

- Tap water and Alconox or liquinox detergent rinse.
- Tap water rinse.
- If trace metals are to be sampled rinse with 10-15% reagent grade nitric acid (the nitric acid should not be used on stainless steel sampling equipment).
- Rinse thoroughly with de-ionized, analyte-free water.
- Rinse with isopropanol
- Rinse thoroughly with de-ionized, analyte-free water
- Air dry.
- Wrap equipment in aluminum foil until use.

Field instruments, used for measuring pH, conductivity, and temperature, etc., will be rinsed first with tap water, then with de-ionized, analyte-free water, and finally with the sample liquid.

4.7 WASTE HANDLING

A waste staging area will be established at the site to store investigative-derived waste (IDW) generated during the sampling activities. Purge water will be collected and containerized in Department of Transportation (DOT) approved (Specification 17C) 55-gallon drums. Each drum will be sealed, labeled and left at a drum staging area, pending groundwater analytical results and/or composite waste sample results for disposal. Decontamination materials generated during the site investigation will be containerized for proper disposal. The disposal of IDW will be coordinated through the NASJAX environmental project manager, who will receive a copy of the Drum Logs at the completion of field activities.

4.8 SAMPLE HANDLING

Sample handling includes the field-related consideration concerning the selection of sample containers, preservatives, allowable holding times and analysis requested. In addition, sample identification, packaging and shipping will be addressed. Sample handling procedures will be in accordance with TtNUS' FDEP-approved CompQAP No. 980038.

4.9 SAMPLE PACKAGING AND SHIPPING

Samples will be packaged and shipped in accordance with TtNUS' CompQAP. During sample collection and in preparation for sample shipment, the field operations leader (FOL) will be responsible for completion of the following:

- Sample labels
- Chain-of-Custody seals
- Appropriate labels applied to shipping coolers
- Chain-of Custody Forms
- Federal Express Air Bills

TtNUS' CompQAP addresses the topics of containers and sample preservation. A summary of bottleware requirements, preservation requirements, and sample holding times are also provided in the CompQAP.

4.10 SAMPLE IDENTIFICATION

Each sample collected will be assigned a unique sample tracking number. Unless otherwise designated by NASJAX, the sample tracking number will consist of a three-segment, alphanumeric code that identifies the site designation, location, the sampling event identifier or sample depth (in case of soil samples) and the quality control (QC) designation, if applicable. Any other pertinent information regarding sample identification will be recorded in the field logbook. The alphanumeric coding to be used in the sample system is explained below:

Sample Identifier:

Site designation – location – other identifier

(Do not use dashes (-) in identifier. They are used here for illustration purposes only.)

Where:

Site Designation = DRMO

Location = either a monitor well identifier (e.g., MW2), or soil/sediment sample location identifier (e.g., PSS1, S&W1). This character string will either be three or four digits in length.

Note: Surface soil/sediment sample locations will be the sample location letter presented on Figure 4-3 (i.e., SS-A, SW-E).

Note: For quality assurance duplicate samples add the letter "D" to the end of the "other identifier" to designate duplicate.

For example, a groundwater sample collected from monitoring well MW-2 at the DRMO Site would be designated as DRMO MW2.

A duplicate sample from monitoring well MW-2 at DRMO would be DRMO MW2 D.

A surface soil sample taken from location SS-A at DRMO would be DRMO SS-A 01.

A sediment sample taken from location SED-A at DRMO would be DRMO SED-A.

A surface water sample taken from location SW-A at DRMO would be DRMO SW-A.

For other quality assurance (QA) samples, use a character string, which includes the site name, and an alpha numeric identifier which details the number of the type of sample and the type of sample separated by a dash (-). See below for some examples.

Field Blank (F) Example:

The first field blank (F) from the DRMO site would be DRMO-01F.

Rinsate Blank (B) Example:

The first equipment rinsate blank (B) from the DRMO site would be DRMO-01B.

Trip Blank (T) Example:

The first trip blank (T) from the DRMO site would be DRMO-01T.

Information regarding sample labels to be attached before shipment to a laboratory is contained in SOP SA-6.3 included in Appendix C. Examples of sample labels, chain of custody seals, and chain-of-custody forms are included in Appendix D.

4.11 SAMPLE CUSTODY

The chain-of-custody begins with the release of the sample bottles from the laboratory and must be documented and maintained from that point forward. To maintain custody of the sample bottles or samples, they must be in someone's physical possession, in a locked room or vehicle, or sealed with an intact custody seal. When the possession of the bottles or samples are transferred from one person to another, it will be documented in the field logbook and on the chain-of-custody.

4.12 QUALITY CONTROL (QC) SAMPLES

In addition to periodic calibration of field equipment and appropriate documentation, QC samples will be collected or generated during environmental sampling activities. QC samples may include field blanks, field duplicates, matrix spike/matrix duplicates, field replicates, and trip blanks. Each type of field quality control sample is defined as follows:

Rinsate Blank - Rinsate blanks are obtained under representative field conditions by running organic free water through sample collection equipment (bailer, split-spoon, etc.) after decontamination and placing it in the appropriate containers for analysis. Rinsate blanks will be used to assess the effectiveness of decontamination procedures. If necessary, rinsate blanks may be collected for each type of non-dedicated sampling equipment used.

Field Duplicate - Field duplicate(s) are two water samples collected independently at a sample location during a single act of sampling under representative field conditions. Field duplicates sample frequencies are provided in Table 5-1 and Table 5-2. If necessary, the duplicates shall be analyzed for the same parameters in the laboratory as indicated in Table 4-1.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Matrix spikes are collected in duplicate for every environmental medium. The purpose of MS/MSD samples is to assure precision and accuracy of laboratory analytical methods.

Trip Blanks - Trip blank(s) will be prepared at the laboratory facility and will accompany the volatile organic aromatics (VOA) vials to the sampling site and back to the laboratory. Trip blanks are not required by the FDEP unless 10 or more volatile samples are collected during a given sampling event. Trip blank sample frequency is provided in Table 4-2.

TABLE 4-2
QUALITY CONTROL SAMPLE FREQUENCY

Sampling and Analysis Plan
Defense Reutilization and Marketing Office
Naval Air Station Jacksonville
Jacksonville, Florida

Number of Samples	Precleaned Equipment Blank	Field Cleaned Equipment Blank	Trip Blank (VOCs)	Duplicate
10 or more	Minimum of one then 5%	Minimum of one then 5%	One per cooler	Minimum of one then 10%
5 to 9	one*	one*	NR	one
Less than 5	one*	one*	NR	NR
NR = Not required * Note: For 9 or fewer samples, a precleaned equipment blank or a field cleaned equipment blank is required. A field-cleaned equipment blank must be collected if equipment is cleaned in the field.				

4.13 FIELD MEASUREMENTS

Certain field measurements will be recorded during sampling activities, including temperature, pH, specific conductance, dissolved oxygen, ORP and turbidity (aqueous samples) and net organic vapor content (air samples). Instruments used in the field to record this data and additional instruments will be calibrated according to the procedures described below.

4.13.1 Parameters

The following equipment or an appropriate equivalent will be used to collect the associated field measurements.

- Air monitoring – FID
- Temperature - Temperature probe
- Specific conductance - Specific conductance meter
- pH - pH meter
- Turbidity - Turbidity meter
- Depth to water table - interface probe
- Dissolved oxygen – Horiba U22 (during sampling and development)
- ORP – Horiba U22

- Radiation Gamma Scintillation (2" by 2" NaI) Detector (or equivalent).
- Exposure Rate - Geiger-Muller (G-M) Detector (or equivalent)

4.13.2 Equipment Calibration

The electronic water-level indicator will be calibrated prior to mobilization and periodically at the discretion of the FOL. The remaining instruments will be calibrated daily and/or according to the manufacturer's operation manual.

Calibration will be documented on an Equipment Calibration Log as shown in Appendix D. During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until defective parts are repaired or replaced.

4.13.3 Equipment Maintenance

Instruments used for quantitative measurements in environmental monitoring/analysis and test equipment used for calibration and maintenance shall be controlled by established procedures. Measuring equipment shall have an initial calibration and shall be recalibrated at scheduled intervals against certified standards.

TtNUS maintains a large inventory of sampling and measurement equipment. In the event that failed equipment cannot be repaired, replacement equipment can be shipped to the site by overnight express carrier to minimize downtime.

4.14 RECORD KEEPING

In addition to chain-of-custody records associated with sample handling, packaging, and shipping, certain standard forms will be completed for sample description and documentation. These shall include sample log sheets (for soil and groundwater samples), daily activities records, and logbooks. An example of these forms can be found in Appendix D.

A bound/weatherproof field notebook shall be maintained by each sampling event leader. The field team leader or designee shall record all information related to sampling or field activities. This information may

include sampling time, weather conditions, unusual events (e.g., well tampering), field measurements, descriptions of photographs, etc.

A site logbook shall be maintained by the FOL. The requirements of the logbook are referenced in Appendix C. This book will contain a summary of the day's activities and will reference the field notebooks when applicable.

At the completion of field activities, the FOL shall submit to the TtNUS Project Manager all field records, data, field notebooks, logbooks, chain-of-custody receipts, sample log sheets, drilling logs, daily logs, etc. The TtNUS project manager shall submit copies of the drum logs to the NASJAX environmental project manager.

4.15 SITE MANAGEMENT AND BASE SUPPORT

TtNUS will perform this project with support from the Navy. This section of the SAP describes the project contacts, support personnel, project milestones and time frames of all major events.

Throughout the duration of the investigation activities, work at NASJAX will be coordinated through SOUTHDIV and NASJAX personnel. The primary contacts are as follows:

1. SOUTHDIV Engineer in Charge
   Mr. Anthony Robinson
   (843) 820-7339

2. NASJAX Facilities
   Mr. Tim Curtin
   (904) 542-2717 ext. 120

TtNUS assumes that NASJAX personnel will provide all historical data, background geological and hydrogeological information, initial site investigation documents, and monitoring well identifiers, as required.

NASJAX personnel will aid in arranging for the following:

- Personnel identification badges, vehicle passes, and/or entry permits.
- A secure staging area (approximately 200 square feet) for storing equipment and supplies.

- A supply (e.g., outside faucet, etc.) of potable water for equipment cleaning, etc.
- As required, provide escorts for contract personnel working in secured areas.
- Establish a decontamination area and waste staging area located adjacent to or near the study area.

The project will be staffed with personnel from the TtNUS' Jacksonville, Florida office. During field activities, TtNUS will provide a staff geologist and equipment technician(s).

Mr. Mark A. Peterson, P. G., is the Task Order Manager (TOM) for CTO 0135 and will be the primary point of contact. He is responsible for cost and schedule control as well as technical performance. Mr. Peterson will serve as the TOM and will provide senior level review and oversight during field activities. Mr. Peterson will be the primary point of contact for the FOL.

4.15.1 Contingency Plan

In the event the sampling team encounters problems during site activities, the SOUTHDIV point of contact will be notified immediately, followed by the TtNUS project manager and the NASJAX point of contact. The TtNUS project manger will determine a course of action that will eliminate or minimize interference with the schedule or budget, and communicate this course of action to SOUTHDIV and NASJAX personnel. Contingency plans will be approved through the SOUTHDIV point of contact before being enacted.

5.0 PROPOSED LABORATORY ANALYSIS

Sediment and soil samples collected for laboratory analyses will be analyzed for parameters listed in Table 5-1, and groundwater samples will be analyzed for parameters listed in Table 5-2.

5.1 LABORATORY DATA PACKAGES AND DATA VALIDATION

The contract laboratory for this task order will supply results of the requested analyses formatted in accordance with the "Navy Installation Restoration Laboratory Quality Assurance Guide", [Naval Facilities Engineering Service Center (NFESC) Interim Guidance Document, and dated February 1996] and will include the elements identified in Attachment D. Upon receipt of analytical results from the laboratory, a TtNUS chemist will perform a qualitative review for quality assurance.

Field and laboratory QA methodologies are documented in the DRMO RI/FS Quality Assurance Project Plan (QAPP). The QAPP has been prepared as a stand-alone document and is incorporated as an Appendix to the RI/FS Work Plan.

TABLE 5-1
SOIL/SEDIMENT GUIDANCE SAMPLING

Sampling and Analysis Plan
Defense Reutilization and Marketing Office
Naval Air Station Jacksonville
Jacksonville, Florida

	Investigation				QA/QC			
Analyte	Grid-based Samples	Biased Samples	Soil/Sediment Samples	Total Investigation Samples	IDW Samples	Rinsate Blanks	MS/MSD	Duplicates
DRMO SOIL/SEDIMENT SAMPLING								
TCL VOCs **SW-846 8260B**	4	10	0	14*	1	1	1	1
TCL SVOCs **SW-846 8270C**	3	8	17	28	1	2	1	3
TCL Pesticides **SW-846 8081A**	17	40	17	74	1	2	1	7
TCL PCBs **SW-846 8082**	17	40	17	74	1	2	1	7
TAL Metals **SW-846 6010B/6020/ 7000A series**	17	40	17	74	1	2	1	7
Total Samples Collected	**17**	**40**	**17**	**74**	**5**	**9**	**5**	**25**
RADIOLOGICAL								
Total Thorium **USEPA 6010B**	0	9	4	13	1	1	0	1
Isotopic Thorium **LANL ER 200**	0	9	4	13	1	1	0	1
Total Radium **USEPA 6010B/ SM 7500**	0	9	4	13	1	1	0	1
Isotopic Radium **SM 7500/ SW-846 9020 & HASL 300**	0	9	4	13	1	1	0	1
Total Uranium **ASTM 5174M**	0	9	4	13	1	1	0	1
Isotopic Uranium **LANL ER 200**	0	9	4	13	1	1	0	1
Uranium 238 by GS **HASL 300**	0	9	4	13	1	1	0	1
Thorium (AC-228) by GS **HASL 300**	**0**	9	4	13	1	1	0	1
Total Samples Collected	**0**	**9**	**4**	**13**	**8**	**8**	**0**	**1**

Note: List OLM4.2 will be used for TCL analyses.
ASTM –American Society of Testing Methods
GS –Gas Spectroscopy
OLM –EPA CLP SOW for Organic Analysis
SM –Standard Methods
SW –Solid Waste
* = VOC samples = 25% of grid based and biased samples total (14 out of 57 total)

TABLE 5-2
GROUNDWATER AND SURFACE WATER SAMPLING

Sampling and Analysis Plan
Defense Reutilization and Marketing Office
Naval Air Station Jacksonville
Jacksonville, Florida

	Investigation			QA/QC			
Analyte	Groundwater	Surface Water	IDW Samples	Rinsate Blanks	Trip Blanks (Aqueous)	MS/MSD	Duplicates
DRMO GROUNDWATER AND SURFACE WATER							
TCL VOCs **SW-846 8260B**	6	6	1	1	0	1	1
TCL SVOCs **SW-846 8270C**	6	0	1	1	0	1	1
TCL Pesticides **SW-846 8081A**	6	6	1	1	0	1	1
TCL PCBs **SW-846 8082**	6	0	1	1	0	1	1
TAL Metals **SW-846 6010B/6020/ 7000A series**	6	7	1	2	0	1	2
Total Samples Collected	**6**	**7**	**1**	**6**	**0**	**5**	**10**
RADIOLOGICAL							
Total Thorium **USEPA 6010B**	6	2	1	0	0	0	1
Isotopic Thorium **LANL ER 200**	6	2	1	0	0	0	1
Total Radium **USEPA 6010B/ SM 7500**	6	2	1	0	0	0	1
Isotopic Radium **SM 7500/ SW-846 9020 & HASL 300**	6	2	1	0	0	0	1
Total Uranium **ASTM 5174M**	6	2	1	0	0	0	1
Isotopic Uranium **LANL ER 200**	6	2	1	0	0	0	1
Gross alpha and beta **EPS 900**	6	2	1	0	0	0	1
Total Samples Collected	**6**	**2**	**1**	**0**	**0**	**0**	**1**
NA Parameters							
Anions- USEPA 300	6	0	0	0	0	0	0
Methane/Ethane/Ethene RSK SOP 147 and 175	6	0	0	0	0	0	0
Total Iron SW-846 6010B	6	0	0	0	0	0	0
TOC- SW-846 9060	6	0	0	0	0	0	0
Sulfide- USEPA 376.1	6	0	0	0	0	0	0
Ammonia- USEPA 350.1	6	0	0	0	0	0	0
TKN- USEPA 351.1	6	0	0	0	0	0	0
Total Samples Collected	**6**	**0**	**0**	**0**	**0**	**0**	**0**

*Note: List OLM4.2 will be used for TCL analyses.

6.0 PROPOSED SCHEDULE

Field activities for the event are proposed to begin in December 2000 and take approximately four weeks to complete. A presentation of the RI results will be provided to the NASJAX Partnering Team approximately 100 days after completion of field activities as described in Section 7.0. The TtNUS Project Manager and SOUTHDIV and NASJAX personnel will determine the course of action if additional sampling activities are mandated.

7.0 REPORTS

A presentation supported by necessary figures and tables summarizing the results of the sampling event will be provided to the NASJAX Partnering Team upon during a regularly scheduled Partnering Team Meeting. The presentation materials will be provided to the partnering team in advance of the presentation for review. The intent of the data presentation will be to obtain concurrence from the partnering team for planned activities that may include additional investigative efforts. After concurrence is obtained from the partnering team, that additional assessment is not required, an RI, HHRA, and Environmental Risk Assessment (ERA) report will be prepared. The results of which will also be presented to the Partnering Team. The RI, HHRA, and ERA report will be submitted, as a component of the RI/FS report, to the NASJAX Partnering Team at the conclusion of RI/FS activities.

8.0 REFERENCES

TtNUS, 1998 Revision. Comprehensive Quality Assurance Plan, FDEP CompQAP # 980038.

HLA, 1999. "Sampling Event Report", Potential Source of Contamination 46 Defense Reutilization and Marketing Office Yard; Potential Source of Contamination 46 Further Remedial Action Decision Report," an attachment to Appendix D/Volume 2 of the Naval Installation Restoration Program (NIRP) Plan. July.

Bechtel Interoffice Memorandum, December 14, 1998. Radiological Survey of DRMO.

NASJAX Internet Site, 2000. NASJAX.navy.mil.

NFESC Interim Guidance Document, 1996. Naval Installation Restoration Laboratory, Quality Assurance Guide.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), 1998. Industrial Radiation Survey No. 27-MH 84444-98, Defense Reutilization and Marketing Office, Jacksonville, FL, June.

Historical Aerial Photograph, April 2, 1946.

APPENDIX A

HUMAN HEALTH RISK ASSESSMENT INFORMATION

ACRONYMS AND ABBREVIATIONS

AWQC	Ambient Water Quality Criteria
BAF	Bioaccumulation Factor
CDI	Chronic Daily Intakes
COPC	Contaminants of Potential Concern
CSF	Carcinogenic Slope Factor
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
ER-L	Effects Range – Low
ER-M	Effects Range – Medium
ESI	Expanded Site Investigation
FDEP	Florida Department of Environmental Protection
GI	gastrointestinal
GW	ground water
HEAST	Health Effects Assessments Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IR	Installation Restoration
IRA	Interim Remedial Action
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
MW	monitoring well
NAS	Naval Air Station
ODA	Oil Disposal Area
ORNL	Oak Ridge National Laboratory
PAH	Polycyclic Aromatic Hydrocarbons
PSC	Potential Source of Contamination
RBC	Risk Based Concentration
RfD	Reference Dose
SB	Subsurface soil
SCTL	Soil Target Cleanup Level
SD	sediment
SERA	Screening-level Ecological Risk Assessment
SS	surface soil
SSL	Sediment Screening Levels
SSSL	Surface Soil Screening Levels
SQB	Sediment Quality Benchmarks
SQC	Sediment Quality Criteria
SVOC	Semi-volatile Organic Compounds
SW	surface water
SWSL	Surface Water Screening Levels
TAL	Total Analyte List
TCL	Total Compound List
TEF	Toxicity Equivalence Factor
TIC	Tentatively Identified Compound
UCL	upper confidence limit
VOC	Volatile Organic Compounds
WQS	Water Quality Standards

A.1.0 INTRODUCTION

This work plan contains the protocol to be used in developing baseline risk assessment for PSC 46 at the Naval Air Station (NAS), Jacksonville, Florida. This site is a Navy Installation Restoration (IR) site and is currently regulated by the United States Environmental Protection Agency (EPA*)* and the Forida Department of Environmental Protection (FDEP). Corrective actions have been performed at the site as described in Bechtel's completion report. The results of the risk assessments (and other factors) will be used to determine whether "no further action" is appropriate or if additional corrective actions are required at any of the site.

A desription of the site and previous investigation and remedail actions which have occurred are presented in the RI/FS workplan.

A.1.1 CURRENT AND FUTURE LAND AND WATER USE

Current and Future Land Use

PSC 46 is currently used as the DRMO. Most of the site is covered with buildings and/or pavement. DRMO has a perimeter fence and access to this area restricted to the public.

Current and Future Groundwater Use

Groundwater in this portion of NAS Jacksonville is not used for any purpose. No potable wells were observed in this area of the base. It is not known whether off-site downgradient groundwater wells are currently used but this area is also supplied by public water.

Current and Future Surface Water Use

Surface water does not exist at DRMO, with the exception of intermittant occurrence of run off in drainage dithches that border the DRMO.

A.1.2 ROLE OF RISK ASSESSMENT

Risk assessments are performed to determine whether contaminant levels present in environmental media pose significant human or environmental health risks. In conjunction with other factors, the Navy will use the results of the risk assessments performed for PSC 46 at to determine whether additional corrective measures are required.

A.2.0 HUMAN HEALTH RISK ASSESSMENT

A.2.1 OVERVIEW

The human health risk assessment (HHRA) characterizes the current and future risks associated with potential human exposures to site-related contaminants at PSC 46 NAS Jacksonville. The following components of human health risk assessment will be addressed in the baseline risk assessment:

- Data Evaluation/Selection of Chemicals of Potential Concern
- Toxicity Assessment
- Exposure Assessment
- Risk Characterization

These components are discussed in Sections 2.2, 2.3, 2.4, and 2.5, respectively.

The HHRA methodology will follow guidance given in the following documents:

- EPA, December 1989. Risk Assessment Guidance for Superfund - Volume I - Human Health Evaluation Manual (Interim Final). EPA/540/1-89/002.
- EPA, March 25, 1991. Risk Assessment Guidance for Superfund - Volume I - Human Health Evaluation Manual - Supplemental Guidance - Standard Default Exposure Factors (Interim Final). OSWER Directive 9285.6-03.
- EPA, August 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa.
- EPA, November 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment.
- EPA, January 1992. Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B.
- EPA, August 18, 1992, Risk Assessment Guidance for Superfund Volume 1. Human Health Evaluation Manual, Draft Supplemental Guidance, Dermal Risk Assessment Interim Guidance.

- EPA, January 1998. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments), Interim. Publication 9285.7-01D.

- EPA, November 6, 1998. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance, Peer Consultation Workshop DraftEPA, November, 1998. Interim Draft . Supplemental Guidance to RAGS: Region 4 Bulletins – Addition #1. Statistical Tests for Background Comparison at Hazardous Waste Sites

- EPA, December 1997. EPA Technology Support Center Issue, The Lognormal Distribution in Environmental Applications

These documents will be used in conjunction with FDEP guidance, memoranda, etc., as well as onsite observations, to prepare a detailed risk assessment for PSC 46 NAS Jacksonville.

A.2.2 DATA EVALUATION/SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPCs)

This section of a baseline risk assessment identifies the environmental data available for baseline risk assessment, provides the criteria used to select chemicals of potential concern (COPCs), and presents the results for the COPC selection process.

A.2.2.1 Data Evaluation

The results of environmental sampling conducted at PSC 46 will be critical to the baseline risk assessment. The assessment will include a summary of the data evaluation/validation of the analytical data, with particular attention to analytical results “rejected “ during the data validation process. The baseline risk assessment will also include tables that summarize descriptive statistics (e.g., frequency of detection, concentration range detected, location of maximum positive detection) for each chemical detected at least once in an environmental media.

All analytical data used in the baseline risk assessment were/will be validated in accordance with the guidance contained in the following documents:

- EPA, February 1994. EPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review. OSWER Publications 9240.1-05-01. EPA-546/R-94-012 and EPA-546/R-94-013.

- Tetra Tech NUS, Inc. November 2000. Quality Assurance Project Plan for Potential Source of Contamination (PSC)-46 Remedial Action/FeasibilityStudy, Naval Air Station Jacksonville, Jacksonville, Florida

Additionally, all method-specific quality control criteria was considered in the data validation process.

A.2.2.2 Chemicals of Potential Concern (COPCs)

A chemical will be included in the COPC selection process if it was detected at least once in validated environmental samples. Tentatively identified compounds (TICs) will not be considered potential COPCs unless there are many TICs present relative to the target analyte list compounds identified. TICs identified as COPCs will be discussed in the uncertainty section of the risk assessment. The COPC selection process will consider environmental conditions (e.g. site geology) and the adequacy of the site investigations conducted to date.

Chemicals may be screened from further consideration as COPCs if they meet any of the following criteria:

- The maximum detected concentration of an inorganic chemical is less than twice the arithmetic mean of the background concentration (EPA, 1995).

- The chemical has a low frequency of detection. Frequency of detection is defined as the number of samples in a medium in which the analyte is detected divided by the number of samples of the medium analyzed for that analyte. A chemical is considered a candidate for exclusion if (1) it has a low frequency of detection (e.g., less than 5 percent), (2) it was not detected in other sampled media or at high concentrations (i.e., contaminated “hot spots” do not exist), and (3) there is no reason to believe that the chemical may be present (EPA, 1989a).

- The maximum detected concentration of the analyte in a medium is less than its corresponding screening level. For soil and sediments, the screening levels will be based on EPA Region 3 risk-based concentrations (RBCs) (EPA 1998c). Soils will also be screened against EPA soil screening levels (SSLs) (EPA 1996) based on the migration of chemicals from soils to groundwater. RBCs

presented in the EPA RBC table are based on a target cancer risk is 1 x ! 0^{6} and the target hazard quotient (HQ) is 1. All RBCs based on noncarcinogenic effects will be adjusted to reflect a target HQ of 0.1 in accordance with Region 4 guidance (EPA, 1995). To make this adjustment, all RBCs based on noncarcinogenic effects will be divided by 10. For groundwater and surface water maximum detected concentrations will be screened against EPA Region 3 RBCs for tap-water; non-carcinogenic RBCs will be adjusted to reflect an HI of unity. State of Florida groundwater and soil clean-up target levels will also be used as screening levels for COPC selection.

- The maximum detected concentration of an essential nutrient (i.e., calcium, magnesium, potassium, and sodium) in a medium is below a toxic level or consistent with or only slightly above its background concentration. Calcium, magnesium, potassium, and sodium will be considered as essential nutrients.

Conservatively, any chemical detected in groundwater or surface water at a maximum concentration exceeding current federal or state drinking water standards, or water quality criteria for the protection of human health will be retained as COPCs.

A.2.3 TOXICITY ASSESSMENT

This section will present the toxicity assessment (also known as dose-response assessment) component of the human health risk assessment. The toxicity assessment will examine information concerning the potential human health effects of exposure to COPCs. For each COPC, the goal of the toxicity assessment is to provide a quantitative estimate of the relationship between the magnitude and type of exposure and the severity and probability of human health effects. This section of the risk assessment will:

- Present toxicity profiles for the COPCs. The toxicity profile for a COPC describes the physical and toxicological properties of the chemical, including the adverse effects that have been associated with exposure to the chemical. Toxicity profiles summarize, qualitatively, the weight of evidence suggesting that there is a potential for adverse noncarcinogenic and carcinogenic health effects if human receptors are exposed to the COPCs. (The actual potential for adverse effects will be dependent upon the magnitude of the exposure.)

- Present the toxicity criteria (i.e., cancer slope factors and reference doses) that will be used along with receptor exposure point concentrations (Section 2.4) in the risk characterization component (Section 2.5) of the risk assessment.

The toxicity criteria will be obtained from the following sources:

- The EPA Integrated Risk Information System [IRIS] (EPA, 1999), the primary source of toxicity criteria.
- The EPA Health Effects Assessments Summary Tables [HEAST] (EPA, 1997a)

If toxicity criteria are not available in IRIS or HEAST, other toxicity criteria presented in the EPA Region III RBC tables may be used. Because there is high uncertainty associated with some of the available values not currently listed in IRIS or HEAST, the decision to use such values will be made on a chemical-by-chemical basis. The uncertainty section will discuss those COPCs lacking toxicity criteria.

A.2.3.1 Toxicity Criteria for the Carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs)

The Toxicity Equivalence Factor (TEF) approach will be used to evaluate carcinogenic polycyclic aromatic hydrocarbons (PAHs) detected in the environmental media. This approach is presented in Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment. (EPA, 1995). A benzo(a)pyrene equivalent concentration is calculated by multiplying the concentration of each carcinogenic PAH by the appropriate TEF and summing these values (see Section 2.4.4). The toxicity criteria for benzo(a)pyrene are used with the benzo(a)pyrene equivalent concentration in the quantitative risk assessment (Sections 2.4.5 and 2.5) to determine the risk associated with carcinogenic PAHs.

A.2.3.2 Toxicity Criteria for the Dermal Route of Exposure

The toxicity criteria for the evaluation of the dermal route of exposure will be derived using the procedure presented in Appendix A of the EPA Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual [Part A] (EPA, 1989a). To the extent available, the GI absorption factors presented in the EPA, November 6, 1998. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance, Peer Consultation Workshop Draft will be used to calculate the toxicity criteria. GI factors in the scientific literature or presented in the following references will be considered for parameters not addressed in the EPA interim guidance:

- Oak Ridge National Laboratory (ORNL) Risk Assessment Information System, which can be found on the internet at http://risk.lsd.ornl.gov/rap_hp.htm.
- Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order (uncited reference courtesy Dr. Ted Simon, EPA Region 4, June 1997).

- Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C. Prepared for the Division of Waste Management, Florida Department of Environmental Protection by the Center for Environmental and Human Toxicology, University of Florida, Gainesville, Florida. (December 21, 1998).

A.2.4 EXPOSURE ASSESSMENT

This section of the baseline risk assessment will evaluate the potential for human exposure to the COPCs identified in the environmental samples collected at PSC 46. The exposure assessment will:

- Briefly characterize the environmental setting, identify sources of contamination, and note the environmental media to be evaluated in the quantitative risk assessment for each site.
- Provide information on the current and anticipated future land, groundwater, and surface water use at PSC 46.
- Present potential pathways, which outline how potential receptors of concern may contact contaminated source areas or environmental media.
- Identify exposure units and present exposure point concentrations for each environmental media evaluated in the exposure assessment.
- Quantify the exposure in terms of an ingested or absorbed dose (intake).

A.2.4.1 Characterization of Environmental Setting and Contamination

The risk assessment narrative for PSC 46 will provide a very brief summary section describing the environmental setting, discussing the suspected sources of contamination, and noting the contaminated environmental media. Detailed information will already have been provided in previous reports, which will be incorporated by reference.

A.2.4.2 Land Use, Groundwater Use, and Surface Water Use

An understanding of the current and anticipated future land, groundwater, and surface water use patterns at and in the vicinity of PSC 46 is critical to the exposure assessment of COPC concentrations. The baseline risk assessment will include information on current and future land and water use to the extent that it is necessary to select/justifiy the receptors of concern to be evaluated.

A.2.4.3 Potential Exposure Pathways

Potential exposure pathways will be identified in the exposure assessment section of the baseline risk assessment. Information will be provided regarding exposure pathways by which an individual human receptor may be exposed to contaminant source areas or environmental media at each site. The information will be summarized in tabular format. A preliminary evaluation is presented in Table 1. The conceptual site model and is based on the following information:

- PSC 46 is currently an active site used by the DRMO.
- All potable water in the vicinity of NASJAX comes from a municipal supply.
- Surface water at the site is limited to occurance, is not used for fishing or swimming, but is accessible to potential receptors.

At a minimum, the following human receptors will be evaluated in the baseline risk assessment; as agreed by the NASJAX Partnering Team.

- ***Occupational (commercial/industrial) workers*** who may contact contaminated media while performing work tasks. Media evaluated include surface soils, surface water, and sediments. Anticipated exposure pathways are incidental ingestion of/dermal contact with COPCs in surface soils, surface water, and sediments, and the inhalation of particulates/vapors from soils. This receptor population is only considered for future conditions because the site is currently not used for any purpose. Exposure incurred by future commercial/industrial workers would be very dependent on work tasks. Office workers may be minimally exposed to site-related contamination when compared to outdoor workers.
- ***Future construction workers*** who may contact contaminated media while excavating or performing construction activities. Media include surface and subsurface soils, groundwater, surface water, and sediments. Anticipated exposure pathways are incidental ingestion of/dermal contact with COPCs in soils, groundwater, surface water, and sediments, and the inhalation of particulates/vapors from soils.
- ***Hypothetical Future on-site residents*** who may reside at PSC 46 at some time in the future. Hypothetical future on-site residents may be exposed to contaminated surface soil, groundwater, surface water, sediment. Anticipated exposure pathways are incidental

ingestion of/dermal contact with COPCs in suface soils, surface water, and sediments; the inhalation of particuilates/vapors from soils; and exposure to COPCs in groundwater via the ingestion, dermal contact, and inhalation (i.e., inhalation of volatile organic chemicals during showering) routes of exposure.

A.2.4.4 Exposure Point Concentrations

Each complete exposure pathway includes a medium, an exposure point (i.e., point of contact between receptor and chemical), and an exposure route (e.g., ingestion). This section presents the methodology that will be used to determine the exposure point concentration (i.e., the exposure concentration to which a receptor is exposed) for each exposure unit (i.e., the areal extent of a receptor's movement during a single day) evaluated.

The EPC will be calculated using one-half the sample detection limit for non-detect results and the average for duplicate sample results. For groundwater, the EPC will be either the maximum concentration (if a small dataset is evaluated [i.e., less than 10 samples]) or the arithmetic mean of the wells in the highly concentrated area of the plume. All other media will be evaluated as follows. Using the Shapiro-Wilk W test (Gilbert, 1987), each data set will be evaluated to determine if it is consistent with a normal or lognormal distribution. If the data is not consistent with either distribution, the distribution will be assumed to be lognormal. If there are less than 10 samples, the maximum concentration will be used as the EPC. If there are 10 or more samples, the EPC will be either (1) the normal 95 percent Upper Confidence Limit (UCL-N) if the Shapiro-Wilk test indicated a normal distribution or (2) the lognormal 95 percent Upper Confidence Limit (UCL-L) if the Shapiro-Wilk test indicated a lognormal distribution or was inconclusive. If the appropriate 95 percent UCL exceeds the maximum concentration, the maximum concentration will be used as the EPC.

For normally distributed data, the calculation of the UCL is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\sum (X_i - \overline{X})^2}{(n-1)} \right]^{1/2}$$

Where:

S	=	standard deviation
X_i	=	individual sample value
n	=	number of samples
$\bar{X}$	=	mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \bar{X} + t \left| \frac{S}{n^{1/2}} \right|$$

Where:

UCL	=	95 percent Upper confidence limit of the mean
$\bar{X}$	=	Arithmetic average
t	=	One-sided t distribution factor ($t_{0.95}$)
s	=	standard deviation
n	=	number of samples

For log-normally distributed data sets, the UCL is calculated using the following equation:

$$UCL = \exp\left| \bar{X} + 0.5 s^2 + \frac{Hs}{(n-1)^{1/2}} \right|$$

Where:

UCL	=	95 percent UCL of the mean
exp	=	Constant (base of the natural log, e)
$\bar{X}$	=	Mean of the transformed data
s	=	Standard deviation of the transformed data
H	=	H-statistic (from Gilbert, 1987; $H_{0.95}$)
n	=	Number of samples

The lognormal UCL equation uses individual sample results that have been transformed by taking the natural logarithm of the results. The concerns presented in the aforementioned EPA Technology Support Center Issue paper (i.e, The Lognormal Distribution in Environmental Applications) will be considered in the calculation of the 95 percent UCL for the lognormal distribution.

For carcinogenic PAHs, a benzo(a)pyrene equivalent concentration will be determined for each sample location by multiplying the concentration of each carcinogenic PAH by the appropriate TEF and summing these values. This approach, including the appropriate TEF values, is presented in Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment. (EPA, 1995). If some of the carcinogenic PAHs results reported for a sample are non-detects, then one-half the detection limit will be used as a surrogate concentration for non-detect carcinogenic PAH concentrations for that sample. If all the carcinogenic PAH results for a sample location are non-detects, then one-half the detection limit of benzo(a)pyrene will be used as the benzo(a)pyrene equivalent concentration at that location. The

benzo(a)pyrene equivalent EPC will be used to calculate quantitative risk estimates in the risk characterization.

A.2.4.5 Quantification of Exposure

The EPC is combined with exposure assumptions (e.g., ingestion rates) to provide a quantitative estimate of the intake or dose for each applicable receptor, media, and exposure pathway. Intakes will be quantified for the current and future receptors, media, and pathways identified in the conceptual site model and the tables provided in Appendix A. The intake equations and parameters will be based on EPA Region 4 guidance, federal EPA risk assessment guidelines, and professional judgment. State of Florida guidelines and recommendations may also be considered. The appendix at the end of this provides intake equations and parameters for each receptor/exposure pathway. Exposure dose assumptions and equations may be modified based on new receptor information.

A.2.5 RISK CHARACTERIZATION

The risk characterization component of a baseline risk assessment evaluates the potential for adverse health effects from exposure to COPC concentrations in environmental media by integrating information developed during the toxicity and exposure assessments. Risk estimates will be calculated using the algorithms presented in the EPA risk assessment guidance (EPA, 1989a). All exposure dose (intake) and risk characterization calculations will be presented in a series of spreadsheets contained in the appendices of the baseline risk assessment. These spreadsheets will be accompanied by hand-written sample calculations so that spreadsheet results can be verified. The spreadsheets will include all variables and intermediate calculations required for clarity. The text will include a summary table of risks for each receptor at each site. All risks will be presented to two significant figures in tables and text. The following paragraphs briefly summarize methodology that will be used to estimate carcinogenic and noncarcinogenic risk.

A.2.5.1 Methodology for Estimation of Carcinogenic Risks

Carcinogenic risks can be estimated by combining information on the strength or potency of a known or suspected carcinogen (Carcinogenic Slope Factor) with an estimate of the individual exposure doses (or intakes) of a chemical. Carcinogenic risk may be estimated as follows:

$$Risk = CSF \ x \ Dose$$

where:

CSF = Carcinogenic Slope Factor (slope of the dose-response curve in $(mg/kg\text{-}day)^{-1}$.
Dose = Amount of a contaminant absorbed by a receptor in mg/kg-day.

The equation presented above, however, is valid only at risk levels less than or equal to 1×10^{-2}. When the risk estimate is expected to be greater than 1×10^{-2}, an alternate equation, such as the following one-hit equation may be used to estimate risk (EPA, 1989a):

$$Risk = 1 - \exp(-Dose \times CSF)$$

The resultant cancer risk value (e.g., 1×10^{-6} or a 1-in-1,000,000 chance) can be applied to a given population to determine the number of excess cases of cancer that could be expected to result from exposure (e.g., 1×10^{-6} is one additional case of cancer in 1,000,000 exposed persons).

The total risk for exposure of an individual receptor to multiple compounds in a particular medium is the sum of the cancer risks for the individual contaminants in that medium to that receptor. Cancer risks can be summed across media for an individual receptor. Risks can be calculated in this manner under the following assumptions:

- There are no antagonist/synergistic effects between chemicals.
- All chemicals produce the same result (cancer).
- Cancer risks from various exposure routes (e.g., ingestion and dermal) are additive, if the exposed populations are the same (EPA, 1989a).

A.2.5.2 Methodology for Estimation of Non-carcinogenic Risks

Potential health risks resulting from exposure to noncarcinogenic compounds are estimated by comparing the maximum daily intake dose calculated for an exposure to an acceptable intake dose, such as a chronic or subchronic reference dose (RfD). The ratio of the exposure dose (intake) to the RfD is referred to as the Hazard Quotient:

Hazard Quotient = Dose/RfD

If the Hazard Quotient (HQ) exceeds unity, there is a potential health risk associated with exposure to that chemical (EPA, 1989a). The Dose/RfD ratio is not a mathematical prediction of the severity or probability of toxic effects; it is simply a numerical indicator of the potential for adverse effects. The summation of HQs for several compounds is referred to as the Hazard Index (HI).

Conservatively, a total HI for any exposure route is calculated by summing the Dose/RfD ratios (HQs) for the individual chemicals of concern (EPA, 1989a). To provide a better indication of risks, Dose/RfD ratios should be summed according to the target organ affected. For example , the Dose/RfD ratios for those chemicals affecting the liver should be summed separately from those chemicals affecting the central nervous system.

A.2.6 UNCERTAINTY ANALYSIS

This section of the baseline risk assessment will qualitatively discuss major uncertainties of the data evaluation, toxicity assessment, exposure assessment, and risk characterization. The analysis will focus on those uncertainties that have the greatest potential effect on the interpretation and use of the baseline risk assessment results.

A.2.7 SUMMARY AND CONCLUSIONS

This section will contain a summary of the results of the risk assessment. The discussion will identify the most significant chemicals for each exposure pathway and those pathways that drive the risk. Carcinogenic and noncarcinogenic risks for each potential receptor at each site will be discussed and summarized by exposure route and medium. Summary tables will be prepared and graphics (e.g., bar charts, pie charts, etc.) may be included.

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Human Health References

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TABLE 1
CONCEPTUAL SITE MODEL AND SELECTION OF EXPOSURE PATHWAYS
PSC 46 - NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	Entire Site	Site Maintenance Workers	Ingestion	Quant(1)	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated soil in the course of their job duties.
					Dermal	Quant(1)	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated soil in the course of their job duties.
		Air	Vapors and Particulates in Air - Entire Site	Site Maintenance Workers	Inhalation	Qual(2)	Exposure is evaluated qualitatively by a comparison of site data to USEPA Generic SSLs(3) for transfers from soil to air.
	Groundwater	Groundwater/Air	Surficial Aquifer/Vapors	Site Maintenance Workers and Trespassers	Ingestion	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not used as a domestic water supply.
					Dermal	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not used as a domestic water supply.
					Inhalation	None	Direct contact with groundwater does not occur under current land use. Shallow groundwater is not used as a domestic water supply.
	Surface Water	Surface Water	Stream Located South of the ODA	Site Maintenance Workers	Ingestion	Quant	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated surface water in the course of their job duties.
					Dermal	Quant	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated surface water in the course of their job duties.
					Ingestion	Quant	Persons may trespass on the site and contact contaminated surface water
					Dermal	Quant	Persons may trespass on the site and contact contaminated surface water
		Air	Vapors from Stream Located South of the ODA	Site Maintenance Workers	Inhalation	None	Inhalation is expected to represent a relatively minor exposure compared to the dermal and ingestion pathways.
	Sediment	Sediment	Stream Located South of the ODA	Site Maintenance Workers	Ingestion	Quant	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated sediment in the course of their job duties.
					Dermal	Quant	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated sediment in the course of their job duties.
					Ingestion	Quant	Persons may trespass on the site and contact contaminated sediment.
					Dermal	Quant	Persons may trespass on the site and contact contaminated sediment.
Future	Surface/ Subsurface Soil	Surface/ Subsurface Soil	Entire Site	Excavation/Construction Workers	Ingestion	Quant	Excavation/construction activities may occur at the site and workers may be exposed to contaminated soil..
					Dermal	Quant	Excavation/construction activities may occur at the site and workers may be exposed to contaminated soil..
		Air	Vapors and Particulates in Air - Entire Site	Excavation/Construction Workers	Inhalation	Qual	Exposure is evaluated qualitatively by a comparison of site data to USEPA Generic SSLs for transfers from soil to air.
	Surface Soil	Surface Soil	Entire Site	Occupational Workers	Ingestion	Quant	Occupational (commercial/industrial) workers, may contact contaminated soil in the course of their job duties.
					Dermal	Quant	Occupational (commercial/industrial) workers, may contact contaminated soil in the course of their job duties.

TABLE 1
CONCEPTUAL SITE MODEL AND SELECTION OF EXPOSURE PATHWAYS
PSC 46 - NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (cont)				Residents	Ingestion	Quant	Hypothetical on-site residents may be exposed to contaminated soil during typical residential activities, such as gardening or playing.
					Dermal	Quant	Hypothetical on-site residents may be exposed to contaminated soil during typical residential activities, such as gardening or playing.
		Air	Vapors and Particulates in Air - Entire Site	Occupational Workers and Residents	Inhalation	Qual	Exposure is evaluated qualitatively by a comparison of site data to USEPA Generic SSLs for transfers from soil to air.
	Groundwater	Groundwater	Surficial Aquifer	Excavation/Construction Workers	Ingestion	Quant	Excavation/construction activities may occur at the site and workers may be exposed to contaminated groundwater.
					Dermal	Quant	Excavation/construction activities may occur at the site and workers may be exposed to contaminated groundwater.
				Residents	Ingestion	Quant	Hypothetical on-site residents may be exposed to contaminated groundwater during typical residential activities.
					Dermal	Quant	Hypothetical on-site residents may be exposed to contaminated groundwater during typical residential activities.
				Occupational Workers	Ingestion	None	There are no drinking water wells on-site.
					Dermal	None	Occupational workers are not likely to contact groundwater.
		Air	Vapors	Excavation/Construction Workers	Inhalation	None	Inhalation is expected to represent a relatively minor exposure compared to the dermal and ingestion pathways.
				Residents	Inhalation	Quant	Hypothetical on-site residents may be exposed to VOCs while showering or bathing.
	Surface Water	Surface Water	Stream Located South of the ODA	Occupational and Excavation/Construction Workers	Ingestion	Quant	Workers may contact contaminated surface water in the course of their job duties.
					Dermal	Quant	Workers may contact contaminated surface water in the course of their job duties.
				Residents	Ingestion	Quant	Hypothetical future on-site residents may be exposed to contaminated surface water.
					Dermal	Quant	Hypothetical future on-site residents may be exposed to contaminated surface water.
		Air	Vapors from Stream Located South of the ODA	Occupational Workers, Excavation/Constuction Workers and Residents	Inhalation	None	Inhalation is expected to represent a relatively minor exposure compared to the dermal and ingestion pathways.
	Sediment	Sediment	Stream Located South of the ODA	Occupational and Excavation/Construction Workers	Ingestion	Quant	Workers may contact contaminated sediment in the course of their job duties.
					Dermal	Quant	Workers may contact contaminated sediment in the course of their job duties.
				Residents	Ingestion	Quant	Hypothetical future on-site residents may be exposed to contaminated sediment.
					Dermal	Quant	Hypothetical future on-site residents may be exposed to contaminated sediment.

Footnotes:
1 Quantitative.
2 Qualitative.
3 Soil Screening Levels (USEPA, May 1996).

APPENDIX A

Intake Equations for Each Receptor/Exposure Pathway.

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this appendix. The values of the exposure parameters used in these equations are presented in Table A-1.

Incidental Ingestion of Soil/Sediment

The incidental ingestion of a small amount of soil and sediment is assumed to occur when a receptor comes into direct contact with a contaminated medium. Intakes associated with soil/sediment ingestion are calculated using the following equation:

$$Intake_i = (C_{soil/sed})(IR)(FI)(EF)(ED)(CF) / (BW)(AT)$$

where:

$Intake_i$	=	intake of contaminant "i" from soil or sediment (mg/kg/day)
$C_{soil/sed}$	=	concentration of contaminant "i" in soil or sediment (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (decimal fraction)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70 years x 365 days/year

Dermal Contact with Soil/Sediment

During direct contact, contaminated soil and sediment may adhere to the skin of potential receptors. Dermal absorption from potentially contaminated soil and sediment is calculated using the following equation:

$$Intake_i = (C_{soil/sed})(SA)(AF)(ABS)(CF)(EF)(ED) / (BW)(AT)$$

where: $Intake_i$ = amount of chemical "i" absorbed during contact with soil or sediment (mg/kg/day)

$C_{soil/sed}$ = concentration of chemical "i" in soil or sediment (mg/kg)

SA = skin surface area available for contact (cm^2/day)

AF = skin adherence factor (mg/cm^2)

ABS = absorption factor (decimal fraction)

CF = conversion factor (10^{-6} kg/mg)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/year;
for carcinogens, AT = 70 years x 365 days/year

Incidental Ingestion of Groundwater/Surface Water

Assuming that groundwater is used as a potable water supply at some time in the future, direct ingestion of groundwater is evaluated for future adult residents Direct contact with surface water at the site could result in the inadvertent ingestion of small amounts of water.

Ingestion of groundwater/surface water is evaluated using the following equations (USEPA, December 1989):

$$Intake_i = (C_{sw})(CR)(ET)(EF)(ED) \ / \ (BW)(AT) \text{ for surface water}$$

$$Intake_i = (C_{gw})(IR)(EF)(ED) \ / \ (BW)(AT) \text{ for groundwater}$$

where: $Intake_i$ = intake of chemical "i" from water (mg/kg/day)

$C_{sw/gw}$ = concentration of chemical "i" in water (mg/L)

CR = contact rate for surface water (L/hour)

IR = groundwater ingestion rate (L/day)

ET = exposure time for surface water (hours/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/year;
for carcinogens, AT = 70 years x 365 days/year

Dermal Contact with Groundwater/Surface Water

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

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

where:

DAD_i	=	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 (years)
EF	=	exposure frequency (days/year)
A	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70years x 365 days/year

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

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

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

where:

t_{event}	=	duration of event (hour/event)
t^*	=	time it takes to reach steady-state conditions (hours)
K_p	=	permeability coefficient from water through skin (cm/hour)
$C_{gw/sw}$	=	concentration of chemical "i" in groundwater/surface water (mg/L)
τ	=	lag time (hour)
π	=	constant (unitless; equal to 3.1416)
CF	=	conversion factor (10^{-3} L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (t_{event}, t^*, K_p, τ, and B) are obtained from the current dermal guidance (USEPA, January 1992).

The following nonsteady-state equation is used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_{sw})(t_{event})$$

Inhalation of Volatiles from Groundwater

The inhalation of volatiles in groundwater could occur during showering, bathing, and other routine household activities. This exposure pathway will be evaluated according to current USEPA Region IV guidance (November 1995), which recommends performing a semi-quantitative evaluation by assuming that inhalation exposure is equal to exposure incurred via direct ingestion.

TABLE A-1
SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURE
PSC 46 - NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Exposure Input Parameter	Site Maintenance Worker	Excavation Worker	Occupational Worker	Adult Resident	Child Resident
All Exposures					
Exposure Concentration - C_{soil} / C_{sed} (mg/kg) C_{gw} / C_{sw} (mg/L)	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL
Exposure Frequency (EF) (days/year)	30(A)	90(A)	250(1)	350(3) / 200(A)	350(3) / 200(A)
Exposure Duration (ED) (years)	25(1)	1(A)	25(1)	24(1)	6(1)
Body Weight (BW) (kg)	70(3)	70(3)	70(3)	70(3)	15(3)
Noncarcinogenic Averaging Time (AT_n) (days)	9,125(3)	365(3)	9,125(3)	8,760(3)	2,190(3)
Carcinogenic Averaging Time (AT_c) (days)	25,550(3)	25,550(3)	25,550(3)	25,550(3)	25,550(3)
Incidental Ingestion/Dermal Contact with Surface Soil (Surface and Subsurface Soil for Construction Workers)					
Ingestion Rate (IR) (mg/day)	50(2)	480(1)	50(1)	100(2)	200(2)
Fraction Ingested from Contaminated Source (Fi) (unitless)	1.0(2)	1.0(2)	1.0(2)	1.0(2)	1.0(2)
Skin Surface Area (SA) (cm^2/day)	5,300(4)	5,300(4)	2,000(4)	5,300(4)	766(4)
Soil-to-Skin Adherence Factor (AF) (mg/cm^2)	1.0(2)	1.0(2)	1.0(2)	1.0(2)	1.0(2)
Absorption Factor (ABS) (unitless)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)
Conversion Factor (CF) (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06
Ingestion/Dermal Contact with Groundwater					
Ingestion Rate (IR_{gw})(L/day)	NA	0.01(A)	NA	2(2)	1(2)
Exposure Time (ET) (hours/day) and t_{event} (hours/event)	NA	1.0(A)	NA	0.2(4)	0.2(4)
Skin Surface Area (A) (cm^2/day)	NA	5,000(4)	NA	20,000(4)	3,066(4)
Event Frequency (EV) (events/day)	NA	1(A)	NA	1(4)	1(4)
Permeability Coefficient from Water through Skin (K_p)(cm/hour)	NA	chemical-specific(4)	NA	chemical-specific(4)	chemical-specific(4)
Bunge Dermal Model variables - t* (hour/event), T (hour), and B (unitless)	NA	chemical-specific(4)	NA	chemical-specific(4)	chemical-specific(4)
Conversion Factor (CF) (L/cm^3)	NA	1E-03	NA	1E-03	1E-03

TABLE A-1
SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURE
PSC 46 - NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Exposure Input Parameter	Site Maintenance Worker	Excavation Worker	Occupational Worker	Adult Resident	Child Resident
Incidental Ingestion/Dermal Contact with Surface Water					
Contact Rate (CR) (L/hour)	0.010(2)	0.010(2)	0.010(2)	0.010(2)	0.050(2)
Exposure Time (ET) (hours/day) and t_{event} (hours/event)	1.0(A)	1.0(A)	1.0(A)	1.0(A)	1.0(A)
Skin Surface Area (A) (cm^2/day)	5,000(4)	5,000(4)	5,000(4)	5,000(4)	766(4)
Event Frequency (EV) (events/day)	1(A)	1(A)	1(A)	1(A)	1(A)
Permeability Coefficient from Water through Skin (K_p)(cm/hour)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)
Bunge Dermal Model variables - t* (hour/event), T (hour), and B (unitless)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)	chemical-specific(4)
Conversion Factor (CF) (L/cm^3)	1E-03	1E-03	1E-03	1E-03	1E-03
Incidental Ingestion/Dermal Contact Sediment					
Ingestion Rate (IR) (mg/day)	5(A)	5(A)	5(A)	5(A)	5(A)
Fraction Ingested from Contaminated Source (Fi) (unitless)	1.0(2)	1.0(2)	1.0(2)	1.0(2)	1.0(2)
Skin Surface Area (SA) (cm^2/day)	5,300(4)	5,300(4)	2,000(4)	5,300(4)	766(4)
Soil-to-Skin Adherence Factor (AF) (mg/cm^2)	1.0(4)	1.0(4)	1.0(4)	1.0(4)	1.0(4)
Absorption Factor (ABS) (unitless)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)	1% (organics) 0.1% (inorganics) (2)
Conversion Factor (CF) (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06

DEFINITIONS

$C_{soil/sed/gw/sw}$ Exposure concentration for soil/sediment/groundwater/surface water.
UCL 95% Upper Confidence Limit, used if the data set is greater than 10 samples.
NA Not Applicable. Receptor/pathway not evaluated.
t* Time it takes to reach steady-state conditions.
T Lag time
B Bunge Model partitioning coefficient

FOOTNOTES

A Assumption, based on professinal judgement
1 U.S. EPA 1991. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Parameters*
2 U.S. EPA Region 4 1995. *Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment*
3 U.S. EPA 1989. R*isk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Interim Final)* EPA/540/1-89/002
4 U.S. EPA 1992. *Dermal Exposure Assessment: Principles and Applications* EPA/600/8-91/011 B
5 U.S. EPA 1997. *Exposure Factors Handbook* EPA/600/p-95/002 Fa

APPENDIX B

ECOLOGICAL RISK ASSESSMENT PROTOCOL

B.1.0 INTRODUCTION

This appendix provides methods and decision criteria for performing Ecological Risk Assessments (ERAs) at individual sites within the Naval Air Station (NAS) Jacksonville, FL. 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. A phased approach to ERA at NAS Jacksonville will be 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 consists of eight steps, in accordance with USEPA (1997), Region IV USEPA (1998) and U.S. Navy (1999) guidance. The first two steps complete the preliminary assessment, as described in Sections 2 and 3. Sections 4 through 8 of this document discuss the remaining steps of the ERA approach, in order, and Section 9 lists the references. In addition to methods, this work plan describes decision points in the process, outlines decision criteria, and provides examples of the types of decisions to be made. Decision points are made part of the process to emphasize the importance of maintaining consensus among the partners (the Navy, the regulators, and TtNUS) on scientific and managerial decisions.

B.2.0 STEP 1: SCREENING-LEVEL PROBLEM FORMULATION

The first step in the ecological risk assessment process includes identifying the

- ecological setting,
- potential receptor groups,
- chemicals of potential concern,
- processes of fate and transport,
- mechanisms of toxicity,
- potentially complete exposure pathways, and
- preliminary endpoints.

A site visit will be conducted, or information collected from previous site visits will be reviewed, so that contaminant sources and biological habitat can be observed/evaluated, apparent effects noted, habitat types and extents described, and potential receptors listed. Key features of the site, such as boundaries, water bodies, and habitat types will be shown on maps or in photographs. Topography, soils, groundwater conditions, and land use (present and future) should be described.

General types of potential receptors are identified at this step, such as terrestrial or aquatic organisms. The choice will depend on the characteristics of the chemicals being investigated, as well as the nature of

the habitat. For example, if the chemical groups of concern is volatile solvents and the apparent pathway is overland transport, then soil organisms and surface water organisms would be logical choices for receptor groups. Chemical groups to consider may come from preliminary data, process descriptions for the site, or the site visit. Characteristics of the chemical groups, in addition to site conditions, will help identify fate and transport processes and mechanisms of toxicity.

Complete exposure pathways are defined by a source of contamination, a mechanism for a contaminant to reach a receptor, and a route of entry into a receptor. The lack of complete pathways may be cause for no further action. An example of a site with no complete pathways is a parking lot with immobile contaminants in the soil beneath it.

“Endpoints” refers to a category of risk assessment jargon with a number of usages. “Assessment endpoints” are usually protection goals, such as “the viability of soil invertebrate populations.” Protection of general categories of receptors, such as “sediment-dwelling organisms,” is appropriate at the screening level. “Measurement endpoints” may be defined as a measurable value that is related to the protection goal. For example, a collection of contaminant concentrations in sediment that are associated with no effects, or a low occurrence of effects, would be an appropriate measurement endpoint. It is anticipated that USEPA Region IV screening values will be used as preliminary measurement endpoints at NAS Jacksonville.

B.3.0 STEP 2: SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK CALCULATION

At the screening level, assumptions made about exposure maximize risk, so screening does not eliminate those sites with unacceptable risk. Therefore, preliminary exposure estimates are the maximum concentrations 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 preliminary risk calculation compares maximum exposure concentrations to USEPA Region IV screening values for soil, sediment, and surface water (attached). This is done in the form of a hazard quotient (HQ), which is calculated by dividing the exposure concentration by the screening value. There will be a HQ for each combination of COPC and applicable medium. A hazard quotient of less than 1 indicates a probable lack of effect, while a value greater than 1 means that a harmful effect is possible. Chemicals with a HQ or one or more will be carried forward to Step 3. Also, chemicals without screening values are carried forward to Step 3.

In addition to their use in decisions regarding the need for more investigation, the HQs and HIs generated for the preliminary assessment may be used for establishing 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 may enter into decisions about the need to proceed beyond the preliminary ecological risk characterization, and there is almost no guidance available on these issues. If contamination is limited to poor habitat caused by permanent development (e.g., parking lots and buildings), this may be reasonable cause for foregoing further risk analysis or consideration of remediation. According to Navy (1999) policy, risk management may also be an important consideration. For example, the Navy may decide that the cost of remediation done immediately after the screening-level assessment would be lower than the cost of additional study. A problem with this decision could be the use of screening values as remediation goals, which may be unnecessarily conservative. Situations like these must be evaluated by the partners on a case-by-case basis. The issues of potential habitat quality, present land use, and future land use should also be addressed in these evaluations.

Documentation of the preliminary risk characterization will be in the form of a technical memorandum, which will briefly present the results of the assessment and recommend whether further investigation is needed. If more work is not recommended, a complete account of the assessment will be made in the RI report. More sampling is usually required if more work is needed, and sampling should be done and the new results analyzed for inclusion in the RI report. The main purpose of the technical memorandum is to identify the need for more sampling as soon as possible, in order to avoid delays in the RI. This memorandum should also include recommendations for interim action, if an immediate response is justified. Recommendation for interim action will lead to risk management decisions regarding a quick response.

B.4.0 STEP 3: PROBLEM FORMULATION

If the preliminary assessment indicates that potential risk to ecological receptors is a concern, then the next issue is to better characterize risk. For example, widespread contamination at concentrations above screening values makes remediation a possibility. In order to establish a range of risk suitable for risk management decisions, reasonable estimates of risk are needed in addition to conservative estimates. Reasonable estimates can be made by altering the conservative exposure and toxicological assumptions made 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 problem formulation, the third step in the ERA procedure. Problem formulation includes assessment endpoint selection, testable hypothesis development, and refinement of earlier work on identification of COPCs, exposure characterization, fate and transport of contaminants, and toxicity evaluation.

In the USEPA's (1997) process document, step 3 results in an enhanced understanding of how the most important contaminants move through the environment and effect valuable receptors. This is done in anticipation of designing a field study. The Navy (1999) has broadened this step to include a reevaluation of ecological risk (Step 3A) with exit criteria, before committing to a field study. If making more reasonable assumptions about exposure, toxicological hazard, and the importance of background concentrations leads to a finding of acceptable risk at the site, then the process should end at this point.

B.4.1 Assessment Endpoints and Testable Hypotheses

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. Examples of assessment endpoints include:

- Survival of individuals in a population of protected species.
- Viability of 95 percent of aquatic populations.
- Viability of wildlife populations (usually grouped by feeding habits - e.g., avian piscivores).
- No change in levels of plant community diversity and standing crop relative to background.

Testable hypotheses are developed to establish whether or not potential threats exist to the environmental values to be protected. Examples of testable hypotheses include the following:

- 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.

Particular COPCs will necessitate selection of certain assessment endpoints. For example, if DDT is a COPC, then the viability of top-level carnivore populations, especially fish-eating birds, is an appropriate assessment endpoint.

B.4.2 Refinement of Preliminary Problem Formulation

The phased approach to ERA is in part an iterative process, in which earlier assumptions and choices may be changed to address new concerns in the assessment. For example, compounded conservativeness or simplifying assumptions that were part of the preliminary assessment may give way to a more realistic approach for estimating actual risk. Refinement of the preliminary problem formulation can include identification of COPCs, exposure characterization for receptors, fate and transport of contaminants, and the toxicity evaluation.

B.4.2.1 Refinement of COPCs

The frequency, pattern, and magnitude of values over the screening value may be considered in deciding if the constituent is to be subject to further analysis (USEPA, 1995). Evaluation of the pattern of elevated concentrations would consider the spacing of "hits", whether they form a gradient identifying a potential source, or are in a scattered pattern making the identification of a pathway difficult. Consideration of frequency is usually important for larger data sets. Contaminants detected at a frequency of less than 5 percent are often excluded from further treatment. Patterns may indicate situations where further work is not necessary, such as finding elevated values only in areas devoid of useful habitat.

Some additional factors that may limit the COPC list include:

- Treatment of qualifiers attached to detected data
- Classification as a common laboratory contaminant and treatment of detected concentrations in blanks
- Comparison to background concentrations
- Association with processes at the site.

For example, it may be specified that site concentrations must be significantly higher than background and blank values in order to be considered a COPC. Most of the foregoing factors bear on exposure and are therefore related to risk. Such things as a COPC's relationship to processes at the site are not related to risk, so they have to be considered within the larger risk picture to ensure protectiveness. For example, only chemicals that have low potential risk should be eliminated because they are not related to site processes. Therefore, at least some of these factors will not be considered until the exposure estimates and toxicological assessments have been refined.

B.4.2.2 Refinement of Exposure Estimates

The screening-level assessment used maximum exposure concentrations for risk characterization. However, the maximum imparts little predictive utility to the assessment if it is above the corresponding screening value. Therefore, midpoints (medians or means) and upper 95 percent confidence levels (USEPA, 1992) may also be used for exposure concentrations to provide balance to the preliminary estimate.

Exposures can be considered to fall into two categories, direct and indirect. Direct exposures apply to organisms that receive most of their exposure directly from the medium that they live in. Soil invertebrates, plants, sediment-dwelling invertebrates, and open water (pelagic) organisms are examples.

Indirect exposures apply to animals that are exposed through the food chain. This dichotomy relates to the behavior of chemicals, because most are either of concern for direct or indirect exposures. Some chemicals, like toxaphene, are important for both direct and indirect effects.

Selection of receptor groups may be refined to accommodate concerns about different exposure pathways. Receptors in the soil and aquatic environments may be adequately described in general categories such as soil invertebrates, sediment-dwelling (benthic) biota and pelagic organisms. Because of the importance of direct exposure for these organisms, the threshold values, effects levels, and water quality criteria that are typically used to characterize their risk are expressed as concentrations. These are directly comparable to exposure concentrations. For vertebrate terrestrial receptors, selection of particular species is required so that intake through eating, drinking, and other routes can be estimated. Indicator species may be selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservativeness, indicator species should be small and have small home ranges. Species known to be sensitive to particular COPCs should be selected. For example, mink are sensitive to PCBs for reproductive endpoints. Also, exposure parameters such as body mass, feeding rate, and drinking rate should be available in published sources for indicator species.

For wildlife species selected as indicators, exposure is a dose that must be calculated. An example is shown below, using exposure of a short-tailed shrew to groundwater contaminated with silver at a seepline. For this example, it is assumed that the bioaccumulation factor for soil invertebrates eating silver in soil is one (1). In actual calculations, values from published sources, if available, will be used in lieu of assumed values. Actual values used or calculated for each parameter are listed in parentheses after the parameter description.

Example Calculation for the Shrew

Drinking water dose:

$$D_W = I_W \times C_{WS}$$

Where D_W = dose from water ingestion, mg/d (0.0000151)

I_W = water ingestion rate, L/d (0.0022; USEPA, 1993b)

C_{WS} = concentration of silver in water at seepline, mg/L (0.0069)

Food and soil dose:

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.

$D_f = I_f x\ C_{ws} x\ K_d\ x\ F$

Where D_f = dose from food (and soil) ingestion, mg/d (0.00161)
I_f = food ingestion rate, kg/d (0.0052; Richardson, 1973, cited in Cothran et al., 1991)
C_{ws} = concentration of silver in water at seepline, mg/L (0.0069)
K_d = soil-water partition coefficient, unitless (45)
F = conversion factor, L/kg (1)

Total dose, body mass adjusted, mg/kg/d = $(D_w + Df) / B_m$ (0.168)

Where Bm = body mass of shrew, kg (0.0097)

Note that the example includes a simple application of fate and transport modeling; the silver in the groundwater partitions between liquid and solid (soil) phases as it seeps into the surface soil. In a preliminary evaluation it is assumed that all behavior resulting in exposure occurs in contaminated areas and contaminants are completely bioavailable. However, less conservative assumptions may be made for additional estimates of exposure, to provide balance to the assessment.

The exposure characterization for indicator species may be varied for a range of exposure estimates. For example, midpoint values for body mass, feeding rate, drinking rate, and other exposure parameters may be selected in addition to conservative estimates.

Fate and transport of contaminants may be reconsidered due to changes in the list of COPCs, 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.

B.4.2.3 Refinement of Ecological Effects Evaluation

For the screening-level assessment, conservatively low toxicity thresholds were used to evaluate the potential for adverse ecological effects. In the refinement, additional guidelines may be used to place the conservative results in perspective. If food chain modeling is being used to assess indirect effects, then appropriate toxicity data will be required. These are typically expressed as doses, with units of mass of contaminant per unit of body mass per unit time (usually mg/kg/day).

If screening values for surface water were not available for a contaminant, there may be adequate toxicity data to calculate a value using the same approach used to develop AWQC (USEPA, 1985) or similar approaches (e.g., Federal Register 60:15366-15425). Alternate guidelines for sediment-dwelling organisms may be developed from available documents, including USEPA's proposed sediment quality criteria, effects guidelines published by a number of regulatory agencies, and the equilibrium partitioning approach for nonionic organic compounds (USEPA, 1993a). Similarly, guidelines for soil concentrations have been published by a number of regulatory agencies, and they may serve to place the screening-level results in perspective. Their use will be considered on a case-by-case basis, and concentrations exceeding these wells will be evaluated using professional judgment.

If threshold toxicity values are needed for wildlife receptors, they will be developed from published toxicity data for each combination of COPC and receptor (see information sources below). Ideally, thresholds are taken from studies incorporating chronic exposures, organisms similar to the receptors of concern, low dosage levels with no adverse effects, and exposure routes that are equivalent to those in the exposure model. Uncertainty results when these conditions are not met, but use of the lowest values from among a number of studies tends to maintain conservativeness. The only adjustment factor that will be used is a value of 0.1 multiplied by the LOAEL to derive a NOAEL.

Reproductive and developmental endpoints may be selected preferentially because of their applicability to effects at the population level. However, other endpoints that can affect population viability may be used if more sensitive than reproductive and developmental endpoints. For example, several studies on the effects of fluoride on mink have shown reproductive or developmental endpoints; however, a lower endpoint is associated with brittle teeth in mink kits. Because this condition could affect kit survival and therefore population recruitment, the lower endpoint is selected. In general, the lowest NOAEL or LOAEL value among appropriate endpoints and test organisms is chosen for a threshold. When the contaminant has been the subject of numerous toxicity studies, this choice adds considerable conservativeness to the assessment. The use of death to derive a measurement endpoint, especially the use of LD_{50} or LC_{50} values, is to be avoided as much as possible. Potential risks associated with exposure to any COPCs lacking toxicity data will be discussed qualitatively.

There are a number of information sources that may be used for toxicity data; the following are compilations. They are listed in an order roughly and subjectively based on reliability, with the most reliable first. Water quality standards will be obtained from the State of Florida and compared with USEPA criteria, available from USEPA Region IV. A review of sediment guideline values has been published by ORNL (Jones et al., 1997). 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 (Atlanta, GA) Toxicological Profile series. Additional sources include the following databases: USEPA's IRIS (risk assessment data),

HSDB (mostly mammalian toxicological data) – both available on the National Library of Medicine's TOXNET (http://toxnet.nlm.nih.gov/servlets/simple-search), and AQUIRE (aquatic toxicological data). The "Screening Benchmarks for Ecological Risk Assessment" electronic data base prepared by the Environmental Sciences and Health Sciences Research Divisions of the Oak Ridge National Laboratory (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.

The ecological effects assessment will contain toxicological profiles for each COPC at the site, to include the toxic mechanism of the chemical and the dose or concentration that causes an adverse effect for the exposure route of interest. The profiles will be appended to the site ecological risk assessment.

B.4.2.4 Refinement of Preliminary Risk Characterization

This is an optional part of Step 3, employed when Step 3A is used to evaluate the possibility that more reasonable assumptions may eliminate the perception of environmental risk for a site. In a similar fashion to the screening-level assessment, exposure levels will be compared to toxicological guidelines to characterize risk.

If the refined risk characterization predicts potential effects, field activities (e.g., tissue residue analysis, toxicity testing) may be conducted to reduce the uncertainties in the assumptions used in the assessment. Evaluation of alternate exposure terms and toxicity thresholds is an appropriate way to evaluate uncertainty in the risk characterization.

Even if a range of risks is provided in the preliminary assessment, conservative assumptions will remain. This means those exposure levels above thresholds may not be harmful in fact. Also, ameliorating conditions may exist in the environment which are not predictable without testing. Therefore, further refinement of the predictive assessment, toxicity testing, and comparative population or community analysis are options for consideration in succeeding steps of the ERA.

B.4.2.5 Refinement of the Conceptual Model

A conceptual exposure pathway model is developed in Step 3. The conceptual site model (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. These 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. Also, the actual use of a site for foraging by wildlife may be assessed by field observations.

Step 3 of the ERA ends with agreement among partners on the scope of the assessment in terms of the resources to be protected and the approach to testing hypotheses in the forthcoming workplan. The criteria used to make these decisions include inclusion 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).

B.5.0 STEP 4: STUDY DESIGN AND DATA QUALITY OBJECTIVES PROCESS

In step 4 of the ERA, measurement endpoints are selected and plans for additional fieldwork are documented. Work plans made at this step should also include the methods to be followed for data interpretation and analysis. DQOs, described in the main text of the work plan, will be used in this step to assure that collected data will meet the needs of the risk assessment.

B.5.1 Measurement Endpoint Selection

Measurement endpoint selection is the first part of Step 4; these endpoints are measurable characteristics related to environmental values to be protected. Examples of measurement endpoints follow:

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, and
    - 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

B.5.2 Study Design

Fieldwork for the assessment may include additional sampling of environmental media, biological tissue sampling, 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.
- Provide information needed in transport models.
- 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 effects range-low (ER-L) for PCBs, which are known to bioaccumulate, is exceeded throughout a tidal creek[1]. The most accurate approach for

[1] The ERL is based on direct toxicity. Region IV accepts the toxicity screening value as a practical substitute for a food-chain-based screening value.

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 should be selected carefully to be free of site contaminants or other unusual man-induced influences. If statistical comparison of reference to site areas is important, standard techniques should be used for establishing the number of samples to be collected from each area, to minimize occurrences of both false positive and false negative errors. An example of this type of study is to compare benthic macroinvertebrate community measurements (taxonomic diversity, density, and functional group composition) in a potentially impacted creek to a reference creek.

Community studies have been criticized for lack of sensitivity in detecting effects. This criticism is especially appropriate when population/community studies 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 determine whether 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 Step 4 of the ERA results in a draft work plan and a sampling and analysis plan (SAP). The decision point at the end of this step is the approval of the work plan and the SAP. Decision criteria include the applicability of the measurement endpoints to the resources to be protected, applicability of the field study elements to the COPCs and receptors of concern, and the appropriateness of the study design given the type and magnitude of potential risks estimated in the preliminary assessment.

An example of an issue in the study design: sampling small fish for PCB content of tissue will be adequate for estimating risk to piscivorous birds, but it may not be adequate for estimating risks to scavengers or opportunistic feeders on larger fish. Another issue is the use of exposure area: foraging area ratio in the exposure model.

B.6.0 STEPS 5 AND 6: SITE ASSESSMENT/FIELD INVESTIGATION

Step 5 in the ERA is a site assessment to confirm that the ecological SAP is based on accurate observations. If problems with the work plan or the SAP are apparent from the site assessment, then changes to these documents are proposed. For this step the partners' decision point is approval of changes in the work plan or SAP.

Step 6 is the site field investigation, in which the fieldwork specified in the work plan and the SAP is carried out. At the completion of fieldwork the process of analysis begins; there is no decision point immediately after the field investigation step.

B.7.0 STEP 7: RISK CHARACTERIZATION

Risk characterization is the seventh step in the ERA process, in which the results of the field assessment are reviewed, combined with data collected earlier, and analyzed. There are potentially three 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, and effects observed in toxicity testing. A risk characterization is developed for each approach, and conclusions are drawn after consideration of each characterization.

Reaching conclusions may be difficult because results from different approaches may be contradictory. If so, a weight-of-evidence approach is used to assess ecological impact, 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 risk assessment will result 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 will be made for future activities. For example, recommendations may be made for future monitoring, habitat enhancement, or particular types of remediation.

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 1, 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 COPC 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 this section of the assessment.

The risk characterization is completed with the production of the ecological risk assessment portion of the RI report. Decisions regarding future actions take place in the risk management step.

B.8.0 STEP 8: RISK MANAGEMENT

Risk management is the eighth and final step in the ERA process. In this step the partners discuss the advisability of no action, remediation, monitoring, or other activities.

Although each risk assessment is centered on an individual site, risk management decisions may best be made by viewing the site as part of a larger system. USEPA Region IV recommends that multi-operable sites such as DOD facilities develop a strategy to evaluate the cumulative ecological risk for the facility. From this approach, a better understanding can be realized concerning the potential for unacceptable risks from the base after the completion of remedial activities. Additionally, ecosystem management is being advocated by many scientists and policy makers as a way to avoid problems that can occur from overemphasizing one component of a system. A potential benefit of this approach is that it can lead to more logical prioritization of action. For example, local PAH concentrations may be high enough for removal in part of Site A. However, when placed in perspective with other areas and their contaminant levels, habitat values, and spatial extent of contamination, it is best for the system as a whole to remediate elsewhere and monitor Site A for the progress of natural attenuation.

Habitat quality 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 are many issues that bear on risk management decisions. Some examples:

- Comparison of baseline ecological risk to risk due to remediation activities
- Comparison of background risk levels to site risks
- Comparison of remediation costs to expected benefits
- Likelihood that natural attenuation will result in acceptable risk levels

If remediation appears to be a reasonable approach, Region IV guidance for cleanup levels calls for establishing the following guidelines:

Low - no risk below this level
High - risk is likely above this level

The partners then negotiate a cleanup level between these two points.

The decision point for this step is agreement on how the site will be managed. The agreement is documented in the Record of Decision for the site.

B.9.0 REFERENCES

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APPENDIX C

SOPs

1.0 PURPOSE

This procedure describes the methodology for measuring elevated beta-gamma radiation levels on surfaces.

2.0 RESPONSIBILITIES

2.1 The Project Radiation Safety Officer (PRSO) is responsible for implementing this procedure.

2.2 Health Physics technicians performing beta-gamma surveys are responsible for following this procedure.

3.0 PREREQUISITES

3.1 Instrumentation

3.1.1 Select an appropriate count rate instrument and probe such as:

- Ludlum Model 2221
- Ludlum Model 3
- Ludlum Model 12
- Eberline Model ESP-1
- Ludlum 44-10 NaI
- Ludlum 44-9 G-M Pancake Probe
- Ludlum 43-68 Gas Proportional Probe

3.1.2 Check instrument to verify it is with in calibration.

3.1.3 Ensure that the appropriate probe (G-M pancake, gas proportional or NaI) which the instrument was calibrated with is attached.

3.1.4 Select an appropriate check source.

3.2 Preoperational Checks

3.2.1 Turn the instrument on.

3.2.2 Check the battery.

3.2.3 Turn on the audio speaker - check head phone audio output, if applicable.

3.2.4 Check the background count rate.

3.2.5 Place the appropriate check source in contact with the G-M probe, gas proportional probe or NaI detector and verify response.

3.2.6 The efficiency for the G-M pancake probe and gas proportional probe will be determined upon receipt from the calibration facility and at a minimum once per month thereafter. The efficiency results will be documented on an appropriate form (Attachment A). Because the NaI detector is only used to determine ambient gamma radiation levels, an efficiency determination is not required.

3.2.7 Determine the G-M pancake and/or gas proportional sample counting instruments minimum detectable count rate (MDCR) and minimum detectable activity (MDA) capabilities, as outlined in Attachment B. The MDCR and MDA will be determined upon receipt from the calibration facility and at a minimum of once per month thereafter. The calculations and results will be documented on an appropriate form (Attachment C).

3.2.8 In order to ensure the beta or gamma instrument is operating properly a daily background and source check will be performed and documented on an appropriate form (Attachment D). If the background or source check counts per minute (cpm) are outside of ± 10% of the established values, the efficiency, MDCR and MDA will be re-determined.

4.0 PROCEDURE

4.1 Beta-Gamma Survey Techniques

Guidance in performing Beta-Gamma surveys is provided in draft NUREG/CR-5849

4.1.1 Hold the G-M pancake probe or gas proportional probe approximately 1/4 to 1/2 inch (0.6 - 1.3 cm) away from the surface to be surveyed.

4.1.2 Pass the probe slowly across the surface.

NOTE: Survey speed will vary depending upon the experience of the surveyor but is usually about 5 cm per second (2 in./sec.).

NOTE: When performing surface gamma scans using the 2" x 2" NaI detector, the speed of the detector movement is typically 0.5 to 1.0 m per second. Gamma scanning is usually performed by wearing headphones and swinging the detector in front of the body in a pendulum manner while progressing at the speed of a slow walk. The detector should be kept as close to the surface as conditions allow.

4.1.3 Due to the delicate nature of the probe face, care must be taken to avoid damage by rough surfaces or sharp objects.

4.1.4 Listen for changes in the audible clicks or whining sound of the detector for quick response to elevated beta-gamma levels.

4.1.5 Mark areas of elevated count rates using paint, grease pencil, survey flags or other methods, depending on the survey location.

4.1.6 Traverse the survey area at very close intervals. Best results are obtained when the areas under the probe overlap due to the directional dependence of the probe.

4.1.7 Record the locations and levels of elevated survey results on the Survey Record Log (Attachment E).

4.1.8 For direct reading surveys calculate the beta-gamma dpm/100 cm^2 by using the following equation or by utilizing the survey data computer program:

Beta-gamma dpm/100 cm^2 =

$$\frac{\text{gross cpm - background cpm}}{\text{efficiency x}\left(\frac{\text{probe area}}{100}\right)}$$

where:

efficiency = source cpm/source dpm
probe area = active area of probe in cm^2

Document the results (dpm/100 cm^2) on the Survey Record Form (Attachment F).

5.0 RECORDS

5.1 The records generated as a result of the implementation of this procedure include:

- Survey Record Log
- Survey Records
- Log Books
- Maps

5.2 These records will be maintained as part of the project files.

6.0 REFERENCES

6.1 Draft NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," NRC, June 1992.

ATTACHMENT A

INSTRUMENT CHECK EFF/BKG

DATE _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____	**DATE** _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____
DATE _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____	**DATE** _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____

T ON = Time On **T OFF = Time Off**

ATTACHMENT B

MDCR
MINIMUM DETECTABLE COUNT RATE

KEY:

TS = Sample counting time (min.)
TB = Background counting time (min.)
RB = Background counting rate (cpm)

Equation:

$$MDCR = \frac{2.71}{TS} + 3.29 \_ \frac{RB}{TB} + \frac{RB}{TS} = \_\_\_\_\_ + BKG = \_\_\_\_\_$$

EXAMPLE:

TS = 1 min.
TB = 1 min.
RB = 40 cpm

$$2.71 + 3.29 \_ \frac{40}{1} + \frac{40}{1} = 32 + 40 = 72$$

MDCR = 72 cpm

MDA
MINIMUM DETECTABLE ACTIVITY

KEY:

TS = Sample counting time (min.)
TB = Background counting time (min.)
RB = Background counting rate (cpm)
EFF - Efficiency (c/dis)

EQUATION:

$$MDA = \frac{\frac{2.71}{TS} + 3.29 \_ \frac{RB}{TB} + \frac{RB}{TS}}{EFF \ (\text{Probe size}/100\ cm^2)} \quad \frac{dpm/100\ cm^2}{\text{not for smears}}$$

EXAMPLE:

44-9 probe : EFF = 0.21 c/.15
RB = 60 cpm
TS = 0.5 min
TB = 1 min

$$MDA = \frac{\frac{2.71}{0.5} + 3.29 \_ \frac{60}{1} + \frac{60}{0.5}}{0.21 \ (15/100)} =$$

$$\frac{5.42 + 3.29 * 13.4}{0.21 * 0.15} = \frac{49.5}{0.0315} = 1571$$

MDA = 1571 dpm/100 cm^2

ATTACHMENT C-1

MDCR CALCULATION SHEET

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

MDA CALCULATION SHEET ATTACHMENT C-2

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF ___ Radiation Type _____

$$MDA = \frac{2.71 + 3.29\sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF ___ Radiation Type _____

$$MDA = \frac{2.71 + 3.29\sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF ___ Radiation Type _____

$$MDA = \frac{2.71 + 3.29\sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF ___ Radiation Type _____

$$MDA = \frac{2.71 + 3.29\sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF ___ Radiation Type _____

$$MDA = \frac{2.71 + 3.29\sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

1.0 PURPOSE

This procedure describes the methodology for measuring elevated alpha radiation levels on surfaces.

2.0 RESPONSIBILITIES

2.1 The Project Radiation Safety Officer (PRSO) is responsible for implementing this procedure.

2.2 Health Physics technicians performing alpha surveys are responsible for following this procedure.

3.0 PREREQUISITES

3.1 Instrumentation

3.1.1 Select an appropriate count rate instrument such as:

- Ludlum Model 2221 (or equivalent)
- Eberline ESP-1 (or equivalent)
- Ludlum 2241 (or equivalent)

3.1.2 Check instrument to verify it is with in calibration.

3.1.3 Ensure that the appropriate alpha scintillation probe is attached.

3.1.4 Select an appropriate check source.

3.2 Preoperational Checks

3.2.1 Turn the instrument on.

3.2.2 Check the battery.

3.2.3 Turn on the audio speaker.

3.2.4 Set the mode on the instrument to scaler or count rate meter mode.

3.2.5 Check the background count rate.

3.2.6 Place the check source in contact with the alpha scintillation probe and verify response.

3.2.7 The alpha instruments counting efficiency will be determined upon receipt from the calibration facility and at a minimum of once a month thereafter. The efficiency results will be documented on an appropriate form (Attachment A).

3.2.8 Determine the alpha sample counting instruments minimum detectable count rate (MDCR) and minimum detectable activity (MDA) capabilities, as outlined in Attachment B. The MDCR and MDA will be determined upon receipt from the calibration facility and at a minimum once a month thereafter. The calculations and results will be documented on an appropriate form (Attachment C).

3.2.9 In order to ensure the alpha instrument is operating properly, a daily background and source check will be performed and documented on an appropriate form (Attachment D). If the background or source check counts per minute (cpm) are outside of ±10% of the established values, the efficiency, MDCR and MDA will be re-determined.

4.0 PROCEDURE

4.1 Alpha Survey Techniques

4.1.1 Hold the alpha scintillation probe approximately 1/4 (0.6 cm) inch away from the surface to be surveyed.

4.1.2 Pass the probe slowly across the surface.

NOTE: Survey speed will vary depending upon the experience of the surveyor, but is usually about 5 cm per second (2 in/sec).

4.1.3 Due to the delicate nature of the probe face, care must be taken to avoid damage by rough surfaces or sharp objects.

4.1.4 Listen for changes in the audible clicks or whining sound of the detector for quick response to elevated alpha levels.

4.1.5 Mark areas of elevated count rates using paint, grease pencil, survey flags or other methods, depending on the survey location.

4.1.6 Traverse the survey area at very close intervals. Best results are obtained when the areas under the probe overlap. This is due to two factors: (1) the directional dependence of the probe, and (2) the short range of alpha particles.

4.1.7 Record the locations and levels of elevated survey results on the Survey Record Log (Attachment E).

4.1.8 For direct reading surveys calculate the alpha dpm/100 cm^2 by using the following equation:

$$A \text{ dpm}/100 \text{ cm}^2 = \frac{\text{gross cpm - background cpm}}{\text{efficiency x } \frac{\text{probe area}}{100}}$$

where:

efficiency = source cpm/source dpm
probe area = active area of probe in cm^2

Document the results (dpm/100 cm^2) on the Survey Record Form (Attachment F).

4.1.9 Guidance on performing alpha surveys is provided in NUREG/CR-5849.

5.0 RECORDS

5.1 The records generated as a result of the implementation of this procedure include:

- Survey Records
- Survey Record Logs
- Maps

5.2 These records will be maintained as part of the project files.

6.0 REFERENCES

6.1 NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," NRC, June 1992.

ATTACHMENT A

INSTRUMENT CHECK EFF/BKG

DATE _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____	**DATE** _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____
DATE _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____	**DATE** _____ **SOURCE** _____ **INST** _____ **S/N** _____ **S/N** _____ **CAL DUE** _____ **BKG** **T ON** _____ **T OFF** _____ **TOTAL MIN** _____ **BKG =** _____ = _____ **EFF** _____ **EFF =** _____ _____ _____ _____ **ESTABLISHED UPPER / LOWER** **FOR** _____ **THRU** _____

T ON = Time On **T OFF = Time Off**

ATTACHMENT B

MDCR
MINIMUM DETECTABLE COUNT RATE

KEY:

TS = Sample counting time (min.)
TB = Background counting time (min.)
RB = Background counting rate (cpm)

Equation:

$$MDCR = \frac{2.71}{TS} + 3.29 \sqrt{\frac{RB}{TB} + \frac{RB}{TS}} = \_\_\_\_\_ + BKG = \_\_\_\_\_$$

EXAMPLE:

TS = 1 min.
TB = 1 min.
RB = 40 cpm

$$2.71 + 3.29 \sqrt{\frac{40}{1} + \frac{40}{1}} = 32 + 40 = 72$$

MDCR = 72 cpm

MDA
MINIMUM DETECTABLE ACTIVITY

KEY:

TS = Sample counting time (min.)
TB = Background counting time (min.)
RB = Background counting rate (cpm)
EFF - Efficiency (c/dis)

EQUATION:

$$MDA = \frac{\frac{2.71}{TS} + 3.29 \sqrt{\frac{RB}{TB} + \frac{RB}{TS}}}{EFF \ (\text{Probe size}/100\ cm^2)} \quad \frac{dpm/100\ cm^2}{\text{not for smears}}$$

EXAMPLE:

44-9 probe : EFF = 0.21 c/.15
RB = 60 cpm
TS = 0.5 min
TB = 1 min

$$MDA = \frac{\frac{2.71}{0.5} + 3.29 \sqrt{\frac{60}{1} + \frac{60}{0.5}}}{0.21 \ (15/100)} =$$

$$\frac{5.42 + 3.29 * 13.4}{0.21 * 0.15} = \frac{49.5}{0.0315} = 1571$$

MDA = 1571 dpm/100 cm^2

ATTACHMENT C-1

MDCR CALCULATION SHEET

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ Radiation Type _____

_____

MDCR = 2.71 + 3.29 _____ + _____ = _____ + _____ = _____

MDCR = _____

MDA CALCULATION SHEET ATTACHMENT C-2

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF _____ Radiation Type _____

MDA = $\frac{2.71 + 3.29 \sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)}$ = _____

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF _____ Radiation Type _____

MDA = $\frac{2.71 + 3.29 \sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)}$ = _____

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF _____ Radiation Type _____

MDA = $\frac{2.71 + 3.29 \sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)}$ = _____

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF _____ Radiation Type _____

MDA = $\frac{2.71 + 3.29 \sqrt{\_\_\_\_\_ + \_\_\_\_\_}}{(\quad /100\ cm^2)}$ = _____

MDA = _____

Date _____ Meter _____ Serial # _____ Probe Size _____

TS _____ TB _____ RB _____ EFF _____ Radiation Type _____

_____

$$MDA = \frac{\underline{2.71} + 3.29 \quad \_\_\_\_\_ + \_\_\_\_\_}{(\qquad /100\ cm^2)} = \_\_\_\_\_$$

MDA = _____

1.0 SCOPE

This procedure establishes the calibration and maintenance criteria for radiological instrumentation. All survey instruments, counting devices, and other equipment used for radioactivity detection and measurement requiring calibration by radioactive means shall be cared for and maintained by this procedure. The following types of equipment shall be calibrated and maintained according to this procedure:

- TLDs and Equipment
- Air Sampling Equipment
- Radiation Survey Instruments

Radiological instrumentation and services shall be supplied by approved vendors.

2.0 RESPONSIBILITIES

2.1 Radiological Control Technicians

All radiation survey equipment shall be visually inspected by the Radiological Control Technician (RCT) prior to use. This visual inspection shall consist of:

- visual inspection for source check
- checking for loose parts or fittings
- checking for a current calibration sticker
- checking the battery (if any) for fully charged condition

After the visual inspection is complete and no defects or potential defects are found, the instrument is ready for use. Specific devices are to be used for the particular task at hand. Modification of any survey meter in the field to fulfill a function for which it is specifically not designed and/or calibrated is prohibited.

The RCT will do only simple instrument maintenance, such as cleaning and battery changeout. All other maintenance or repair will be done by a qualified vendor.

Radiation survey meters and their associated devices are often used in hostile environments. Hostile environments are defined as those where high temperature, low temperature, moisture, or other similar conditions exist which could potentially affect the operation or accuracy of the device. Users of this equipment will make provisions prior to the start of work to protect the device from these factors. Provisions may include limiting the time spent in a hot or cold area or the selection of a clean, dry equipment laydown area.

Contamination of instruments by radioactive materials is to be avoided or limited whenever possible. This may be accomplished by wrapping the device in clear plastic or by the use of masking tape on a probe. Protective coverings must not interfere with ability of the device to perform its function (i.e., covering a probe detection surface with a plastic sheet may effectively shield against the radiation or particle which the user wishes to measure).

2.2 Radiological Controls Supervisor (RCS)

The advice of the Radiological Controls Supervisor (RCS) should be sought when use of radiation survey equipment is anticipated in hostile environments.

3.0 PREREQUISITES

None.

4.0 PROCEDURES

4.1 Calibration

The calibration of all radiation survey instrumentation will be conducted using calibration standards traceable to the National Institute of Standards and Technology. All instruments used for surveys will be calibrated every six months and after instrument repair, when required.

All instrument calibrations will be performed by the original manufacturer or a qualified vendor. The original calibration certificates will be held by the Radiological Controls Supervisor (RCS). The RCS will confirm that the certification of calibration and the calibration sticker attached to the radiation survey instrument agree and are up to date. No instrument will be used for any purpose whatsoever after the calibration date has been exceeded.

4.2 Instrument Checks

Only Radiological Control personnel will source check and battery check radiation survey instruments. Radiation survey instruments shall be response checked with known sources to verify that instruments respond properly to radiation. This ensures that the instrument responds to a known dose rate rather than merely verifying that radiation causes the indicator to move. Results of this check shall be kept in the instrument log books and will be referenced prior to use of instrument.

Alpha and beta-gamma friskers and portable alpha survey meters shall be response source checked such that any measurements taken with these meters are accomplished within one day <u>after</u> a satisfactory response source check. When these instruments are in continuous use, response source checks once each day satisfy this requirement.

Battery checks for instruments with a battery check switch shall be performed prior to each use.

5.0 RECORDS

5.1 The records generated as a result of the implementation of this procedure include:

The following records will be maintained by the Radiological Control Supervisor (RCS).

An instrument file for each survey instrument utilized on the Chemetron Remediation Project will be established and contain, as a minimum, the following:

- Initial purchase and/or procurement information.
- A copy of the actual calibration certification provided by the calibration vendor.
- A record of all maintenance and/or repair performed on the instrument.
- A copy of any correspondence associated with either the calibration or maintenance of the instrument.

The Radiological Control Supervisor will ensure that an instrument log is maintained listing all instruments in operation, their calibration date, their calibration due date, and operational status.

All records identified in this section will be maintained as part of the Chemetron Remediation Project site.

6.0 REFERENCES

6.1 NUREG/CR-5849, “Manual for Conducting Radiological Surveys in Support of License Termination,” NRC, June 1992.

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ATTACHMENTS

1 SAFE WORK PERMIT 6

1.0 PURPOSE

The purpose of this procedure is to provide general reference information on Direct Push Technology (DPT). DPT is designed to collect soil, groundwater, and soil gas samples without using conventional drilling techniques. The advantage of using DPT over conventional drilling includes the generation of little or no drill cuttings, sampling in locations with difficult accessibility, reduced overhead clearance requirements, no fluid introduction during probing, and typical lower costs per sample than with conventional techniques. Disadvantages include a maximum penetration depth of approximately 15 to 40 feet in dense soils (although it may be as much as 60 to 80 feet in certain types of geological environments), reduced capability of obtaining accurate water-level measurements, and the inability to install permanent groundwater monitoring wells. The methods and equipment described herein are for collection of surface and subsurface soil samples and groundwater samples. Soil gas sampling is discussed in SOP SA-2.4.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for DPT. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

Direct Push Technology (DPT) - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste.

Geoprobe® - Geoprobe® is a manufacturer of a hydraulically-powered, percussion/probing machines utilizing DPT to collect subsurface environmental samples. Geoprobe® relies on a relatively small amount of static weight (vehicle) combined with percussion as the energy for advancement of a tool string. The Geoprobe® equipment can be mounted in a multitude of vehicles for access to all types of environmental sites.

HydroPunch™ - HydroPunch™ is a manufacturer of stainless steel and Teflon® sampling tools that are capable of collecting representative groundwater and/or soil samples without requiring the installation of a groundwater monitoring well or conventional soil boring. HydroPunch™ is an example of DPT sampling equipment.

Flame Ionization Detector (FID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing a flame as the energizing source.

Photo Ionization Detector (PID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing ultraviolet radiation as the energizing source.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for selecting and/or reviewing the appropriate DPT drilling procedure required to support the project objectives.

Field Operations Leader (FOL)- The FOL is primarily responsible for performing the DPT in accordance with the project-specific plan.

5.0 SOIL SAMPLING PROCEDURES

5.1 General

The common methodology for the investigation of the vadose zone is soil boring drilling and soil sampling. However, drilling soil borings can be very expensive. Generally the advantage of DPT for subsurface soil sampling is the reduced cost of disposal of drilling cuttings and shorter sampling times.

5.2 Sampling Equipment

Equipment needed for conducting DPT drilling for subsurface soil sampling includes, but is not limited to, the following:

- Geoprobe® Sampling Kit
- Cut-resistant gloves
- 4-foot x 1.5-inch diameter macrocore sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Disposable acetate liners for soil macrocore sampler
- Cast aluminum or steel drive points
- Geoprobe® AT-660 Series Large Bore Soil Sampler, or equivalent
- Standard decontamination equipment and solutions

For health and safety equipment and procedures, follow the direction provided in the Safe Work Permit in Attachment 1, or the more detailed directions provided in the project's Health and Safety Plan.

5.3 DPT Sampling Methodology

There are several methods for the collection of soil samples using DPT drilling. The most common method is discussed in the following section. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project-specific plan.

- Macrocore samplers fitted with detachable aluminum or steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material. A Roto-hammer may also be used if very dense soils are encountered.

- The sampler is advanced continuously in 4-foot intervals or less if desired. No soil cuttings are generated because the soil which is not collected in the sampler is displaced within the formation.

- The sampler is retracted from the hole, and the 4-foot continuous sample is removed from the outer coring tube. The sample is contained within an inner acetate liner.

- Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tail gate is not available, secure the trough on another suitable surface.

- Place the acetate liner containing the soils in the trough.

- While wearing cut-resistant gloves (constructed of leather or other suitable material), but the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. Do not attempt to cut the acetate liner while holding it in your hand.

- Field screen the sample with an FID or PID, and observe/examine the sample (according to SOP GH-1.3). If appropriate, transfer the sample to sample bottles for laboratory analysis. If additional volume is required, push an additional boring adjacent to the first and composite/mix the same interval. Field compositing is usually not acceptable for sample requiring volatile organics analysis.

- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes should be finished smooth to existing grade.

- In the event the direct push van/truck cannot be driven to a remote location or a sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with battery/electric operated equipment (e.g., jack hammer).

- Sampling equipment is decontaminated prior to collecting the next sample.

6.0 GROUNDWATER SAMPLING PROCEDURES

6.1 General

The most common methodology for the investigation of groundwater is the installation and sampling of permanent monitoring wells. If only groundwater screening is required, the installation and sampling of temporary well points may be performed. The advantage of temporary well point installation using DPT is reduced cost due to no or minimal disposal of drilling cuttings and well construction materials, and shorter installation/times sampling.

Two disadvantages of DPT drilling for well point installation are:

- In aquifers with low yields, well points may have to be sampled without purging or development.
- If volume requirements are high, this method can be time consuming for low yield aquifers.

6.2 Sampling Equipment

Equipment needed for temporary well installation and sampling using DPT includes, but is not limited, to the following:

- 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point
- Connecting rods
- Roto-hammer with 1.5-inch bit
- Mechanical jack
- 1/4-inch OD polyethylene tubing
- 3/8-inch OD polyethylene tubing
- Peristaltic pump
- Standard decontamination equipment and solutions

6.3 DPT Temporary Well Point Installation and Sampling Methodology

There are several methods for the installation and sampling of temporary well points using DPT. The most common methodology is discussed below. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project specific plan.

- A 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point attached to connecting rods is driven into the ground to the desired depth using a rotary electric hammer or other direct push drill rig. If there is concrete or pavement over a sampling location, a Roto-hammer or electric coring machine is used to drill a hole through the surface material.

- The well point will be allowed to equilibrate for at least 15 minutes, after which a measurement of the static water level will be taken. The initial measurement of the water level will be used to assess the amount of water which is present in the well point and to determine the amount of silt and sand infiltration that may have occurred.

- The well point will be developed using a peristaltic pump and polyethylene tubing to remove silt and sand which may have entered the well point. The well point is developed by inserting polyethylene tubing to the bottom of the well point and lifting and lowering the tubing slightly while the pump is operating. The pump will be operated at a maximum rate of approximately 2 liters per minute. After removal of sediment from the bottom of the well point, the well point will be vigorously pumped at maximum capacity until discharge water is visibly clear and no further sediments are being generated. Measurements of pH, specific conductance, temperature, and turbidity shall be recorded every 5 minutes during the purging process. After two consistent readings of pH, specific conductance, temperature and turbidity ($\pm$10 percent), the well may be sampled.

- A sample will be collected using the peristaltic pump set at the same or reduced speed as during well development. Samples (with the exception of the samples to be analyzed for volatile organic compounds, VOCs) will be collected directly from the pump discharge. Sample containers for VOCs will be filled by (first shutting off the pump) crimping the discharge end of the sample tubing when filled, removing the inlet end of the sample tubing from the well, suspending the inlet tubing above the vial, and allowing water to fill each vial by gravity flow.

- Once the groundwater sample has been collected, the connecting rods and well point will be removed from the hole with the direct push rig hydraulics. The hole will be backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch will be used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

- In the event the direct push van/truck cannot be driven to a remote location or sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with battery/electric-operated equipment (e.g., jack hammer).

- Decontaminate the equipment before moving to the next location.

7.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets, as needed. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation.

ATTACHMENT 1
SAFE WORK PERMIT FOR DPT OPERATIONS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): **Monitoring well drilling and installation through direct push technology**

II. Required Monitoring Instruments: _____

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. 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 ☒

Level D Minimum Requirements: Sleeved shirt and long pants, safety footwear, and work gloves. Safety glasses, hard hats, and hearing protection will be worn when working near or sampling in the vicinity of the DPT rig.

Modifications/Exceptions.

VI. Chemicals of Concern | Action Level(s) | Response Measures

VII. 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/warming regimen	☐ Yes	☐ No

Modifications/Exceptions: Reflective vests for high traffic areas.

VIII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☐	☐
Daily tail gate meetings	☒	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

IX. Site Preparation

Utility Clearances obtained for areas of subsurface investigation	☐ Yes	☐ No
Physical hazards removed or blockaded	☐ Yes	☐ No
Site control boundaries demarcated/signage	☐ Yes	☐ No

X. 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	☐	☒

XI. Additional Permits required (Hot work, confined space entry). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

XII. Special instructions, precautions:

_____

Permit Issued by: _____ Permit Accepted by: _____

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1.0 PURPOSE

The purpose of this procedure is to describe the methods and equipment necessary to perform soil and rock borings and identify the equipment, sequence of events, and appropriate methods necessary to obtain soil, both surface and subsurface, and rock samples during field sampling activities.

2.0 SCOPE

This guideline addresses most of the accepted and standard drilling techniques, their benefits, and drawbacks. It should be used generally to determine what type of drilling techniques would be most successful depending on site-specific geologic conditions and the type of sampling required.

The sampling methods described within this procedure are applicable to collecting surface and subsurface soil samples, and obtaining rock core samples for lithologic and hydrogeologic evaluation, excavation/foundation design, remedial alternative design and related civil engineering purposes.

3.0 GLOSSARY

Rock Coring - A method in which a continuous solid cylindrical sample of rock or compact rock-like soil is obtained by the use of a double tube core barrel that is equipped with an appropriate diamond-studded drill bit which is advanced with a hydraulic rotary drilling machine.

Wire-Line Coring - As an alternative to conventional coring, this technique is valuable in deep hole drilling, since this method eliminates trips in and out of the hole with the coring equipment. With this technique, the core barrel becomes an integral part of the drill rod string. The drill rod serves as both a coring device and casing.

4.0 RESPONSIBILITIES

Project Manager - In consultation with the project geologist, the Project Manager is responsible for evaluating the drilling requirements for the site and specifying drilling techniques that will be successful given the study objectives and the known or suspected geologic conditions at the site. The Project Manager also determines the disposal methods for products generated by drilling, such as drill cuttings and well development water, as well as any specialized supplies or logistical support required for the drilling operations.

Field Operations Leader (FOL) - The FOL is responsible for the overall supervision and scheduling of drilling activities, and is strongly supported by the project geologist.

Project Geologist - The project geologist is responsible for ensuring that standard and approved drilling procedures are followed. The geologist will generate a detailed boring log for each test hole. This log shall include a description of materials, samples, method of sampling, blow counts, and other pertinent drilling and testing information that may be obtained during drilling (see SOPs SA-6.3 and GH-1.5). Often this position for inspecting the drilling operations may be filled by other geotechnical personnel, such as soils and foundation engineers, civil engineers, etc.

Determination of the exact location for borings is the responsibility of the site geologist. The final location for drilling must be properly documented on the boring log. The general area in which the borings are to be located will be shown on a site map included in the Work Plan and/or Sampling and Analysis Plan.

Drilling Subcontractor - Operates under the supervision of the FOL. Responsible for obtaining all drilling permits and clearances, and supplying all services (including labor), equipment and material required to perform the drilling, testing, and well installation program, as well as maintenance and quality control of such required equipment except as stated in signed and approved subcontracts.

The driller must report any major technical or analytical problems encountered in the field to the FOL within 24 hours of determination, and must provide advance written notification of any changes in field procedures, describing and justifying such changes. No such changes shall be made unless requested and authorized in writing by the FOL (with the concurrence of the Project Manager). Depending on the subcontract, the Project Manager may need to obtain written authorization from appropriate administrative personnel before approving any changes.

The drilling subcontractor is responsible for following decontamination procedures specified in the project plan documents. Upon completion of the work, the driller is responsible for demobilizing all equipment, cleaning up any materials deposited on site during drilling operations, and properly backfilling any open borings.

5.0 PROCEDURES

5.1 General

The purpose of drilling boreholes is:

- To determine the type, thickness, and certain physical and chemical properties of the soil, water and rock strata which underlie the site.
- To install monitoring wells or piezometers.

All drilling and sampling equipment will be cleaned between samples and borings using appropriate decontamination procedures as outlined in SOP SA-7.1. Unless otherwise specified, it is generally advisable to drill borings at "clean" locations first, and at the most contaminated locations last, to reduce the risk of spreading contamination between locations. All borings must be logged by the site geologist as they proceed (see SOPs SA-6.3 and GH-1.5). Situations where logging would not be required would include installation of multiple well points within a small area, or a "second attempt" boring adjacent to a boring that could not be continued through resistant material. In the latter case, the boring log can be resumed 5 feet above the depth at which the initial boring was abandoned, although the site geologist should still confirm that the stratigraphy at the redrilled location conforms essentially with that encountered at the original location. If significant differences are seen, each hole should be logged separately.

5.2 Drilling Methods

The selected drilling methods described below apply to drilling in subsurface materials, including, but not limited to, sand, gravel, clay, silt, cobbles, boulders, rock and man-made fill. Drilling methods should be selected after studying the site geology and terrain, the waste conditions at the site, and reviewing the purpose of drilling and the overall subsurface investigation program proposed for the site. The full range of different drilling methods applicable to the proposed program should be identified with final selection based on relative cost, availability, time constraints, and how well each method meets the sampling and testing requirements of the individual drilling program.

5.2.1 Continuous-Flight Hollow-Stem Auger Drilling

This method of drilling consists of rotating augers with a hollow stem into the ground. Cuttings are brought to the surface by the rotating action of the auger. This method is relatively quick and inexpensive. Advantages of this type of drilling include:

- Samples can be obtained without pulling the augers out of the hole. However, this is a poor method for obtaining grab samples from thin, discrete formations because of mixing of soils which occurs as the material is brought to the surface. Sampling of such formations requires the use of split-barrel or thin-wall tube samplers advanced through the hollow core of the auger.
- No drilling fluids are required.
- A well can be installed inside the auger stem and backfilled as the augers are withdrawn.

Disadvantages and limitations of this method of drilling include:

- Augering can only be done in unconsolidated materials.

- The inside diameter of hollow stem augers used for well installation should be at least 4 inches greater than the well casing. Use of such large-diameter hollow-stem augers is more expensive than the use of small-diameter augers in boreholes not used for well installation. Furthermore, the density of unconsolidated materials and depths become more of a limiting factor. More friction is produced with the larger diameter auger and subsequently greater torque is needed to advance the boring.

- The maximum effective depth for drilling is 150 feet or less, depending on site conditions and the size of augers used.

- In augering through clean sand formations below the water table, the sand will tend to flow into the hollow stem when the plug is removed for soil sampling or well installation. If the condition of "running" or "flowing" sands is persistent at a site, an alternative method of drilling is recommended, in particular for wells or boreholes deeper than 25 feet.

Hollow-stem auger drilling is the preferred method of drilling. Most alternative methods require the introduction of water or mud downhole (air rotary is the exception) to maintain the open borehole. With these other methods, great care must be taken to ensure that the method does not interfere with the collection of a representative sample (which may be the prime objective of the borehole construction). With this in mind, the preferred order of choice of drilling method after hollow-stem augering (HSA) is:

- Cable tool
- Casing drive (air)
- Air rotary
- Mud rotary
- Rotosonic
- Drive and wash
- Jetting

However, the use of any method will also depend on efficiency and cost-effectiveness. In many cases, mud rotary is the only feasible alternative to hollow-stem augering. Thus, mud rotary drilling is generally acceptable as a first substitute for HSA.

The procedures for sampling soils through holes drilled by hollow-stem auger shall conform with the applicable ASTM Standards: D1587-83 and D1586-84. The guidelines established in SOP SA-1.3 shall

also be followed. The hollow-stem auger may be advanced by any power-operated drilling machine having sufficient torque and ram range to rotate and force the auger to the desired depth. The machine must, however, be equipped with the accessory equipment needed to perform required sampling, or rock coring.

The hollow-stem auger may be used without the plug when boring for geotechnical examination or for well installation. However, when drilling below the water table, specially designed plugs which allow passage of formation water but not solid material shall be used (see Reference 1 of this guideline). This drilling configuration method also prevents blow back and plugging of the auger when the plug is removed for sampling.

Alternately, it may be necessary to keep the hollow stem full of water, at least to the level of the water table, to prevent blowback and plugging of the auger. If water is added to the hole, it must be sampled and analyzed to determine if it is free from contaminants prior to use. In addition, the amount of water introduced, the amount recovered upon attainment of depth, and the amount of water extracted during well development must be carefully logged in order to ensure that a representative sample of the formation water can be obtained. Well development should occur as soon after well completion as practicable (see SOP GH-2.8 for well development procedures). If gravelly or hard material is encountered which prevents advancing the auger to the desired depth, augering should be halted and either driven casing or hydraulic rotary methods should be attempted. If the depth to the bedrock/soil interface and bedrock lithology must be determined, then a 5-foot confirmatory core run should be conducted (see Section 5.2.9).

At the option of the Field Operations Leader (in communication with the Project Manager), when resistant materials prevent the advancement of the auger, a new boring can be attempted. The original boring must be properly backfilled and the new boring started a short distance away at a location determined by the site geologist. If multiple water bearing strata were encountered, the original boring must be grouted. In some formations, it may be prudent to also grout borings which penetrate only the water table aquifer, since loose soil backfill in the boring may still provide a preferred pathway for surface liquids to reach the water table. Backfilling requirements may also be driven by state or local regulations.

5.2.2 Continuous-Flight Solid-Stem Auger Drilling

This drilling method is similar to hollow-stem augering. Practical application of this method is severely restricted compared to use of hollow-stem augers. Split-barrel (split-spoon) sampling cannot be performed without pulling the augers out, which may allow the hole to collapse. The continuous-flight solid-stem auger drilling method is therefore very time consuming and is not cost effective. Also, augers would have to be withdrawn before installing a monitoring well, which again, may allow the hole to collapse. Furthermore, geologic logging by examining the soils brought to the surface is unreliable, and depth to water may be difficult to determine while drilling.

There would be very few situations where use of a solid-stem auger would be preferable to other drilling methods. The only practical applications of this method would be to drill boreholes for well installation where no lithologic information is desired and the soils are such that the borehole can be expected to remain open after the augers are withdrawn. Alternatively, this technique can be used to find depth to bedrock in an area when no other information is required from drilling.

5.2.3 Rotary Drilling

Direct rotary drilling includes air-rotary and fluid-rotary drilling. For air or fluid-rotary drilling, the rotary drill may be advanced to the desired depth by any power-operated drilling machine having sufficient torque

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1.0 PURPOSE

The purpose of this procedure is to provide general reference information regarding the sampling of groundwater wells.

2.0 SCOPE

This procedure provides information on proper sampling equipment, onsite water quality testing, and techniques for groundwater sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

3.0 GLOSSARY

Conductivity – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valence, and relative concentrations, and on temperature of measure. Conductivity is highly dependent on temperature and should be reported at a particular temperature, i.e., 20.2 mS/cm at 14C.

Dissolved Oxygen (DO) – DO levels in natural and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode, immersed in water, as referenced against a standard hydrogen electrode.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

pH Paper - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Salinity – Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved slats in a given mass of solution. Note: most field meters determined salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or % (e.g., 35 ppt will equal 3.5%).

Turbidity – Turbidity in water is caused by suspended matter, such as clay, silt, fine organic and inorganic matter. Turbidity is an expression the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

4.0 RESPONSIBILITIES

Project Hydrogeologist - Responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), and equipment to be used, and providing detailed input in this regard to the project plan documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of the site sampling personnel.

Project Geologist - is primarily responsible for the proper acquisition of the groundwater samples. He/she is also responsible for the actual analyses of onsite water quality samples, as well as instrument calibration, care, and maintenance. When appropriate, such responsibilities may be performed by other qualified personnel (e.g., field technicians).

5.0 PROCEDURES

5.1 General

To be useful and accurate, a groundwater sample must be representative of the particular zone of the water being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis in order to keep any changes in water quality parameters to a minimum.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of the groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water due to sampling techniques. In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. To safeguard against collecting non-representative stagnant water in a sample, the following approach shall be followed prior to sample acquisition:

1. All monitoring wells shall be purged prior to obtaining a sample. Evacuation of three to five volumes is recommended prior to sampling. In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, extensive evacuation prior to sample withdrawal is not as critical.

2. For wells that can be purged dry, the well shall be evacuated and allowed to recover prior to sample acquisition. If the recovery rate is fairly rapid, evacuation of more than one volume of water is required.

3. For high-yielding monitoring wells which cannot be evacuated to dryness, there is no absolute safeguard against contaminating the sample with stagnant water. One of the following techniques shall be used to minimize this possibility:

    - A submersible pump or the intake line of a surface pump or bailer shall be placed just below the water surface when removing the stagnant water and lowered as the water level drops. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. Once this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.

    - The intake line of the sampling pump (or the submersible pump itself) shall be placed near the bottom of the screened section, and approximately one casing volume of water shall be pumped from the well at a low purge rate, equal to the well's recovery rate (low flow sampling).

Stratification of contaminants may exist in the aquifer. Concentration gradients as a result of mixing and dispersion processes, layers of variable permeability, and the presence of separate-phase product (i.e.,

floating hydrocarbons) may cause stratification. Excessive pumping or improper sampling methods can dilute or increase the contaminant concentrations in the recovered sample compared to what is representative of the integrated water column as it naturally occurs at that point, thus the result is the collection of a non-representative sample.

5.2 Sampling, Monitoring, and Evacuation Equipment

Sample containers shall conform with the guidelines expressed in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

- Sample packaging and shipping equipment - Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler, ice, labels and chain-of-custody documents.

- Field tools and instrumentation - Multi-parameters water quality meter capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity and salinity or individual meters (as applicable), pH paper, camera and film (if appropriate), appropriate keys (for locked wells), engineer's rule, water level indicator.

- Pumps

  - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable.

  - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.

- Other sampling equipment - Bailers and inert line with tripod-pulley assembly (if necessary).

- Pails - Plastic, graduated.

- Decontamination solutions - Deionized water, potable water, laboratory detergents, 10% nitric acid solution (as required), and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

5.3 Calculations of Well Volume

To insure that the proper volume of water has been removed from the well prior to sampling it is first necessary to know the volume of standing water in the well pipe. This volume can be easily calculated by the following method. Calculations shall be entered in the site logbook or field notebook or on a sample log sheet form (see SOP SA-6.3):

- Obtain all available information on well construction (location, casing, screens, etc.).

- Determine well or casing diameter.

- Measure and record static water level (depth below ground level or top of casing reference point).

- Determine depth of well by sounding using a clean, decontaminated, weighted tape measure.
- Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- Calculate one static well volume in gallons $V = (0.163)(T)(r^2)1$

where:	V	=	Static volume of well in gallons.
	T=		Thickness of water table in the well measured in feet (i.e., linear feet of static water).
	r	=	Inside radius of well casing in inches.
	0.163	=	A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.

- Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

5.4 Evacuation of Static Water (Purging)

5.4.1 General

The amount of purging a well shall receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately the well can be pumped until the parameters such as temperature, specific conductance, pH, and turbidity (as applicable), have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook, field notebook, or on standardized data sheets.

5.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. Note that all of these techniques involve equipment which is portable and readily available.

Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of pipe with a sealed bottom (bucket-type bailer) or, as is more useful and favored, with a ball check-valve at the bottom. An inert line is used to lower the bailer and retrieve the sample.

Advantages of bailers include:

- Few limitations on size and materials used for bailers.
- No external power source needed.
- Bailers are inexpensive, and can be dedicated and hung in a well to reduce the chances of cross-contamination.

- There is minimal outgassing of volatile organics while the sample is in the bailer.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Transfer of sample may cause aeration.
- Use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low volume pump that uses rollers to squeeze a flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross contamination.

These pumps are all portable, inexpensive and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause significant loss of dissolved gases and volatile organics.

Air-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a venturi to force the water up a sampling tube. These pumps are also relatively inexpensive. Air (or gas)-lift samplers are more suitable for well development than for sampling because the samples may be aerated, leading to pH changes and subsequent trace metal precipitation, or loss of volatile organics.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. The operation principles vary and the displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

- They may have low delivery rates.
- Many models of these pumps are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time-consuming.

5.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen (DO)
- Oxidation Reduction Potential (ORP)
- Certain Dissolved Constituents Using Specific Ion Elements
- Turbidity
- Salinity

This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, and colloidal material or suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Since instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use.

5.5.1 Measurement of pH

5.5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken.

Two methods are given for pH measurement: the pH meter and pH indicator paper. The indicator paper is used when only a rough estimate of the pH is required, and the pH meter when a more accurate measurement is needed. The response of a pH meter can be affected to a slight degree by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

5.5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific pH range hydrion paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion concentration across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

5.5.1.3 Equipment

The following equipment is needed for taking pH measurements:

- Stand-alone portable pH meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs).
- Buffer solutions, as specified by the manufacturer.
- pH indicator paper, to cover the pH range 2 through 12.
- Manufacturer's operation manual.

5.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

The following procedure is used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

- Inspect the instrument and batteries prior to initiation of the field effort.
- Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
- If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- Calibrate on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on an equipment calibration log sheet.
- Immerse the electrode(s) in the sample, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.
- Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH unit. Also record the sample temperature.
- Rinse the electrode(s) with deionized water.
- Store the electrode(s) in an appropriate manner when not in use.

Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is adequately determined.

5.5.2 Measurement of Specific Conductance

5.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

5.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.5.2.3 Equipment

The following equipment is needed for taking specific conductance (SC) measurements:

- Stand alone portable conductivity meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available which may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirement of the sampling program.

5.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet. Potassium chloride solutions with a SC closest to the values expected in the field shall be used for calibration. Attachment B provides guidance in this regard.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the electrode in the sample and measure the conductivity. Adjust the temperature setting to the sample temperature (if applicable).
- Read and record the results in a field logbook or sample log sheet.
- Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for details.

5.5.3 Measurement of Temperature

5.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury filled or dial-type thermometers. In addition, various meters such as specific conductance or dissolved oxygen meters, which have

temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

5.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample:

- Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.
- Record values in a field logbook or sample log sheet.

If a temperature meter or probe is used, the instrument shall be calibrated according to manufacturer's recommendations.

5.5.4 Measurement of Dissolved Oxygen

5.5.4.1 General

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms as well as the rate of corrosivity, are dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of dissolved oxygen meters only. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible, and is not susceptible to interference caused by color, turbidity, colloidal material or suspended matter.

5.5.4.2 Principles of Equipment Operation

Dissolved oxygen probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, while leaving the surface of the solution undisturbed.

Dissolved oxygen probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide, which are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field log book and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer.

5.5.4.3 Equipment

The following equipment is needed to measure dissolved oxygen concentration:

- Stand alone portable dissolved oxygen meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

5.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure the dissolved oxygen concentration:

- The equipment shall be calibrated and have its batteries checked before going to the field.
- The probe shall be conditioned in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
- The instrument shall be calibrated in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature. Dissolved oxygen values for air-saturated water can be determined by consulting a table listing oxygen solubilities as a function of temperature and salinity (see Attachment C).
- Record all pertinent information on an equipment calibration sheet.
- Rinse the probe with deionized water.
- Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells can be moved up and down.
- Record the dissolved oxygen content and temperature of the sample in a field logbook or sample log sheet.
- Rinse the probe with deionized water.
- Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This however, may not always be practical. Be sure to record whether the liquid was analyzed in-situ, or if a sample was taken.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen solubilization and positive test interferences.

5.5.5 Measurement of Oxidation-Reduction Potential

5.5.5.1 General

The oxidation-reduction potential (ORP) provides a measure of the tendency of organic or inorganic compounds to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of oxidized to reduced species in the sample.

5.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as dissolved oxygen, may be correlated with ORP to provide a knowledge of the quality of the solution, water, or wastewater.

5.5.5.3 Equipment

The following equipment is needed for measuring the oxidation-reduction potential of a solution:

- Portable pH meter or equivalent, with a millivolt scale.
- Platinum electrode to fit above pH meter.
- Reference electrode such as a calomel, silver-silver chloride, or equivalent.
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring oxidation-reduction potential:

- The equipment shall be calibrated and have its batteries checked before going to the field.

- Check that the platinum probe is clean and that the platinum bond or tip is unoxidized. If dirty, polish with emery paper or, if necessary, clean the electrode using aqua regia, nitric acid, or chromic acid, in accordance with manufacturer's instructions.

- Thoroughly rinse the electrode with deionized water.

- Verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of the test solution is altered. The ORP will increase when the pH of the test solution decreases, and the ORP

will decrease if the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note the ORP drops sharply when the caustic is added (i.e., pH is raised) thus indicating the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions. If the ORP does not respond as above when the caustic is added, the electrodes shall be cleaned and the above procedure repeated.

- After the assembly has been checked for sensitivity, wash the electrodes with three changes of water or by means of a flowing stream of deionized water from a wash bottle. Place the sample in a clean container and insert the electrodes. Set temperature compensator throughout the measurement period. Read the millivolt potential of the solution, allowing sufficient time for the system to stabilize and reach temperature equilibrium. Measure successive portions of the sample until readings on two successive portions differ by no more than 10 mV. A system that is very slow to stabilize properly will not yield a meaningful ORP. Record all results in a field logbook or sample logsheet, including ORP (to nearest 10 mV), sample temperature and pH at the time of measurement.

5.5.6 Measurement of Turbidity

5.5.6.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and microscopic organisms, including plankton.

It is important to obtain a turbidity reading immediately after taking a sample, since irreversible changes in turbidity may occur if the sample is stored too long.

5.5.6.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidmeter. Therefore, nephelometric turbidity units (NTU) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

5.5.6.3 Equipment

The following equipment is needed for turbidity measurement:

- Stand alone portable turbidity meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 61).

- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.6.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the probe in the sample and measure the turbidity. The reading must be taken immediately as suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
- Read and record the results in a field logbook or sample log sheet. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
- Rinse the electrode with deionized water.

5.5.7 Measurement of Salinity

5.5.7.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Note: Most field meters determined salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or % (e.g., 35 ppt will equal 3.5%).

5.5.7.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (found in *Standard methods for the Examination of Water and Wastewater*). Depending on the meter, the results are displayed in either ppt or %. The salinity measurements are carried out in reference to the conductivity of standard seawater (*corrected to S = 35*).

5.5.7.3 Equipment

The following equipment is needed for Salinity measurements:

- Multi-parameter water quality meter capable of measuring conductive, temperature and converting them to salinity (e.g., Horiba U-10 or YSI 610).
- Calibration Solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.7.4 Measurement Techniques for Salinity

The steps involved in taking Salinity measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the cell with the sample to be tested.
- Immerse the probes in the sample and measure the salinity. Read and record the results in a field logbook or sample log sheet.
- Rinse the probes with deionized water.

5.6 Sampling

5.6.1 Sampling Plan

The sampling approach consisting of the following, shall be developed as part of the project plan documents which are approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.6.2 Sampling Methods

The collection of a groundwater sample consists of the following steps:

1. The site Health & Safety Officer (or designee) will first open the well cap and use volatile organic detection equipment (PID or FID) on the escaping gases at the well head to determine the need for respiratory protection.

2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet (see SOP SA-6.3); then calculate the fluid volume in the well pipe (as previously described in this SOP).

3. Calculate well volume to be removed as stated in Section 5.3.

4. Select the appropriate purging equipment (see Attachment A). If an electric submersible pump with packer is chosen, go to Step 10.

5. Lower the purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner (as applicable). Lower the purging device, as required, to maintain submergence.

6. Measure the rate of discharge frequently. A graduated bucket and stopwatch are most commonly used; other techniques include use of pipe trajectory methods, weir boxes or flow meters.

7. Observe the peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.

8. Purge a minimum of three to five casing volumes before sampling. In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Purged water shall be collected in a designated container and disposed in an acceptable manner.

9. If sampling using a pump, lower the pump intake to midscreen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.

10. (For pump and packer assembly only). Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.

11. In the event that recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this occurrence in the site logbook.

12. Fill sample containers (preserve and label as described in SOP SA-6.1).

13. Replace the well cap and lock as appropriate. Make sure the well is readily identifiable as the source of the samples.

14. Process sample containers as described in SOP SA-6.1.

15. Decontaminate equipment as described in SOP SA-7.1.

5.7 Low Flow Purging and Sampling

5.7.1 Scope & Application

Low flow purging and sampling techniques are sometimes required for groundwater sampling activities. The purpose of low flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at near natural flow conditions. The minimum stress procedure emphasizes negligible water level drawdown and low pumping rates in order to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 2 inches or more and a saturated screen, or open interval, length of ten feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This procedure is not designed to collect non-aqueous phase liquids samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs), using the low flow pumps.

The procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 5 NTU and to achieve a water level drawdown of less than 0.3 feet during purging and sampling. If these goals cannot be achieved, sample collection can take place provided the remaining criteria in this procedure are met.

5.7.2 Equipment

The following equipment is required (as applicable) for low flow purging and sampling:

- Adjustable rate, submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom filling bailers may be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing - Teflon, Teflon-lined polyethylene, polyethylene, PVC, Tygon, stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device, 0.01 foot accuracy, (electronic devices are preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies.
- Interface probe, if needed.

- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments - pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional Indicators - ORP and dissolved oxygen, flow-through cell is required. Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s), and other forms (e.g., well purging forms).
- Sample Bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event.
- Field Sampling Plan.
- PID or FID instrument for measuring VOCs (volatile organic compounds).

5.7.3 Purging and Sampling Procedure

Use a submersible pump to purge and sample monitoring wells which have a 2.0 inch or greater well casing diameter.

Measure and record the water level immediately prior to placing the pump in the well.

Lower pump, safety cable, tubing and electrical lines slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is three feet or less of standing water in the well.

When starting the pump, slowly increase the pump speed until a discharge occurs. Check water level. Adjust pump speed to maintain little or no water level drawdown. The target drawdown should be less than 0.3 feet and it should stabilize. If the target of less than 0.3 feet cannot be achieved or maintained, the sampling is acceptable if remaining criteria in the procedure are met. Subsequent sampling rounds will probably have intake settings and extraction rates that are comparable to those used in the initial sampling rounds.

Monitor water level and pumping rate every five to ten minutes (or as appropriate) during purging. Record pumping rate adjustments and depths to water. Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During initial pump start-up, drawdown may exceed the 0.3 feet target and then recover as pump flow adjustments are made (minimum purge volume calculations should utilize stabilized drawdown values, not the initial drawdown). If the recharge rate of the well is less than minimum capability of the pump do not

allow the water level to fall to the intake level (if the static water level is above the screen, avoid lowering the water level into the screen). Shut off the pump if either of the above is about to occur and allow the water level to recover. Repeat the process until field indicator parameters stabilize and the minimum purge volume is removed. The minimum purge volume with negligible drawdown (0.3 feet or less) is two saturated screen length volumes. In situations where the drawdown is greater than 0.3 feet and has stabilized, the minimum purge volume is two times the saturated screen volume plus the stabilized drawdown volume. After the minimum purge volume is attained (and field parameters have stabilized) begin sampling. For low yields wells, commence sampling as soon as the well has recovered sufficiently to collect the appropriate volume for all anticipated samples.

During well purging, monitor field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every five to ten minutes (or as appropriate). Purging is complete and sampling may begin when all field indicator parameters have stabilized (variations in values are within ten percent of each other, pH +/- 0.2 units, for three consecutive readings taken at five to ten minute intervals). If the parameters have stabilized, but turbidity remains above 5 NTU goal, decrease pump flow rate, and continue measurement of parameters every five to ten minutes. If pumping rate cannot be decreased any further and stabilized turbidity values remain above 5 NTU goal record this information. Measurements of field parameters should be obtained (as per Section 5.5) and recorded.

VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples: (1) Collect the non-VOCs samples first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample and record the new flow rate; (2) reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel), or clamp which should reduce the flow rate by constricting the end of the tubing; (3) insert a narrow diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, collect sample from the narrow diameter tubing.

Prepare samples for shipping as per SOP SA-6.1.

6.0 REFERENCES

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ATTACHMENT A

PURGING EQUIPMENT SELECTION

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet		X	X	X	X			
	Water Level >25 feet				X				
2-Inch	Water level <25 feet	X	X	X	X	X	X		
	Water Level >25 feet	X			X		X		
4-Inch	Water level <25 feet	X	X	X	X	X	X	X	X
	Water Level >25 feet	X			X		X	X	X
6-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X
8-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 2

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, Inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump	Portable; peristaltic (suction)	<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	670 mL/min with 7015-20 pump head	$500-600	AC/DC; variable speed control available; other models may have different flow rates.
ECO Pump Corp.	SAMPLifier	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift	$400-700	AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	$185	Acts as piezometer; requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	$1,500-3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflon®, PP, PE, Detrin®, acetal	0-150	0-7,500 mL/min	$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teflon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#0500)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	$1,400-1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	$300-400	Requires compressed gas; piezometric level indicator; other materials available.

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 3

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; peristaltic (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	$1,200-1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Bennett Co.	Model 180	Portable; piston (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	$2,600-2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Canada Ltd.	5W Water Sampler	Portable; grab (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	$1,300-1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; grab (positive displacement)	1.66/Custom	PVC, PP	No limit	250 mL/ft of bailer	$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon®, Teflon®	0-150	350 mL/flushing cycle	$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; bladder (positive displacement)	1.38/48	SS, silicone, Delrin®, Tygon®	0-125	0-4,000 mL/min	$800-1,000	Compressed gas required; DC control module; custom built.

Construction Material Abbreviations:

- PE Polyethylene
- PP Polypropylene
- PVC Polyvinyl chloride
- SS Stainless steel
- PC Polycarbonate
- EPDM Ethylene-propylene diene (synthetic rubber)

Other Abbreviations:

- NA Not applicable
- AC Alternating current
- DC Direct current

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.

ATTACHMENT B

SPECIFIC CONDUCTANCE OF 1 MOLAR KCl AT VARIOUS TEMPERATURES[1]

Temperature (°C)	Specific Conductance (umhos/cm)
15	1,147
16	1,173
17	1,199
18	1,225
19	1,251
20	1,278
21	1,305
22	1,332
23	1,359
24	1,368
25	1,413
26	1,441
27	1,468
28	1,496
29	1,524
30	1,552

[1] Data derived from the International Critical Tables 1-3-8.

ATTACHMENT C

VARIATION OF DISSOLVED OXYGEN CONCENTRATION IN WATER AS A FUNCTION OF TEMPERATURE AND SALINITY

Temperature (°C)	Dissolved Oxygen (mg/L)					
	Chloride Concentration in Water					Difference/ 100 mg Chloride
	0	5,000	10,000	15,000	20,000	
0	14.6	13.8	13.0	12.1	11.3	0.017
1	14.2	13.4	12.6	11.8	11.0	0.016
2	13.8	13.1	12.3	11.5	10.8	0.015
3	13.5	12.7	12.0	11.2	10.5	0.015
4	13.1	12.4	11.7	11.0	10.3	0.014
5	12.8	12.1	11.4	10.7	10.0	0.014
6	12.5	11.8	11.1	10.5	9.8	0.014
7	12.2	11.5	10.9	10.2	9.6	0.013
8	11.9	11.2	10.6	10.0	9.4	0.013
9	11.6	11.0	10.4	9.8	9.2	0.012
10	11.3	10.7	10.1	9.6	9.0	0.012
11	11.1	10.5	9.9	9.4	8.8	0.011
12	10.8	10.3	9.7	9.2	8.6	0.011
13	10.6	10.1	9.5	9.0	8.5	0.011
14	10.4	9.9	9.3	8.8	8.3	0.010
15	10.2	9.7	9.1	8.6	8.1	0.010
16	10.0	9.5	9.0	8.5	8.0	0.010
17	9.7	9.3	8.8	8.3	7.8	0.010
18	9.5	9.1	8.6	8.2	7.7	0.009
19	9.4	8.9	8.5	8.0	7.6	0.009
20	9.2	8.7	8.3	7.9	7.4	0.009
21	9.0	8.6	8.1	7.7	7.3	0.009
22	8.8	8.4	8.0	7.6	7.1	0.008
23	8.7	8.3	7.9	7.4	7.0	0.008
24	8.5	8.1	7.7	7.3	6.9	0.008
25	8.4	8.0	7.6	7.2	6.7	0.008

ATTACHMENT C
VARIATION OF DISSOLVED OXYGEN CONCENTRATION IN WATER AS A FUNCTION OF TEMPERATURE AND SALINITY
PAGE TWO

Temperature (°C)	Dissolved Oxygen (mg/L)					
	Chloride Concentration in Water					Difference/ 100 mg Chloride
	0	5,000	10,000	15,000	20,000	
26	8.2	7.8	7.4	7.0	6.6	0.008
27	8.1	7.7	7.3	6.9	6.5	0.008
28	7.9	7.5	7.1	6.8	6.4	0.008
29	7.8	7.4	7.0	6.6	6.3	0.008
30	7.6	7.3	6.9	6.5	6.1	0.008
31	7.5					
32	7.4					
33	7.3					
34	7.2					
35	7.1					
36	7.0					
37	6.9					
38	6.8					
39	6.7					
40	6.6					
41	6.5					
42	6.4					
43	6.3					
44	6.2					
45	6.1					
46	6.0					
47	5.9					
48	5.8					
49	5.7					
50	5.6					

Note: In a chloride solution, conductivity can be roughly related to chloride concentration (and therefore, used to correct measured D.O. concentration) using Attachment B.

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1.0 PURPOSE

This procedure describes methods and equipment commonly used for collecting environmental samples of surface water and aquatic sediment for either onsite examination and chemical testing, or for subsequent laboratory analysis.

2.0 SCOPE

The information presented in this guideline is generally applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions and equipment different from those described herein.

3.0 GLOSSARY

Environmental Sample - a sample containing (or suspected to contain) low-level concentrations of contaminants, which does not require special handling or transport considerations as detailed in SOP SA-6.1.

Hazardous Waste Sample - a sample containing (or suspected to contain) higher concentrations of contaminants thus requiring special handling and/or transport considerations per SOP SA-6.1.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel.

Field Operations Leader - The Field Operations Leader (FOL) is responsible for the in-field supervision of the conduct of onsite water quality analyses, ensuring the completion and accuracy of all field documentation, and making sure that custody of all samples obtained is maintained according to proper procedures.

5.0 PROCEDURES

5.1 Introduction

Collecting a representative sample from surface water or sediments is difficult because of water movement, stratification, or patchiness. To collect representative samples, one must standardize sampling bias related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification.

Representativeness is a qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been taken. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples.

5.2 Defining the Sampling Program

Many factors must be considered in developing a sampling program for surface water or sediments including study objectives, accessibility, site topography, physical characteristics of the water body (such as flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on the vertical and lateral mixing within the body of water. For sediments, dispersion depends on bottom current or flow characteristics, sediment characteristics (density, size) and geochemical properties (which affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes, but also must understand the role of fluvial-sediment transport, deposition, and chemical sorption.

5.2.1 Sampling Program Objectives

The objective of surface water sampling is to determine the surface water quality entering, leaving or remaining within the site. The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or within a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., spills). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the waterbody, direct waste disposal (solid or liquid) into the water body; and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) which encompass the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the location of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc., shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation are: (1) move the site far enough downstream to allow for adequate mixing, or (2) collect integrated samples in a cross section. Also, nonhomogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and the heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

5.2.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream, because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes and reservoirs, as well as those on larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Sampling in marshes or tidal areas may require the use of an all-terrain vehicle (ATV). The same precautions mentioned above with regard to sediment disturbance apply.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed in order to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of streamflow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Streamflow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining streamflow data by direct or indirect methods.

5.2.3 Frequency of Sampling

The sampling frequency and the objectives of the sampling event will be defined by the project plan documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of the contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples shall be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly, and during droughts and floods). Samples of bottom material shall be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water-quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

5.3 Surface Water Sample Collection

5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts)

Methods for sampling streams, rivers, outfalls, and drainage features at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode, shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of DO, pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project plan documents.

5.3.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally-formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline which is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer which is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several verticals with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality since it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in-situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen, some cations and anions, and light penetration.

5.3.3 Estuaries

Estuarine areas are by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types dependent upon freshwater inflow and mixing properties. Knowledge of the estuary type is necessary to determine sampling locations. Each type of estuarine area is described below:

- Mixed Estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is shallow and is found in major freshwater sheetflow areas. Being well mixed, the sampling locations are not critical in this type of estuary.

- Salt Wedge Estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.

- Oceanic Estuary - characterized by salinities approaching full-strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh-saline water mixing occurring near, or at, the shore line.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical dissolved oxygen and temperature profiles.

5.3.4 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. The most frequently used samplers are:

- Open tube.
- Dip sampler.
- Weighted bottle.
- Hand pump.
- Kemmerer.
- Depth-Integrating Sampler.

The dip sampler and the weighted bottle sampler are used most often, and detailed discussions for these devices only (and the Kemmerer sampler) are addressed subsequently in this section.

The criteria for selecting a sampler include:

1. Disposability and/or easy decontamination.
2. Inexpensive cost (if the item is to be disposed).
3. Ease of operation.
4. Nonreactive/noncontaminating properties - Teflon-coated, glass, stainless-steel or PVC sample chambers are preferred (in that order).

As specified in the project plan document plan documents, each sample (grab or each aliquot collected for compositing) shall be measured for:

- Specific conductance.
- Temperature.
- pH.
- Dissolved oxygen (optional).

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample logsheets (see SOP SA-6.3). These analyses will provide information on water mixing/stratification and potential contamination.

Dip Sampling

Water is often sampled by filling a container either attached to a pole or held directly, from just beneath the surface of the water (a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration that is distributed throughout the water column and in the cross section. Therefore, whenever possible, it is recommended to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of a stopped glass or plastic bottle, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The procedure for sampling with this device is:

- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- Pull out the stopper with a sharp jerk of the stopper line.
- Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- Raise the sampler and cap the bottle.

- Decontaminate the outside of the bottle. This bottle can be used as the sample container as long as the bottle is an approved container type.

Kemmerer

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless-steel or acrylic cylinder, with rubber stoppers that leave the ends open while being lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles.

5.3.5 Surface Water Sampling Techniques

Most samples taken during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following suggestions are made to help ensure that the samples obtained are representative of site conditions:

- The most representative samples are obtained from mid-channel at a 0.6 foot stream depth in a well-mixed stream.

- Even though the containers used to obtain the samples are previously laboratory cleaned, it is suggested that the sample container be rinsed at least once with the water to be sampled before the sample is taken. This is not applicable when sample containers are provided "pre-preserved."

- For sampling running water, it is suggested that the farthest downstream sample be obtained first, and that subsequent samples be taken as one works upstream. In general, work from zones suspected of low contamination to zones of high contamination.

- To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid node is combined into one sample, or several grid nodes are selected at random.

- Care should be taken to avoid excessive agitation of the water, as loss of volatile constituents could result.

- When obtaining samples in 40 mL septum vials for volatile organics analysis, it is important to exclude any air space in the top of the bottle and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. The vial can be turned upside down to check for air bubbles.

- Do not sample at the surface, unless sampling specifically for a known constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the approximate depth, and held at about a 45-degree angle with the mouth of the bottle facing upstream. When sample containers are provided "pre-preserved," use a dedicated, clean, un-preserved bottle for sampling and transfer to an appropriately-preserved container.

5.4 Onsite Water Quality Testing

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

5.5 Sediment Sampling

5.5.1 General

Sediment samples are usually collected at the same verticals at which water samples were collected. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body.

Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center of a water body will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathometry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials, shall be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are below detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3.

5.5.2 Sampling Equipment and Techniques

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

When boats are used for sampling, life preservers must be provided and two individuals must undertake the sampling. An additional person shall remain onshore in visual contact at all times.

The following samplers may be used to collect bottom materials:

- Scoop sampler.
- Dredge samplers.

Each type of sampler is discussed subsequently.

Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and best way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping the sampler along the bottom in the upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

Dredges

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices (i.e., coarse-grained or partially-cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger". Most dredges are heavy (up to several hundred pounds) and require use of a winch and crane assembly for sample retrieval. There are three major types of dredges: Peterson, Eckman and Ponar dredges.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave" and permitting direct access to the secured sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

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1.0 PURPOSE

This procedure discusses the methods used to collect surface, near surface, and subsurface soil samples. Additionally, it describes the method for sampling of test pits and trenches to determine subsurface soil and rock conditions, and recover small-volume or bulk samples.

2.0 SCOPE

This procedure is applicable to the collection of surface, near surface and subsurface soils for laboratory testing, which are exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites.

3.0 GLOSSARY

Composite Sample - A composite sample exists as a combination of more than one sample at various locations and/or depths and times, which is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples are not to be collected for volatile organics analysis.

Grab Sample - One sample collected at one location and at one specific time.

Non-Volatile Sample - A non-volatile sample includes all other chemical parameters (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Hand Auger - A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2-inch OD to 3-1/2 inch OD. The larger sizes are commonly used when a larger volume of sample material is required.

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher excavator, or bulldozer).

Confined Space - As stipulated in 29 CFR 1910.146, a confined space means a space that: 1) is large enough and so configured that an employee can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults, and pits, and excavations are spaces that may have limited means of entry.); and 3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for determining sampling objectives, as well as, the field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches, and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring and excavation activities, and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - The FOL is responsible for finalizing the location of surface, near surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits and trenches, and for adherence to OSHA regulations during these operations.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of soil samples and the completion of all required paperwork (i.e., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms).

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

5.0 PROCEDURES

5.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they have migrated into the water table, and can establish the amount of contamination sorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during the sampling operations, particularly noting the location, depth, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. As a result, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be obtained from published soil

surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

5.2 Soil Sample Collection

5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds

The above described traditional sampling techniques, used for the collection of soil samples for volatile organic analysis, have recently been evaluated by the scientific community and determined to be ineffective in producing accurate results (biased low) due to the loss of volatile organics in the sampling stages and microbial degradation of aromatic volatiles. One of the newly adopted sampling procedures for collecting soil samples includes the field preservation of samples with methanol or sodium bisulfate to minimize volatilization and biodegradation. These preservation methods may be performed either in the field or laboratory, depending on the sampling methodology employed.

Soil samples to be preserved by the laboratory are currently being performed using method SW-846, 5035. Laboratories are currently performing low level analyses (sodium bisulfate preservation) and high level analyses (methanol preservation) depending on the end users needs.

It should be noted that a major disadvantage of the methanol preservation method is that the laboratory reporting limits will be higher than conventional testing. The reporting levels using the new method for most analytes are 0.5 µg/g for GC/MS and 0.05 µg/g for GC methods.

The alternative preservation method for collecting soil samples is with sodium bisulfate. This method is more complex to perform in the field and therefore is not preferred for field crews. It should also be noted that currently, not all laboratories have the capabilities to perform this analysis. The advantage to this method is that the reporting limits (0.001 µg/g for GC/PID or GC/ELCD, or 0.010 for GC/MS) are lower than those described above.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

5.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organics that are to be preserved at the laboratory will be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample will be obtained using a reusable sampling handle provided with the EnCore™ sampler. The sample is collected by pushing the EnCore™ sampler directly into the soil, ensuring that the sampler is packed tight with soil, leaving zero headspace. Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives.

Once the sample is collected, it should be placed on ice immediately and shipped to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

If the lower detection limits are necessary, an option would be to collect several EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

5.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) method and medium-level (methanol preservation) method.

Methanol Preservation (Medium Level):

Soil samples to be preserved in the field with methanol will utilize 40-60 mL glass vials with septum lids. Each sample bottle will be filled with 25 mL of demonstrated analyte-free purge and trap grade methanol. Bottles may be prespiked with methanol in the laboratory or prepared in the field.

Soil will be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol preserved sample bottle. Calibration of the scale should be performed prior to use and intermittently throughout the day according to the manufacturers requirements.

The sample should be collected by pulling the plunger back and inserting the syringe into the soil to be sampled. The top several inches of soil should be removed before collecting the sample. Approximately 10 grams $\pm$2g (8-12 grams) of soil should be collected. The sample should be weighed and adjusted until obtaining the required amount of sample. The sample weight should be recorded to the nearest 0.01 gram in the field logbook and/or sample log sheet. The soil should then be extruded into the methanol preserved sample bottle taking care not to contact the sample container with the syringe. The threads of the bottle and cap must be free of soil particles.

After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

Samples to be preserved using the sodium bisulfate method are to be prepared as follows:

Add 1 gram of sodium bisulfate to 5 mL of laboratory grade deionized water in a 40-60 mL glass vial with septum lid. Bottles may be prespiked in the laboratory or prepared in the field. The soil sample should be collected in a manner as described above and added to the sample container. The sample should be weighed to nearest 0.01 gram as described above and recorded in field logbook or sample log sheet.

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soils containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode.

When preparing samples using the sodium bisulfate preservation method, duplicate samples must be collected using the methanol preservation method on a one for one sample basis. The reason for this is because it is necessary for the laboratory to perform both the low level and medium level analyses. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

If the lower detection limits are necessary, an option to field preserving with sodium bisulfate would be to collect 3 EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

5.2.2 Procedure for Collecting Non-Volatile Soil Samples

Non-volatile soil samples may be collected as either grab or composite samples. The non-volatile soil sample is thoroughly mixed in a stainless steel or disposable, inert plastic tray, using a stainless steel trowel or other approved tool, then transferred into the appropriate sample container(s). Head space is permitted in a non-volatile soil sample container to allow for sample expansion.

5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83)

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) will be employed. The following method will be used:

1. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Use of any side-discharge bits is permitted.

3. A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.

4. To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they're more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.

5. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Clean filler must be placed in voids at either end of the tube prior to sealing with wax. Place plastic caps on the ends of the sample tube, tape the caps in place, and dip the ends in wax.

6. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label. Mark the "up" direction on the side of the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms (see SOP SA-6.3). Do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the

ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs, and therefore their use shall be weighed against the need for acquiring an undisturbed sample.

5.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples (most commonly collected to a depth of 6 inches) for subsequent analysis is by use of a stainless steel trowel. Surface soils are considered 0-12 inches bgs.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Real-time air monitoring instrument (e.g., PID, FID, etc.).
- Latex gloves.
- Required Personal Protective Equipment (PPE).
- Required paperwork.
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Sealable polyethylene bags (i.e., Ziploc® baggies).
- Heavy duty cooler.
- Ice (if required) double-bagged in sealable polyethylene bags.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, the following procedure shall be used:

1. Carefully remove vegetation, roots, twigs, litter, etc., to expose an adequate soil surface area to accommodate sample volume requirements.

2. Using a decontaminated stainless steel trowel, follow the procedure cited in Section 5.2.1 for collecting a volatile soil sample. Surface soil samples for volatile organic analysis should be collected from 6-12 inches bgs only.

3. Thoroughly mix (in-situ) a sufficient amount of soil to fill the remaining sample containers and transfer the sample into those containers utilizing the same stainless steel trowel employed above. Cap and securely tighten all sample containers.

4. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.

5. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

5.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6-18 inches) can be accomplished with tools such as shovels and stainless steel or pre-cleaned disposable trowels.

The following equipment is necessary to collect near surface soil samples:

- Clean shovel.
- The equipment listed under Section 5.3 of this procedure.
- Hand auger.

To obtain near-surface soil samples, the following protocol shall be observed:

1. With a clean shovel, make a series of vertical cuts to the depth required in the soil to form a square approximately 1 foot by 1 foot.

2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

3. Follow steps 2 through 5 listed under Section 5.3 of this procedure.

5.5 Subsurface Soil Sampling With a Hand Auger

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2" long, and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), and a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth (approximately 6"). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls.
- The equipment listed under Section 5.3 of this procedure.

To obtain soil samples using a hand auger, the following procedure shall be followed:

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.

2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).

3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook or on standardized data sheets) any changes in the color, texture or odor of the soil.

4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.

5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.

6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.

7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.

8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.

9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.

10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.

11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

5.6 Subsurface Soil Sampling With a Split-Barrel Sampler (ASTM D1586-84)

Split-barrel (split-spoon) samplers consist of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment A). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-lb. or larger casing driver.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (O.D. 2 inches, I.D. 1-3/8 inches, either 20 inches or 26 inches long); Larger O.D. samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-lb. weight, driving head and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed under Section 5.3 of this procedure.

The following steps shall be followed to obtain split-barrel samples:

1. Remove the drive head and nosepiece, and open the sampler to reveal the soil sample. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.). Carefully separate the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.

2. Collect the volatile sample from the center of the core where elevated readings occurred. If no elevated readings where encountered the sample material should still be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.

3. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.

4. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

5.7 Subsurface Sol Sampling Using Direct Push Technology

Subsurface soil samples can be collected to depths of 40+ feet using direct push technology (DPT). DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

5.8 Excavation and Sampling of Test Pits and Trenches

5.8.1 Applicability

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise which control the method of excavation. No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is still required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. Any entry may constitute a Confined Space and must be done in conformance with all applicable regulations. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, 29 CFR 1910.134, AND 29 CFR 1910.146.

Excavations are generally not practical where a depth of more than about 15 feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

5.8.2 Test Pit and Trench Excavation

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented as described in SOP SA-6.3.

Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, gives a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area, and spoils pile will be predicated based on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

As mentioned previously, no personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is still required, Occupational Safety and Health Administration (OSHA) requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry). It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

5.8.3 Sampling in Test Pits and Trenches

5.8.3.1 General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as described in SOP SA-6.3. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable Health and Safety and OSHA requirements have been met.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information would include soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples, which can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

5.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks and hand augers, stainless steel trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.

- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment B).

5.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.7.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.

- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:

- Any fluid phase or groundwater seepage is encountered in the test pit.

- Any drums, other potential waste containers, obstructions or utility lines are encountered.

- Distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Remove loose material to the greatest extent possible with backhoe.

- Secure walls of pit if necessary. (There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)

- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material once it has been deposited on the ground. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or SSO then approaches the bucket and monitors its contents with a photoionization or flame ionization detector. The sample is collected from the center of the bucket or pile and placed in sample containers using a decontaminated stainless steel trowel or spatula.

- If a composite sample is desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

- Using the remote sampler shown in Attachment B, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench shall first be scraped (using a long-

handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.

- Complete documentation as described in SOP SA-6.3.

5.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There is no practical alternative means of obtaining such data.
- The Site Safety Officer and Competent Person determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- A Company-designated Competent Person determines that the pit/trench is stable or is made stable (by grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements must be strictly observed.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit, usually Level B. He/she will be affixed to a safety rope and continuously monitored while in the pit.

A second individual will be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon. As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sample operations. In the event of a cave-in they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.7.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.

- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.7.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.7.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3.

5.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

5.9 Records

The appropriate sample log sheet (see SOP SA-6.3; Field Documentation) must be completed by the site geologist/sampler. All soil sampling locations must be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see SOP SA-6.3; Field Documentation) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of boring and excavation.
- Approximate surface elevation.
- Total depth of boring and excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

6.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

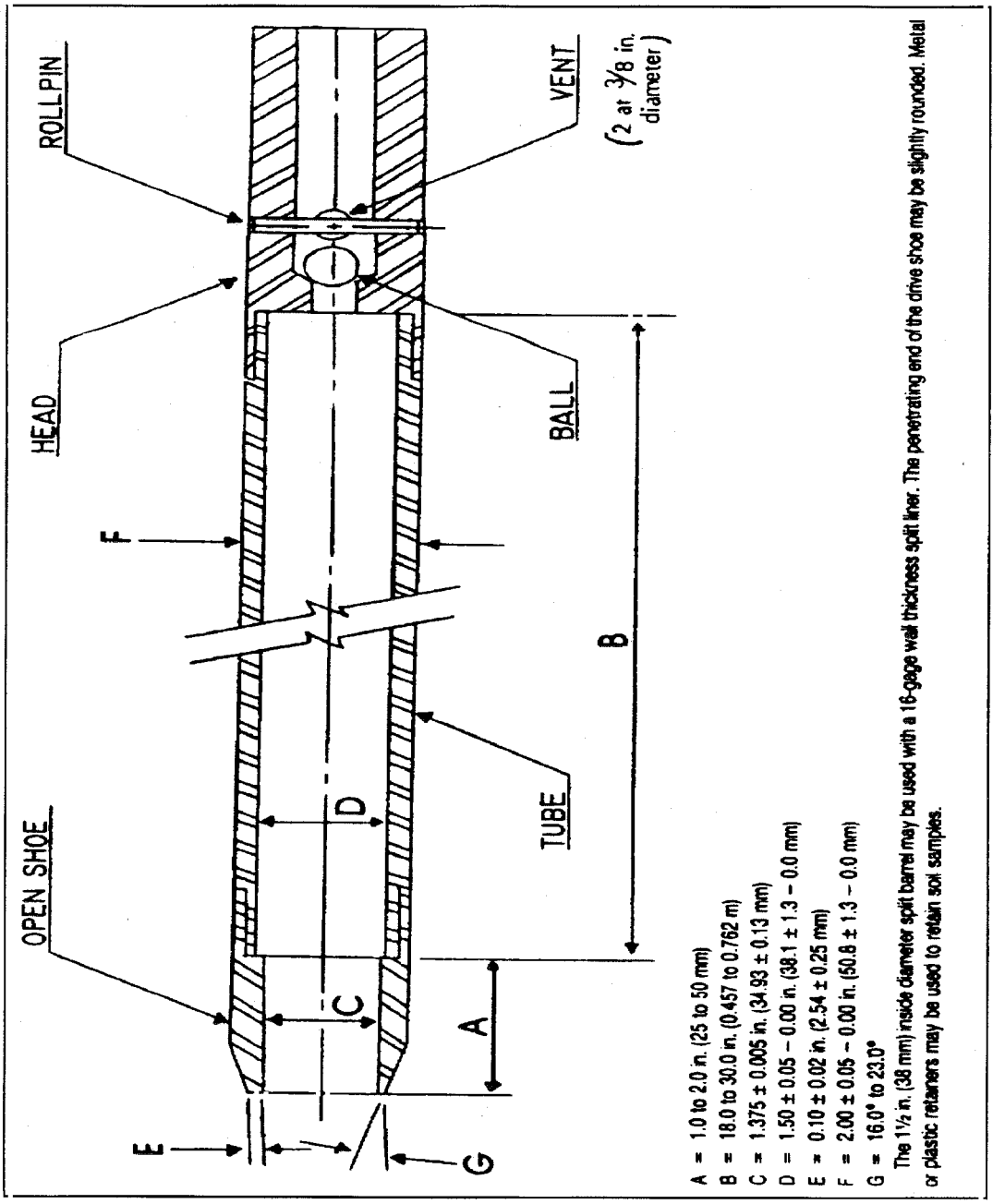
NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

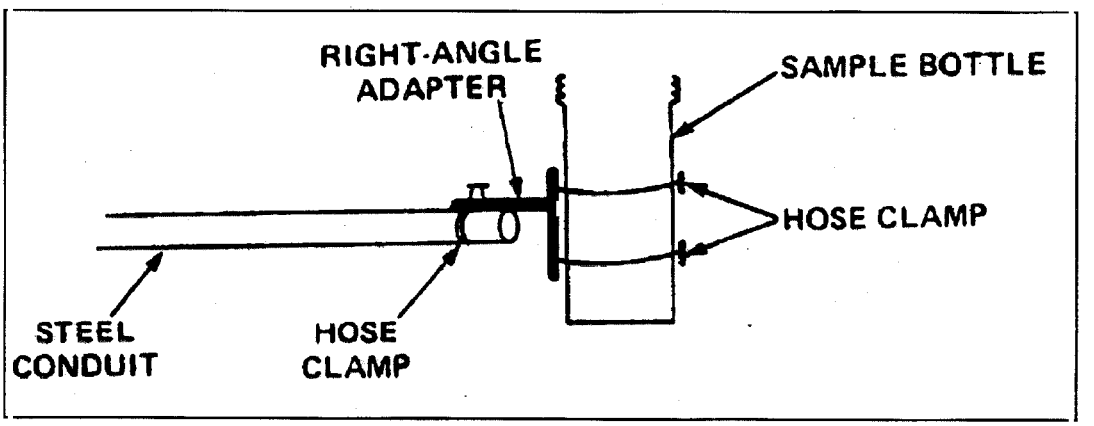
ATTACHMENT A
SPLIT-SPOON SAMPLER



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 – 0.00 in. (38.1 ± 1.3 – 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 – 0.00 in. (50.8 ± 1.3 – 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

ATTACHMENT B
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING



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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded or referenced (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 Field Notebooks

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 Sample Forms

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in the Table of Contents for this SOP. Forms may be altered or revised for project-specific needs contingent upon client

approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments B-1 to B-4 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager, while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment B-6. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the samplers and affixed across the opening edges of each cooler containing environmental samples. COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.1.5 Field Analytical Log Sheets for Geochemical Parameters

Field Analytical Log Sheets (Attachment B-8) are used to record geochemical and/or natural attenuation field test results. Attachments B-8 (3-page form) should be used when applicable.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log, (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these results must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Monitoring Well Materials Certificate of Conformance (Attachment C-11) should be used as the project directs to document all materials utilized during each monitoring well installation.

The Monitoring Well Development Record (Attachment C-12) should be used as the project directs to document all well development activities.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Daily Activities Report

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

APPENDIX D

FIELD DATA FORMS

Tetra Tech NUS, Inc.

PROJECT: _____ LOCATION: _____

JOB & CTO #: _____ DEPART: _____

TOM: _____ RETURN: _____

SAMPLING FIELD CHECKLIST

EQUIPMENT

- ___ Well Key/ Gate Key
- ___ Submersible Pump
- ___ Peristaltic Pump
- ___ Horiba
- ___ Umbrella
- ___ Chair
- ___ Measuring cup
- ___ Clips
- ___ Well Tool (9/16)
- ___ Drum Wrench (15/16)
- ___ Buckets/lids
- ___ Water Level Indicator
- ___ Hach Kit Tests for NA
- ___ Box cutter knife
- ___ Machete
- ___ Batteries
- ___ Charger
- ___ Car Adaptor for batteries
- ___ Scrub Brush
- ___ OVA/FID
- ___ Bungee cords
- ___ Drum/Pallets
- ___ Cell Phone/charger
- ___ Secondary Spill pans
- ___ Sampling Filters

DOCS

- ___ Work Plan
- ___ HASP Addendum
- ___ EISOPQAM
- ___ COMPQAP

EXPENDABLES

- ___ Silicone Tubing
- ___ Teflon Tubing
- ___ DI Cube
- ___ DI Sprayer
- ___ Paper Towels
- ___ Gloves
- ___ Trash Bags
- ___ Liquinox
- ___ Bottleware (extra VOA vials)
- ___ Isopropyl
- ___ Ziplock Bags
- ___ Tape/dispenser
- ___ Bubblewrap
- ___ Ice
- ___ Sharpie Pens
- ___ Drinks
- ___ Small cups (if water in wells)
- ___

FORMS

- ___ Labels
- ___ COC's
- ___ Low Flow Purge Sheet
- ___ Development sheet
- ___ Field Book
- ___ Drum Labels
- ___ Custody seals
- ___ Fed Ex Air bill
- ___ Field Calibration Sheet
- ___ Groundwater Sample sheet
- ___ Site Map

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: NAS Jacksonville **Project No.:** _____

Location: _____ **Personnel:** _____

Weather Conditions: _____ **Measuring Device:** _____

Tidally Influenced: Yes ___ No _X_ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Page ___ of ___

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: _____
Project No.: _____

[ ] Domestic Well Data
[X] Monitoring Well Data
[ ] Other Well Type: _____
[ ] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	Visual	Standard	mS/cm	°C	NTU	mg/l	%	
Method: Low Flow Peristaltic								

PURGE DATA

Date:	SEE LOW FLOW PURGE DATA SHEET
Method: Low Flow Peristaltic	
Monitor Reading (ppm):	
Well Casing Diameter:	
Well Casing Material:	
Total Well Depth (TD):	
Static Water Level (WL):	
One Casing Volume(gal/L):	
Start Purge (hrs):	
End Purge (hrs):	
Total Purge Time (min):	
Total Vol. Purged (gal/L):	

SAMPLE COLLECTION INFORMATION

Analysis	Preservative	Container Requirements	Laboratory	Collected

OBSERVATIONS / NOTES

Laboratory:

phone:
fax:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: _____ **WELL ID.:** _____

PROJECT NUMBER: _____ **DATE:** _____

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	Sal. (%)	Comments

SIGNATURE(S): _____

PAGE___OF___

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: NAS Jacksonville
PROJECT NUMBER:
DRILLING COMPANY:
DRILLING RIG:

BORING NUMBER:
DATE:
GEOLOGIST:
DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

Tetra Tech NUS, Inc.

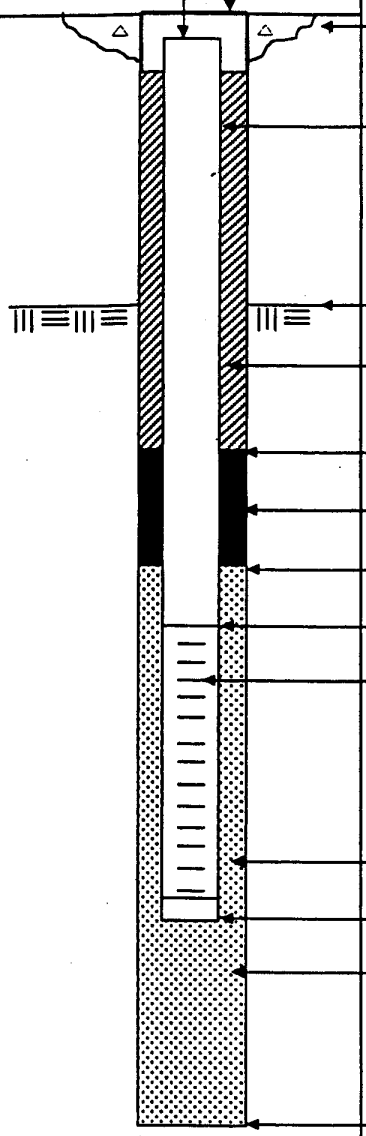
WELL No.: _____

MONITORING WELL SHEET

PROJECT:	NAS CECIL FIELD	DRILLING Co.:	_____	BORING No.:	_____
PROJECT No.:	0039	DRILLER:	_____	DATE COMPLETED:	_____
SITE:	_____	DRILLING METHOD:	_____	NORTHING:	_____
GEOLOGIST:	_____	DEV. METHOD:	_____	EASTING:	_____

Ground Elevation =

Datum:



Not to Scale

Elevation / Depth of Top of Riser: ____/____

Elevation / Height of Top of Surface Casing: ____/____

I.D. of Surface Casing: _____

Type of Surface Casing: _____

Type of Surface Seal: _____

I.D. of Riser: _____

Type of Riser: _____

Borehole Diameter: _____

Elevation / Depth Top of Rock: ____/____

Type of Backfill: _____

Elevation / Depth of Seal: ____/____

Type of Seal: _____

Elevation / Depth of Top of Filter Pack: ____/____

Elevation / Depth of Top of Screen: ____/____

Type of Screen: _____

Slot Size x Length: _____

I.D. of Screen: _____

Type of Filter Pack: _____

Elevation / Depth of Bottom of Screen: ____/____

Elevation / Depth of Bottom of Filter Pack: ____/____

Type of Backfill Below Well: _____

Elevation / Total Depth of Borehole: ____/____

Tetra Tech NUS, Inc.
TASK MODIFICATION REQUEST FORM

Project/Installation Name	Project Number	Task Mod. Number
To	Site/Sample Location	Date

Description: _____

Reason for Change: _____

Recommended Disposition: _____

Field Operations Leader (Signature) _____ Date _____

Disposition: _____

Task Order Manager (Signature) _____ Date _____

Distribution:
Program Coordinator-
Quality Assurance Officer -
Task Order Manager -
Field Operations Leader -

Others: _____

Equipment Usage Log

Vehicle										
Noise Dosimeter										
Aerosol Monitor										
Transducer										
VHF Radio										
Generator										
Transducer										
Hermit Data Logger										
Redi Flo Pump										
Oil Water Interface Probe										
Four Gas Meter										
Water Quality Meter										
LEL/02 Meter										
DO Meter										
Micro PID										
PID										
FID										
WBS3										
W/O										
Job #										
Date										

DIG PERMIT/REQUEST

1. Costs associated with utility locates will be the responsibility of the requestor.

2. The requestor is responsible for the repair of any utilities damaged during the digging operation. Hand digging to locate lines is recommended.

3. The JPA Cecil Field Aviation does not accept any financial responsibility associated with repairs due to any other damage associated with this request.

4. Contact "Sunshine State One Call Center" to coordinate all your utility locates. The service is free of charge.

REQUESTOR (NAME): _____ PHONE NUMBER: _____

COMPANY: _____ REQUEST DATE: _____

LOCATION(S): _____

PURPOSE: _____

_____

UTILITY LOCATED AND/OR AREA SCREENED (Sunshine State One Call Center: 1-800-432-4770)

	Yes/No
GAS:	_____/_____
ELECTRICAL:	_____/_____
WATER:	_____/_____
SEWAGE:	_____/_____
CABLE:	_____/_____
TELEPHONE:	_____/_____
STORMWATER:	_____/_____

CARETAKER REVIEW (BLDG. 1; corner of Authority Ave. and Skillside St.)

ENVIRONMENTAL: _____
(signature/date)

CARETAKER SITE OFFICER: _____
(signature/date)

_____ Recommend Approval/Disapproval Date: _____
Aviation Facilities Coordinator

_____ Approved/Disapproved Date: _____
Facility Manager

COMMENTS: _____

_____.

Phone Numbers:
Aviation Facilities Coordinator: Roy Craigue- 573-1607 (W); 393-4179 (Beeper)
Facilities Manager: Ken Melchiorre- 573-1604 (W); 504-5286 (Cell Phone)

Enclosure (2)

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: _____ Depth to Bottom (ft.): _____ Responsible Personnel: _____
Site: _____ Static Water Level Before (ft.): _____ Drilling Co.: _____
Date Installed: _____ Static Water Level After (ft.): _____ Project Name: NAS CECIL FIELD
Date Developed: _____ Screen Length (ft.): _____ Project Number: 0039
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

APPENDIX B

Health and Safety Plan for Remedial Investigation/Feasibility Study for the Defense Reutilization and Marketing Office, Naval Air Station Jacksonville, Jacksonville, Florida, January 2001

HEALTH AND SAFETY PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY FOR THE DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)

NAVAL AIR STATION
JACKSONVILLE, FLORIDA

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0135

January 2001

HEALTH AND SAFETY PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FOR
THE DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)

NAVAL AIR STATION
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
TETRA TECH NUS
661 Andersen Drive Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0135

JANUARY 2001

PREPARED UNDER THE SUPERVISION OF:

MARK PETERSON, P.G.
TASK ORDER MANAGER
TETRA TECH NUS
JACKSONVILLE, FLORIDA

APPROVED FOR SUBMITTAL BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH AND SAFETY MANAGER
TETRA TECH NUS
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

Authorization: This Health and Safety Plan (HASP) and the work described within are completed under the authorization of:

Contract: Comprehensive Long-Term Environmental Action Navy (CLEAN) III

Contract Number: N62467-94-D-0888

Contract Task Order: 0135

Statement of Work: #156-Revision A – Remedial Investigation/Feasibility Study Phase 2 for the Defense Reutilization and Marketing Office (DRMO) Yard Naval Air Station (NAS) Jacksonville (JAX) Jacksonville, Florida. Determine the extent of contamination (horizontal and vertical) to surface and subsurface soils, surface and groundwater, and sediments.

Proposed Dates of Work: September 2000 to September 2002

Application: This HASP has been written to encompass site activities that are to be conducted at the NAS JAX located in Jacksonville, Florida. Activities to be conducted as per this HASP are defined in detail in Section 4.0.

Compliance: The elements of this HASP are intended to be in compliance with the requirements established by:

- Occupational Safety and Health Administration (U.S. Department of Labor) (OSHA) 29 Code of Federal Regulators (CFR) 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
- Applicable sections of 29 CFR 1926 "Safety and Health Regulations For Construction."
- Tetra Tech NUS, Inc. (TtNUS) Health and Safety Program

This HASP must be accompanied by the TtNUS Health and Safety Guidance Manual. The Guidance Manual provides additional information on program support, standard operating procedures, and safe work practices.

Modifications/Changes: The following conditions are considered sufficient basis review and possible changes to this document

- The addition or modification of activities outside of those specified in Section 4.0, Scope of Work.
- New information becomes available through the course of the investigation or from outside sources.

All changes to this HASP will be requested through the Task Order Manager (TOM) to the TtNUS Health and Safety Manager (HSM). It is the responsibility of the TOM to notify all affected personnel of all changes to this HASP. Changes to the HASP will be documented using a Document Review Record.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in onsite activities. Personnel assigned to these positions will exercise the primary responsibility for all onsite health and safety. These persons will be the primary points of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for onsite activities.

- The TtNUS TOM 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 based on task and potential hazards.
  iv. Determining emergency response procedures and emergency contacts.
  v. Stipulating training and medical surveillance requirements.
  vi. Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.
  vii. Modifying this HASP, as it becomes necessary.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed Site Safety Officer (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 onsite. In this capacity the SSO:

  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 in areas of operation.
  iv. Implements air monitoring program for onsite activities.
  v. Verifies training and medical clearance of onsite personnel status in relation to site activities.
  vi. Implements Hazard Communication, Respiratory Protection Programs, and other associated health and safety programs as they may apply to site activities.
  vii. Coordinates emergency services.
  viii. Provides site-specific training for all onsite personnel.
  ix. Investigates all accidents and injuries (see Attachment I - Illness/Injury Procedure and Report Form)
  x. Provides input to the PHSO regarding the need to modify, this HASP, or applicable health and safety associated documents as per site-specific requirements.

- Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the TtNUS CLEAN HSM.

Note: In some cases one person may be designated responsibilities for more than one position. For example, at NAS JAX the FOL may also be responsible for the SSO duties. This action will be performed only as credentials, experience, and availability permits.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Air Station Jacksonville **Address**: Jacksonville, Florida

Navy Engineer-in-Charge (EIC): Mr. Anthony Robinson **Phone Number**: (843) 820-5628

Facility Contact: Mr. Tim Curtin **Phone Number**: (904) 542-2717 Ext. 120

Purpose of Site Visit: This activity is divided into a multi-task operation (see Section 4.0).

Project Team:

TtNUS Personnel:	Discipline/Tasks Assigned:	Phone Number:
Mark Peterson, PG	Task Order Manager (TOM)	904/281-0400
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager (HSM)	412/921-8912
Thomas M. Dickson, CSP	Project Health and Safety Officer (PHSO)	412/921-8457
TBD	Field Operations Leader (FOL)	
TBD	Site Safety Officer (SSO)	
Tom Patton	Equipment Manager	412/262-4583

NAS JAX
Tetra Tech NUS, Inc.
Project Support Staff

Debbie Wroblewski Program Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8968 FAX: (412) 921-4040
Joseph Samchuck Data Validation Manager Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	(412) 921-8510 FAX: (412) 921-4040
Brian Lewis Statistician Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	(412) 921-7105 FAX: (412) 921-4040

Non-TtNUS Personnel	Affiliation/Discipline/Tasks Assigned	
TBD	Analytical (Chemical/Radiological) Laboratory	
TBD	Drilling Contractor	
B.Koh & Associates (Barry Koh)	Radiological Contractor (Technical/Field Support)	(410) 356-6612
FedEx	Parcel/Sample Shipment	1(800)463-3339

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:

Thomas M. Dickson, CSP

PG – Professional Geologist
CIH – Certified Industrial Hygienist
CSP – Certified Safety Professional
TBD – To Be Determined

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an incidental or emergency release or occurrence. TtNUS will, through necessary services, include incidental response measures for incidents such as:

- Initial stage fire fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provide initial medical support for injuries or illnesses requiring only first-aid level support
- Provide site control and security measures as necessary

Incidental response measures will only be provided to the capabilities of on-site personnel and available resources. Incidental response measures are not considered an emergency response as per 29 CFR 1910.120 (b). Incidents and situations that are deemed to be an emergency response as defined by 29 CFR 1910.120 (b) will be handled by outside resources. It has been determined that these off-site response agencies are capable of providing the most effective response and 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. These agencies will be contacted through NAS JAX Emergency Dispatch. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

2.2 EMERGENCY PLANNING

Based on planned activities, the potential for field personnel to encounter significant emergency situations is minimal. However, based on the initial hazard/risk assessment effort, some potential exists for injuries or illnesses resulting from exposure to chemical, physical, radiological hazards or fire could be encountered during site activities. To minimize and eliminate these potential emergency situations, emergency planning activities associated with this project, the following responsibilities are assigned to the FOL and/or the SSO:

- Coordinating response actions with NAS JAX Emergency Services personnel to ensure that TtNUS emergency action activities are compatible with existing facility emergency response procedures. This will serve as the initial review of the Emergency Action Plan.
- Establishing and maintaining information at the project staging area (Support Zone) for easy access in the event of an emergency. This information includes the following:

- Chemical Inventory (for substances used onsite), with Material Safety Data Sheets (MSDSs).
- Onsite personnel medical records (medical data sheets).
- A logbook identifying personnel onsite each day.
- Emergency notification phone numbers in all site vehicles

Note: It is the responsibility of the TtNUS FOL and/or the SSO to ensure that this information is available and present at the site.

- Identifying a chain of command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.
- Preview work areas to remove physical hazards where identified.
- Pre-screen radiological contaminated areas to determine area and personnel restrictions.
- Pre-screen environmental media to determine radiological levels prior to sending samples off-site

2.3 EMERGENCY RECOGNITION AND PREVENTION

The primary focus of this section is the ability to recognize and control factors, which could contribute to an emergency situation/condition. The FOL, and/or the SSO will preview all site work location prior to committing personnel or resources. Their actions will be as follows:

- Identify, remove, and/or barricade physical hazards within the estimated work area.

  - Ensure that approach paths to monitoring wells are maintained (cleared, mowed, etc.)
  - Inspect monitoring well protective casings are cleared of spider and insect nests.
  - Inspect remote sample locations for signs of natural hazards (i.e., heavy brush – ticks; snakes, etc.).
- Provide the necessary equipment to control potential emergencies (i.e., safety cans for flammable liquid storage, spill containment equipment, personal protective equipment (PPE), and emergency equipment such as portable fire extinguishers).
- Evaluate operations to ensure that necessary measures are taken to control and/or minimize the impact of emergency situations/conditions.
- Complete site characterization for all radiological contaminated areas to quantify and qualify the hazards associated with those areas. Based on the results obtained the areas will be demarcated and restricted to only approved personnel.

Field Crew shall:

- Identify, remove, or barricade physical hazards within the estimated work area.
- Follow the guidelines for control of emergency conditions
- Report any potential emergency situation to the FOL and/or the SSO.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

Upon activation of the on-site emergency alarm system the following actions will occur:

- All operations will cease.
- Field personnel will note the direction of the wind based on the position of wind socks or other wind direction indicator placed at the top of the mast (i.e., streamer, flag, etc.).
- Based on the wind direction, personnel will move cross and up wind to either the primary or secondary safe place of refuge as identified in Figure 2-1.
- All personnel will remain at this location until directed otherwise by the FOL and/or the SSO.

The FOL and/or the SSO shall identify a safe place of refuge (in the event of an emergency) on the Safe Work Permit (SWP). This location will be selected and conveyed to the Field Crew as part of issuing the SWP at the beginning of each field task.

2.4.1 Critical Operations

There are no operations being conducted under this scope of work that are considered critical and would require and individual or individuals to staff during an emergency. Therefore in the event of an emergency all personnel will cease all operations and report to the safe place of refuge.

2.5 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 emergency would occur which would require workers to evacuate the site without first performing decontamination procedures. Decontamination of medical emergencies will proceed in the following manner.

S:\NAVY\SITES\CTO 135\CAD\0522BM02

ROOSEVELT BLVD.

(U.S. HWY 17)

SECONDARY PLACE OF SAFE REFUGE

1902

ASPHALT

CONCRETE

ASTs

OIL-WATER SEPARATOR

PRIMARY PLACE OF SAFE REFUGE

FORMER GAS STATION

SHED

174

238

1740

1901

1903

1900

178A

178B

RAILROAD

RR SPUR

224

MOBILE HOME SALES

WOODS

0 60 120

APPROXIMATE SCALE In FEET

LEGEND

APPROXIMATE BOUNDARY PSC 46

FENCE

DRAINAGE DITCH

RUNOFF WATER FLOW DIRECTION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/28/00

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

DRMO SITE MAP
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 2-1

REV. 0

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2.5.1 Non-Life Threatening Medical Incident (Bruises, Cuts, Scrapes, Etc.)

The area of clothing or suit penetration will be isolated from the decontamination procedure by removing the protective garments or clothing surrounding the area of the injury and applying a light gauze wrap and plastic cover. The area will be surveyed for contamination by a radiological control technician. Decontamination for unaffected areas will proceed as per Table 5-1 of this HASP.

2.5.2 Life Threatening

- Notify offsite response agencies.
- If it will not endanger the injured individual (i.e., spinal cord injury, etc.) remove any outer PPE. Removal may require the use of bandage scissors to remove the outer garments.
- If it will not endanger the injured individual, the individual should be surveyed for contamination by a radiological control technician.
- Begin life saving techniques as appropriate [cardiopulmonary resuscitation (CPR), cooling or warming regimens, etc.].
- Wrap the injured in a blanket for transport to the hospital.

Note: One person from the field team will accompany the injured to the hospital with his/her medical data sheet, appropriate MSDSs, a copy of this HASP, and the incident forms. This person will collect as much information as possible and transfer that information to the HSM and Work Care as per the Incident Response Protocol provided in Figure 2-2. All other personnel will engage site control/site security measures.

2.5.3 Emergency Medical Treatment

TtNUS and subcontractor personnel are only permitted to provide treatment to the level of their First-Aid Training.

Emergency medical treatment will be initiated under the following guarded restrictions:

- Notify the FOL and/or the SSO of the incident.
- Take the necessary precautions to prevent direct contamination with the injured person's body fluids.
  - Use surgeons gloves when handling cuts, abrasions, bites, punctures, etc. or any part of the injured person. The use of safety glasses and surgeons masks maybe necessary, if there is the potential for uncontrolled spread of body fluids.
  - Should CPR be required, use a CPR Micro-Shield mouthpiece when administering CPR.

FIGURE 2-2
EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations.

In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a TtNUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, or follow the voice prompt for after hours and weekend notification and be prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved TtNUS employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.
- As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-2 (continued)
WORKCARE
POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known):_____

_____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing?_____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was their skin contact? _____

Was the exposing agent inhaled?_____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

If an emergency occurs on Base, the following procedures are to be initiated:

- Initiate an emergency notification by hand signals, voice commands, air horn, or two-way radios to the FOL/SSO. Describe to the SSO (who will serve as the Incident Coordinator) what has occurred and provide as many details as possible.

- Evacuate non-essential persons from the incident scene, engage initial response measures given the emergency type (i.e., spill response, fire extinguisher, first-aid).

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL and/or SSO will enact the emergency notification procedures to secure additional outside assistance in the following manner:

- Call NAS JAX Emergency Dispatch
- Give the emergency operator the location of the emergency and a brief description of what has occurred.
- Stay on the phone and follow the instructions given by the operator
- The appropriate agency will be notified and dispatched
- Call Navy On-Site Representative
- Call the TOM and the HSM

If an incident occurs at outside of our designated operating areas impacting field personnel, the following procedures are to be initiated:

- Initiate an evacuation (if needed) by voice commands, hand signals, air horns, or two-way radio.
- Call Navy On-Site Representative
- Proceed to the assembly points as directed by NAS JAX or other Navy personnel.

2.7 PPE AND EMERGENCY EQUIPMENT

A first aid kit, eye wash units, stretcher, and fire extinguishers will be maintained on-site at an easily accessible location and shall be immediately available for use in the event of an emergency. Based on the hazards anticipated, these incident response abatement items may be maintained at the exclusion zone of on-going operations as determine and communicated to the field crew through the SWP. This will be at the discretion of the SSO.

The FOL and/or the SSO should ensure the First-Aid Kits are provided stocked with the necessary equipment. All first-aid kits purchased for the job-site shall be American National Standards Institute (ANSI) approved for industrial applications. The SSO will determine the number of kits necessary based on the number of personnel and the number of remote operations being conducted under the scope of work. It is the SSO's responsibility to assess work site applications for specific first-aid needs based on operations being conducted

PPE levels to be used in an emergency will not exceed those items used in the completion of identified tasks.

2.7.1 PPE Requirements - Incidental Spill of Investigative Derived Wastes (IDW)

- Polyvinyl Chloride (PVC) Rain-Suits or Tyvek based on the potential for soiling work clothes during clean-up
- PVC or Neoprene Over-boots (Pant legs on the outside of the over-boots)
- Nitrile inner surgeons gloves with Nitrile outer gloves over top
- Hard hat as conditions or overhead hazards exist
- Protective eye glasses

The determination to tape seams (pant legs and sleeves to boots and gloves) will be decided based on existing environmental conditions (external temperatures) and the potential for heat stress.

Spill equipment (identified in Section 9.0) will be maintained in the investigative derived waste storage area to support rapid response.

2.7.2 PPE Requirements – Radioactive Contaminated Areas

- PVC Rain-Suits or Tyvek based on the potential for soiling work clothes during clean-up
- PVC or Neoprene Over-boots (Pant legs on the outside of the over-boots)
- Nitrile inner surgeons gloves with Nitrile outer gloves over top
- Hard hat as conditions or overhead hazards exist
- Full-face Air Purifying Respirator with Organic Vapor/High Efficiency Particulate Air (HEPA) Cartridges (If required by radioactive conditions)
- Protective eye glasses

2.7.3 Fire Fighting

Standard field attire will be used to combat incipient fires, from a sufficient distance as not to endanger field personnel. All personnel will be trained to use the fire extinguishers onsite as part of site-specific training. Fire extinguishers will be maintained at the following locations:

- Support trailer
- On each drill rig
- At all locations which store, dispense or otherwise handle flammable or combustible liquids.

All personnel will be trained in the proper use and maintenance of the fire extinguishers provided by their employer for use. The training information to be provided during site-specific training may be found in Attachment VII of this document.

2.8 EMERGENCY CONTACTS

Prior to performing work at the site, all personnel will be briefed on the emergency procedures to be followed in the event of an incident. A mobile phone shall be available on site. Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table must be posted on site where it is readily available to all site personnel.

2.9 INJURY/ILLNESS REPORTING

In addition, TtNUS personnel who are injured or become ill on the job must notify appropriate company representatives. Figure 2-2 and Attachment I present the procedure for reporting an injury/illness, and the form to use for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps in Figure 2-2.**

TABLE 2-1

EMERGENCY REFERENCE
NAS JACKSONVILLE

AGENCY	TELEPHONE
EMERGENCY (Police, Fire, and Ambulance Services)	**911**
NAS JAX Emergency Dispatch	
NAS Naval Hospital (for life threatening emergencies only)	(904) 542-4530
Base Contact Mr. Tim Curtin	(904) 542-2717 Ext. 120
Task Order Manager Mark Peterson, PG	(904) 281-0400
CLEAN Health and Safety Manager Matthew Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer Thomas Dickson, CSP	(412) 921-8457
Columbia Orange Park Medical Center 2001 Kingsley Avenue Orange Park, Florida	(904) 276-8580
Navy Onsite Representative Cdr. James Need	(904) 542-2424
Utilities (On Base) (Utility clearance and Emergencies) Mr. Mike Manz	(904) 542-2717 Ext. 111
Utilities (Public Utility Locating Service) Sunshine (Florida One Call)	1(800) 432-4770
Chemtrec National Response Center Poison Control Center	(800) 424-9300 (800) 424-8802 (800) 962-1253
TtNUS, Jacksonville Office	(904) 281-0400
TtNUS, Pittsburgh Office	(412) 921-7090

2.10 EMERGENCY ROUTE TO HOSPITAL

See Figure 2-3 for Map.

Directions to NAS Naval Hospital from the DRMO Yard:

Take Highway 17 (Roosevelt Blvd.) North to Birmingham Gate. Take Birmingham Ave. to Child Street. Turn right on Child Street, Hospital is on the right off of Child Street.

Directions from NAS JAX Main Gate (Yorktown Avenue Gate) To Columbia Orange Park Medical Center:

South (left) on Roosevelt Boulevard (US Hwy17), approximately 4.2 miles. Make a right turn (west) onto Kingsley Avenue (SR 224). Travel approximately 2.5 miles. Columbia Orange Park Medical Center is on the right (labeled Humana Hospital on Map, See Figure 2-3).

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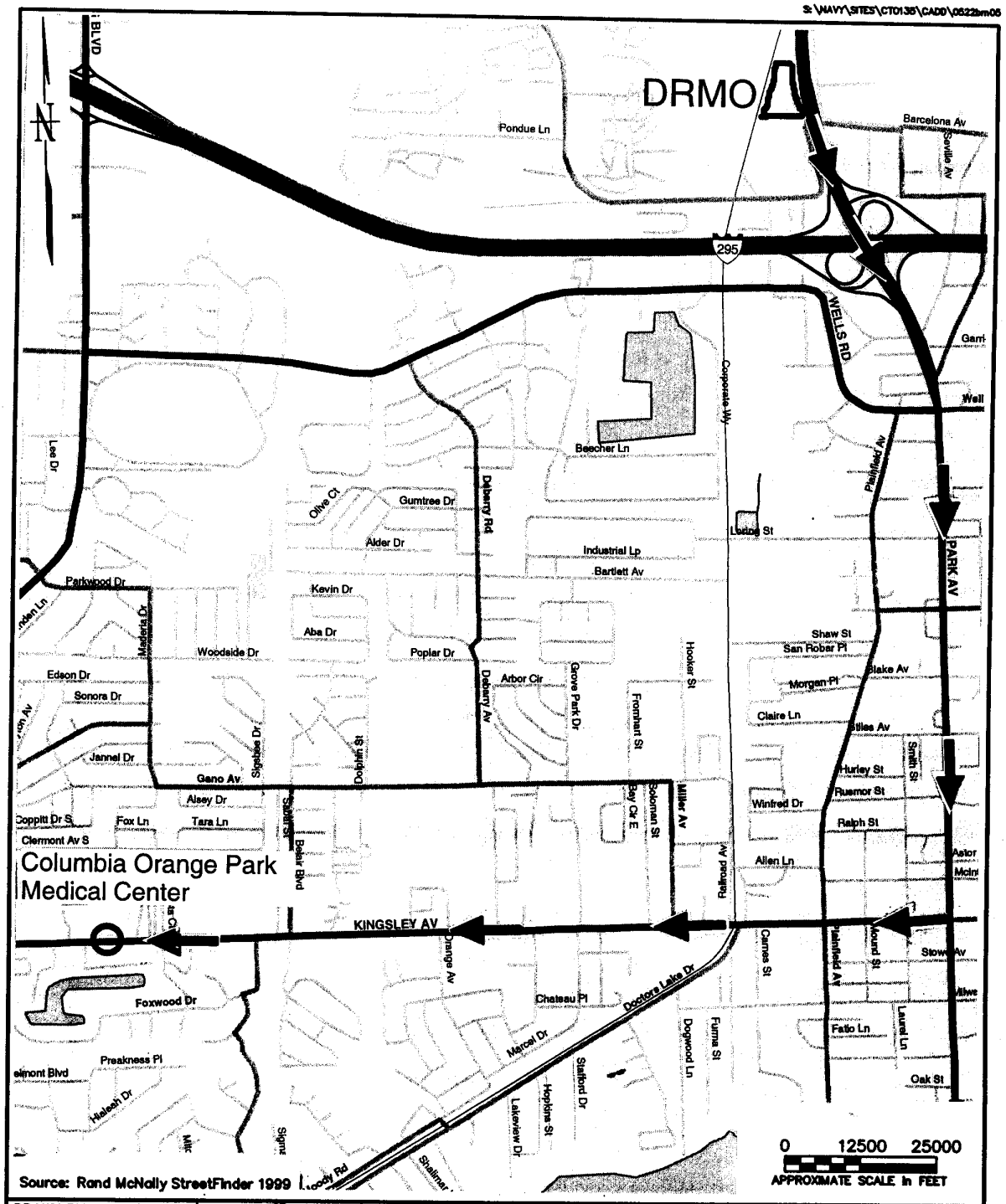

DRAWN BY CW DATE 10/11/00	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	HOSPITAL ROUTE MAP	CONTRACT NO. 0522
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-3 REV. 0

FORM CADD NO. SDIV_AV.DWG – REV 0 – 1/20/98

3.0 SITE BACKGROUND

3.1 SITE DESCRIPTION

NAS JAX is located in Duval County, Florida. The land incorporated into NAS JAX has been used for U.S.Navy operations since 1940. NAS JAX was placed on the United States Environmental Protection Agency's (EPA's) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) as a result of pollution resulting from past waste disposal practices that predate CERCLA. United States Department of Navy has entered into a Federal Facilities Agreement (FFA) with EPA to define the overall extent of contamination.

The DRMO is a relatively flat fenced yard that contains administrative and storage buildings. Its approximate dimensions are 640 feet (ft) wide on the southern edge, 1500 ft long, and 110 ft wide on the northern edge. In map view, these dimensions approximate a rectangle elongated north-south. The west central part of the yard, where most of the buildings are located, is paved with the exception of a few small areas of mowed grass and sandy gravel fill. The surface along the perimeter fence line consists of a sandy gravel fill. The vast majority of the fenced area is covered with buildings and asphalt pavement.

Drainage ditches are located along the eastern, western, and southern sides of the property. Approximately 300 feet of the southern perimeter ditch is concrete lined (eastern portion). Portions of these ditches, notably in the northern sector of the Potential Source of Contamination (PSC), only carry water during and following rain events. Flow in the eastern and western perimeter ditches is to the south. The southern ditch receives outflow from the western ditch, flows eastward, and discharges to the eastern perimeter ditch at the southeast corner of the PSC. The eastern ditch parallels the western side of U.S. Highway 17, eventually turning eastward and crossing under the highway. Ultimately, discharge from these ditches is to tributaries of the Ortega River.

The main Amtrak railroad line parallels the western boundary of PSC 46. A spur from this main line enters DRMO along the west-central property boundary and provides rail access to the largest of the site structures, Building 178 (A and B).

Two aboveground storage tanks (ASTs) and an oil-water separator are present at the southeast corner of the DRMO yard. Stormwater runoff from a large portion of the yard drains to the separator and is discharged through overflow pipes into the concrete-lined portion of the south perimeter ditch.

3.2 SITE HISTORY AND CURRENT OPERATIONS

The DRMO has been in operation since 1939. The yard first served as a smelter for the decommissioning of airplanes. Later, DRMO arranged the transfer and disposal of used petroleum products, out-of- service transformers, and hazardous wastes generated at NAS JAX. These materials were stored both inside and outside the buildings at the DRMO yard. The DRMO stored used electrical transformers and battery cases on the southern and western parts of the yard, respectively. The transformers may have contained polychlorinated biphenyls (PCBs). According to a NAS JAX Public Works Center employee, the paving at the DRMO yard used to be in poor shape. Chemicals, scrap metal, vehicles, appliances, and furniture are currently stored, repaired and/or sold at DRMO.

Site screening was performed at PSC 46 (April 3-July 31, 1997) to assess whether hazardous substances had been released to the environment. This action was initiated as a result of several events beginning in the early nineties. In 1991, NAS JAX personnel observed that storage areas for lead acid batteries, hazardous materials, drums, and transformers drained into the western perimeter ditch, a pathway eventually leading offsite, as noted earlier. In 1994, a sludge sample from the first access hatch in the oil-water separator was reported to have a benzene toxicity characteristic leaching procedure level of 70 milligrams per liter (mg/L), exceeding the Toxicity Characteristic Leaching Procedure (TCLP) threshold of 0.5 mg/L. Consequently, the sludge had to be classified as a Resource Conservation and Recovery Act (RCRA) hazardous waste. Also in 1994 (April 22), a site reconnaissance was performed in which oily water was observed on the ground outside the opening to the oil-water separator and a “strong chemical odor” was said to be emanating from the southern perimeter ditch. A sheen was also observed on standing water in the eastern perimeter ditch near the oil-water separator. Other observations made during the April 1994 inspection included: soil staining where transformers are stored along the western fence; military-type vehicles leaking fluids onto the ground in the northern half of the PSC 46; and canisters of paint, cleaning compound, solvent, adhesive, sealant, containers of corrosive acids and bases, scrap metal, and empty drums.

Details of the site screening performed by the Lead Agency (LA) in 1997 are documented in the Sampling Event Report (SER) (1999). Six micro wells were installed around the site perimeter and sampled to assess groundwater quality. Nine surface water, four surface soil, and five sediment samples were collected from the drainage ditches to assess impacts to those media. Samples were submitted to the laboratory for analysis of target compound list volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, PCBs, and target analyte list inorganic compounds.

Detected values in groundwater samples were compared to United States Environmental Protection Agency (USEPA) maximum contaminant levels and Florida Department of Environmental Protection (FDEP) groundwater guidance concentrations. Values reported in surface water samples were compared

to the Florida surface water standard for each compound. Surface soil analytical values were compared to FDEP residential soil cleanup goals and concentrations in sediment samples were compared to FDEP sediment quality assessment guidelines.

On June 30, 1998, representatives from the U.S. Army Center for Health Promotion and Prevention Medicine (USACHPPM) conducted an industrial radiation survey at DRMO and identified several areas with elevated radiation exposure readings. A follow-up study was conducted by Bechtel Environmental, Inc. (BEI) later in 1998 in which radiation readings were taken in 3 distinct areas within DRMO based on USACHPPMs measurements. Maximum readings in counts per minute (cpm) ranged from 10 to 60 times average background readings in the specified areas. The maximum cpm value obtained was 395,382 cpm versus a background value of 10,208.4 cpm. Radiological impacts are thought to have originated during airplane disassembly operations conducted at DRMO in the 1940s and 1950s because paints used on these aircraft contained radium.

4.0 SCOPE OF WORK

The following subsections discuss the specific tasks that are to be conducted as part of this scope of work as identified by Contract Task Order (CTO) 0135 and Statement of Work 156 Revision A. These tasks as identified by the scope of work are the only ones addressed by this HASP. Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this document. The TOM or a designated representative will submit all requested modifications to this document to the HSM.

Specific tasks to be conducted include, but are not necessarily limited to, the following:

- Mobilization/demobilization activities
- Monitoring well installation using Direct Push Technology (DPT) and Hollow Stem Auger (HSA) Methods
- Monitoring well development/redevelopment
- Aquifer pump tests
- Multi-media Sampling
  - Groundwater sampling
  - Soil sampling
  - Sediment sampling
  - Surface water sampling
- Decontamination of sampling equipment
- Surveying
- IDW Management

4.1 MOBILIZATION/DEMOBILIZATION

This task includes, but not limited to, the following:

- The procurement and shipping of equipment, and materials for the field investigation.
- Review of planning documents [i.e., HASP, Sampling and Analysis Plan (SAP), Work Plan, etc.]
- Site Reconnaissance to include site characterization of potential radioactive contaminated areas, site preparation, the layout of sampling locations and to secure the necessary utility clearances and isolate physical hazards, where applicable.
- Secure, construct, or equip decontamination facilities to support the field investigations.
- Secure, construct, or equip IDW storage facilities to support the field investigations.

Primary hazards associated with this activity includes those of a physical nature such as lifting, strains/sprains, lacerations achieved during unpacking of equipment and during site preparation (i.e., cutting open boxes, lifting equipment, locating sample points, cutting paths to sample locations)

4.2 MONITORING WELL INSTALLATION

The installation of monitoring wells for this field effort may comprise multiple methods based on the function of the well and the established data quality objectives. The primary method to be used at NAS JAX is HSA. DPT will be employed to install micro-wells in the area of suspected radioactive contamination. These methods are summarized below.

4.2.1 Continuous-Flight HSA Drilling

This method of drilling consists of rotating augers with a hollow stem into the ground. Cuttings are brought to the surface by the rotating action of the auger. Advantages of this type of drilling include:

- Samples can be obtained while augers remain in the ground. Sampling requires the use of split-barrel or thin-wall tube samplers advanced through the hollow core of the auger.
- No drilling fluids are required.
- A well can be installed inside the auger stem and back-filled as the augers are withdrawn.

Primary physical hazards associated with this activity include lifting, rotating equipment, caught between/pinches and compressions, slips, trips and falls in and around rotating equipment, noise, underground or overhead energized sources, overhead hazards, and equipment failure. By bringing contamination to the surface through the drilling action the potential now also exists for chemical and/or radiological contaminant exposure.

4.2.2 Monitoring Well Installation Using Direct Push Applications

Monitoring well installation using Direct Push Applications can proceed in a number of methods. The first method for the installation of temporary well points uses a screen point sampler. This sampler is attached to 3-foot sections of drive pipe which advance the sampler to the desired depth. Once at the desired depth a stainless steel rod is inserted into the drive piping to knock out the disposable drive tip. With the tip out the drive pipe is extracted allowing the screen to be exposed at the desired depth.

The second method used employs a vertical slotted sampler pushed to the desired depth.

Lastly, temporary wells are installed through the acquisition of soil borings using a Macro Core Sampler to advance to a desired depth. During this activity samples may be extracted during the descent to the desired depth or the Macro Core can be fitted with a disposable tip. Once at the desired depth the sampler and drive pipe are extracted and the pre-packed well is inserted into the annulus left by the extraction of the Macro Core device.

In all cases the tooling is advanced through hydraulic push and percussion hammer.

Hazards associated with this activity occur when retracting contaminated tooling from the contaminated media (direct contact), noise, pinch and compression, underground or overhead energized sources, overhead hazards, and high-pressure hydraulic lines.

4.3 MONITORING WELL DEVELOPMENT/REDEVELOPMENT

The steps to develop or redevelop the new and existing monitoring wells are as follows:

- The depth to water and total depth of the well is measured using an M-scope or other electronic water level indicator.
- A surge block or submersible pump is lowered into the screened section of the well. The surge block or submersible pump is rapidly lowered and raised in the well causing groundwater to flow in and out of the well screen thus flushing fine sediment and debris out of the sandpack.
- A submersible pump or airlift hose is lowered into the well. The monitoring wells are pumped using a submersible pump, or by airlift. The pumping will continue until well stabilization parameters (pH, temperature, specific conductance, etc.) have stabilized or the amount of water extracted from the well has reached a predetermined volume.

The primary hazards during this activity are chemical contaminant exposure that can occur by aerolization of the contaminated media during pumping into the drum. This activity agitates the contaminated media increasing the potential for release. Secondary to the chemical exposure, however, resulting in more reported incidents are the material handling hazards. Site personnel trying to move full drums resulting in back injuries, smashed fingers (between drums), etc.

4.3.1 Aquifer Testing (Pump Tests)

This activity employs a pump at an established flow rate within a designated well. The intent is to create a cone of depression within the area being pumped. Water level measurements are taken from surrounding wells to determine the influence based on groundwater media being removed from the extraction well.

Draw down and recovery are measured to determine the hydraulic conductivity of the aquifer in the area of the pumping test.

Primary hazards associated with this activity are similar to those associated with well development. When this activity is conducted in remote locations the added hazards of operating generators, noise, fueling generators, etc.

4.4 MONITORING WELL SAMPLING

The monitoring wells will be sampled using low-flow purging and sampling techniques. Peristaltic pumps will be used to purge and to collect the samples. Field measurements of pH, temperature, specific conductance, and turbidity will be made during purging. These measurements will be taken at the start of purging and every three to five minutes until the parameters have stabilized. The wells will be purged until a sufficient predetermined amount of water has been removed and the water quality measurements are acceptable. All tubing used for sampling will be dedicated. After collecting the sample, the tubing will be surveyed for contamination and disposed of appropriately.

See primary hazards for monitoring well development (Section 4.3 above).

4.4.1 Water Level Measurements

Water level measurements will be taken at the existing and newly installed monitoring wells during this field investigation. The water levels will be taken with an electric water level indicator using the top of the well casing as the reference point for determining water depths. Water levels will be conducted upon completion of the newly installed wells. All wells will be allowed to set for 24 hours after installation prior to development and 24 hours after that prior to the one round of water level measurements. The water level; measurements will be conducted within the same time interval (same day) to ensure minimal fluctuation.

Potential chemical and/or radiological exposure exists in this situation through direct contact with the contaminated water level measurement device. In addition to this hazard, but more predominant in remotely located wells are the potential for insect (bees) and spiders nest in the wells protective casing.

4.5 MULTI-MEDIA SAMPLING

4.5.1 Surface and Subsurface Soil Samples

Surface and Subsurface soil samples will be collected utilizing a variety of techniques.

4.5.1.1 Hand Augers

The hand auger borings will be advanced to the desired depth utilizing stainless steel hand auger stems with an over size bucket. Once at the desired depth, the oversize bucket will be exchanged for a smaller diameter bucket to grab the sample. The sample is extracted from the bucket and is placed in a stainless steel bowl, scanned with a direct reading instrument, then transferred into the appropriate glass container using a stainless steel trowel.

Hazards include direct chemical and/or radiological contaminant exposure, strain and sprain, and pinches and compressions when attempting to separate auger flights and buckets. Natural hazards, foot and vehicular traffic hazards also must be addressed relative to the location of the sampling point.

4.5.1.2 Drill Rigs Hollow-Stem Auger and Direct Push Technologies

Surface and Subsurface soil sample acquisition from mechanized equipment will use split spoon, shelby tube, macro-core sampler by inserting them into either the borehole or annulus to extract a sample from a desired depth. The sample is removed from the device, scanned with the direct reading instrumentation, then transferred into the appropriate sample container.

See hazards in monitoring well installation (Section 4.2) above.

4.5.1.3 DPT

This method uses hydraulic pressure and percussion hammer to advance tooling into the ground. For soil sampling a Macro-core sampler is advanced in 2-foot intervals for soil sample extraction.

See hazards in monitoring well installation above.

4.5.2 <u>Surface Water and Sediments</u>

The collection of these environmental media will proceed as follows:

- Selection of location
- Direct-Reading monitoring instrument sweep.
- Transfer the selected environmental media into the containers to be sent to the analytical laboratory using direct pour, peristaltic pumps, or for sediments using stainless steel or disposable trowels
- Screen the sample for radioactivity and record any readings more than twice background
- Wipe the exterior of the sample container with maslin and screen for contamination

Hazards associated with activities of this nature include the potential for direct contact with contaminated media that in many cases is diluted or washed over. Natural hazards play a greater role in these locations because many species utilize streams and bodies of water for nesting or sustenance. This increases the potential for direct contact.

4.6 GEOGRAPHICAL/GEOPHYSICAL SURVEYING

This activity is generally non-intrusive in nature, however limited brush removal may be required. The brush removal will facilitate lines of sight and passage routes for the equipment during the survey. Given these activities are to take place at improved areas with only limited samples remotely situated from the DRMO Yard, removal of vegetation for this purpose is not anticipated to any great extent.

Hazards associated with this activity are generally physical or natural hazards including lacerations (clearing brush), slips trips and falls, traffic hazards, insect (spiders, ticks, bees, etc.) and animal bites.

4.7 DECONTAMINATION

The equipment involved in the field activities for this investigation will be decontaminated prior to, during and after the sampling activities.

4.7.1 Sampling Equipment

All non-dedicated sampling equipment (i.e. stainless-steel hand augers, trowels, bowls) will be decontaminated prior to the initiation of field sampling, between sample locations, and at the completion of the field activities. The following decontamination steps will be taken.

- Potable water rinse
- Alconox or Liquinox detergent wash
- Deionized (DI) water rinse
- Solvent rinse (Isopropanol)
- DI water rinse
- Air dry

All dedicated sampling and PPE equipment will be rinsed to remove gross contamination, checked for radiological contamination, and, pending the sampling results, be disposed of accordingly.

The primary hazards associated with this activity include direct contact with contaminated tooling or media as well as contact with cleaning solvents. Other associated hazards include noise (pressure washers and

steam cleaners), high pressure water (potential for water lacerations), flying projectiles, and material handling hazards (handling and stacking heavy auger flights).

4.8 IDW MANAGEMENT

This task includes the containerization, labeling, staging, monitoring, and final deposition IDW. These are as follows:

Containerization – Materials generated including soils; development, decontamination, and purge waters (any and all materials that cannot be cleaned which may have direct contact with contaminated media). Containerization may utilize bulk storage (i.e., roll-off boxes or frac-tanks) or smaller United Nations approved 55-gallon drums (UN 1A2).

Labeling – All containers will be labeled as to their contents. The labels will include the following information

- Site
- Job Number
- Location [Solid Waste Management Unit (SWMU)]
- Date – To be completed upon filling the container or when no more material is to be added
- Drum Number – Assign an inventory number to be added to a comprehensive log
- Contents – Description
- Volume – Final volume
- Contact – This person should be available on base. (An updated inventory should be provided at the close of each shift to this person.)
- Emergency Number – Contact person provided above

Staging – All drums will be staged on pallets (four to a pallet) with lid retention ring bolt accessible on the outside as well as the label. Pallet rows will maintain a minimum of 3 feet between rows for access and monitoring for leaks.

Monitoring – During staging site personnel will examine containers to ensure they are not leaking.

Final Deposition – IDW materials will be separated as determined through sampling and disposed of through pre-determined routes.

For more detailed description of the associated tasks, refer to the SAP. Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this HASP. The PHSO or a designated representative will submit all requested modifications to this document to the HSM.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site specific HASP. This table is intended to assist project personnel in the recognition of hazards and recommended procedures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which personal protective equipment (PPE) and decontamination procedures to be used as well as appropriate air monitoring techniques and site-specific conditions. The evaluation of each task provides detailed information including anticipated hazards, recommended control measures, air monitoring recommendations, required PPE, and decontamination measures. This table must be updated if the scope of work, contaminants of concern, or pertinent conditions change.

Table 5-1 and the HASP are not meant to be stand alone documents and must be accompanied by the TtNUS Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site specific operations 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 TtNUS's Standard Operating Procedures (SOPs) also provided in the Guidance Manual.

SWPs will be issued for all exclusion zone activities (see Section 10.2). The FOL and/or the SSO will use the elements defined in Table 5-1 as the primary reference. The FOL and/or the SSO completing the SWP will add additional site-specific information as warranted. In situations where the SWP is more conservative than the direction provided in Table 5-1 due to the incorporation of site-specific elements, the SWP will be followed.

TABLE 5-1
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TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
NAVAL AIR STATION JACKSONVILLE, FLORIDA

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Mobilization/ Demobilization	***Chemical hazards:*** 1) The on-site Hazard Communication Program (Section 5.0 TtNUS Health and Safety Guidance Manual) will be followed. All chemicals brought onto the site by Tetra Tech NUS and subcontractor personnel will be inventoried and have an MSDS on site, on file. This effort shall include - Accurate Chemical Inventory List (Entries will match chemicals brought on-site, as the names appear on the MSDS) This list, which also includes quantities and storage locations will be provided to NAS JAX Emergency Response Units. - MSDS's will be maintained in a central location, accessible to all personnel. All containers will have labels specifying the following information: - Chemical Identity (As it appears on the label, MSDS, and Chemical Inventory List) - Appropriate Warning (i.e., Eye and skin irritation, flammable, etc.) - Manufacturer's Name Address and Phone Number It will be the FOL and/or the SSO's responsibility to insure this is completed. ***Physical hazards:*** 2) Lifting (strain/muscle pulls) 3) Pinches and compressions/Struck by 4) Slips, trips, and falls 5) Heavy equipment hazards (rotating equipment, hydraulic lines, etc.) 6) Vehicular and foot traffic 7) Ambient temperature extremes (heat/cold stress) ***Natural hazards:*** 8) Insect/animal bites and stings, poisonous plants, etc. 9) Inclement weather	***Chemical hazards:*** 1) All personnel will be required to review the appropriate MSDS's, prior to the use of a specified chemical substance. This direction should also be communicated on the Safe Work Permit completed for this task. 2) Use machinery or multiple personnel for heavy lifts. - Use proper lifting techniques - Lift with your legs, not your back, bend your knees move as close to the load as possible, and ensure good hand holds are available. - Minimize the horizontal distance to the center of the lift to your center of gravity. - Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time. - Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive. - Plan your lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves. - Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury. In determining whether you can lift an item several factors must be considered, these are as follows: Maximum weight lifted by a single person should not exceed 70 pounds. Items over 70 pounds or the amount you feel you can confidently lift up to 70 pounds should define a point where assistance in the lift is sought. Other considerations defining lifting hazards - Area available to maneuver the lift. - Area of the lift – Work place clutter, slippery surfaces - Overall physical condition 3) Keep any machine guarding in place. Do not modify tooling without manufacturer's expressed permission. - Avoid moving parts. - Use tools or equipment where necessary to avoid contacting pinch points. - Adjust machine guarding as necessary to minimize distance between guards and point of operation. - When staging equipment, insure all stacked loads, shelving, are adequately secure to avoid creating a hazard from falling objects. - All equipment will undergo a thorough equipment inspection. Mechanized and powered equipment inspections will be documented on the Equipment Inspection Checklist provided in Attachment III. All hand tools will be inspected (handle condition, cutting attachment, as applicable) to insure acceptable condition. 4) Preview work locations for unstable/uneven terrain. - Cover, guard and barricade all open pits, ditches, and floor opening as necessary. - The FOL and the SSO during site surveys and site preparation should identify these potential hazards. - All approach routes leading towards rotating equipment shall be leveled to prevent slips, trips, and falls approaching operating equipment 5) All equipment will be - Inspected in accordance with OSHA and manufacturer's design. - Operated by knowledgeable operators and ground crew. 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom or mast + 5 feet). - Foot and vehicular traffic routes shall be well defined - Secure all loose articles. - All self-propelled equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the site requirements. - The FOL and/or the SSO as a precautionary measure to remove or demarcate physical hazards shall preview traffic routes (foot and vehicular) before the commitment of personnel and resources. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat and cold stress is provided in Section 4.0 of the TtNUS Health and Safety Guidance Manual. 8) Avoid nesting areas; Tape pant legs to work boots when in high brush (knee high) (tick hazards); Use repellents – Apply Permonone over clothing articles to avoid skin irritation. Application of repellants should concentrate where ticks and other insects will gain entry. Pant to boots, shirt to pants, collar; Perform close body inspections upon exiting high brush areas to facilitate and remove ticks and other insects; Report potential hazards to the SSO. Follow guidance presented in Section 4.0 of the TtNUS Health and Safety Guidance Manual. 9) Suspend or terminate operations until directed otherwise by SSO.	Visual observation of work practices by the SSO to minimize potential physical hazards (i.e., improper lifting, unsecured loads, noise, etc.).	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - *Safety glasses* - *Hardhat (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.*	Not required. However, as previously instructed during site characterization and site preparation the potential to encounter natural hazards such as ticks exists. To minimize the potential for the ticks or other insects to attach, persons exiting woods or high brush areas should perform a close body inspection to identify and remove these vectors. This should be conducted prior to entering site vehicles, trailers, etc. where the ticks or other insects may detach impacting other whose use this equipment or facilities.

TABLE 5-1
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TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
NAVAL AIR STATION JACKSONVILLE, FLORIDA

Task/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Soil borings and Monitoring Well Installation These tasks will be accomplished using the following methods: **Soil boring:** - DPT (Geoprobe) - Hand Augering - Drill Rig (Hollow Stem Auger) **Monitoring Well Installation** - Drill Rig (Hollow Stem Auger)	***Chemical hazards:*** 1) Previous analytical data identified the following compounds as contaminants of concern (Air - Dust/particulate contaminants) Within (DRY) Sediments Beryllium Lead Although several contaminants were noted in excess of clean-up standards, very few represented occupational exposure threats based on concentrations existing within the soils, groundwater, and surface waters. It is recommended that exposure (via inhalation, ingestion, or skin contact) to these contaminants be minimized. Further information on these contaminants and other potential contaminants is presented in Table 6-1. Well Construction Materials - Bentonite - Grout - Filter Sand 2) Transfer of contamination into clean areas or onto persons ***Physical hazards:*** 3) Heavy equipment hazards (pinch/compressions points, rotating equipment, hydraulic lines, etc.) 4) Noise in excess of 85 dBA 5) Energized systems (contact with underground or overhead utilities) 6) Lifting (strain/muscle pulls) 7) Slips, trips, and falls 8) Vehicular and foot traffic 9) Ambient temperature extremes (heat/cold stress) 10) Flying projectiles 11) Site characterization ***Natural hazards:*** 12) Insect/animal bites and stings, poisonous plants, etc. 13) Inclement weather	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, activities must be suspended until dust levels subside, or until an acceptable alternative control method can be selected. - Verify monitoring well construction materials (grout, bentonite, sand, and decontamination solutions) MSDS are included in Hazard Communication Program. Ensure personnel constructing wells have reviewed the MSDS and understand potential health effects. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. Wrap all portable equipment to be transported across clean areas of the site to the central decontamination pad. 3) All equipment 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 III of this HASP. - Operated and supported by knowledgeable operators, and ground crew. - Used within 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. See Section 9.0 of this HASP. 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. - A remote sampling device must be used to sample drill cuttings near rotating tools - Only manufacturer-approved equipment may be used in conjunction with equipment repair procedures (e.g., flight connectors). - 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 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 the drill rig and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - The drill rig and support vehicles will be moved no closer than 3 feet to unsupported side-walls of excavations and embankments. 4) Hearing protection will be used during all subsurface activities using drill rig or DPT when noise levels are between 87 and 92 dBA. (during operation). Boundaries will be established to limit noise hazard. Height of the mast + 5 feet or a minimum of 25 feet is normal. Excessive noise levels are being approach when you have to raise your voice to talk to someone within 2 feet of your location . 5) All drilling activities will proceed in accordance with the Utility Locating and Excavation Clearance found in Attachment II. All utility clearances will be obtained, in writing, and locations identified and marked prior to activities. Overhead utilities will also be identified. 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Mobilization/Demobilization for Proper lifting techniques). 7) Preview work locations for unstable/uneven terrain. 8) Use traffic-warning signs, flag persons, and high visibility vests as determined by the SSO when working in or along traffic thoroughfares. 9) Wear appropriate clothing for weather conditions. Acceptable shelter and liquids for field crews. 10) Wear eye protection and hard hat when the drill rig or DPT rig is operating. Restrict all others from the area. 11) The FOL/SSO will screen work areas to ensure that physical hazards are identified and demarcated, prior to committing resources. 12) Avoid nesting areas; Tape pant legs to work boots when in high brush or unimproved areas; Use repellents (Permanone) over the clothing to avoid skin irritation concentrating on entry points (pants to boots, shirt to pants, collar. Report potential hazards to the SSO. See Section 4.0 of the TtNUS Health and Safety Guidance Manual for additional information concerning natural hazards. 13) Suspend or terminate operations until directed otherwise by SSO.	Site screening will encompass monitoring for two separate and distinct parameters as well as monitoring for the Health and safety of field personnel. All samples will be screened for - Levels of radioactivity - Volatile organic concentrations **Radiological Screening** Radiation monitoring will be supported using a Ludlum Model 3 with a Pancake Geiger-Mueller Detector suitable for beta/gamma emissions (Radium source). Ludlum Model 3 Count Rate Meter with a Model 43-5 50 cm Squared Alpha Scintillation Probe – This instrument will be used for monitoring alpha emissions (Thorium source). Radiation Release Limit: 2 µCi or <250 cpm above background will be considered non-hazardous from a radiological threat. >2 µCi or >250 cpm – - Notify NAS JAX Radiation Safety Office - Segregate IDW generated from this location - Label shipping and waste storage containers appropriately. All site personnel will be equipped with a Pocket dosimeter and Thermoluminescent Detector (TLD) Badges. In all cases where radiological concerns are evident based on field screening ALARA (As Low As Reasonably Achievable) concepts will be practiced. This includes Clear definition of effected area boundaries - Radiological Area >5mrem but< 100 mrem - Radiological Buffer Zones Within these areas protective clothing, respiratory protection (if required by the SSO), and personnel dosimetry will be required. Minimizing time of exposure through efficient work practices and rotational of personnel and reduced stay time in the effected areas. **Note:** This information is provided as a contingency plan. This operation will be supported by B.Koh & Associates who specializes in radiological investigation. This HASP will be modified to, but not limited to, include a Radiation Safety Plan (RSP) including monitoring (action levels), work practices, area delineation and signage, as well as shipping requirements for the radiological contaminated media. **VOCs Screening** A direct reading Photoionization Detector (PID) with a 10.6 eV lamp (Primary), or a Flameionization Detector (FID) (Secondary/Back-up), will be used to screen samples and to detect the presence of any potential volatile organics. Source monitoring of the sample collection area 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 readings (greater than 5 minute in duration; no more than three separate events) above 5 ppm in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. - Work may only resume if airborne readings in worker breathing zone return to below 5 ppm. If elevated readings in worker breathing zone persist, the PHSO and HSM will be contacted to determine necessary actions and levels of protection. Dusts/Particulates - > 2mg/m^3 (Visible dusts) Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, evacuating the operation area until dust subsides, ascension to Level C protection.	For all areas outside of the Radiological contaminated areas Level D Requirements - Standard field attire including sleeved shirt and long pants - Safety shoes (Steel toe/shank) - Chemical Resistant Boot Covers - Safety glasses - Surgical style gloves *(double-layered if necessary)* - Hard hat (when overhead hazard exists) - Tyvek coveralls; Impermeable garments if the potential exists for soiling or saturating. - Hearing protection for high noise areas - *Reflective vest for traffic areas* **Driller and Driller Helper** Same as above with the exception that impermeable aprons may be used to prevent the soiling of work clothes. Level C - (Minimum Requirements) Radiation Areas or surpassing the action levels specified for Level C. **Subsurface Soils - Borings and well advancement** **Screening and Sampling Staff** - Full-face APR with organic vapor/HEPA cartridges - Standard field attire including sleeved shirt and long pants - Safety shoes (Steel toe/shank) - Chemical Resistant Boot Covers - Safety glasses - Surgical style gloves *(double-layered if necessary)* - Hard hat (when overhead hazard exists) - Tyvek coveralls; Impermeable garments if the potential exists for soiling or saturating. - Hearing protection for high noise areas - *Reflective vest for traffic areas* **Driller and Driller Helper** - Full-face APR with organic vapor/HEPA cartridges - Standard field attire including sleeved shirt and long pants - Safety shoes (Steel toe/shank) - Chemical Resistant Boot Covers - Safety glasses - Nitrile inner gloves; Butyl outer gloves - Hard hat (when overhead hazard exists) - Impermeable outer garments such as PVC Rain-suit or Saranex , PE coated Tyvek due to contact with contaminated tooling. Guantlet gloves or sleeves and apron is acceptable due to heat stress. - Hearing protection for high noise areas - *Reflective vest for traffic areas* Ascension greater than Level C is not anticipated. At the close of each shift, the APR cartridges will be removed, and made incapable of reuse and discarded with the used PPE. **Monitoring Well Construction** **Driller, Driller Helper, and Oversight** Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (steel toe/shank) - Chemical Resistant Boot Covers - Safety glasses - *Reflective vest for high traffic areas* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists.* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* **Note:** The Safe Work Permit(s) for this task (see Attachment IV) 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 or conditions associated with any identified task. Protective levels may require modification should this activity be required to be conducted within a controlled zone due to an on-going operation.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). This decontamination function may be subdivided into two locations. Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad. The sequential procedure is as follows: Stage 1: Equipment drop, remove outer protective wrapping; personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable Stage 4: Disposable PPE will be removed , surveyed for radiological contamination, bagged, disposed of appropriately Stage 5: Wash face and hands Stage 6: Report to the frisking station when working in areas of radiological concerns to verify decontamination process. Stage 7: Depending on ambient conditions, you may be required to report for medical evaluation. This evaluation consists of pulse, breathing rate, oral temperature, and body weight. This medical screening will be performed when ambient conditions dictate and during periods of acclimatization. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner or pressure washer. Heavy equipment 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 have restricted access to exclusion zones, and 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 onsite activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. 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, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.

TABLE 5-1
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TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
NAVAL AIR STATION JACKSONVILLE, FLORIDA

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Multi-media sampling, including soils (surface and subsurface); surface water, ground water, and seeps; sediments. This task also includes well development of existing and newly installed ground water monitoring wells and aquifer testing.	***Chemical hazards:*** 1) Previous analytical data identified the following compounds as contaminants of concern (Air - Dust/particulate contaminants) Within (DRY) Sediments Beryllium Lead Although several contaminants were noted in excess of clean-up standards, very few represented occupational exposure threats based on concentrations existing within the soils, groundwater, and surface waters. It is recommended that exposure (via inhalation, ingestion, or skin contact) to these contaminants be minimized. Further information on these contaminants and other potential contaminants is presented in Table 6-1. It is recommended that exposure (via inhalation, ingestion, or skin contact) to these contaminants be minimized. Further information on these contaminants and other potential contaminants is presented in Table 6-1. 2) Transfer of contamination into clean areas ***Physical hazards:*** 3) Noise in excess of 85 dBA 4) Lifting (strain/muscle pulls) 5) Pinches and compressions 6) Slips, trips, and falls 7) Ambient temperature extremes (heat/cold stress) 8) Vehicular and foot traffic 9) Site Characterization ***Natural hazards:*** 10) Insect/animal bites and stings, poisonous plants, etc. 11) Inclement weather	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, activities must be suspended until dust levels subside, or until an acceptable alternative control method can be selected. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. See decontamination of heavy and sampling equipment for direction in this task. 3) When sampling at an operating DPT or Hollow Stem Auger or other type of drill rig use hearing protection. The use of hearing protection outside of 25 feet from the DPT rig should be incorporated under the following condition: If you have to raise your voice to talk to someone who is within 2 feet of your location, you may be approaching excessive noise levels (>85dBA) and hearing protection should be worn until the noise source may be positively quantified. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Lifting Mobilization/Demobilization, Page 1 of 6, Table 5-1). 5) Avoid moving parts, do not remove any machine guarding. - Use tools or equipment where necessary to avoid contacting pinch points. - A remote sampling device must be used to sample drill cuttings near rotating tools. The equipment operator shall shutdown machinery if the sampler is near moving machinery parts. - Remove any snag points. - Follow SWP and Safe Work Practices for drilling procedures when working in and around the drill rigs(See Section 5.1 & 5.2). 6) Preview work locations for unstable/uneven terrain. - Ruts, roots, and other tripping hazards should be eliminated from around the rotating apparatus to minimize trips and falls when approaching the rotating tooling. - Use multiple persons and small loads to pack sampling resources to remote locations. - Construct rope ladders and other engineered assistance for traversing hills and inclines > 45°. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4.0 of the Health and Safety Guidance Manual. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Mast or Boom + 5 feet). See Section 9 of the HASP for specific safety zones and established clearance recommendations. - All self-propelled equipment shall be equipped with movement warning systems. - When sampling along roadways, use signs to indicate men working as well flag persons, as necessary. Personnel working in and around any established traffic patterns should wear high visibility vests to increase visual recognition. 9) Work areas will be surveyed prior to committing personnel or resources. The survey will be conducted by the FOL and/or the SSO. The purpose is to identify physical and natural hazards that may impact the proposed work area. These hazards are to be identified, barricaded, or eliminated to the extent possible to minimize potential effect to field crew. 10) Avoid nesting areas, use repellents approved by the FOL. Report potential hazards to the SSO. 11) Suspend or terminate operations until directed otherwise by the SSO.	Site screening will encompass monitoring for two separate and distinct parameters as well as monitoring for the Health and safety of field personnel. All samples will be screened for - Levels of radioactivity - Volatile organic concentrations **Radiological Screening** - Radiation monitoring will be supported using a Ludlum Model 3 with a Pancake Geiger-Mueller Detector suitable for Beta and Gamma emissions. - Ludlum Model 3 Count Rate Meter with a Model 43-5 50 cm Squared Alpha Scintillation Probe – This instrument will be used for monitoring alpha emissions (Thorium source). Radiation Release Limit 2 µCi or <250 cpm above background will be considered non-hazardous from a radiological threat. >2 µCi or >250 cpm – - Notify NAS JAX Radiation Safety Office - Segregate IDW generated from this location - Label shipping and waste storage containers appropriately. In all cases where radiological concerns are evident based on field screening ALARA (As Low As Reasonably Achievable) concepts will be practiced. This includes Clear definition of effected area boundaries Radiological Area >5mrem but< 100 mrem Radiological Buffer Zones Within these areas protective clothing, respiratory protection (as required by the SSO), and personnel dosimetry will be required. Minimizing time of exposure through efficient work practices and rotational of personnel and reduced stay time in the effected areas. All site personnel will be equipped with a Pocket dosimeter and Thermoluminescent Detector (TLD) Badges. **Note:** This information is provided as a contingency plan. This operation will be supported by a Subcontractor B.Koh & Associates who specializes in radiological investigation. This HASP will be modified to, but not limited to, include a Radiation Safety Plan (RSP) including monitoring (action levels), work practices, area delineation and signage, as well as shipping requirements for the radiological contaminated media. **VOCs Screening** A direct reading Photoionization Detector (PID) with a 10.6 eV lamp (Primary), or a Flameionization Detector (FID) (Secondary/Back-up), will be used to screen samples and to detect the presence of any potential volatile organics. Source monitoring of the sample collection area 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 readings in air > 5 ppm in the Workers breathing zone for greater than 5 minutes in duration (not to exceed three events for the day) requires site activities to be suspended and site personnel to retreat to an unaffected area and notify the PHSO and/or the HSM. - Work may only resume if airborne readings in worker breathing zone return to below 5 ppm or when worker protection levels are modified at the PHSO and/or the HSM's direction. Dusts - > 2mg/m^3 (Visible dusts) Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be minimized to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, evacuating the operation area until dust subsides, through ascension to Level C protection.	Level D protection will be utilized for the following sampling activities outside of those areas designated as radiological contaminated. Surface soils, subsurface soils, surface water, groundwater, and sediments Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (steel toe/shank) - Safety glasses - Surgical style gloves *(double-layered if necessary)* - *Reflective vest for high traffic areas* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists.* - *Impermeable aprons are also acceptable to prevent soiling work clothes yet providing relief in consideration of heat stress.* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* Upgrades to Level C protection will be based on the following: <u>VOCs</u> Concentrations in air > 5 ppm in the Workers breathing zone for greater than 5 minutes in duration (not to exceed three events for the day). **Radioactivity** - > 250 cpm above background **Subsurface Soils** Level C Protection: - Full-face (APR 1000) with organic vapor/HEPA cartridges - Level D minimum requirements as stated above**.** **Dusts -** Dusts - > 2mg/m^3 (Visible dusts) This action level is primarily directed at dry sediments. This is the area where beryllium and lead pose a potential occupational threat. Change out schedule – At the close of each shift, the canisters will be removed, respirator cleaned and prepared for the following day's activities. Cartridges will be made incapable of reuse and discarded with used PPE. **Note:** The Safe Work Permit(s) for this task (See Attachment IV) 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 or conditions associated with any identified task.	**Personnel Decontamination** Personal decontamination will vary based on the type of sampling conducted. These are as follows: Supporting subsurface investigations at the drill rig. - Decontamination will be the same as prescribed for the drilling activity. Sampling surface water, groundwater, sediments, and seeps the following provisions will apply: - Upon completion of the sampling dedicated trowels, tubing, etc. will be bagged for transport back to the central decontamination area. - PPE (gloves) will be removed and also bagged for disposal. - Handi-Wipes or similar product will be used to clean hands prior to moving to the next location. **Equipment Decontamination** All equipment used in remote sampling locations will be brought back to the central decontamination area for decontamination and re-use or decontamination and gross removal of contamination prior to disposal. **Note:** Field screening instruments will be wrapped to minimize the necessary decontamination except for wiping down parts which are necessary to expose to the external environment. The equipment reference above is largely directed at hand tools. Decontamination of equipment (sampling and hand tools) will proceed as indicated in the Sampling and Analysis Plan and/or Work Plan.

TABLE 5-1
01/10/01
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
NAVAL AIR STATION JACKSONVILLE, FLORIDA

Tasks/Operation/**Locations**	**Anticipated Hazards**	**Recommended Control Measures**	**Hazard Monitoring - Type And Action Levels**	**Personal Protective Equipment** *(Items In Italics Are Deemed Optional As Conditions Or The FOL Or the SSO Dictate.)*	**Decontamination Procedures**
Surveying – Geographical and Geophysical This activity is proposed for improved areas. The likelihood of encountering some of the natural hazards discussed is negligible. However, the information is provided in the event that benchmarks (horizontal and vertical control) has to be carried from a remote location.	***Chemical hazards:*** Significant exposure to site contaminants is anticipated to be unlikely given the nature of this task. ***Physical hazards:*** 1) Slips, trips, and falls 2) Struck by 3) Ambient temperature extremes (heat stress) ***Natural hazards:*** 4) Inclement weather 5) Insect/animal bites or stings, poisonous plants, etc.	***Physical hazards:*** 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) If hand tools (brush hooks, machetes, etc.) are necessary to clear and carry lines and bench marks to the area of operation the following precautions are recommended: - Insure handles are of good construction (no cracks, splinters, loose heads/cutting apparatus. - Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade. - All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals when not in use. - All personnel will maintain a 10-foot perimeter around persons clearing brush. **Note:** It is not anticipated that trees will be required to be dropped as part of this operation and therefore will not be addressed. The additional use of chainsaws and chippers will require this HASP to be modified. 3) Wear appropriate clothing for weather conditions. Acceptable shelter and liquids for field crews. ***Natural hazards:*** 4) Suspend or terminate operations until directed otherwise by SSO. 5) To combat the potential impact of natural hazards, the following actions are recommended: - Avoid nesting – Preview routes, monitoring well protective casings for nests. Avoid if at all possible. - Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control. - Tape pant legs to work boots to block direct access. - Use repellents – Permanone should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars. - Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin. - If clearing lines in snake infested areas surveyors are recommended to wear snake chaps as a precaution. - Report potential hazards or signs and symptoms to the SSO. See Section 4.0 of the TtNUS Health and Safety Guidance Manual for additional information concerning natural hazards.	No air monitoring is needed given the unlikelihood that airborne contaminants will be present. The potential for exposure to site contaminants during this activity is considered minimal. As most of this activity is conducted either before or after the intrusive aspect of this operation, therefore, minimizing potential exposure.	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 - Safety shoes (Steel toe/shank) - Work gloves shall be worn when clearing brush. - *Safety glasses, hard hats (if working near machinery, or overhead hazards)* - *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.* **Note:** The Safe Work Permit(s) for this task (See Attachment IV) 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 or conditions associated with any identified task. Protective levels may require modification should this activity be required to be conducted within a controlled zone due to an on-going operation.	**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.

TABLE 5-1
01/10/01
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
NAVAL AIR STATION JACKSONVILLE, FLORIDA

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment It is anticipated that this activity will take place at centralized locations. Gross contamination will be removed to the extent possible at the site. Contaminated tooling then will be wrapped in polyethylene sheeting for transport to the centralized location for a full decontamination and evaluation.	***Chemical hazards:*** 1) The only chemicals to pose an occupational threat during sampling was beryllium and lead. These substances were previously encountered in the sediments. These substances, once wetted down are not considered to pose an occupational threat through inhalation. However, ingestion may still pose an exposure threat. Table 6-1 provides additional information about each of the identified contaminants of concern. 2) Decontamination fluids - Liquinox (detergent); isopropanol (decontamination solvent) ***Physical hazards:*** 3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Struck by 7) Slips, trips, and falls ***Natural hazards:*** 8) Inclement weather	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Control potential non-occupational exposures through good work hygiene practices (i.e., avoid hand to mouth contact; wash hands and face before breaks and lunch; minimize contact with contaminated media). Obtain manufacturer's MSDS for any decontamination fluids used on-site. Solvents may only be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDS or within this HASP. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication Program provided in Section 5.0 of the TtNUS Health and Safety Guidance Manual. 3) Use multiple persons where necessary for lifting and handling heavy equipment, such as auger flights for decontamination purposes. - Employ proper lifting techniques as described in Table 5-1, Mobilization/Demobilization. 4) Wear hearing protection when operating the pressure washer and/or steam cleaner. Sound pressure levels measured during the operation of similar pieces of equipment indicate a range of 87 to 93 dBA. 5) Use eye and face protective equipment when operating the pressure washer and/or steam cleaner, due to flying projectiles. All other personnel must be restricted from the area. In addition to minimize hazards (flying projectiles, water lacerations and burns) associated with this operation, the following controls will be implemented - A Fan Tip 25° or greater will be used on pressurized systems over 3,000 psi. This will reduce the possibility of water lacerations or punctures. - Thermostat control will be in place and operational to control the temperature levels of the water where applicable. - Visual evaluations of hoses and fittings for structural defects - Construct deflection screens as necessary to control overspray and to guard against dispersion of contaminants driven off by the spray. 6) Struck by – Insure wash and drying racks are suitable construction to support heavier items such as auger flights and will secure them against falling during this process. 7) The decontamination pad should be constructed to contain wash waters generated during decontamination procedures. Temporary decontamination pads are usually 10-30 mil polyethylene or polyvinyl chloride tarp construction. Although these items when used as a liner offer containment, they also present a slipping hazard. When these temporary liners are employed, it is recommended that a light coating of sand be spread over the walking surface to provide traction. - In addition, adequate slope should be provided to the pad to permit drainage away from the object being cleaned. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. - Hoses should be gathered when not in use to eliminate potential tripping hazards. 8) Suspend or terminate operations until directed otherwise by SSO.	Use visual observation and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried. After decontamination is completed and parts are visually clean - Screen dried equipment with a PID/FID. If any elevated readings (i.e., above background) are observed, perform rinse process again and re-screen. Repeat until no elevated PID/FID readings are noted. The intent is two-fold. First to ensure the removal of all site contaminants. Secondly, to ensure the removal of decontamination solvents to prevent cross contamination. - If radiological contamination is encountered during the subsurface investigation, then all tooling associated with this operation shall be subjected to a surface scan using the radiation survey meter. Readings in excess of background will require the tooling to be re-decontaminated and then re-screened. A survey report shall be compiled for each piece of equipment. In all cases where radiological concerns are evident based on field screening ALARA (As Low As Reasonably Achievable) concepts will be practiced. This includes Clear definition of effected area boundaries Radiological Area >5mrem but< 100 mrem Radiological Buffer Zones Within these areas protective clothing, respiratory protection (if required by the SSO), and personnel dosimetry will be required. Minimizing time of exposure through efficient work practices and rotational of personnel and reduced stay time in the effected areas.	For Heavy Equipment This applies to pressure washing and/or steam cleaning operations and soap/water wash and rinse procedures. Level D Minimum requirements: - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves over nitrile inner gloves - Safety glasses underneath a splash shield - Hearing protection (plugs or muffs) - Hooded PVC Rainsuits or PE or PVC coated Tyvek **For sampling equipment** (trowels, Macro-Core Samplers, bailers, etc.), the following PPE is required: **Note**: Consult MSDS for PPE guidance. Otherwise, observe the following: Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves over nitrile inner gloves - Safety glasses - Impermeable Apron In the event of overspray of chemical decontamination fluids, employ PVC Rainsuits or PE or PVC coated Tyvek as necessary. Change out schedule – Close out every day, make cartridges unusable, dispose of with used PPE, clean and sanitize respirator for the following day. **Note:** The Safe Work Permit(s) for this task (See Attachment IV) 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 or conditions associated with any identified task.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). This decontamination function may be subdivided into two locations. Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad. The sequential procedure is as follows: Stage 1: Equipment drop, remove outer protective wrapping; personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves. Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable. Stage 4: Disposable PPE will be removed and bagged. Stage 5: Wash face and hands. Stage 6: Depending on the area of the operation you may be required to perform radiological frisking. This will entail scanning the entire body to determine that the decontamination was successful. Failure to pass the frisk will require re-decontamination of the effected areas. Stage 7: Depending on ambient conditions, you may be required to report for medical evaluation. This evaluation consists of pulse, breathing rate, oral temperature, and body weight. This medical screening will be performed when ambient conditions dictate and during periods of acclimatization. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner. Heavy equipment 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 have restricted access to exclusion zones, and 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. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. 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, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation. This will include the screening process for radiological contaminants.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices identified on Table 5-1, the following general safe work practices are to be followed when conducting work onsite. These safe work practices address a pattern of general precautions and measures for reducing risks associated with site operations. This list is not all-inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, or smoke in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Prior to exiting a known or suspected contaminated area, perform a whole body survey (self-frisk). Remove PPE as instructed.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Avoid puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment. Keep monitoring equipment away from potentially contaminated surfaces.
- Obey all instructions in the site-specific HASP.
- Take note of the location of the nearest telephone and all emergency telephone numbers. See Section 2.0, Table 2-1.
- Attend briefings on anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and mark entrance, exit, and emergency escape routes. See Section 2.0.
- Rehearse unfamiliar operations prior to implementation.
- Buddies should maintain visual contact with each other and with other onsite team members by remaining in close proximity to assist each other in case of emergency.
- Establish appropriate Safety Zones including Support, Contamination Reduction, and Exclusion Zones.
- Minimize the number of personnel and equipment in contaminated areas (such as the Exclusion Zone). Non-essential vehicles and equipment should remain within the Support Zone.

- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to SSO.
- Matches and lighters are restricted from entering in the Exclusion Zone or Contamination Reduction Zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 DRILLING AND DIRECT PUSH OPERATIONS – SAFE WORK PRACTICES

The following Safe Work Practices are to be followed when working in or around Direct Push Operations.

5.2.1 Before Drilling and Direct Push Operations

- Identify all underground utilities and buried structures before drilling. Use the Utility Locating and Excavation Clearance SOP provided in Attachment II.
- All drilling and direct push rigs will be inspected by a Competent Person (the SSO or designee), prior to the acceptance of the equipment at the site and prior to the use of the equipment. All repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Attachment III. Inspection frequencies will be once every 10 day shift or following repairs.
- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding operating equipment.
- The driller's helper will establish an equipment staging and laydown plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects such as drill flights will be provided to avoid the collapse stacked equipment.
- All potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located decontamination unit.

5.2.2 During Drilling and Direct Push Operations

- Minimize contact to the extent possible with contaminated tooling and environmental media.

- Support functions (sampling and screening stations) will be maintained a minimum distance from the drilling and/or the direct push rig of the height of the mast plus five feet to remove these activities from within physical hazard boundaries.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill and/or the direct push rig.

- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move heavy tooling, where necessary.

- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone. Site visitors will be escorted at all times.

5.2.3 After Drilling and Direct Push Operations

- All equipment used within the exclusion zone will undergo a complete decontamination, radiological survey and evaluation by the SSO to determined cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.

- All motorized equipment will be fueled prior to the commencement of the days activities. During fueling operations all equipment will be shutdown and bonded to the fuel provider.

- When not in use all direct push rigs will be shutdown, emergency brakes set, and wheels chocked.

- All areas subjected to subsurface investigative methods will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be removed these areas will be barricaded to minimize the impact on field crews working in the area.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical, physical, radiological, and natural hazards associated with the sites to be investigated and the activities that are to be conducted as part of the scope of work. Table 6-1, which is included as part of this HASP, provides information on potential chemical and radiological contaminants, including exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with work to be conducted at NAS JAX include inhalation, ingestion, and dermal contact with contaminants that may be present in ground water and shallow soils. Based on the site history and prior sampling efforts, the following have been identified as the primary classes of site contaminants, including the specific compound(s) of interest:

Sediments (DRY)

- Beryllium
- Lead

Note: Lead only presents and exposure threat if dust concentration exceed 5mg/m^3 in the air. This is well above action level prescribe of > 2 mg/m^3.

Other substances have been identified exceeding recommended clean-up values, however, concentrations within the media were considered insufficient to present an exposure threat.

Table 6-1 provides information on these compounds and individual substances likely to be present at the sites to be investigated. Included is information on the toxicological, chemical, and physical properties of these substances. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (soil borings, sampling, etc.). Exposure to these compounds is most likely to occur through inhalation or dermal contact of contaminated soil or water, or through ingestion via hand-to-mouth contact during soil disturbance activities. For this reason, PPE and basic hygiene practices (e.g., washing face and hands before leaving site) will be extremely important. Inhalation exposure will be avoided by using appropriate PPE and engineering controls where necessary. Given the nature of planned activities and that work will be conducted outside in the open air, however, it us highly unlikely

TABLE 6-1
CHEMICAL PHYSICAL AND TOXICOLOGICAL PROPERTIES OF CONTAMINANTS SUSPECTED TO BE AT NAS JACKSONVILLE, JACKSONVILLE, FLORIDA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Beryllium	7440-41-7 as Be	Particulate form - This substance is unable to be detected by PID/FID.	Air sample using a particulate filter; acid desorption; AAS/GF detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7102.	OSHA: 0.002 mg/m^3, (Ceiling) 0.005 mg/m^3 NIOSH: 0.0005 mg/m^3 ACGIH: 0.002 mg/m^3	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 5378°F; 2970°C **Melting Pt:** 2332°F; 1278°C **Solubility:** Insoluble **Flash Pt:** Not available (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 1.85 **Incompatibilities:** Halocarbons, strong oxidizers, acids and caustics **Appearance and odor:** gray to white hard light metal, brittle	Overexposure to this substance may result in respiratory symptoms including difficulty in breathing, coughing, rales, chest pain, possibly pulmonary edema, weakness, fatigue, headache, weight loss. Direct contact may result in irritant action on the skin (dermatitis), eyes (conjunctivae), and mucous membranes. This substance has been identified as a potential human carcinogen.
Lead	7439-92-1	Particulate form - Unable to be detected by either PID or FID.	Air sample using a mixed cellulose ester filter; or HNO_3 or H_2O_2 desorption; or Atomic absorption detection. NIOSH Method #7082 or #7300.	OSHA: 0.05 mg/m^3 ACGIH: 0.15 mg/m^3 NIOSH: 0.10 mg/m^3 IDLH: 100 mg/m^3 as lead	The use of a air purifying, full-face respirator with high efficiency particulate air filter for up to 2.5 mg/m^3. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 3164°F; 1740°C **Melting Pt:** 621°F; 327°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 11.34 **Incompatibilities:** Strong oxidizers, peroxides, sodium acetylide, zirconium, and acids **Appearance and Odor:** Metal: A heavy ductile, soft gray solid.	Overexposure to this substance via ingestion or inhalation may result in metallic taste in the mouth, dry throat, thirst, Gastrointestinal disorders (burning stomach pain, nausea, vomiting, possible diarrhea sometimes bloody or black, accompanied by severe bouts of colic), CNS effects (muscular weakness, pain, cramps, headaches, insomnia, depression, partial paralysis possibly coma and death. Extended exposure may result in damage to the kidneys, gingival lead line, brain, and anemia.

that any appreciable airborne concentrations will be present. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (i.e., groundwater, subsurface soils).

Other sources of potential chemical exposure are decontamination fluids (e.g., Liquinox, isopropanol), and analytical preservatives. For any substances brought onto the site, the SSO is responsible for instituting a site-specific Hazard Communication Program (see Section 5.0 of the TtNUS Health and Safety Guidance Manual) and for collecting the appropriate Material Safety Data Sheets (MSDS) from the chemical manufacturers/suppliers. The SSO is also responsible for completing the SWP for the decontamination task using the appropriate MSDS and for reviewing the contents of the MSDSs and SWP with anyone who will use these substances.

6.2 RADIOLOGICAL HAZARDS

Based on the site history and prior radiological survey efforts, radium and thorium have been identified as the radiological contaminants of concern.

Radium

Radium (Ra-226) is a natural radionuclide, found in the earth's crust, which results from the decay of uranium (U-238). Much of the radium used in the past (i.e., radium dials) was technologically enhanced. Radium has a half-life of 1,622 years. It decays to Radon-222 via alpha and gamma radiation.

Once inside the body (by ingestion or inhalation) the high energy of the alpha radiation is dissipated in living alpha particles are extremely limited in their ability to penetrate matter. The dead outer layer of the skin is sufficiently thick to absorb the alpha radiation from radium (and thorium). As a consequence, alpha radiations from sources outside the body do not constitute a tissue, particularly skeletal bone. Radium incorporated into the mineral structure of the bone has been demonstrated to cause bone damage including osteogenic sarcoma.

Thorium

Thorium (Th-232) is a natural radionuclide also found in the earth's crust. Thorium has a half-life of 1.39 x 10^{10} years and decays to Radium 228. Like Radium-226, thorium is an alpha emitter. Other daughters of thorium which include, but are not limited to Ac-228 and Th-228, are gamma emitters. Thorium, like radium is considered an internal hazard due to its high energy alpha radiation.

Radionuclide - **RADIUM**

Contamination Guideline

Surface Structures
100 dpm/100 cm^2 alpha, beta-gamma average over 1 m^2
300 dpm/100 cm^2 alpha, beta-gamma maximum over 1 m^2
20 dpm/100 cm^2 alpha, beta-gamma removable
Soil
5 pCi/g

Occupational Value (Annual Limit of Inhalation uCi))
Ingestion - 2
Inhalation - 6×10^{-1}

Effluent Concentration (uCi/ml)
Air - 9×10^{-13}
Water 6×10^{-8}

Half-life (years)
1,622

Specific Activity (Ci/g)
0.988

Radionuclide - **THORIUM**

Contamination Guideline
Surface Structures
1,000 dpm/100 cm^2 alpha, beta-gamma average over 1 m^2
3,000 dpm/100 cm^2 alpha, beta-gamma maximum over 1 m^2
200 dpm/100 cm^2 alpha, beta-gamma removable
Soil - 5 pCi/g

Occupational Value (Annual Limit of Inhalation uCi)
Ingestion - 7×10^{-1}
Inhalation - 1×10^{-3}

Effluent Concentration (uCi/ml)

Air - 4×10^{-15}
Water -3×10^{-8}

Half-life (years)
1.39×10^{10}

Specific Activity (Ci/g)
1.09×10^{-7}

TABLE 6-2
RADIOLOGICAL PROPERTIES OF CONTAMINANTS SUSPECTED TO BE AT NAS JACKSONVILLE, JACKSONVILLE, FLORIDA

Radionuclide	**RADIUM**	**THORIUM**
Contamination Guideline	**Surface Structures** 100 dpm/100 cm^2 alpha, beta-gamma average over 1 m^2 300 dpm/100 cm^2 alpha, beta-gamma maximum over 1 m^2 20 dpm/100 cm^2 alpha, beta-gamma removable **Soil** - 5 pCi/g	**Surface Structures** 1,000 dpm/100 cm^2 alpha, beta-gamma average over 1 m^2 3,000 dpm/100 cm^2 alpha, beta-gamma maximum over 1 m^2 200 dpm/100 cm^2 alpha, beta-gamma removable **Soil** - 5 pCi/g
Occupational Value (Annual Limit of Inhalation (uCi)	Ingestion - 2 Inhalation - 6×10^{-1}	Ingestion - 7×10^{-1} Inhalation - 1×10^{-3}
Effluent Concentration (uCi/ml)	Air - 9×10^{-13} Water - 6×10^{-8}	Air - 4×10^{-15} Water -3×10^{-8}
Half-life (years)	1,622	1.39×10^{10}
Specific Activity (Ci/g)	0.988	1.09×10^{-7}

6.3 PHYSICAL HAZARDS

In addition to the chemical hazards discussed above, the following physical hazards may be present during the performance of the site activities.

- Slips, trips, and falls
- Cuts (or other injuries associated with hand tool use)
- Lifting (strain/muscle pulls)
- Ambient temperature extremes (cold and heat stress)
- Pinches and compressions
- Heavy equipment hazards (rotating equipment, hydraulic lines, etc.)
- Energized systems (contact with underground or overhead utilities)
- Vehicular and foot traffic
- Noise in excess of 85 dBA
- Flying projectiles

Each of these physical hazards is discussed in greater detail in Section 4.0 of the TtNUS Health and Safety Guidance Manual. Additionally, information on the associated control measures for these hazards are discussed in Table 5-1 of this HASP. Some of these hazards and the associated control measures are discussed below.

6.3.1 Slips, Trips, and Falls

Conditions such as steep terrain and/or heavy vegetation may create an increased potential for slip, trip, and fall hazards.

- The safest approach to sample points will be identified and cleared to permit field crew access to sample locations.
- Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
- Footwear with an adequate traction.
- Prepare work areas by removing tripping hazards (ruts, roots, and debris). This is especially critical around rotating equipment, where a fall into the rotating apparatus could be life threatening.

6.3.2 Cuts or Other Injuries Associated with Hand Tool Use

The clearing of brush and vegetation will be performed using hand tools that may include machetes, and brush axes. However, the use of hand tools has only briefly discussed. The control measures presented below will help minimize the potential for physical and cutting hazards.

- Wear leather or heavy cotton work gloves when using tools to protect against blisters, cuts, or other hand injuries.
- Wear eye protection (safety glasses with side shields) to protect the eyes from twigs, sticks, or flying debris.
- Clear the immediate cutting area of all personnel (radius of the tool swing area).
- Wear long pants and long-sleeved shirts to protect against abrasions.
- Wear hard hats if work will involve areas with overhead hazards (e.g., overhanging branches).
- Wear sturdy work boots.
- Inspect all hand tools [i.e., shovel handles (cracks, splinters, etc.), brush hook handles and blade attachment points, etc.]
- Ensure all hand tools are sharp to facilitate cutting action. This will avoid persons forcing the tool to cut and increasing potential hazards.
- Use the proper tool for the intended purpose. This to will avoid potential injury possibly created through improper use.

6.3.3 Energized Systems (Contact with Underground or Overhead Utilities)

Underground utilities such as pressurized lines, water, telephone, buried utility, and high voltage power lines may be present throughout the facility. **Therefore, all subsurface activities must be conducted following the requirements of the TtNUS SOP for "Utility Locating and Excavation Clearance (HS-1.0)"**. A copy of this SOP is provided as Attachment II. Clearance of underground and overhead utilities for each location will be coordinated with the NAS JAX Public Works Department. Additionally, drilling operations will be conducted at a safe distance from overhead power lines as discussed in Attachment II. In certain cases, there may be a need to de-energize electrical cables using facility lockout/tagout procedures to insure electrical hazards are eliminated.

6.4 NATURAL HAZARDS

Insect/animal bites and stings, poisonous plants, and inclement weather are natural hazards that may be present given the location of activities to be conducted. As previously discussed, some portions of the site include vegetated areas which increases the potential for field crews to encounter ticks, bees, mosquitoes/insects, snakes, and poisonous vegetation.

6.4.1 Insect Bites and Stings

Various insects and animals may be present and should be considered. For example, fire ants present a unique situation when working outdoors in Florida. Their aggressive behavior and their ability to sting repeatedly can pose a unique health threat. The sting injects venom (formic acid) that causes an extreme burning sensation. Pustules form which can become infected if scratched. Allergic reactions of people sensitive to the venom include dizziness, swelling, shock and in extreme cases unconsciousness and death. People exhibiting such symptoms should see a physician. Fire ants can be identified by their habitat. They build mounds in open sunny areas sometimes supported by a wall or shrub. The mound has no external opening. The size of the mound can range from a few inches across to some which are in excess of two feet or more in height and diameter. When disturbed they defend it by swarming out and over the mound, even running up grass blades and sticks.

Insect/animal bites and stings are difficult to control given the climate and environmental setting of NAS JAX. However, in an effort to minimize this hazard the following control measures will be implemented where possible.

- Commercially available bug sprays and repellents will be used whenever possible. Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxaphene and heptachlor. Commercially available repellants may be used providing they do not contain substances which appear on the analytical list for pesticide analysis. 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.

- Where possible, loose-fitting and light-colored clothing with long sleeves should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.

- The FOL/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 be flagged and communicated to all site personnel.

- The FOL/SSO must determine if site personnel (through completion of Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. Field crew members who are allergic to bites should have their emergency kit containing antihistamine and a preloaded syringe of epinephrine readily available.

Any allergies (insect bites, bee stings, etc.) must be reported on the Medical Data Sheet and to the SSO.

6.4.1.1 Tick and Mosquito Transmitted Illnesses and Diseases

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. Information concerning Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Section 4.0 of the TtNUS Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then passed on to another person through the biting action. Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

6.4.2 Snakes and Other Wild Animals

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may be present at the site. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals. This is not generally considered to be a problem at this location as most of the activities will take place in improved areas. It is however addressed as part some tasks that may take personnel off of Improved areas.

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. The FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. Snake chaps will be required as a precaution.

6.4.2.1 Snake Bites

All initial efforts will be directed to avoid, where possible, nesting and territorial areas. However, should field personnel come in contact with these animals and receive a bite, the following actions are necessary.

- 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.

- 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.

- 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.

- Seek medical attention immediately.

6.4.3 Poisonous Plants

Various plants which can cause allergic reactions may be encountered during field work. These include, poison ivy, poison oak, and poison sumac. Contact with these plants may occur when clearing vegetation for access to work areas, or as a result of movement through these plants. An irritating, allergic reaction can occur after direct contact with the plant or indirect contact through some piece of equipment or clothing article. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not be limited to, the following:

- Identify plants for field personnel.

  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.

  - Poison Sumac - 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. However, these white fruits and berries may exist only during pubescent stages.

  - Poison oak - 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 wearing disposable garments such as Tyvek when clearing brush. These may be carefully 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 bare skin layer is contacted. This can be aggravated when skin pores are open (perspiring), or through breaks in the skin such as 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, lunchtime, etc. personnel should 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 skin.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed.

6.4.4 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 HAZARD MONITORING – TYPES AND ACTION LEVELS

This section provides direction and protocol for the real time monitoring. The monitoring of hazardous conditions has two primary objectives.

- Qualify and quantify potential hazards (chemical, radiological, physical, and biological) that, may impact the work force or sensitive receptors in the immediate area.

- Evaluate environmental sampling media, which will be sent off-site. The purpose of this evaluation will be to qualify potential hazards to provide sufficient warning to down stream parties, which may potentially encounter these hazards. This would include hazard qualification for transportation purposes as well as notification to the analytical laboratory of potentially high hazard samples.

7.1 TASKS TO BE CONDUCTED

The following tasks are to be conducted as part of the scope of work. It is hazards associated with these tasks, which may be monitored for the purpose of quantification/ qualification of those hazards.

- HSA Drilling or DPT
- Monitoring Well Development/Monitoring Well Sampling
- Multi-media Sampling – Surface and subsurface soils; sediment; surface and groundwater sampling
- Decontamination activities
- Geographical surveying

7.2 ASSOCIATED HAZARDS

Hazards associated with these tasks for which monitoring may be used to qualify/quantify, include, but not limited to:

- Noise – Information obtained from previous monitoring efforts indicate noise levels associated with this type of activity, dependent on the type of rig,

    - HSA Drill rig sound levels range from 87 to 92 dBA- Time Weighted Average (TWA)
    - DPT range from 90 to 102 dBA-TWA
    - Generators – When generators are used as portable power sources for well development or sampling, the generator should be placed a sufficient distance from the operation to eliminate the noise hazard. The generators emit approximately 82 to 88 dBA.

- Steam Cleaners and pressure washers – Previous data indicate that these machines emit from 94 to 102 dBA.

Noise dosimetry may be performed to quantify noise levels associated with the type of rig selected to perform the subsurface investigation. In addition noise quantification may be performed to insure the hearing protection devices selected attenuation capabilities are sufficient for those noise levels produced. All noise monitoring will proceed in accordance with the Hearing Conservation Program provided in Section 6.0 of the TtNUS Health and Safety Guidance Manual.

- Chemical hazards (Contaminated environmental media exposure) – The contaminants evaluated for determining exposure threat were those that exceeded regulatory limits (for clean-up purposes). These contaminants were then evaluated based on their concentration that existed in the media to determine exposure threat. From this a final list of contaminants of concern was generated. This information has been used to determine potential worker exposure during tasks such as monitoring well installation/development and sampling. These contaminants represent maximum detected concentrations and are considered worst case scenario.

- Radiological hazards – In addition to the chemical contaminants, historical information indicates that radium laden paint and possible thorium contamination also exists at this site, citing past practices. Information concerning the amounts and areas of contamination are sketchy at best. Monitoring for this hazard would entail surface scans of soil cores and surface scans to determine the presence of radiological contamination above natural background levels and frisks of personnel and surveys of equipment passing through decontamination to determine impact. In addition to the sampling and analysis of discharge waters, surface scans for Beta and Gamma radiation will be performed. There have been three distinct areas identified within the DRMO Yard. Frequency of monitoring may be modified to reflect conditions associated within site investigation activities outside of those areas.

All efforts concerning radiation exposure will be directed at employing As Low As Reasonably Achievable (ALARA) concepts.

7.3 INSTRUMENTS TO BE USED FOR HAZARD MONITORING

The following instrument will be used for monitoring the hazards identified above.

7.3.1 Metrosonics dB-307 Noise Dosimeter

The db-307 is a dual purpose sound level meter and noise dosimeter. The instrument is calibrated in accordance with manufacturers instructions using a 102dBA acoustical calibrator. The instrument is

calibrated pre and post to monitoring activities in accordance with the Hearing Conservation program provided in Section 6.0 of the TtNUS Health and Safety Guidance Manual. Information regarding calibration is recorded either on the Noise Dosimetry Log or the Sound Level Measurement Log, relative to the type of monitoring being performed.

7.3.1.1 Frequency of Monitoring

Noise dosimetry and sound level measurements will be performed under the following circumstances:

- Noise source exists for which no similar data is available.
- Quantification is necessary to evaluate hearing protection attenuation capabilities.

Additional monitoring will only be performed if it is necessary to quantify other noise sources or through changes in procedure that may result in higher noise levels.

This monitoring will be conducted during intervals of the project, as deemed necessary, during the operation of powered equipment capable of generating noise sources over 85 dBA.

7.3.2 Chemical Contaminant Monitoring

Monitoring for airborne chemical contaminants released from environmental media will be performed during the following intrusive activities:

- Soil boring and monitoring well installation
- Multi-media sampling and well development

Chemical air monitoring will be performed by the SSO or field team members using a photo-ionization detector (PID) as a primary screening instrument. This activity denotes general screening based on previous analytical results these substances do not present an exposure threat based on concentrations reported in the media.

Should information parameters change, selection of the primary screening instrument may also change to a combination PID/Field Ionization Detector (FID) instrument such as the TVA 1000 by Foxboro. This would permit a wide range of components to be measured simultaneously.

The PID was selected over the FID as a primary screening instrument due to its ease of use, maintenance requirements, and resource demand. In addition, many of the contaminants are diluted and contaminated. This may make detection through combustion of the sample and hence detection through flame-ionization,

difficult and unreliable. Should it be determined through initial field application and performance, that the FID based on its relative response ratio to the contaminants in question is a better choice, then the instruments will be switched out.

7.3.3 Radiological Contamination Monitoring

7.3.3.1 Soil Screening

Soil samples extracted will be screened for radiological activity using a Ludlum Model 2221 coupled with a Ludlum Model 44-9 detector (or equivalent). The purpose of this screening is to provide a general level of the hazard.

It is necessary to dry samples for alpha testing as the surface tension of the water or moisture may skew the results. Upon drying the sample the soil will be spread as thin as possible and a surface scan will be performed under a radiation survey meter. A release limit of 2 uCi or 250 cpm above background has been established as a non-radiological hazard.

7.3.3.2 Personal Monitoring and Sampling

Personnel will self frisk prior to exiting the work area. Equipment will be surveyed and decontaminated, if necessary, prior to release or disposal. This support effort will be accomplished only if radioactivity at the source is detected.

Personnel radiological air monitoring will be conducted, if it is determined to be necessary, by using two high flow air samplers positioned in the down gradient sectors of the work area. The air samplers will be operated for a pre-determined amount of time and then the air filter will be checked using a radiation monitoring instrument or counter. If the air borne radioactive concentration exceeds the established limit, a review will be conducted to determine if respiratory equipment and/or engineering controls are sufficient.

Personnel will use a Geiger-Muller survey meter to “frisk” themselves. If found, the area that is contaminated will be washed with soap and water and re-surveyed to determine if any contamination is still present on the individual. This process will be continued until the individual is found to be free of contamination.

Personnel will also wear thermoluminescent dosimeters (TLDs), which will be worn at all times by at-risk workers at the site. The TLDs will be collected and returned to the laboratory for analysis at the end of each quarter and the completion of the investigation. A new TLD will be issued for continuous personnel monitoring. A radiological dose record will be kept for each individual worker to ensure exposure limits are not exceeded.

Based on the level of radioactivity detected during the initial field activities Pencil Dosimeters may be utilized. It will be the determination of the SSO with the technical support of the radiological contractor in determining any additional monitoring or modification to that which has been provided. Authorization for all changes and modification to this monitoring scheme will be done with the expressed permission of the PHSO and/or the HSM.

7.3.3.3 Equipment Used for Surveys

Instruments to measure radiation at the project site are described below:

Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 43-5 50 cm Squared Alpha Scintillation Probe (or equivalent) – This instrument will be used for monitoring alpha emissions. This instrument has been selected based on the potential for radium and thorium contamination which is considered an alpha emitter.

Ludlum Model 2221 Portable Scaler/ Rate Meter with a Model 44-9 Pancake Geiger-Muller Detector (or equivalent) – This instrument will be used for scan surveys to detect both fixed and loose surface beta/gamma radiation.

Ludlum Model 19 Micro R Survey Meter (or equivalent) – This instrument will be used to measure exposure rates.

Ludlum 2929 Dual Alpha, Beta/Gamma Scaler with Model 43-10 Detector – This instrument will be used for counting air filters and smears.

Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 44-10 Gamma Scintillation (2" by 2" NaI) Detector (or equivalent) – This instrument will be used to conduct surface scans in open land areas.

Each instrument will be checked daily prior to use by source check and verifying meter response.

7.3.3.4 Natural Background Determination

Natural background radiation levels (i.e., counts per minute [cpm], cpm/probe area, micro-rem per hour [µR/hr]) will be determined by taking background radiation measurements at locations unaffected by site operations.

Natural background radiation will represent an averaged value measured and calculated from the same media to be sampled. A grid over the sample area will be laid out to represent an odd number of points

(preferably nine points). A reading will be taken at each location. These readings will be averaged to determine background. It should be noted that this background determination will occur prior to the drill rig moving in. Addition measurements will be taken if it is determined that the constructed material of the drill rig is influencing natural background.

A threshold for declaring the presence of radioactivity will be a multiple of the background rate measured at any given time. A common value that is used by nuclear facilities is two times the background rate (i.e., if a survey shows a measured dose rate that is twice the background rate measured just before surveying the item, then the item would be assumed to be contaminated). This HASP has established a value of >250 cpm above background as a release limit. Pending direction from the radiological contractor this value will stand. If it determined to be more feasible to use twice that of a measured background value, or some other predetermined value then Table 5-1 and the safe work permits will be altered to reflect the advised action level.

7.4 INSTRUMENT PREPARATIONS FOR FIELD SERVICE

All direct reading instruments will require calibration prior to use. The frequency of this calibration is stated below.

- Noise Dosimeter - Manufacturer yearly service and primary calibration
  In the field – Pre and Post secondary calibration to a yearly calibrated acoustical reference.

- PID/FID – Manufacturer yearly service and primary calibration
  In the field – Pre and Post secondary calibration to a reference gas

- Radiation Survey Meters – Manufacturer yearly service and primary calibration
  In the field – Pre and Post operations checks with a source check.

All instruments will operated and calibrated in accordance to manufacturers instructions.

Calibration information will be recorded on the equipment calibration sheet provided as Figure 7-1.

7.5 INSTRUMENT MAINTENANCE

Maintenance activities to be conducted on site are as follows:

- Wiping down the outer shells of the monitoring equipment used – Daily
- Battery charging – Daily (As applicable)

- PID – Lamp Cleaning – Once per 10-day shift or as conditions dictate
- PID/FID – Filter Replacement – Daily

Maintenance greater than that mentioned above will require the attention of a certified technician and will not be performed on site.

7.6 INSTRUMENT CALIBRATION AND MAINTENANCE

Hazard monitoring instruments will be maintained and pre-field calibrated by the TtNUS Equipment Manager or selected commercial vendor. 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's standard operating procedure (copies of which can be found in the Health & Safety Guidance Manual which will be maintained on site for reference). All calibration observations must be documented. Figure 7-1 is provided for documenting these calibration observations. This information may instead be recorded in a field operations 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 number, source concentration, and supplier)
- Any relevant comments or remarks

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ **PROJECT NO.:**_____

Date of Calibration	Instrument Name and Model	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 specifies health and safety training and medical surveillance requirements for both TtNUS and subcontractor personnel participating in on site activities.

8.1.1 Requirements For All Field Personnel

All TtNUS and subcontractor personnel who will engage in field associated activities as described in this HASP must have:

- Completed 40 hours of introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e).
- Completed 8-Hour Refresher Training, if the identified persons had introductory training more than 12 months prior to site work.
- Completed 8-hour Supervisory training in accordance with 29 CFR 1910.120(e)(4), if their assigned function will involve the supervision of subordinate personnel.

Documentation of introductory training or equivalent work experience, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.2 SITE-SPECIFIC TRAINING

TtNUS will provide site-specific training to all TtNUS employees and subcontractor personnel who will perform work on this project.

Figure 8-1 will be used to document the provision and content of the project-specific and associated training. All site personnel will be required to sign this form prior to commencement of site activities.

TtNUS will conduct a pre-activities training session prior to initiating site work. Additionally, a brief meeting will be held daily to discuss operations planned for that day. At the end of the workday, a short meeting may be held to discuss the operations completed and any problems encountered. This activity will be supported through the use of a SWP System (see Section 10.10).

FIGURE 8-1

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing field investigation activities at NAS JAX, Jacksonville, FL 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 (Section 1.2)
- Safety, health, and other hazards present on site (Table 5-1 and 6-1)
- Use of personal protective equipment (Table 5-1 and Attachments)
- Safe use of engineering controls and equipment
- Medical surveillance requirements (Section 8.3)
- Signs and symptoms of overexposure (Table 6-1)
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points) (Section 2.0)
- Incipient response procedures (Section 2.0)
- Review of the contents of relevant MSDSs
- Review of the use of SWPs

My signature below indicates that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction and that the date of my training and my medical surveillance requirements indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for TtNUS and Subcontractor Personnel

All TtNUS and subcontractor personnel participating in project field activities will have had a physical examination. All physical examinations shall meet the minimum requirements of paragraph (f) of OSHA 29 CFR 1910.120. The physical examinations will be performed to ensure all personnel are medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained at the job site and made available, as necessary. Subcontractor personnel may use an alternative documentation for this purpose. The "Subcontractor Medical Approval Form" can be used to satisfy this requirement, or a letter from an officer of the company. The letter should state that the persons listed in the letter participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of CFR, Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response." The letter should further state the following:

- The persons listed have had physical examinations under this program within the frequency as determined sufficient by their occupational health care provider.
- Date of the exam.
- The persons identified have been cleared by a licensed physician to perform hazardous waste site work and to wear positive- and negative- pressure respiratory protection.

A sample Subcontractor Medical Approval Form and form letter have been provided to all eligible subcontractors in the Bid Specification package.

8.3.2 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 the Medical Data Sheet also supplied to eligible subcontractors as part of the Bid Specifications Package. 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 EXCEPTION

If through the execution of their contract elements the subcontractor will not enter the exclusion zone and there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from the training and medical surveillance requirements with the exception of Section 8.2. Examples of

subcontractors who may qualify as exempt from training and medical surveillance requirements may include surveyors who perform surveying activities in site perimeter areas or areas were there is no potential for exposure to site contaminants and support or restoration services. **Use of this Subcontractor Exception is strictly limited to the authority of the CLEAN Health and Safety Manager.**

9.0 SPILL PREVENTION AND CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

This program applies to the single or aggregate accumulation of bulk storage materials (over 55-gallons). As the classification of certain materials such as IDW is unknown, all materials will be treated as hazardous, pending laboratory certification to the contrary. The types of materials for which this program will apply are as follows:

- IDWs such as decontamination fluids, soil cuttings, and purge and well development waters
- Resource Storage – Limited fuel and lubricant storage

The spill containment and control will be engaged any time there is a release of the above identified materials from a containment system or vessel. This spill containment program will be engaged in order to minimize associated hazards.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated that all IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of these analyses will determine the method of disposal.

9.3 CONTAINMENT AREAS

In order to facilitate leak and spill inspection and response, and to minimize potential hazards which may impact the integrity of the storage containers, the staging area for these substances will be structured as follows:

9.3.1 IDW

- 55 Gallon Drums (United Nations 1A2 configurations) – 4 Drums to a Pallet; labels and the retaining ring bolt and nut on the outside of each drum to facilitate easy access; Minimum 3 feet between each row of pallets. The decision to construct a bermed and lined area will be the decision of project management .

- Storage Tank – Polyethylene Construction – Tank shall be placed into a bermed enclosure of sufficient size to accommodate 110% of anticipated volume (Largest container plus 10% for rainwater and container displacement).

Regardless of container types selected, the staging area will be identified as a Satellite Storage Area with proper signage, points of contact in the event of an emergency, alternate contacts, and identification of stored material (i.e., purge or decontamination waters, soil cuttings, etc.).

An Inventory Log will be maintained by the FOL regarding types of IDW and volumes generated. An updated Inventory List will be provided by the FOL to the designated Emergency Response Agency or Base Contact during days off and between shifts or phases of operations.

9.3.2 Flammable/Petroleum/Oil/Lubricants (POL) Storage

Flammable storage [i.e., fuels, decontamination solvents (Isopropanol)] and POL will require proper dispensing containers and necessary storage for cumulative volumes in excess of 25 gallons. Storage and dispensing will comply with the following requirements:

- All fuels, which will be stored and dispensed from portable containers, will utilize safety cans.
- All portable hand held storage containers will be labeled per Hazard Communication requirements.
- Larger volumes stored for fueling equipment will be stored in approved ASTs with secondary containment capable of holding the tank volume plus 10%.
- All portable flammable liquid storage tanks will be properly grounded and will have bonding capabilities for the transfer of loading and off-loading of its contents.
- All dispensing locations will be supported by a fire extinguisher positioned no closer than 50 feet from the storage tank, properly mounted and identified.
- The storage location will be well marked with proper signage, protective bumper poles and will have straight through access/egress for vehicles.

9.4 MATERIALS HANDLING

To minimize the hazards associated with moving drums and containers (i.e., lifting, pinch and compression points) material handling will be supported in the following manner:

- A drum cart with pneumatic tires will be required, if drums are used for IDW storage. This cart will be used to relocate drums within the staging and satellite storage location.

- In addition, a mechanized means such as a suitably equipped skid loader or back-hoe will be provided to move IDW containers from the field location to the staging and satellite storage location. This piece of equipment will also be used in site clearance and restoration as deemed appropriate and necessary.

Other means of material handling will be evaluated by the SSO based on their ability to minimize or eliminate material handling hazards.

9.5 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums or in the Resource Deployment area will be conducted during working hours to visually determine that storage vessels are not leaking. If a leak is detected, the FOL will be notified and the Spill Containment/Control Response Plan as specified in Section 9.8 will be engaged. All inspections will be documented in the project logbook.

9.6 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed in the procedures for incipient 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 Coordinators for this operation, should the need arise. Personnel through the course of this project will be drilled as part of testing the EAP.

9.7 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging areas at all times for the purpose of supporting this Spill Containment/Control Plan.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Extra Drums (55-gallon U.N. 1A2) should the need to transfer material from leaking containers arise.

- Pumps (Gas or Electric necessary for transferring liquids from leaking containers)/tubing
- Drum Repair Kit
- Shovels, rakes, and brooms
- Container labels
- Personal Protective Equipment
  - Nitrile outer gloves
  - Splash Shield
  - Impermeable over-boots
  - Rain suit

9.8 SPILL CONTAINMENT/CONTROL RESPONSE PLAN

This section describes the procedures the TtNUS field personnel will employ upon the detection of a spill or leak.

- Notify the SSO or FOL immediately upon detection of a leak or spill. Activate emergency alerting procedures for that area to remove all non-essential personnel.

- Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

- Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.

- Recontainerize spills, including 2-inch of top cover (if over soils) impacted by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures specified in Section 2.0 of this HASP.

10.0 SITE OPERATIONS AND CONTROL

Site operations and control will be facilitated through the use of established work zones and security and control of those zones. These activities will minimize the impact and spread of contaminants brought to the surface through subsurface investigative methods as well as protect personnel and visitors within these zones during ongoing operations.

10.1 WORK ZONES

TtNUS will delineate and use work zones in conjunction with decontamination procedures to prevent the spread of contaminants to other areas of the site. A three-zone approach will be used for work at this site; an Exclusion Zone, a Contamination Reduction Zone, and a Support Zone. These will be used to control access to the work areas, restricting the general public, avoiding potentials to spread any contaminants, and to protect individuals who are not cleared to enter by way of training and/or medical surveillance qualifications.

10.1.1 Exclusion Zone

An Exclusion Zone will be established at each sampling point/location. The purpose of the exclusion zone is to define a area where a more rigorous protocol for workers within what is determined to be an impact area. The impact area is that area which could be adversely impacted by either chemical or physical hazards. Exclusion zone size and dimensions will vary based on activities. Impact areas dimensions will be influenced by the following considerations:

- Physical and topographical features of the site
- Weather conditions
- Field and analytical measurements of air and environmental contaminants
- Air dispersion calculations
- Potential for explosion and dispersion
- Physical, chemical and toxicological properties of the contaminants being investigated
- Tasks to be conducted
- Decontamination procedures
- Potential for exposure

As conditions change the dimensions of the exclusion zone will change. However, the following dimension represent a starting point from which the exclusion zones will be expanded:

- Monitoring well installation (HSA or DPT). The exclusion zone for this activity will be set at the height of the mast, plus five feet surrounding the point of operation, with a minimum of 25 feet. This distance will also apply when subsurface soil sampling from behind these type rigs.

- Monitoring well development and sampling. The exclusion zone for this activity will be set at 10 feet surrounding the well head and discharge collection container.

- Surface soils and surface water sampling. The exclusion zone for this activity will be set at five feet surrounding the point of operation.

- Clearing and grubbing. The exclusion zone for this activity will be set at 10 feet surrounding someone with a brush hook or machete. 50 feet surrounding a person using a chainsaw or a chipping operation.

- Decontamination operation. The exclusion zone for this activity will be set at 25 feet surrounding the gross contamination wash and rinse as well as 25 feet surrounding the heavy equipment decontamination area.

- IDW area will be constructed and barricaded. Only authorized personnel will be allowed access.

All exclusion zones shall remain marked until the SSO has evaluated the restoration effort and has authorized changing the zone status.

Exclusion zones will be marked using barrier tape, traffic cones and/or drive poles. Signs will be posted to inform and direct site personnel and site visitors.

10.1.2 Contamination Reduction Zone

The contamination reduction zone will be split to represent two separate functions. The first function will be a control/supply point for supporting exclusion zone activities. The second function, which may take place a sufficient distance from the exclusion zone is the decontamination of personnel and heavy equipment.

In order to move from the exclusion zone to a separate location the following activities will be used:

- As samplers move from location to location during sampling activities, dedicated sampling devices and PPE will be washed of gross contamination, removed, separated, and bagged. Personnel will use

hygenic wipes, such as Handy Wipes, as necessary. At the first available opportunity personnel will wash their face and hands. This is critical prior to breaks and lunch when contamination can be transferred to the mouth through hand to mouth contact.

- Muddy over-boots and gloves may be required to go through a gross contamination wash at the exclusion zone. These items will then be cleaned thoroughly at the centralized decontamination unit.

- Potentially contaminated tooling will be wrapped, when necessary, for transport to the decontamination area.

- Upon completion of the assigned tasks all personnel will move through the central decontamination area to clean reusable PPE and field equipment. All personnel and field equipment will be suveyed at the termination of decontamination procedures If radiological contamination has been detected or is suspected at the source. Based on ambient conditions medical evaluations will take place at the termination point of the decontamination line. These evaluations will include pulse rate, oral temperature, breathing rate to evaluate physiological demands on site personnel. As stated earlier, these evaluations will be based on ambient conditions and acclimation periods.

10.1.3 Support Zone

The Support Zone will consist of a field trailer, storage, laydown areas, or some other uncontaminated, controlled point. The Support Zone for this project will include a staging area where site vehicles can be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established in clean areas of the site.

10.2 SAFE WORK PERMITS

All Exclusion Zone work conducted in support of this project will be performed using SWPs to guide and direct field crews on a task by task basis. An example of the SWP is included in Figure 10-1. The daily meetings conducted by the FOL/SSO will further support these work permits. The use of these permits will ensure that site-specific considerations and changing conditions are incorporated into the planning effort. All SWPs will require the signatures of either the FOL or the SSO. All personnel engaged in onsite

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): _____

_____

II. Names: _____

_____

III. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☐ Level B ☐
Level C ☐ Level A ☐

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

Hardhat ..... ☐ Yes ☐ No
Safety Glasses ..... ☐ Yes ☐ No
Chemical/splash goggles ..... ☐ Yes ☐ No
Splash Shield ..... ☐ Yes ☐ No
Splash suit/coveralls (Type:_____) ☐ Yes ☐ No
Steel toe/shank Workboots ..... ☐ Yes ☐ No
Chemical Protective Over-boots (Type:_____) ☐ Yes ☐ No
Hearing Protection (Plugs/Muffs) .. ☐ Yes ☐ No
Safety belt/harness ..... ☐ Yes ☐ No
Radio ..... ☐ Yes ☐ No
Barricades ..... ☐ Yes ☐ No
Gloves (Type) ..... ☐ Yes ☐ No
Work/rest regimen ..... ☐ Yes ☐ No

Modifications/Exceptions:_____

_____

_____

VII. Procedure review with permit acceptors

	Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐
Procedure for safe job completion	☐	☐
Contractor tools/equipment inspected	☐	☐
Emergency alarms	☐	☐
Evacuation routes	☐	☐
Assembly points	☐	☐

VII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Equipment and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

VIII. Additional Permits required (Hot work, confined space entry, excavation, etc.). ☐Yes ☐No
If yes, See SSO for appropriate permit

IX. Special instructions, precautions:_____

_____

_____

Permit Issued by:_____ Permit Accepted by:_____

activities must be made aware of the elements indicating levels of protection and precautionary measures to be used.

The use of these permits will establish and provide 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 SWP will take precedence over the HASP when more conservative measures are required based on specific site conditions.

Upon completion of the work for which the SWP was assigned, the SWP will be turned into the FOL or the SSO. Concerns, complaints, and suggestions may be made on the reverse of the SWP for consideration by the FOL and/or the SSO. All permit turned in with suggestions, difficulties, or complaints will be forwarded to the PHSO for review.

The SWP and the HASP will serve as the primary reference for work place evaluations and audits conducted to determine if the task is being conducted under the direction conveyed by the HASP and the SWP.

10.3 SITE MAP

Once the areas of contamination, access routes, topography, dispersion routes are determined, a site map will be generated and adjusted as site conditions change. This map will be posted to illustrate up-to-date information of contaminants and adjustment of zones and access points. This map will be posted at the field support trailer. Figure 10-2 will serve as the preliminary version until investigation reveals more information.

10.4 BUDDY SYSTEM

Personnel engaged in onsite activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

10.5 MSDS REQUIREMENTS

TtNUS 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 or the substances onsite. The MSDSs will be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request. The SSO will be responsible for

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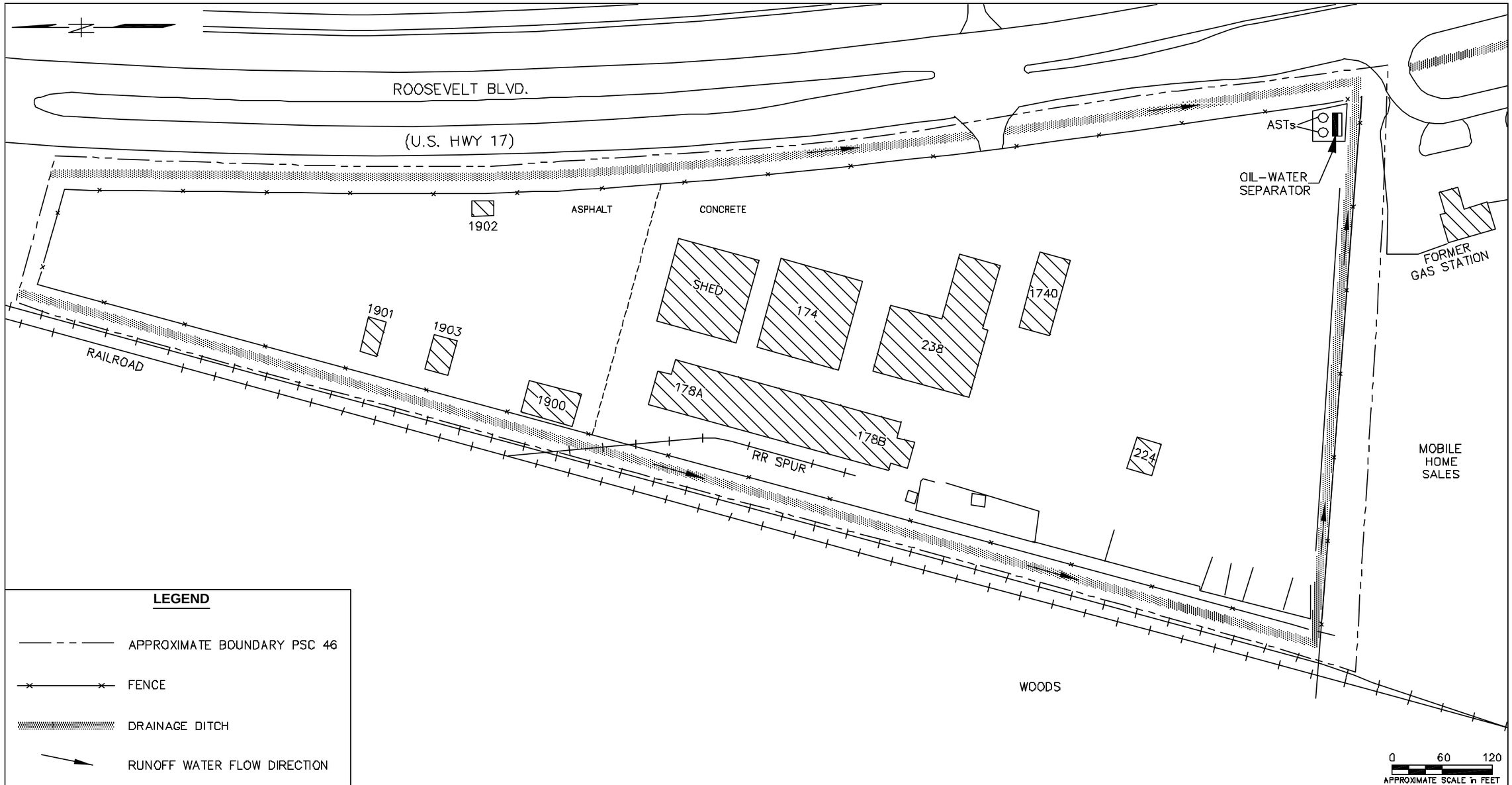

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY CW DATE 7/28/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DRMO SITE MAP
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 10-2 REV. 0

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

implementing a site-specific Hazard Communication Program (see Section 5.0 of the TtNUS Health and Safety Guidance Manual). This includes collection of MSDSs, creation and maintenance of an accurate Chemical Inventory Listing, addressing container labeling and personnel training issues, and other aspects of Hazard Communication.

10.6 COMMUNICATION

It is anticipated that site personnel will be working in close proximity during proposed field activities. In the event that site personnel are in isolated areas or are separated by significant distances, a supported means of communication between field crews will be utilized. Two-way radio communication devices, if needed, will be used only with NAS JAX approval.

External communications will be accomplished utilizing telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of site activities, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

The hand-held radios and cellular phones which will be used if permitted are as follows:

Motorola HT-1000	Power Output 5 watts
Cellular Phone	Power Output 5 watts

10.7 SITE VISITORS

Potential site visitors that may be encountered during the performance of the field work could include the following:

- Personnel invited to observe or participate in operations by TtNUS.
- Regulatory personnel [i.e., Department of Defense (DOD), FDEP, EPA, OSHA, etc.]
- Southern Division Navy personnel
- Other authorized visitors

All non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the TtNUS TOM or designee and following established base access procedures.

Once access to the base is obtained, all personnel who require access to TtNUS work sites (areas of ongoing operations) will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the work site, all site visitors wishing to observe operations in progress will be required to meet the minimum requirements as stipulated 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 individuals name (proper identification required), who they represent, and the purpose for the visit. **The FOL is responsible for ensuring that site visitors are escorted at all times.**

- All site visitors will be required to produce the necessary information supporting clearance on to the site. This includes information attesting to applicable training (40-hours of HAZWOPER training required for all Southern Division Navy Personnel) and medical surveillance as stipulated in Section 8.3 of this document. In addition, to enter the sites 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 site and applicable operational areas. All visitors are required to observe the protective equipment and site restrictions in effect at the work areas visited. Any and all visitors not meeting the requirements as stipulated in this plan for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause all onsite activities to be terminated until that visitor can be removed. Removal of unauthorized visitors will be accomplished with support form the Base Contact, if necessary. At a minimum, the Base Contact will be notified of any unauthorized visitors.

10.8 SITE SECURITY

As this activity will take place at a Navy facility, the first line of security will be provided by the base gate restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL and Base Contact.

Security at the work areas will be accomplished using field personnel. This is a multiple person operation, involving multiple operational zones. TtNUS personnel will retain complete control over active operational zones.

The Base Contact will serve as the focal point for base personnel and interested parties and will serve as the primary enforcement contact.

10.9 SANITATION AND BREAK AREAS

This section will address the following items:

- Toilets
- Potable water
- Showers and change rooms
- Break Areas

10.9.1 Toilets

One toilet will be provided for every 20 people. All toilets will be unisex and will have locking doors. The toilet provided will either be a chemical toilet and service provider or the flush toilet associated with a predetermined location.

10.9.2 Potable Water

Potable water as well as electrolyte balance sports drinks such as Gatorade will be provided to the field crews for fluid replacement. Storage and dispensing will proceed as follows:

- All containers will be clean and replenished daily.

- All containers will clearly marked as to their contents (Potable Water – Drinking Water Only; Gatorade, etc.).

- Dispensing locations will be placed in identified break areas within the support zone. The most likely location will be a break trailer. This will serve as an area for cooling or warming as well as an identified food and drink consumption area.

- If larger containers are used, dispensing cups will be provided.

- The coolers used for storage of potable drinks and cups will be stored in plastic bags away from potentially contaminating materials.

Fluid intake recommendations will be made based on the medical evaluations conducted at the end of the decontamination process.

10.9.3 Showers and Change Rooms

Based on this scope and duration of this project shower facilities and locker rooms will not be provided.

10.9.4 Break Areas

Suitable locations will be provided for field personnel for the following use:

- Break areas for food and drink consumption
- Areas suitable for warming and cooling regimens
- Areas suitable for Safety Meetings

This location will be either the project trailer, or its own separate trailer based on the crew size. This area will be climate control to provide suitable shelter to combat heat or cold stress.

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 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 the HSM will have to be notified.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS 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
- MSDSs for all chemicals brought onto the site including decon solutions, fuels, lime, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- Emergency Reference Information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents all chemicals brought on-site, including decontamination solutions, sample preservations, fuel, etc. This list should be posted in a central area.

MSDSs (maintained) - 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 onsite. 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 (posted) - 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 (maintained) - This list is found within the training section of the HASP (see Figure 8-2). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. The 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) (posted) - This list of numbers and directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by 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) (posted) - This standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation placards and acceptable [Hazard Communication 29 CFR 1910.1200(f)] labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.

13.0 GLOSSARY

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AST	Aboveground Storage Tank
BEI	Bechtel Environmental, Inc.
CERCLA	Comprehensive Environmental Response Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNS	Central Nervous System
cpm	counts per minute
CPR	Cardiopulmonary Resuscitation
CSP	Certified Safety Professional
CTO	Contract Task Order
DI	Deionized
DOD	Department of Defense
DPT	Direct Push Technology
DRMO	Defense Reutilization and Marketing Office
EIC	Engineer-in-Charge
EPA	Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FFA	Federal Facilities Agreement
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
HSA	Hollow Stem Auger
HSM	Health and Safety Manager
IDW	Investigative-Derived Waste
JAX	Jacksonville
LA	Lead Authority
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PCB	Polychlorinated biphenyls

PG	Professional Geologist
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
POL	Petroleum/Oil/Lubricant
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SER	Sampling Event Report
SOP	Standard Operating Procedure
SSO	Site Safety Officer
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
SWP	Safe Work Permit
TBD	To Be Determined
TCLP	Toxicity Characterization Leaching Procedure
TLD	Thermoluminescent dosimeters
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
TWA	Time Weighted Average
USACHPPM	U.S. Army Center for Health Promotion and Prevention Medicine
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

case no. _____

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Diethorn at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Diethorn at (412) 921-8475 for the number of the Referral Unit.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits.

All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are not covered by Tetra Tech's Worker's Compensation plan.

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

case no. _____

TETRA TECH NUS, INC.
INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

To: Corporate Health and Safety Manager
Human Resource Administrator

Prepared by: _____

Position: _____

Project Name: _____

Office: _____

Project No. _____

Telephone: _____

Information Regarding Injured or Ill Employee:

Name: _____

Office: _____

Home address: _____

Gender: M ☐ F ☐ No. of dependents: _____

_____

Marital status: _____

Home telephone: _____

Date of birth: _____

Occupation (regular job title): _____

Social Security No.: _____

Department: _____

Date of Accident: _____

Time of Accident: _____

Location of Accident Was place of accident or exposure on employer's premises Yes ☐ No ☐

Street address: _____

City, state, and zip code: _____

County: _____

Narrative Description of How Accident Occurred: (Be specific. Explain <u>what</u> the employee was doing and <u>how</u> the accident occurred.)

TETRA TECH, INC.
INJURY/ILLNESS REPORT

Did employee die? Yes ☐ No ☐
Was employee performing regular job duties? Yes ☐ No ☐
Was safety equipment provided? Yes ☐ No ☐
Was safety equipment used? Yes ☐ No ☐
Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name:

Address:

Telephone:

Describe the Illness or Injury and Part of Body Affected:

Name the Object or Substance which Directly Injured the Employee:

Medical Treatment Required:

☐ No ☐ Yes ☐ First Aid Only

Physician's Name: _____

Address: _____

Hospital or Office Name: _____

Address: _____

_____

Telephone No.: _____

Lost Work Days:

☐ No. of Lost Work Days _____

Last Date Worked _____

Time Employee Left Work _____

Date Employee Returned to Work _____

☐ No. of Restricted Work Days _____

☐ None

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ Time of Report: _____

	Printed Name	Signature	Telephone No.	Date
Project or Office Manager				
Site Safety Coordinator				
Injured Employee				

To be completed by Human Resources:

Date of hire: Hire date in current job:

Wage information: $ _____ per _____ (hour, day, week, or month)

Position at time of hire:

Shift hours:

State in which employee was hired:

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date:

To be completed during report to workers' compensation insurance carrier:

Date reported: Reported by:

TeleClaim phone number:

TeleClaim account number:

Location code:

Confirmation number:

Name of contact:

Field office of claims adjuster:

ATTACHMENT II

STANDARD OPERATING PROCEDURE FOR UTILITY LOCATING AND EXCAVATION CLEARANCE

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1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy must be reviewed by anyone potentially involved with underground or overhead utility services.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence or absence of utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the geophysical methods may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure and the TtNUS Utility Locating and Clearance Policy.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy.

Site Personnel – Responsible for understanding and implementing this SOP and the TtNUS Utility Locating and Clearance Policy.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. The following procedure must be followed prior to beginning any excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State “one-call” services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, “one call” systems may still be required to provide location services on military installations.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using such methods as passive and intrusive surveys, physical probing, or hand augering. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in many states, initial excavation is required by hand to a specified depth.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand auger or pole (tile probe) made of non-conductive material. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be

adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

Electromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand-auger Surveys

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings must be hand-augered for all locations where there is a potential to impact buried utilities. The minimum hand-auger depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the

placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand-auger depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs). For augering, the hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand-auger. It is important to note that a post-hole digger must not be used in place of a hand-auger.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand-augers. Tile probes must be performed to the same depth requirements as hand-augers. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify “One Call” service. If possible, arrange for an appointment to show the One Call representative the subsurface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

8.0 REFERENCES

TtNUS Utility Locating and Clearance Policy
TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction
TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys
TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys

ATTACHMENT 1
LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES

ALABAMA
Alabama Line Location (800) 292-8525

Tucson Blue Stake Center (800) 782-5348

Alaska
Locate Call Center of Alaska Inc. (800) 478-3121

Arizona
Arizona Blue Stake Inc. (800) 782-5348

Arkansas
Arkansas One Call System Inc. (800) 482-8998

California
Underground Service Alert North (800) 227-2600

Underground Service Alert South (800) 227-2600

Colorado
Utility Notification Center of Colorado
(800) 922-1987

Connecticut
Call Before You Dig (800) 922-4455

Delaware
Miss Utility of Delmarva
(800) 282-8555

District of Columbia
Miss Utility (800) 257-7777

Florida
Call Sunshine (800) 432-4770

Georgia
Utilities Protection Center Inc.
(800) 282-7411

Idaho
Palouse Empire Underground Coordinating Council
(800) 882-1974

Utilities Underground Location Center
(800) 424-5555

Kootenai Country Utility Coordinating Council
(800) 428-4950

Shoshone County One Call (800) 398-3285

Dig Line (800) 342-1585

One Call Concepts (800) 626-4950

Illinois
Julie Inc. (800) 892-0123

Digger (Chicago Utility Alert Network)
(312) 744-7000

Indiana
Indiana Underground Plant Protection Services
(800) 382-5544

Iowa
Underground Plant Location Service Inc.
(800) 292-8989

Kansas
Kansas One-Call Center (800) 344-7233

Kentucky
Kentucky Underground Protection Inc.
(800) 752-6007

Louisiana
Louisiana One Call (800) 272-3020

Maine
Dig Safe – Maine (800) 225-4977

Maryland
Miss Utility (800) 257-777

Miss Utility of Delmarva (800) 282-8555

Massachusetts
Dig Safe – Massachusetts (800) 322-4844

Michigan
Miss Dig System (800) 482-7171

Minnesota
Gopher State One Call (800) 252-1166

Mississippi
Mississippi One-Call System Inc. (800) 227-6477

Missouri
Missouri One Call System Inc. (800) 344-7483

Montana
Utilities Underground Location Center
(800) 424-5555

Montana One Call Center (800) 551-8344

Nebraska
Diggers Hotline of Nebraska (800) 331-5666

Nevada
Underground Service Alert North (800) 227-2600

New Hampshire
Dig Safe – New Hampshire (800) 225-4977

New Jersey
New Jersey One Call (800) 272-1000

New Mexico
New Mexico One Call System Inc.
(800) 321-ALERT

Las Cruces-Dona Utility Council (505) 526-0400

New York
Underground Facilities Protection Organization
(800) 962-7962

New York City: Long Island One Call Center
(800) 272-4480

North Carolina
The North Carolina One-Call Center Inc.
(800) 632-4949

North Dakota
Utilities Underground Location Center
(800) 795-0555

Ohio
Ohio Utilities Protection Service
(800) 362-2764

Oil & Gas Producers Underground Protection Service
(800) 925-0988

Oklahoma
Call Okie (800) 522-6543

Oregon
Utilities Underground Location Center
(800) 424-5555

Douglas Utilities Coordinating Council
(503) 673-6676

Josephine Utilities Coordinating Council
(503) 476-6676

Rogue Basin Utility Coordinating Council
(503) 779-6676

Utilities Notification Center
(800) 332-2344

Pennsylvania
Pennsylvania One Call System Inc.
(800) 242-1776

Rhode Island
Dig Safe – Rhode Island (800) 225-4977

South Carolina
Palmetto Utility Protection Service Inc.
(800) 922-0983

South Dakota
South Dakota One Call (800) 781-7474

Tennessee
Tennessee One-Call System (800) 351-1111

Texas
Texas One Call System (800) 245-4545

Texas Excavation Safety System (800) 344-8377

Lone Star Notification Center (800) 669-8344

Utah
Blue Stakes Location Center (800) 662-4111

Vermont
Dig Safe – Vermont (800) 225-4977

Virginia
Miss Utility of Virginia (800) 552-7001

Miss Utility (800) 257-7777

Miss Utility of Delmarva (800) 441-8355

Washington
Utilities Underground Location Center
(800) 424-5555

Grays Harbor & Pacific County
Utility Coordinating Council
(206) 535-3550

Utilities County of Cowlitz County
(360) 425-2506

Chelan-Douglas Utilities Coordinating Council
(509) 663-6111

Upper Yakima County
Underground Utilities Council
(800) 553-4344

Inland Empire Utility Coordinating Council
(509) 456-8000

Palouse Empire Utilities Coordinating Council
(800) 822-1974

Utilities Notification Center (800) 332-2344

West Virginia
Miss Utility of West Virginia Inc. (800) 245-4848

Wisconsin
Diggers Hotline Inc. (800) 242-8511

Wyoming
West Park Utility Coordinating Council
(307) 587-4800

Call-In Dig-In Safety Council (800) 300-9811

Fremont County Utility Coordinating Council
(800) 489-8023

Central Wyoming Utilities Coordinating Council
(800) 759-8035

Southwest Wyoming One Call (307) 362-8888

Carbon County Utility
Utility Coordinating Council (307) 324-6666

Albany County Utility Coordinating Council
(307) 742-3615

Southeast Wyoming Utilities Coordinating Council
(307) 638-6666

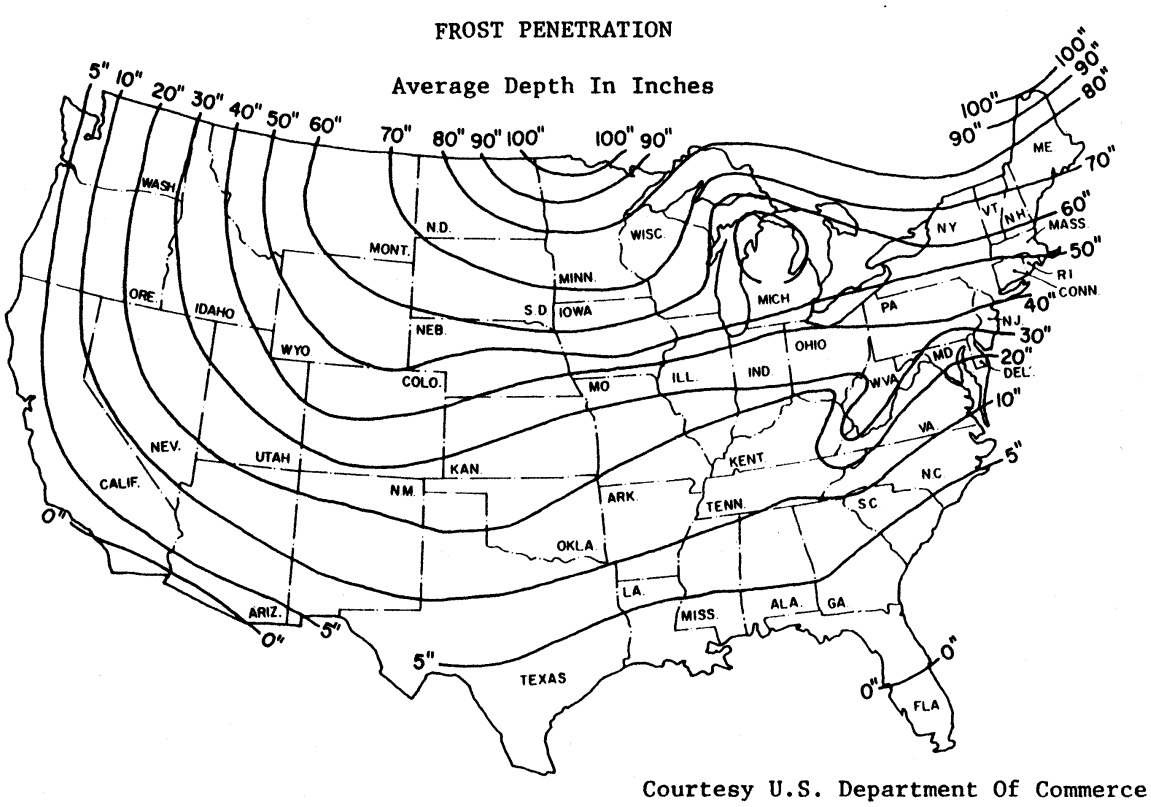
Wyoming One-Call
(800) 348-1030

Utilities Underground Location Center
(800) 454-5555

Converse County Utility Coordination Council
(800) 562-5561

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



ATTACHMENT 3
UTILITY CLEARANCE FORM

Client: _____ Project Name: _____

Project No.: _____ Completed By: _____

Location Name: _____ Work Date: _____

Excavation Method/Overhead Equipment:_____

1. Underground Utilities — Circle One

a)	Review of existing maps?	yes	no	N/A
b)	Interview local personnel?	yes	no	N/A
c)	Site visit and inspection?	yes	no	N/A
d)	Excavation areas marked in the field?	yes	no	N/A
e)	Utilities located in the field?	yes	no	N/A
f)	Located utilities marked/added to site maps?	yes	no	N/A
g)	Client contact notified Name _____ Telephone:_____ Date: _____	yes	no	N/A
g)	State One-Call agency called? Caller: _____ Ticket Number: _____ Date: _____	yes	no	N/A
h)	Geophysical survey performed? Survey performed by:_____ Method: _____ Date: _____	yes	no	N/A
i)	Hand augering performed? Augering completed by:_____ Total depth:_____feet Date: _____	yes	no	N/A
j)	Trench/excavation probed? Probing completed by:_____ Depth/frequency: _____ Date: _____	yes	no	N/A

2. Overhead Utilities — Present Absent

a)	Determination of nominal voltage	yes	no	N/A
b)	Marked on site maps	yes	no	N/A
c)	Necessary to lockout/insulate/re-route	yes	no	N/A
d)	Document procedures used to lockout/insulate/re-route	yes	no	N/A
e)	Minimum acceptable clearance (SOP Section 5.2): _____			

3. Notes:

_____

_____

_____

Approval:

_____ _____

Site Manager/Field Operations Leader Date

c: PM/Project File
Program File

ATTACHMENT III

EQUIPMENT INSPECTION CHECKLIST

EQUIPMENT INSPECTION FOR DRILL RIGS

COMPANY:_____ **UNIT NO.**_____

FREQUENCY: Inspect at the initiation of the project, after repairs, once every 10-day shift.

Inspection Date: ____/____/____ Time: _____ Equipment Type:_____

(e.g., **Drill Rigs** Hollow Stem, Mud Rotary, Direct Push)

	Good	Need Repair	N/A
Emergency Stop Devices (At points of operation)	❒	❒	❒
Tires (Tread) 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	❒	❒	❒
Mast condition (Mast Height_____)	❒	❒	❒
Access-ways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
➢ Hooks			
- Safety Latch	❒	❒	❒
- Wear in excess of 10% original dimension	❒	❒	❒
- A bend or twist exceeding 10% from the plane of an unbent hook	❒	❒	❒
- Increase in throat opening exceeding 15% from new condition	❒	❒	❒
- Excessive nicks and/or gouges	❒	❒	❒
➢ Wire Rope (Hoist Mechanism)			
- Reduction in Rope diameter (5/16 wire rope>1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope>1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope>3/64 reduction nominal size-replace)	❒	❒	❒
- Number of broken wires (12 randomly broken wires in one rope lay) (4 broken wires in one strand)	❒	❒	❒
- Number of wire rope wraps left on the Running Drum at nominal use ($\geq$3 required)	❒	❒	❒
- Lead (primary) sheave is centered on the running drum	❒	❒	❒
- Lubrication of wire rope (adequate?)	❒	❒	❒

	Good	Needs Repaired	N/A
- Number of U-Type (Crosby) Clips (5/16 – 5/8 = 3 clips minimum) (3/4 – 1 inch = 4 clips minimum) (1 1/8 – 1 3/8 inch = 5 clips minimum)	❒	❒	❒
➢ Kinks, bends – Flattened to > 50% diameter	❒	❒	❒
➢ Hemp/Fiber rope (Cathead/Split Spoon Hammer)			
- Minimum ¾;maximum 1inch rope diameter (Inspect for physical damage)	❒	❒	❒
- Rope to hammer is securely fastened	❒	❒	❒

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?_____	❒	❒
Are any structural members bent, rusted, or otherwise show signs of damage?_____	❒	❒
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?_____	❒	❒

Cleanliness:

Overall condition (was 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?_____
Flammable solvents stored in the operators cab?_____

Operator Qualifications (as applicable for all heavy equipment):

Does the operator have proper licensing where applicable, (e.g., CDL)?_____
Does the operator, understand the equipment's operating instructions?_____
Is the operator experienced with this equipment? _____
Is the operator 21 years of age or more?_____

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:_____

Site Safety Officer Signature:_____

Approved for Use: ❒ Yes ❒ No

ATTACHMENT IV

SAFE WORK PERMITS

SAFE WORK PERMIT
DECONTAMINATION ACTIVITIES
NAS JACKSONVILLE, FLORIDA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Decontamination of sampling equipment and machinery (i.e., drill rigs, augers). Brushes and spray bottles will be used to decon small sampling equipment. Pressure washers or steam cleaning units will be used to decon the augers and drilling.

II. Required Monitoring Instrument(s): PID with 10.6 eV (or higher) lamp source (used to screen equipment)

III. Field Crew: _____

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector _____ _____
TtNUS

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: Minimum requirement include sleeved shirt and long pants, safety glasses, safety footwear, and nitrile gloves. When using pressure washers, steam cleaners field crews will wear hearing protection, and face shields.

V. Chemicals of Concern	Action Level(s)	Response Measures
Beryllium, lead, traces of VOC's and SVOC's	Elevated readings are not anticipated to be encountered	If airborne readings are observed, report to an unaffected area

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 - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: PVC rain suits or PE or PVC coated Tyvek for protection against splashes and overspray. Chemical resistant boot covers if excessive liquids are generated or to protected footwear.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☒	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☒	Assembly points	☒	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☒
Physical Hazards Barricaded and Isolated	☐	☐	☒
Emergency Equipment Staged	☐	☐	☒

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: Chemical hazards with decontamination because of use of fluids such as isopropyl alcohol, methanol, etc. To minimize the potential for exposure, site personnel will use PPE and prevent contact with potentially contaminated equipment. Refer to the manufacturer's MSDS regarding PPE, handling, storage, and first-aid measures related to decontamination fluids.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
MOBILIZATION AND DEMOBILIZATION ACTIVITIES
NAS JACKSONVILLE, FLORIDA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Mobilization and demobilization activities.

II. Required Monitoring Instruments: None

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

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: Minimum requirement include sleeved shirt and long pants and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment. Safety glasses will be worn when required.

V.

Chemicals of Concern	Action Level(s)	Response Measures
None anticipated given the		
nature of surveying activities		
and limited contact w/ media.		

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 - Nitrile)	☐ Yes	☒ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Tyvek coverall to protect against natural hazards (e.g., ticks). If working in areas where snakes are a threat, wear snake chaps to protect against bites.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☒	Assembly points	☒	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☒
Physical Hazards Barricaded and Isolated	☐	☐	☒
Emergency Equipment Staged	☐	☐	☒

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: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Avoid potential nesting areas. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Inspect clothing and body for ticks. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
MULTI-MEDIA SAMPLING
NAS JACKSONVILLE, FLORIDA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Multi media sampling including soils (surface and sub surface); sediments; groundwater and IDW.

II. Required Monitoring Instrument(s): PID with 10.6 eV (or higher) lamp source

III. Field Crew: _____

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector _____ _____
TtNUS

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: Minimum requirement include sleeved shirt and long pants, safety footwear, safety glasses and nitrile gloves. Hard hats and hearing protection will be worn when working near operating equipment and or when required by the facility.

V. Chemicals of Concern	Action Level(s)	Response Measures
Beryllium, lead, traces of VOC's and SVOC's	Any sustained readings above 5 ppm in worker breathing zones.	Suspend site activities and report to an unaffected area until readings are below 5 ppm

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 - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Tyvek coverall if there is a potential for soiling work cloths and PVC or PE coated Tyvek if saturation or work cloths may occur.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☒	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☒	Assembly points	☒	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☒	☐	☐
Physical Hazards Barricaded and Isolated	☒	☐	☐
Emergency Equipment Staged	☒	☐	☐

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: _____

SAFE WORK PERMIT
SOIL BORING AND SUBSURFACE SOIL SAMPLING OPERATIONS
NAS JACKSONVILLE, FLORIDA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Subsurface soil sample collected via HSA and DPT.

II. Required Monitoring Instruments: PID with 10.6 eV (or higher) lamp source

III. Field Crew: _____

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector _____ _____
TtNUS

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	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves. Safety glasses, hard hats, and hearing protection will be worn when working near or sampling in the vicinity of the drill rigor other operating equipment.

V.

Chemicals of Concern	Action Level(s)	Response Measures
Beryllium, lead, traces of VOCs, SVOCs	Any sustained readings above 5 ppm in worker breathing zones.	Suspend site activities and report to an unaffected area. Until reading return to below 5 ppm

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 - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall if there is a potential for soiling work cloths. PVC or PE coated Tyvek if saturation or work cloths may occur.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☒	☐	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☒	☐	Assembly points	☒	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☒	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☒	☐	☐
Physical Hazards Barricaded and Isolated	☒	☐	☐
Emergency Equipment Staged	☒	☐	☐

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: Anything suspected of being UXO will be avoided and reported to the UXO specialist and/or the site contact. Avoid generating any airborne dusts.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT FOR
SURVEYING ACTIVITIES AT
NAS JACKSONVILLE, FLORIDA

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Geographical Surveying

II. Required Monitoring Instruments: None

III. Field Crew: _____

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector _____ _____
TtNUS

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	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements include sleeved shirt and long pants and safety footwear.(except for magnetometer, geophysical surveys) Safety glasses, hard hats, and hearing protection will be worn when working near operating equipment.

V.

Chemicals of Concern	Action Level(s)	Response Measures
None anticipated given the	None	
nature of surveying activities		
and limited contact w/ media.		

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 - Work)	☒ Yes	☐ No
Steel toe Work shoes or boots	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Tyvek coverall to protect against natural hazards (e.g., ticks). If working in areas where snakes are a threat, wear snake chaps to protect against bites.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☒	Assembly points	☒	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☒
Physical Hazards Barricaded and Isolated	☐	☐	☒
Emergency Equipment Staged	☐	☐	☒

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: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Avoid potential nesting areas. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Inspect clothing and body for ticks. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather.

Permit Issued by:_____ Permit Accepted by:_____

ATTACHMENT V

MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in a central location during the execution of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next Kin _____

Drug or other Allergies _____

Particular Sensitivities _____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals _____

_____

_____

What medications are you presently using? _____

_____

_____

Do you have any medical restrictions? _____

_____

_____

Name, Address, and Phone Number of personal physician: _____

_____

_____

_____

I am the individual described above. I have read and understand this HASP.

_____ _____

Signature Date

ATTACHMENT VI

HEARING CONSERVATION PROGRAM

HEARING CONSERVATION PROGRAM

1.0 PROGRAM OBJECTIVE

To protect Tetra Tech NUS and Subcontractor employees from the harmful effects of exposure to excessive noise levels. Excessive noise in this case will be considered employee noise exposures at or above an 8-hour Time Weighted Average (TWA) of 85 decibels measured on the A-Weighted scale.

This objective will be accomplished through

- Establishing administrative and site-specific hearing conservation procedures and guidelines for employees.
- Audiometric testing of affected employees.
- Site specific monitoring of representative job classifications and operations to determine noise levels and appropriate protective measures.
- Establishment of procedures and guidelines for the selection care and use of hearing protection.
- Warning signs and information.
- Training.

This Hearing Conservation Program (HCP) is divided into two sections. The first section presents the responsibilities of individuals associated with this program and a description of the program's key elements. The second section provides a fill-in the blank tool that is to be used to implement a site-specific HCP on projects where noise exposure is a concern. This second section is presented in Attachment A and must be completed by the Site Safety Officer (SSO) or the Field Operations Leader (FOL) on projects where noise exposure is a recognized potential hazard. The completed fill-in the blank portion, administrative guidelines, and a copy of 29 CFR 1910.95 must be on-site and available to site personnel to ensure regulatory compliance.

2.0 SCOPE

This program applies to all Tetra Tech NUS operations and other support activities where exposure above specified action levels may occur. This program has been developed to comply with OSHA General Industry Standard 29 CFR 1910.95 (Occupational Noise Exposure, retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html).

3.0 RESPONSIBILITIES

Corporate Health and Safety Manager (HSM): Serve as HCP Administrator and provide technical management and oversight of this program, as well as technical support to aid all Tetra Tech NUS office locations in effectively implementing these requirements. The HSM is also responsible for monitoring the overall effectiveness of this program. This will be accomplished by:

- Periodically reviewing random completed Sound Level Measurement and/or Noise Dosimetry Logs.
- Performing field audits of select project sites where the HCP elements are implemented.
- Eliciting feedback from office health and safety Points of Contact.
- Modifying elements of this program, when or as appropriate.
- Establishing minimum components and content of the HCP training course material.
- Maintaining appropriate record-keeping for this program.
- Regularly communicating with Tetra Tech, Inc. Corporate Health and Safety, to satisfy overall company requirements.

Project Health and Safety Officer (PHSO) - The PHSO shall ensure that hearing conservation measures are adequately addressed in the Site Specific Health and Safety Plan for assigned projects. In addition, it is the PHSO's responsibility to provide technical assistance to the Site Safety Officer and/or the Field Operations Leader.

Site Safety Officer (SSO) - The SSO will serve as the Site HCP Administrator and is responsible for the implementation of this HCP at project specific locations. This activity may also include on-site evaluations of noise levels. The SSO shall be responsible for the enforcement of the elements of this program to prevent excessive exposure to high levels of noise.

Field Operations Leader (FOL) – The FOL will share responsibility with the SSO or in the absence of an SSO ensure the implementation of this program for all operations conducted under their direction employing hearing protection.

Project Manager (PM)/Task Order Manager(TOM) - The PM/TOM is also ultimately responsible for the effective compliance with these requirements. The PM/TOM will ensure that sufficient information has been provided to the PHSO to develop a site-specific HCP appropriate for the nature of the planned activities. This is to be accomplished in conjunction with the preparation of the site-specific Health and Safety Plan (HASP).

Tetra Tech NUS Employees - The employees are responsible for following the tenets of this hearing conservation program and/or conditions or modifications of this program, that may be site-specific in nature. In addition the employees are responsible for reporting any deficiencies or inadequacies of these program or site-specific elements to the SSO and/or the FOL.

4.0 NOISE LEVEL MONITORING

Noise level monitoring will be accomplished using quantitative and qualitative principles to determine potential high noise areas. Quantitative monitoring will be accomplished using portable sound level survey meters and noise dosimeters. The monitoring results will be used for the following purposes:

- Identifying and defining high operational noise areas and high noise job classifications.
- Identification of personnel for inclusion into the Site-Specific HCP.
- Determining employee exposure to noise.

In addition, qualitative monitoring of work areas may be employed by the FOL and/or SSO or field personnel to determine approximate noise level conditions and the need for hearing protection. This involves observing a common simple rule of thumb. This rule of thumb is that, if you must raise your voice to be heard by someone who is standing within arm's length of you to be heard, then noise levels are likely to exceed 85 dBA. Therefore, hearing protection would be required. This rule of thumb may be used for short duration or intermittent activities, or for activities which have been previously quantified.

Quantitative monitoring may be performed for longer-term projects or for tasks that have not been previously characterized. This will be performed using a sound level meter (SLM), noise dosimeters, or both.

Representative data may be used when appropriate from one project to the next to preclude the necessity to monitor similar tasks and activities .

4.1.1 Noise Level Monitoring Data Accumulation and Recordkeeping

The Sound Level Measurement Log and the Noise Dosimetry Log provided in Attachment A will be completed to document quantitative measurements recorded on-site. Upon completion copies of these documents will be

1. Attached to their applicable Safe Work Permits
2. Forwarded to the PHSO for review

Direction for the completion of these documents will be provided through the site-specific HASP. If information is not requested it may be assumed that quantitative measurements for the operations in question are not necessary, or that representative data already exists.

4.1.2 Noise Monitoring Frequency

Depending on the nature of planned operations, the SSO and/or the FOL, may be tasked to perform an initial noise survey on Tetra Tech NUS and subcontractors operations and work areas by the use of a sound level meter and/or noise dosimeters.

Repeat noise monitoring will be conducted should operations, productions, or processes change which could impact noise levels that are generated.

4.2 Health and Safety Plan (HASP)

The HASP will set policy on mandatory use of hearing protection in affected areas, and while performing certain operations such as drilling, excavation, operation of motorized and electrical hand tools and equipment, and/or other activities that can be anticipated to generate excessive noise levels. The FOL and/or SSO will notify all Tetra Tech NUS and subcontractor personnel of high noise areas and operations, prior to work initiation. Notification of these personnel will take place in the following manner:

- Site-specific training – Review of the scope of work inherent hazards and control measures to be employed to minimize the effects of these hazards.

- Personnel will be notified through issuance of the Safe Work Permit.

- Information concerning hearing protection for operations not conducted under a Safe Work Permit will be conveyed verbally and documented within the project logbook.

- Information on high noise areas and hearing protection requirements is most effectively conveyed to Tetra Tech NUS and subcontractor personnel through the use of signs. The FOL and/or the SSO will post or otherwise identify areas of operations that exceed 85 dBA. If significant changes in noise levels occur (such as a shutdown or modification of an operating unit), the noise levels shall be re-evaluated by the SSO and/or the FOL to determine hearing protection needs.

5.0 HEARING PROTECTION

The following information establishes responsibility for the acquisition, selection, dispersal, training, care, storage and use, and evaluation of hearing protection.

5.1 Acquisition

When engineering and/or administrative controls are not feasible to control noise levels, hearing protection will be required. These hearing protection devices will be provided to employees

- Who may be exposed to noise levels in excess of 85 dBA.
- Employees who have not yet had a baseline audiogram.
- Employees who have experienced a >10 dB Standard Threshold Shift (STS) at frequencies of 2,000, 3,000, or 4,000 hertz range in either ear.

The FOL will arrange for hearing protection in the following manner

- Complete an Equipment Requisition indicating the types of hearing protection required and amounts. Remember additional quantities of protective devices may be required for site visitors. Approved site visitors should be equipped to the same level of protection as field personnel.

- When arranging for hearing protection device purchases through procurement the following actions should be taken

    1. Contact the PHSO for assistance in identifying the appropriate hearing protection types and performance criteria.

    2. Complete a Material Requisition sheet describing the type, attenuation capabilities, and quantities required.

    3. Turn in the completed Material Requisition to the Contract Procurement Officer.

5.2 Selection/Dispersal

Employees will be provided with a variety of hearing protection devices to choose from. They will select from these hearing protection devices, unless specific medical restrictions and/or qualifications have been established through the medical surveillance program. All hearing devices made available and approved for use will provide attenuation to lower noise exposures to no more than an 8-Hour TWA of 85 dBA.

The SSO and/or the PHSO will evaluate the attenuation factors of hearing protection devices and may modify selections based on sound level monitoring or personal dosimetry results. These completed documents are to be copied and forwarded to the PHSO upon completion.

The FOL and/or the SSO will be responsible for ensuring adequate stock of hearing protection is maintained and available at the project site for employees and approved site visitors.

Hearing protectors shall be replaced as necessary (per the manufacturer's recommendation).

Employees will be responsible for the care, cleaning, storage, and inspection of hearing protection issued.

5.3 Training

The Health Sciences Group will institute and maintain a training program in support of the HCP covering the following subject matter

- The elements of this HCP
- The mechanism of hearing
- The deleterious effects of excessive noise on hearing
- Medical surveillance of the participants of this program (i.e., audiometric testing).
- Controlling excessive noise through engineering, administrative, and Personal Protective Equipment (PPE)
- PPE – Types, selection, limitations and advantages
- Use, care, and storage of hearing protective devices
- Noise monitoring methodologies and reporting
- Record-keeping – Documentation, retention, and access

Training will be provided to all effected employees through mechanisms including, but not limited to, 40-Hour Hazardous Waste Site General Site Worker Training, 8-Hour Hazardous Waste Site General Site Worker Refresher Training, 8-Hour Management/Supervisory Training, annual Hearing Conservation Program refresher, and Project or Site-Specific training. In addition, training materials may be obtained from the HSM.

Note: Course curriculum for training obtained from outside vendors must be approved by the HSM.

5.4 Care

Individuals issued reusable hearing protection such as earmuffs and plugs will be responsible for the care and of those devices. This includes the removal of any debris using a light detergent with a water rinse, or as directed using manufacturer's instructions.

Disposable plugs are to be disposed of after each use.

5.5 Storage

Hearing protection approved for use will be stored in their individual manufacturer supplied packaging. When this is not possible, storage within suitable containers such as Ziplock bags after cleaning and drying is acceptable.

Hearing protective devices should be stored to

- Prevent distortion
- Prevent contact from chemicals and/or contaminants
- Away from direct sunlight and heat sources which may cause photolytic or thermal degradation

5.6 Use

Hearing protection shall be used in accordance with the employee's training, and as directed within the HASP, Safe Work Permits, as directed by signs, or as directed by the FOL and/or the SSO. Failure to comply with these requirements will result in disciplinary action. The FOL and/or the SSO are responsible for the enforcing the use of hearing protection at project specific locations.

5.7 Evaluation

The elements of this hearing conservation program and the implementation at project sites will be evaluated periodically through the existing health and safety audit function under the direction of the Health and Safety Manager. In addition to this function the program will be evaluated under the following conditions

- STS is indicated within a protected body of employees.
- Normal auditing procedures indicate discrepancies within the implementation of the HCP.

6.0 RECORD KEEPING

The following records will be maintained in support of this HCP

- Exposure measurements - This includes Sound Level Measurement Logs and/or the Noise Dosimetry Logs, and related records. Copies will be kept at the site while the originals are forwarded to the

PHSO for review and record retention in the project file. Exposure measurement records will be maintained for a minimum of two years.

- Audiometric Testing Records – These records are maintained as part of the medical surveillance program and all employees who receive an audiogram will be provided a written copy of the results. These records will be retained the duration of the effected employees employment.

- Training Records – Training records for the 40-Hour, 8-Hour Refresher, 8-Hour Management/Supervisory course content is maintained by the HSM and at the project level. The FOL and/or the SSO will be responsible for obtaining from identified field personnel certificates of the most recent successful completion of these courses to be maintained at the site. Site-specific training concerning the elements of this HCP will be maintained at the project site.

Record retention will be performed in accordance with the time periods stated in 29 CFR 1910.95 (retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html and 1910.1020 http://www.osha-slc.gov/OshStd_data/1910_1020.html).

7.0 AUDIOMETRIC TESTING

Audiometric testing will be performed on all participants of this HCP based on measured or anticipated noise levels that they may be exposed. The purpose of this testing will be as follows

- Establish an initial or revised baseline audiogram, as applicable, of the participant's current hearing condition.
- Repeat audiograms, in order to track any changes within the participants hearing measured under the baseline examination.
- Provide a mechanism for exit audiograms for personnel leaving the employment of Tetra Tech NUS, or a change in job duties where participation in the HCP is no longer necessary.

These audiograms and documentation pertaining to these tests are administered and maintained under the Tetra Tech NUS Medical Surveillance Program.

ATTACHMENT A

WORK SITE
HEARING CONSERVATION PROGRAM

HEARING CONSERVATION PROGRAM

The following information pertaining to the use of hearing protection is to be completed by the Site Safety Officer (SSO), their duly appointed representative, or the Field Operations Leader (FOL). This work site portion of the Hearing Conservation Program (HCP) will be completed only if hearing protection is to be used in the completion of the assigned tasks as identified per the scope of work, in the work plan, the health and safety plan, bid specifications, or as determined through hazard assessment of the tasks and potential hazards which may be involved. Upon completion of the site-specific elements of this HCP, the Sound Level Measurement Log and/or the Noise Dosimetry Log should be copied and attached to the Safe Work Permit(s) for each activity directed by the HASP to be monitored. Permits and logs should then be forwarded to the Project Health and Safety Officer (PHSO) for evaluation.

Personnel Responsible For Program Completion

The following persons are available to provide assistance in all elements of this program including question/conflict resolution and modification variances. These persons exercise the primary responsibility for the implementation of this site-specific program.

I) **Site Safety Officer (Site HCP Administrator):**_____**Phone #:**_____

Field Operations Leader: _____**Phone #:**_____

Project Health and Safety Officer:_____**Phone #:**_____

Health and Safety Manager: _____**Phone #:**_____

Personnel Who (by Way of Assignment) Will Wear Hearing Protection

The following list represents TtNUS or subcontractor personnel working under the provisions of this HCP. The persons listed below are included in this site-specific HCP and are required to wear hearing protection when performing tasks producing excessive noise.

II)

Personnel	Make/Model of Hearing Protective Devices to be used	Hearing Protection Noise Reduction Rating (NRR #)

III) **<u>Noise Evaluation Technique or Quantitative Noise Evaluations</u>**

Noise level monitoring performed on-site will be done to quantify noise levels generated during certain operations. Documentation of these measurements will be performed using either the Sound Level Measurement Log or the Noise Dosimetry Log provided in Figure 1 and Figure 2.

<u>The Sound Level Monitoring</u>

Sound level measurements can be used in establishing noise levels for persons working within the exclusion zone. Sound level monitoring will be performed using a Type II Sound Level Meter (SLM) set on the A-Weighted scale and on the SLOW response setting. This type of SLM survey is necessary when the general rule of thumb for noise levels is exceeded, in order to determine if hearing conservation is an issue, and if so, to set the boundaries for where hearing protection will be required. SLM surveys are also used to identify areas or operations where more specific noise exposure evaluations (using noise dosimetry) are appropriate.

GENERAL RULE OF THUMB FOR DETERMINING THAT NOISE LEVELS MAY BE EXCESSIVE

> *If noise levels are loud enough that you need to raise your voice in order to communicate with another person who is within two feet of you, then noise levels may be excessive. In this case, hearing conservation issues must be considered and hearing protection must be used until and unless sound level monitoring or noise dosimetry indicate that it is not necessary.*

To perform a SLM survey, first make sure that the SLM is on the proper settings as noted above, and ensure that it is properly calibrated in accordance with the manufacturer's instructions. Then, take **at least 3 random readings at each location** starting at the spot where the noise source is loudest and working your way away from the noise source, until you have readings that are below an average of 85 decibels on the A-weighted scale (dBA). You should position the SLM so that it is pointing perpendicular to the noise source (do not point the microphone directly at the noise source. This can result in inaccurate readings). "Random readings" means that you should hold the SLM in place and occasionally glance at the readout and record the reading that you see. You should <u>not</u> watch the readout and record the highest peak reading that you see. Pay particular attention to taking readings at any employee or subcontractor employee typical work locations (such as at the controls of a drill rig, at the area where samples are taken, etc.). Record your readings on a draft sketch of the work area (or on a floorplan if working inside of a building).

After you have taken enough readings to adequately characterize the work area, post calibrate the SLM and record the distance from the noise source where the average of the 3 readings was no more than 85 dBA (using Figure 1). All areas inside of the 85 dBA boundary line are to be designated as requiring hearing protection, and this must be communicated to all members of the field team. This can be accomplished by placing appropriate signs at the boundary line, posting Figure 1 at the work area, and by reviewing Figure 1 with the field team as part of a daily tailgate meeting or Safe Work Permit review.

Also, areas where average sound levels are 85 dBA or greater should be brought to the attention of the PHSO for considerations for noise dosimetry.

The Sound Level Measurement Log will be used in the following circumstances

- Setting exclusion zone boundaries based on noise levels generated.
- Establishing noise contours surrounding operations.

Noise Dosimetry Log

Noise dosimetry is used to accurately characterize the noise exposure that a person actually experiences during a working period. Dosimetry is much simpler to perform than a SLM survey, but it does involve the participation and cooperation of more people (namely, the workers who will wear the dosimeters). As with the use of any instrumentation, you need to closely follow the recommendations of the dosimeter manufacturer. Complete a Noise Dosimetry Log (Figure 2) for each dosimetry evaluation. In general, make sure that each dosimeter is properly calibrated before use, then attach the device to the worker so that the microphone is near the area of their head (i.e., at the collar). The worker should wear the device for the entire day, including breaks, and you should periodically check the device and record any notations

of activities performed during the shift, using the Worker Activity Log in Figure 3. At the end of the shift, remove the dosimeter from the worker and post-calibrate it.

Noise Monitoring Results - Notification

The results of the noise monitoring (Sound Level Measurement Log and/or the Noise Dosimetry Log) will be copied and attached to the applicable Safe Work Permit(s). Copies of these documents will be forwarded to the PHSO for evaluation. In addition, a copy or the original shall be posted to inform personnel involved in the test as to the results. The SSO will also provide a narrative of the results to all personnel and subcontractor personnel who wish further explanation.

Calibration

All instruments used for sound level measurements and noise dosimetry will require calibration prior to use. All calibration will proceed as per manufacturer's instructions provided with the instruments. Information required for calibration is provided on the Sound Level and Noise Dosimetry Logs. Pre-and post-calibrations must be performed and recorded for all noise evaluations performed.

IIIA) Sound Level Measurement Log

The Sound Level Measurement Log (Figure 1) is to be used as a general record for sound level measurements recorded during operations. The diagram of the work area is to be completed by the SSO and/or the FOL. Information should include operator/helpers positions, support functions (sample tables, etc.), and noise measurements along the contours provided below. When designating the 85 dBA boundary line, make the approximate distance from the noise source so that it is clearly evident to site personnel where hearing protection is needed. A better approach would be to put signs in place where noise levels are above 85 dBA that hearing protection is required in this area. The contours provided below are set at ten feet intervals from the center, if alternate distances are desired indicate as such on the contour boundaries.

FIGURE 1

SOUND LEVEL MEASUREMENT LOG

Date of Survey	Location of Survey	Surveyed By
Sound Level Meter(Type)	Model #	Serial #
Calibration Date	Calibrated By	
Pre-Calibration Reading	Post-Calibration Reading	

Activity Being Conducted:_____

_____

Equipment Used:_____

Duration of Activity:_____

Hearing Protection Used?_____Type:_____NRR:_____

Comments:_____

_____

IIIB) NOISE DOSIMETRY LOG (FIGURE 2)

This log will be employed when conducting Noise Dosimetry of operations or job classifications. This log contains the necessary information queues for worker information as well as calibration of the noise dosimeters to insure complete documentation. On the reverse side a running log of worker activity is provided. Upon completion of this log, a copy should be made for the file on site, and the original sent to the PHSO for evaluation.

NOISE DOSIMETRY LOG

DATE OF SAMPLE:_____

Individuals conducting the dosimetry initials below indicate that noise dosimeter(s) were calibrated, and the unit(s) test parameters verified, prior to sampling:

_____ 90 dB Criterion

_____ 5 dB Exchange

_____ 80 dB Cut-off Threshold

_____ Pre-sample Calibration @ _____dBA

_____ Post-sample Calibration @____dBA

Calibrator:_____

Type of Noise Dosimeter employed:_____

Worker Sampled:_____Dosimeter Identification No._____

S.S. Number:_____

Job Classification:_____

Job/Task being performed:_____

Equipment/Tools used:_____

Type of Hearing Protection Employed:_____ Noise Reduction Rating:_____

Representative Exposure: _____ _____ _____

For: _____ _____ _____

Start-time: ___:___ Lmax._____ Lavg._____ Lpk._____

Stop-time: ___:___

Elapsed-time: ___:___ Dose: _____% Projected Dose: _____%

Comments:_____

_____

_____

_____ _____

Supervisor in Charge SSO and/or FOL

ALSO COMPLETE WORKER ACTIVITY LOG ON REVERSE SIDE

FIGURE 3

WORKER ACTIVITY LOG

TEST HOUR	TASK(S)	*	LOCATION(S)
1			
2			
3			
4			
5			
6			
7			
8			

IV) Audiometric Testing

Audiometric testing is a standard part of the examination protocol in the Tetra Tech NUS Medical Surveillance Program. If based on scope of work, personnel or subcontractor personnel are required to wear hearing protection as part of their task assignment, it will be the SSO's or the FOL's responsibility to inquire whether their medical evaluation included audiometric testing. At all Tetra Tech NUS, Inc. project sites where hearing protection is required it is imperative that personnel be in a program of audiometric testing. For those who have not had even an initial (or baseline) evaluation, hearing protection will be required if Time-weighted are 8 hour exposure > 85 dBA.

V) Information Access

The implementation of this HCP requires information be made available to the participants of this program. Information to be made available include the following:

- Code of Federal Regulations, Subsection 1910.95 - This standard shall be posted on site accessible to all personnel. (retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html).

- Monitoring Results – Information concerning quantitative monitoring will be posted accessible to all site personnel.

- Informational materials pertaining to the standard supplied to the employer by the Department of Labor.

IV) Record-Keeping

The following information will be maintained at the project site by the SSO and/or the FOL during the course of on-site activities.

- Exposure monitoring documentation (Sound Level Measurement and Noise Dosimetry Logs shall be maintained with the applicable Safe Work Permit). This information at project completion will be maintained in the project files for a period of no less than two years.

- Medical Surveillance information – Information concerning the individual's fitness for duty should include a declaration that the medical evaluation included establishing a baseline quantification of that persons hearing capabilities.

- Training – On project sites where noise is recognized as a potential hazard (either in the HASP, by following the general rule-of-thumb, or as a result of noise monitoring), hearing conservation training must be provided to al personnel working in these areas. This can be accomplished using Attachment 2.. If training is provided, in part or in whole regarding the subject matter minimum content documentation should be provided attesting to such.

ATTACHMENT VII

FIRE EXTINGUISHER
USE AND INSPECTION

FIRE EXTINGUISHER

USE AND INSPECTION

Fire Extinguisher Use and Inspection procedures will be conducted in support of the activities to be conducted at NCBC Gulfport. The following text is intended to provide general instruction to the field personnel charged with this responsibility.

Fire Extinguisher Use

All personnel trained in incidental response measures may be required to use and operate a fire extinguisher in response to an incipient stage fire. Therefore, the following instruction is provided and will be conveyed to all field personnel as part of site-specific training.

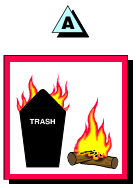
To use a portable fire extinguisher, the user should be familiar with the operation of the specific fire extinguisher located in the workplace. The following procedure will properly extinguish a small fire.

1) IDENTIFY THE TYPE OF FIRE (CLASS A, B, C, D).

CLASSES OF FIRE/FIRE EXTINGUISHER IDENTIFICATION

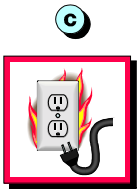
Fire is divided into four classes for easy identification and extinguishment. The type of fuel or ignition source will determine the type of extinguishing medium required.

Class A - Ordinary combustibles (wood, paper, rubber, plastic, and cloth). Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle is green.



Class B - Flammable liquids, gases, and greases. Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square is red. <u>This type of extinguisher is effective on small petroleum product fires</u>.

Class C - Electrically energized systems. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle is blue.



Class D - Combustible metals (sodium, magnesium, phosphorus). Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star is yellow.

<u>Note: Water and other extinguishing media, such as carbon dioxide and dry chemicals, are ineffective on metal fires.</u>

Class A, B, C

Class B, C

Class A, B

Class A

Mutli-class (ABC) Fire extinguishers will be provided for use on site. If you will buy a Fire Extinguisher, this is the type recommended. Size or rating recommended is 2 1/2 to 5 lbs.

1. Determine whether the extinguisher is adequate for this fire.

Rating number – The rating number assigned to a fire extinguisher is based on the capabilities of that fire class, for example
Class 5 A – Will provide extinguishing capabilities equal to that of 5 gallons of water.
Class 20 B - Will provide extinguishing capabilities equal to 20 square feet of flammable liquid burning.
Class C & D are not rated as to their limitations.

2. If adequate, hold the extinguisher upright and pull the ring pin.
3. Stand back 10 feet and aim at base of fire. Be careful not to spread burning material with pressurized extinguishing material.
4. Squeeze lever; sweep extinguisher in a side-to-side motion.

Portable Fire Extinguisher Placement/Mounting

Portable Fire Extinguishers will be placed/mounted in clear view in the areas where flammable materials are stored and/or dispensed. Mounting and placement of fire extinguishers will follow the following requirements

Fixed Locations (Flammable Storage)

- Extinguisher location will be marked by a red painted post to indicate extinguisher location
- The travel distance to access a fire extinguisher shall be no greater than 50 feet.
- The fire extinguisher will be mounted at a maximum height of four feet.

Mobile Locations (Drill Rigs, Support Vehicles)

All vehicles carrying fuel containers or used in the dispensing of fuel will carry at a minimum a 5 pound rated fire extinguisher.

Portable Fire Extinguisher Inspection

All fire extinguishers used in support of this field effort will be inspected on the following frequencies:

- A certified provider will perform maintenance checks of fire extinguishers at least once a year. A tag attached to the neck of the fire extinguisher will indicate documentation of the maintenance check.

- All fire extinguishers will have a current hydrostatic inspection. For the type of extinguishers selected for use at NCBC Gulfport hydrostatic inspections are required every 5 years.

- All fire extinguishers will be inspected monthly. The monthly inspection will cover the following
  - Are the fire extinguisher(s) placed in their designated location(s)?
  - Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?
  - Is the access impeding travel to the fire extinguisher blocked or restricted in any way?
  - Has the fire extinguisher been partially or completely discharged?
  - Is there signs of obvious physical damage?
  - Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?

This inspection shall be documented on the attached tag provided by the maintenance/hydrostatic inspection service.

FIRE EXTINGUISHER CHECKLIST

NAS JACKSONVILLE

Project Name: NCBC Gulfport	**CTO 0143**	**Date of Inspection:**_____
Fire Extinguisher Identification Number:_____		**Fire Extinguisher Location:** _____

Measurement Criteria	**Yes**	**No**	**N/A**	**Needs Repaired**
Are the fire extinguisher(s) placed in their designated location(s)?				
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?				
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?				
Has the fire extinguisher been partially or completely discharged?				
Is there signs of obvious physical damage?				
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?				

Project Name: NCBC Gulfport	**CTO 0143**	**Date of Inspection:**_____
Fire Extinguisher Identification Number:_____		**Fire Extinguisher Location:** _____

Measurement Criteria	**Yes**	**No**	**N/A**	**Needs Repaired**
ARE THE FIRE EXTINGUISHER(S) PLACED IN THEIR DESIGNATED LOCATION(S)?				
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?				
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?				
Has the fire extinguisher been partially or completely discharged?				
Is there signs of obvious physical damage?				
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?				

APPENDIX C

Quality Assurance Project Plan for Remedial Investigation and Feasibility Study for the Defense Reutilization and Marketing Office, Naval Air Station Jacksonville, Jacksonville, Florida, January 2001

QUALITY ASSURANCE PROJECT PLAN
FOR REMEDIAL INVESTIGATION AND FEASABILITY STUDY
DEFENSE REUTILIZATION AND MARKETING OFFICE YARD (DRMO)
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
7018 A.C. Skinner Parkway, Suite 250
Jacksonville, Florida 32256
904.281.0400

Anthony Robinson – Engineer-in-Charge
Department of the Navy – Southern Division
1/10/01
Date

Mark Peterson, P.G. – Task Order Manager
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1/10/01
Date

Paul Frank – QA Manager
Tetra Tech NUS, Inc.
1-19-01
Date

Deborah McGrath – Laboratory Director
Katahdin Analytical Services
1/22/01
Date

Deborah Nadeau – Laboratory Quality Assurance Officer
Katahdin Analytical Services
1·22·01
Date

Linda Freeman – Laboratory Director
Air Toxics, LTD
Date

DEP Form 62-160.900(1) (Revised 1-92)

QUALITY ASSURANCE PROJECT PLAN
FOR REMEDIAL INVESTIGATION AND FEASABILITY STUDY
DEFENSE REUTILIZATION AND MARKETING OFFICE YARD (DRMO)
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Submitted to:
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Naval Facilities Engineering Command
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Anthony Robinson – Engineer-in-Charge
Department of the Navy – Southern Division — 1/10/01 Date

Mark Peterson, P.G. – Task Order Manager
Tetra Tech NUS, Inc. — 1/10/01 Date

Paul Frank – QA Manager
Tetra Tech NUS, Inc. — 1-19-01 Date

Deborah McGrath – Laboratory Director
Katahdin Analytical Services — Date

Deborah Nadeau – Laboratory Quality Assurance Officer
Katahdin Analytical Services — Date

Linda Freeman – Laboratory Director
Air Toxics, LTD — 01/25/01 Date

DEP Form 62-160.900(1) (Revised 1-92)

James Parker — 2/14/01

James Parker -- Laboratory Quality Assurance Officer
Air Toxics, LTD. Re - QAPP for Phase II Detection Monitoring PSC 47 NAS Jacksonville FL

Date

Robert Harris – Laboratory Director
Southwest Laboratory Of Oklahoma

Date

Chuck Hoover -- Laboratory Quality Assurance Officer
Southwest Laboratory Of Oklahoma

Date

DEP Oversight:

DEP Project Manager

Date

DEP QA Manager

Date

James Parker – Laboratory Quality Assurance Officer
Air Toxics, LTD.

Date

Robert Harris – Laboratory Director
Southwest Laboratory of Oklahoma

1/30/01
Date

Chuck Hoover – Laboratory Quality Assurance Officer
Southwest Laboratory of Oklahoma

2/2/01
Date

DEP Oversight:

DEP Project Manager

1/11/2001
Date

DEP QA Manager

1/11/2001
Date

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QUALITY ASSURANCE ELEMENTS

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Section 3.0 PROJECT DESCRIPTION

3.1 Site Identification and History

Site Name: Defense Reutilization & Marketing Office (DRMO)
Site Address: Naval Air Station (NAS), Jacksonville, Florida

3.1.1 Site History

The DRMO occupies a wedge shaped tract of land located at NAS Jacksonville. The facility has been used for multiple purposes since 1939 including demolition and smelting of used aircraft, equipment storage and maintenance, transformer storage, and battery storage.

DRMO activities have resulted in impacts to the environment. These impacts have resulted from releases of various contaminants to the ground surface through leaks, spills, and direct placement of fluid on surface soils. Storm water runoff appears to have transported contaminants into drainage ditches located on the west, south, and east sides of the site.

Environmental site assessment work conducted at DRMO to date has identified environmental impacts at the site. Contaminants include radionuclides thought to have resulted from aircraft disassembly, principally from radium contained in paints used on aircraft. Other chemicals of concern include volatile organic constituents (VOCs), semi-volatile organic constituents (SVOCs), pesticides, polychorinated biphenyls (PCBs), and metal constituents.

Confirmation sampling of groundwater found only metal constituents to be above regulatory standards. The data indicate that impacts to groundwater may be limited, however, no data have been collected from the interior portion of the site, and no radiological data were obtained from prior groundwater investigation activities.

Surface water has been shown to contain VOCs, pesticides, and several metals. The results of these analyses indicated that only metal constituents exceed surface water standards.

3.1.2 Summary of Historical Data

A summary of available historical data is presented in Table 3.1.

3.2 Project Scope and Purpose

3.2.1 Purpose of this Project

The purpose of the project is to determine the levels and extent of primary constituents of concern in environmental media at DRMO.

TABLE 3.1
SUMMARY OF HISTORICAL DATA
(Positive Detections Only)

DRMO Surface Soil	
Parameter	Max Concentration *
Aluminum	171,000 mg/kg
Arsenic	15.5 mg/kg
Chromium	1,300 mg/kg
Copper	16,600 mg/kg
Iron	76,400 mg/kg
Manganese	1,650 mg/kg
Benzo(a)pyrene	870 mg/kg
Benzo(b)fluoranthene	1,900 mg/kg
Aroclor-1260	2,400 mg/kg

DRMO Groundwater	
Parameter	Max Concentration *
Aluminum	3.68 mg/L
Antimony	0.0112 mg/L
Iron	10.1 mg/L
Manganese	0.329 mg/L

DRMO Surface Water	
Parameter	Max Concentration *
Cadmium	0.0094 mg/L
Mercury	0.0002 mg/L
Silver	0.0017 mg/L

DRMO Sediment	
Parameter	Max Concentration *
Cadmium	82.7 mg/kg
Chromium	2,560 mg/kg
Copper	102,000 mg/kg
Lead	1,610 mg/kg
Mercury	0.86 mg/kg
Nickel	2,070 mg/kg
Silver	268 mg/kg
Zinc	3,340 mg/kg
2-Methylnaphthalene	3.1 mg/kg
Acenaphthene	29 mg/kg
Acenapthylene	0.49 mg/kg
Anthracene	26 mg/kg
Benzo(a)anthracene	120 mg/kg
Benzo(a)pyrene	120 mg/kg
Chrysene	110 mg/kg
Dibenz(a,H)anthracene	7.3 mg/kg
Flouranthene	370 mg/kg
Flourene	19 mg/kg
Naphthalene	3.4 mg/kg
Phenanthrene	210 mg/kg
Pyrene	230 mg/kg
Bis(2-Ethylhexyl)phthalate	2.6 mg/kg **
4,4'-DDD	0.024 mg/kg
4,4'-DDT	0.0435 mg/kg
Arochlor-1260	2.9 mg/kg
Dieldrin	0.012 mg/kg
alpha-Chlordane	0.097 mg/kg

* Maximum concentration is listed instead of concentration range because most constituents were not detected at multiple locations.

** Value was attributed to sample collection or laboratory methods and was not a reflection of site conditions (HLA, 1999)

3.2.2 Intended End Use of Data:

___ Permit Compliance
_X_ Feasibility Study
___ Consent Order Compliance
___ Remedial Action
___ Contamination Assessment
___ Water Quality Database (Specify which Database: _____)
___ Facility Operating Report
_X_ Other: __Remedial Investigation_____

3.2.3 Project Schedule and Scope of Work

February 1, 2000
Project Beginning Date

March 31, 2005 (due to end of contract with consultant)
Project Ending Date

Major Project Tasks

The major tasks of this project include:

Begin soil sampling and installation of monitoring wells	within 21 days of receipt of approved Quality Assurance Project Plan (QAPP)
Well development and initial groundwater sampling	5 days
Chemical analysis of soil and water samples by Katahdin	30 days
Radiological analysis of soil and water samples by Southwest Laboratory	30 days
Data validation, chemical database entry and GIS	30 days

Reporting will be conducted at the conclusion of the Feasibility Study (FS). The NAS Jacksonville Partnering Team will evaluate the results of Remedial Investigation (RI) Activities during presentations of the results made during the Partnering Team meetings. Decisions necessary to complete the RI, human health risk assessments, ecological risk assessments, and FS will be made based on these presentations of data. A draft RI/FS report will then be submitted to the Partnering Team for review.

3.3 Project Organization

3.3.1 Project Organization

Sample collection activities for chemical constituents will be conducted by **Tetra Tech NUS, Inc. (TtNUS)** personnel. Sample collection for the radiological constituents will be conducted by TtNUS subcontractor **B. Koh & Associates.** The radiological analytical work will be performed by **Southwest Laboratory of Oklahoma**, who is a Florida Department of Health – Division of Laboratory Services laboratory certified to perform the analyses requested for this project. Southwest Laboratory has a current FDEP-approved Comprehensive Quality Assurance Plan (CompQAP) (CompQAP number 890099), last updated March 30, 2000.

The chemical analytical work will be performed by **Katahdin Analytical Services**, who is a Florida Department of Health – Division of Laboratory Services laboratory certified to perform the analyses requested for this project. Katahdin has a current FDEP-approved CompQAP (CompQAP number 960089), last updated May 4, 2000.

Refer to Figure 3.1 for the specific organization of this project.

3.3.2 Personnel Modifications or Additions

The following personnel are not included in the CompQAPs of the referenced organizations (include brief descriptions of project responsibilities):

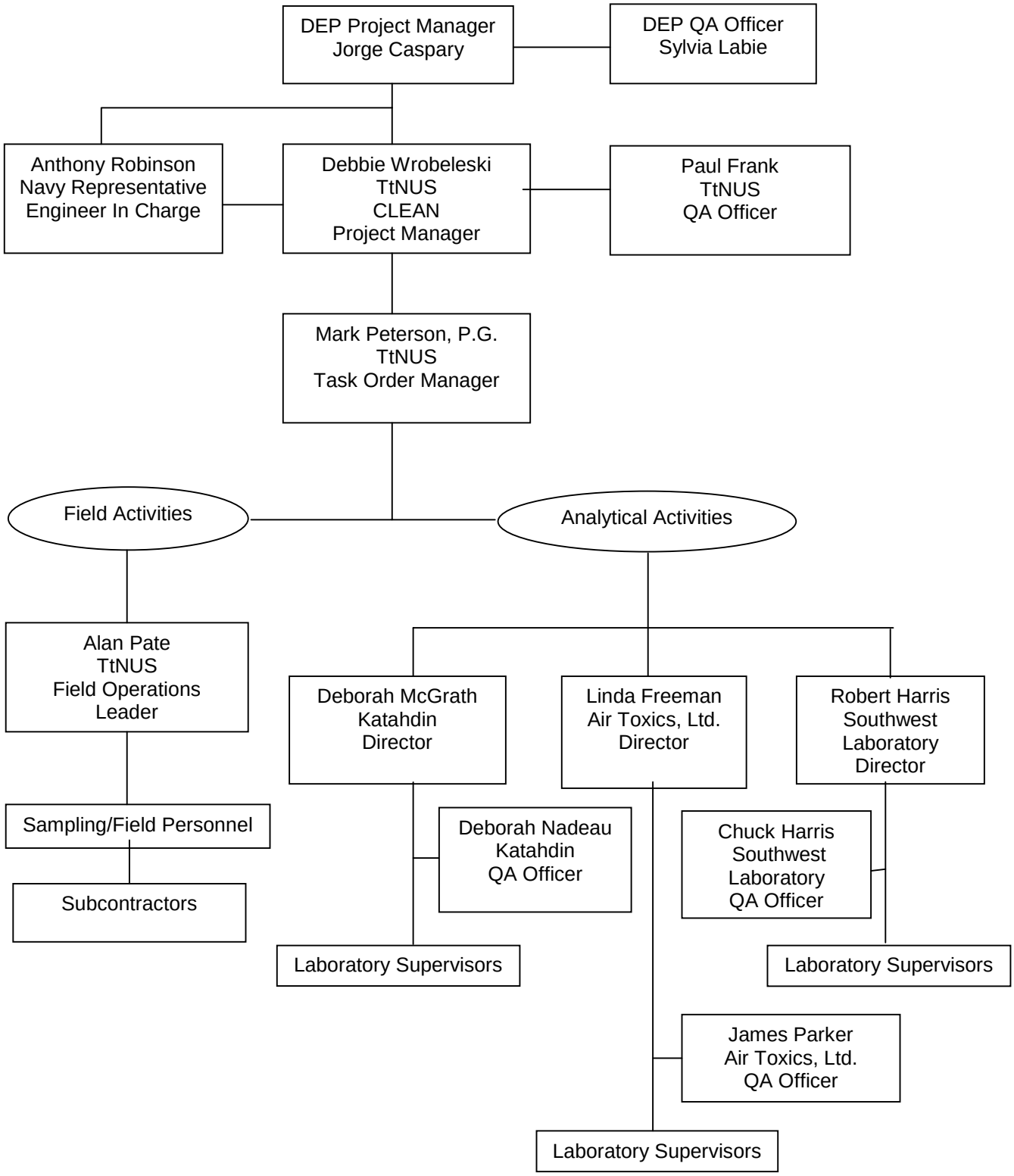
A. Field Personnel

1. No modifications

B. Laboratory Personnel

1. No modifications

FIGURE 3.1
PROJECT ORGANIZATION



3.4 Project Objectives

3.4.1 Data Quality Objectives

__X__ The data quality objectives for this project are the routine QA targets listed in the laboratory CompQAP.

_N/A_ The minimum detection limits are specified in the laboratory CompQAP and are included as a part of Table 3.2.

_N/A_ The precision and accuracy requirements differ from the routine targets specified in the laboratory CompQAP and are included as a part of Table 3.2.

3.4.2 Proposed Samples for Project

a. See Figure 3.2 for a map of the project site.

b. See Table 3.2 of this section for a summary of the sampling and analysis activities.

3.4.3 Summary of Matrix Types, Analytical Methods and QA Targets

Field and laboratory analytical measurements are presented in Table 3.2.

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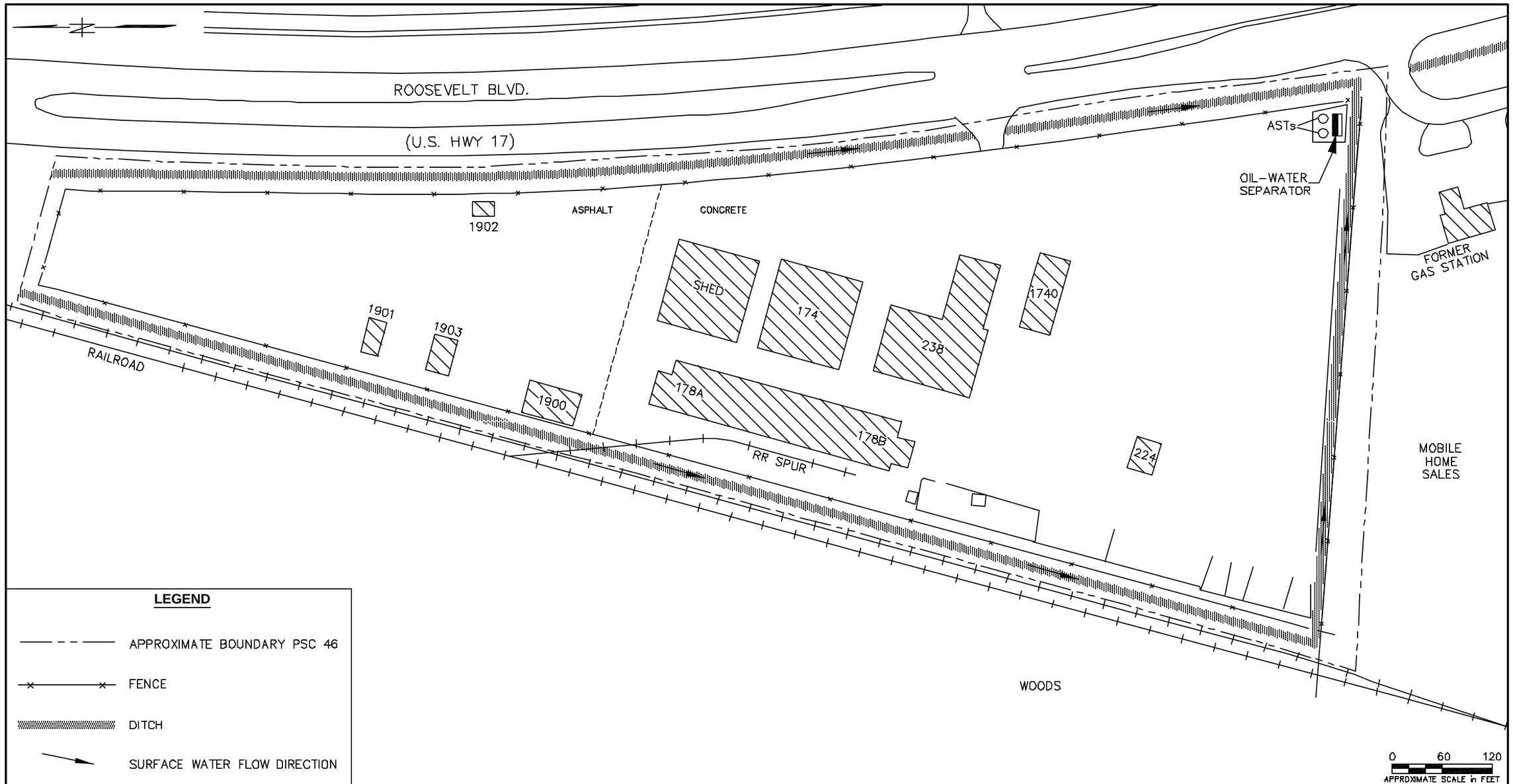

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY LLK DATE 5/23/00
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE PLAN
PSC 46 – DEFENSE REUTILIZATION
AND MARKETING OFFICE YARD
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 0522
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 3.2 REV. 0

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

TABLE 3.2
PROPOSED SAMPLES, MATRICES AND ANALYTICAL METHODS FOR THE PROJECT

The standards outlined in DEP Rule **62-777** are the limit criteria for this project. The detection limits reported for this project shall at least meet, or be lower than the stated standards.

FIELD MEASUREMENTS WILL BE PERFORMED BY: **TtNUS,** whose CompQAP is **980038** with annual approval on **August 24, 2000.**

PARAMETER*	METHOD
Alkalinity	CHEMetrics K9810/K9815(based on SM 2320B)
Carbon Dioxide	HACH 8205(based on SM4500-CO_2, modified)
Dissolved Oxygen	CHEMetrics K7501/K7512(based on ASTM D5543-94/D888-87)
Eh	SM 2580B
Ferrous Iron	HACH 8146(based on SM 315, modified)
Hydrogen Sulfide	HACH HS-C proprietary (based on SM 427 (3.c), modified)
pH	pH Probe (based on EPA 150.1)
Specific Conductance	Specific Conductance probe (based on EPA 120.1)
Temperature	Electronic thermometer (based on EPA 170.1)
Turbidity	Turbidimeter (based on EPA 180.1)

*These are screening measurements used to evaluate the utility of natural attenuation remedial options. Unless otherwise indicated, only water will be tested for the parameter.

FIELD SAMPLE COLLECTION ACTIVITIES WILL BE PERFORMED BY THE ABOVE NAMED ORGANIZATION.

LABORATORY ANALYSES WILL BE PERFORMED BY: **Katahdin Analytical Services**, whose COMPQAP is **960089** approved on **May 4, 2000**.

FREQUENCY	SAMPLE MATRIX	SAMPLE SOURCE	# SAMPLES	TB[2]	EB	FD	ANALYTICAL METHOD #	COMPONENT[3,4]	QA Targets[1]		
									P	A	MDL
Initial Investigation	Surface Water	Ditch around DRMO	7		1	1	SW-846 3015A/6010B	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn			
			7		1	1	SW-846 7470A	Mercury (Hg)			
Initial Investigation	Soil/Sediment	Ditch around DRMO	20		1	2	SW-846 8270 SIM	EPA PAHs			
			20		1	2	SW-846 3550B/8081A & 8082	EPA TCL Pesticides & PCBs			
			20		1	2	SW-846 3050B/6010B	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn			
			20		1	2	SW-846 9060	Total Organic Carbon			
			20		1	2	SW-846 7471A	Mercury (Hg)			

FREQUENCY	SAMPLE MATRIX	SAMPLE SOURCE	# SAMPLES	TB[2]	EB	FD	ANALYTICAL METHOD #	COMPONENT[3,4]	QA Targets[1]		
Initial Investigation (one sample per boring)	Soil	17 Shallow borings	17		1	2	SW-846-3550B/8081A & 8082	EPA TCL Pesticides & PCBs			
			3				SW-846 8270 SIM	EPA PAHs			
			4	2			SW-846 5035/8260B	EPA TCL VOCs			
			17		1	2	SW-846 3050B/6010B	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn			
			17		1	2	SW-846 7471A	Mercury (Hg)			
Initial Investigation (two samples per boring)	Soil	22 Deep borings	44		1	4	SW-846-3550B/8081A & 8082	EPA TCL Pesticides & PCBs			
			8				SW-846 8270 SIM	EPA PAHs			
			10	2			SW-846 5035/8260B	EPA TCL VOCs			
			8				SW-846 3050B/6010B	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn			
			8				SW-846 7470A	Mercury (Hg)			
Initial Investigation (post well installation)	Groundwater	6 Monitoring Wells at DRMO	6	1	1	1	SW-846 5030B/8260B	EPA TCL VOCs			
			6		1	1	SW-846 8270 SIM	EPA PAHs			
			6		1	1	SW-846 3510C/8081A & 8082	EPA TCL Pesticides & PCBs			
			6		1	1	SW-846 3050B/6010B	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn			
			6		1	1	SW-846 7470A	Mercury (Hg)			
			6		1	1	EPA 353.2	Nitrate/Nitrite			
			6		1	1	EPA 325.2	Chloride			
			6		1	1	EPA 375.4/376.1	Sulfate/Sulfide			
			6		1	1	EPA 350.1/351.2	Ammonia/TKN			
			6		1	1	EPA 310.1	Alkalinity			
			6		1	1	EPA 415.1	Total Organic Carbon			

GW – Groundwater
TB – Trip Blank
P – Precision
SS – Soil Sample
EB – Equipment Blank
A – Accuracy
SED – Sediment
FD – Field Duplicate
MDL – Method Detection Limit

[1]These values need to be completed if the Data Quality Objectives stated in the project description are different from the routine QA objectives cited in the CompQAP(s) or are not included in the CompQAP(s).
[2]One trip blank will be used in each sample cooler.
[3]These components are listed as target analytes in the laboratory CompQAP, except for methane/ethane/ethene, chloride, and sulfate, which are screening parameters for evaluating the utility of natural attenuation.
[4]Compliance target analytes are listed in Attachment 1 and are part of the routine target analytes for SW-846 methods cited in this QAPP.

TABLE 3.2a
PROPOSED SAMPLES, MATRICES AND ANALYTICAL METHODS FOR THE PROJECT

The standards outlined in DEP Rule **62-777** are the limit criteria for this project.

FIELD MEASUREMENTS WILL BE PERFORMED BY: **TtNUS,** whose CompQAP is **980038** with annual approval on **August 24, 2000.**

PARAMETER	METHOD
Same as Table 3.2	Same as Table 3.2

FIELD SAMPLE COLLECTION ACTIVITIES WILL BE PERFORMED BY THE ABOVE NAMED ORGANIZATION.

LABORATORY ANALYSES WILL BE PERFORMED BY: **Air Toxics, Ltd.**.

FREQUENCY	SAMPLE MATRIX	SAMPLE SOURCE	# SAMPLES	TB	EB	FD	ANALYTICAL METHOD #	COMPONENT**	QA Targets[1]		
									P	A	MDL
Initial Investigation (post well installation)	Ground water	6 MWs at DRMO	6	N/A	1	1	RSK SOPs 147 and 175	Methane/ethane/ethene			

**These components are screening parameters for evaluating the utility of natural attenuation.

TABLE 3.2b
PROPOSED SAMPLES, MATRICES AND ANALYTICAL METHODS FOR THE PROJECT

The standards outlined in DEP Rule **62-777** are the limit criteria for this project, and are compared against the detection limits reported for this project in Appendix 3. For cases where reporting limits exceeding criteria, resolution will be made on a case by case basis with the NASJAX Partnering Team.

FIELD MEASUREMENTS WILL BE PERFORMED BY: **TtNUS,** whose CompQAP is **980038** with annual approval on **August 24, 2000.**

PARAMETER	METHOD
Same as Table 3.2	Same as Table 3.2

FIELD SAMPLE COLLECTION ACTIVITIES WILL BE PERFORMED BY: **B. Koh & Associates.**

LABORATORY ANALYSES WILL BE PERFORMED BY: **Southwest Laboratory of Oklahoma** whose COMPQAP is **890099** with annual approval on **March 30.**

FREQUENCY	SAMPLE MATRIX	SAMPLE SOURCE	# SAMPLES	TB	EB	FD	ANALYTICAL METHOD #	COMPONENT[2]	QA Targets[1]		
									P	A	MDL
Initial Investigation (one sample per boring)	Soil	17 Shallow borings	15	N/A	1	2	Calculation	Total Thorium			
							EPA 907M	Isotopic Thorium			
							EPA 903.0M	Total Radium			
							EPA 901.1M	Isotopic Radium			
							Calculation	Total Uranium			
							EPA 907M	Isotopic Uranium			
							EPA 901.1M	Uranium 238 by GS			
							EPA 901.1M	Thorium (AC-228) by GS			
Initial Investigation (post well installation)	Ground water	6 Monitoring Wells at DRMO	6	N/A	1	1	Calculation	Total Thorium			
							EPA 907M	Isotopic Thorium			
							EPA 903.0M	Total Radium			
							EPA 904M	Isotopic Radium			
							Calculation	Total Uranium			
							EPA 907M	Isotopic Uranium			
							EPA 900	Gross alpha and beta			

[1]These values need to be completed if the Data Quality Objectives stated in the project description are different from the routine QA objectives cited in the CompQAP(s) or are not included in the CompQAP(s).
[2]These components are listed as target analytes in the laboratory CompQAP.

Section 4.0 FIELD PROCEDURES AND QUALITY CONTROL

This section specifies the protocols and procedures to be used by **TtNUS** personnel when conducting sampling activities for this project.

4.1 Sampling Equipment

See Table 4.1 for a list of the equipment to be used for this project.

4.2 Field Activities

See Table 4.2

4.2.1 Sampling Protocols

Only the protocols specified in the CompQAP will be used for this project.

4.2.2 Disposal Protocols

Disposal protocols for this project for handling wastes differ from those specified by the CompQAP. Investigation Derived Wastes (IDW) will be handled according to the following protocols:

Purge waters will be contained on-site until receipt of analytical data. Copies of drum logs will be provided to the NAS Jacksonville environmental office following the completion of field activities. Laboratory analytical results of the IDW samples will also be provided to the NAS Jacksonville environmental office upon receipt by TtNUS. The Navy will manage the waste in accordance with the installation's protocol for waste management.

4.3 Field Measurements

Field measurements are listed in Table 3.2 of this QAPP. The field screening measurements that will be made are:

1. Alkalinity	CHEMetrics K9810/K9815(based on SM 2320B)
2. Carbon Dioxide	HACH 8205(based on SM4500-CO_2, modified)
3. Dissolved Oxygen	CHEMetrics K7501/K7512(based on ASTM D5543-94/D888-87)
4. Eh	SM 2580B
5. Ferrous Iron	HACH 8146(based on SM 315, modified)
6. Hydrogen Sulfide	HACH HS-C, proprietary (based on SM 427 (3.c), modified)
7. pH	pH Probe (based on EPA 150.1)
8. Specific Conductance	Specific Conductance probe (based on EPA 120.1)
9. Temperature	Electronic thermometer (based on EPA 170.1)
10. Turbidity	Turbidimeter (based on EPA 180.1)

TABLE 4.1
PROPOSED SAMPLING EQUIPMENT

The following equipment may be used by **TtNUS** for this project. With the exception of additional equipment, discussions on use and restrictions are included in CompQAP No. **980038** updated with annual amendments, which are approved on **August 24, 2000**.

EQUIPMENT DESCRIPTION	CONSTRUCTION MATERIALS	USE
Purging Equipment (include construction of tubing, tail pipes, etc.):		
1. Grundfos Redi-Flo 2" submersible pump	Stainless Steel	Purging
2. Hosing	Food Grade PVC	Purging
3. Low-flow peristaltic pump	N/A	Purging
Sampling Equipment		
1. Tubing	Teflon	GW Sampling
2. Tubing	Other Plastic (Medical grade silicone)	GW Sampling
3. Low-flow peristaltic pump	N/A	GW Sampling
4. Spoons	Stainless Steel	Soil Sampling
5. Spatulas	Plastic	Soil Sampling
6. Bowls	Stainless Steel	Soil Sampling
7. Hand Bucket Augers	Stainless Steel	Soil Sampling
8. Encore Samplers (low level)	proprietary	Soil VOC Sampling
9. Encore Samplers (high level)	proprietary	Soil VOC Sampling

Additional equipment not addressed in the CompQAP includes [1]:

1. none

[1] If the sampling protocols for using this equipment are not included in the cited CompQAP, the sampling protocols must be discussed in Section 4.2.1 of this QAPP.

Field Measurement Equipment (construction does not need to be specified):

1. Keck ET94 Water level Indicator
2. YSI Water Quality Meter 6820/6920 (for screening)
3. Horiba Water Quality Meter U-22 (for screening pH, Temperature, Tubidity, Dissolved Oxygen, Oxidation-Reduction Potential, & Specific Conductance)
4. Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 44-10 Gamma Scintillation (2-inch by 2-inch NaI) Detector (or equivalent).
5. Ludlum Model 2221 Portable Scaler/Rate Meter with a Model 44-9 Pancake Geiger-Muller (G-M) Detector (or equivalent)
6. Ludlum Model 19 Micro R Survey Meter (or equivalent)

TABLE 4.2
FIELD ACTIVITIES

The following field protocols will be used by **TtNUS** personnel. The CompQAP number for **TtNUS** is **980038**. The date of the last update approval is **August 24, 2000**.

All protocols, procedures and policies in the above-mentioned document which are pertinent to this Quality Assurance Project Plan will be followed and are summarized below:

	VOCs	Extractable Organics	Metals	Inorganic Anions	Organics	Physical Properties	Micro	Other (Specify): Radiological
Groundwater	X	X	X	X	X			X
Groundwater (in-place plumbing)								
Potable Water								
Surface Water	X	X	X	X	X			X
Soil	X	X	X	X	X			X
Sediment/Sludges	X	X	X	X	X			X
Automatic Samplers								
Field Filtration								
Waste Water								
Stormwater								
Air								

SAMPLE CONTAINERS

Sample containers will be provided by the Florida Department of Health – Division of Laboratory Services approved laboratory, Katahdin for chemical analysis and by Southwest Laboratory of Oklahoma for radiological analysis**. (See Appendix II) ***

__X__ Sample containers will be pre-preserved by the above-referenced organization and be provided; **or**

____ Field organizations will preserve samples onsite using protocols outlined in the CompQAP.

*** If more than one organization is involved with these activities, this QAPP must specifically identify the equipment and/or sample containers to be provided by each organization.**

EQUIPMENT DECONTAMINATION

Equipment decontamination will follow protocols outlined in the TtNUS CompQAP.

EQUIPMENT SHALL BE PRECLEANED PRIOR TO ON-SITE ARRIVAL

WASTE DISPOSAL

___ The procedures for handling wastes from equipment cleaning and from sampling are discussed in the above-referenced CompQAP.

__X__ The disposal procedures for handling wastes for this project differ from those outlined in the above-referenced CompQAP and are outlined in Section 4.2.2.

Section 5.0 LABORATORY PROCEDURES AND QUALITY CONTROL

The laboratory analyses shall be conducted by the **Katahdin Analytical Services, Air Toxics, Ltd., and Southwest Laboratory of Oklahoma**.

Section 5.0a Katahdin Analytical Services – Westbrook ME

The CompQAP number for Katahdin is **960089**. The date of the last update approval is **May 4, 2000.**

All protocols, procedures, and policies in the above-mentioned document that are pertinent to this QAPP shall be followed. The laboratory shall analyze the samples for this project by the methods specified in Table 3.2 of this QAPP.

Section 5.0b Air Toxics, Ltd. – Folsom, CA

Air Toxics, Ltd. will perform screening analysis for dissolved gases (methane, ethane, and ethene), following RSK SOPs 147 and 175. These screening parameters are for evaluating the utility of natural attenuation, which does not require an FDEP approved CompQAP.

All protocols, procedures and policies in Air Toxics, Ltd. Laboratory Quality Assurance Plan that are pertinent to this QAPP shall be followed. The laboratory shall analyze the samples for this project by the methods specified in Table 3.2 of this QAPP.

Section 5.0c Southwest Laboratories of Oklahoma – Broken Arrow, OK

The CompQAP number for Southwest Laboratories of Oklahoma is **890099**. The date of the last update approval is **March 30, 2000**.

All protocols, procedures and policies in the above-mentioned document that are pertinent to this QAPP shall be followed. The laboratory shall analyze the samples for this project by the methods specified in Table 3.2 of this QAPP.

5.1a Quality Control Checks, Katahdin Analytical Services

The types of laboratory control checks that will be used when analyzing samples for this project in the Katahdin laboratory are:

Chemical:

___ Reagent Blanks
_X_ Duplicate Samples
_X_ Duplicate Matrix Spikes
_X_ Continuing Calibration Standards
_X_ Other: _LCS_____
_X_ Matrix Spikes
___ QC Check Samples
_X_ QC Check Standards

Microbiology:

___ Duplicates
___ Carry over blanks (MF)
___ Positive & Negative Controls
___ Other: _____
___ Control Blanks (MF)
___ Dilution Blanks (MPN)

5.1b Quality Control Checks, Air Toxics, Ltd.

The types of laboratory control checks that will be used when analyzing samples for this project in the Air Toxics Laboratory are:

Chemical:

___ Reagent Blanks
_X_ Duplicate Samples
_X_ Duplicate Matrix Spikes
_X_ Continuing Calibration Standards
_X_ Other: _LCS_____
_X_ Matrix Spikes
___ QC Check Samples
_X_ QC Check Standards

Microbiology:

___ Duplicates
___ Carry over blanks (MF)
___ Positive & Negative Controls
___ Other: _____
___ Control Blanks (MF)
___ Dilution Blanks (MPN)

5.1c Quality Control Checks, Southwest Laboratory of Oklahoma

The types of laboratory control checks that will be used when analyzing samples for this project in the Southwest Laboratory of Oklahoma are:

Radiochemical:

_X_ Reagent Blanks
_X_ Duplicate Samples
_X_ Duplicate Matrix Spikes*
_X_ Continuing Calibration Standards
_X_ Other: _LCS_____
_X_ Matrix Spikes
_X_ QC Check Samples
_X_ QC Check Standards

Note: MSs and MSDs will be run on alpha beta only.

Section 6.0 QUALITY ASSURANCE MANAGEMENT

6.1 Corrective Actions

In addition to corrective actions cited in the approved CompQAP, all involved parties will initiate any corrective action deemed necessary by FDEP.

6.2 Performance and System Audits

6.2.1 Field Activities

Specific audits planned for this project are

Audit Type	Frequency/Date	Description
1. Routine	As indicated in CompQAP (DER SOP 12.0)	Routine

6.2.2 Laboratory Activities

Specific audits planned for this project are:

Audit Type	Frequency/Date	Description
1. Routine	As indicated in CompQAP (DER SOP 12.0)	Routine

ALL INVOLVED PARTIES WILL CONSENT TO AUDITS BY FDEP IF DEEMED NECESSARY.

6.3 Quality Assurance Reports

Project specific QA Reports will be submitted to FDEP and the Navy at the end of this RI/FS.

Note: Frequency must comply with Table V, Appendix D of the DEP Manual for Preparing Quality Assurance Plans or Table 6 of Chapter 62-160, F.A.C., Quality Assurance.

APPENDIX 1
Primary Contaminants of Concern - DRMO

Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Test Method
TCL Volatiles	SW-846 8260B
PAHs	8270 SIM
TCL Pesticides & PCB's	SW-846 8081A & 8082
TAL Metals	SW-846-6010/7000
Radiological	
Gross alpha and beta	EPA 900
Thorium, total and isotopic	EPA 907M
Radium, total and isotopic	EPA 901.1, 903.0M, & 904
Uranium, total and isotopic	EPA 907M
Uranium 238 by Gamma Spectroscopy	EPA 901.1
Thorium (AC-228) by Gamma Spectroscopy	EPA 901.1

Notes:
Total Thorium and Total Uranium performed by calculation.

APPENDIX 2
Sample Containers

Parameter	Matrix*	Container(s)	Preservation	Laboratory
TCL Volatiles	SS	3 Encore Samplers	4 ^{o} C	Katahdin
TCL Volatiles	SED	1 x 4 oz. WM glass	4 ^{o} C	Katahdin
PAHs	SS/SED	1 x 4 oz. WM glass	4 ^{o} C	Katahdin
TAL Metals	SS/SED	1 x 4 oz. WM glass	4 ^{o} C	Katahdin
TCL Pesticides/PCBs	SS/SED	1 x 4 oz. WM glass	4 ^{o} C	Katahdin
Thorium, total and isotopic	SS/SED	1 x 8 oz. WM glass	4 ^{o} C	Southwest Laboratory
Radium, total and isotopic	SS/SED	1 x 8 oz. WM glass	4 ^{o} C	Southwest Laboratory
Uranium, total and isotopic	SS/SED	1 x 8 oz. WM glass	4 ^{o} C	Southwest Laboratory
Uranium 238 & Thorium 228 by Gamma Spectroscopy	SS/SED	1 x 8 oz. WM glass	4 ^{o} C	Southwest Laboratory
TCL Volatiles	GW/SW	3 x 40ml glass vial	HCl, 4 ^{o} C	Katahdin
PAHs	GW/SW	2 x 1L amber glass	4 ^{o} C	Katahdin
TAL Metals	GW/SW	1 x 1L HDPE	HNO_3	Katahdin
TCL Pesticides/PCBs	GW/SW	2 x 1L amber glass	4 ^{o} C	Katahdin
Nitrate/Nitrite, Alkalinity Chloride, Sulfate	GW	1 x 1L HDPE	4 ^{o} C	Katahdin
Sulfide	GW	1 x 1L HDPE	NaOH/ZnOAc., 4 ^{o} C	Katahdin
Ammonia/TKN	GW	1 x 1L HDPE	H_2SO_4, 4 ^{o} C	Katahdin
Total Organic Carbon	GW	1 x 1L glass	H_2SO_4, 4 ^{o} C	Katahdin
Methane/ethane/ethene	GW	2 x 40ml glass vial	HCl, 4 ^{o} C	Katahdin
Thorium, total and isotopic	GW/SW	2 x 1L HDPE	HNO_3	Southwest Laboratory
Radium, total and isotopic	GW/SW	2 x 1L HDPE	HNO_3	Southwest Laboratory
Uranium, total and isotopic	GW/SW	2 x 1L HDPE	HNO_3	Southwest Laboratory
Gross alpha & beta	GW/SW	2 x 1L HDPE	HNO_3	Southwest Laboratory

*GW – Groundwater SW – Surface Water SS – Soil Sample SED – Sediment
WM – wide-mouth HDPE – High Density Polyethylene

Appendix 3
Summary of Florida Criteria versus Laboratory Reporting Limits

The following table presents VOC, SVOC, pesticide, herbicide and metal contaminants of interest for this project. Also presented are the Florida of Administrative Code (F.A.C.) 62-777 acceptance limits for those chemicals.

COMPOUND	EPA METHOD	FL GROUNDWATER CRITERIA µg/L	LAB REPORTING LIMIT – AQUEOUS µg/L	FL RESIDENTIAL SOIL CLEAN-UP CRITERIA mg/kg	FL LEACHABILITY OF GROUNDWATER CRITERIA mg/kg	LAB REPORTING LIMIT - SOIL µg/kg
VOLATILE ORGANICS			**KATAHDIN**			**KATAHDIN**
ACETONE	8260B	700	5	770	2.8	10
2-BUTANONE	8260B	280	5	4800	22	10
BENZENE	8260B	1	1	1.1	0.007	5
BROMODICHLOROMETHANE	8260B	1	1	1.4	0.006	5
BROMOFORM	8260B	4.4	1	53	0.04	5
BROMOMETHANE	8260B	9.8	2	2.2	0.05	5
CHLOROBENZENE	8260B	100	1	30	1.3	5
CHLOROETHANE	8260B	12	2	5.8	23	5
CHLOROFORM	8260B	5.7	1	0.4	0.04	5
CHLOROMETHANE	8260B	2.7	2	1.7	0.01	5
CARBON DISULFIDE	8260B	700	1	200	5.6	5
CARBON TETRACHLORIDE	8260B	3	1	0.4	0.04	5
CYCLOHEXANE	8260B	***	5	***	***	10
1,1-DICHLOROETHANE	8260B	70	1	340	0.5	5
1,1-DICHLOROETHENE	8260B	7	1	0.01	0.06	5
1,2-DICHLOROETHANE	8260B	3	1	0.6	0.02	5
1,2 DICHLOROPROPANE	8260B	5	1	0.03	0.03	5
DIBROMOCHLOROMETHANE	8260B	0.4	1*	1.4	0.003	5
cis-1,2-DICHLOROETHENE	8260B	70	2	19	0.4	5
trans-1,2-DICHLOROETHENE	8260B	100	2	35	0.6	5
DICHLORODIFLUOROMETHANE	8260B	1400	5	56	44	10
cis-1,3-DICHLOROPROPENE	8260B	0.2	1*	0.1	0.001	5**
trans-1,3-DICHLOROPROPENE	8260B	0.2	1*	0.1	0.001	5**
ETHYLBENZENE	8260B	30	1	240	0.4	5
2-HEXANONE	8260B	280	4	650	2	10
ISOPROYLBENZENE	8260B	***	5	***	***	10
4-METHYL-2-PENTANONE	8260B	560	3	280	3.7	10

COMPOUND	EPA METHOD	FL GROUNDWATER CRITERIA µg/L	LAB REPORTING LIMIT – AQUEOUS µg/L	FL RESIDENTIAL SOIL CLEAN-UP CRITERIA mg/kg	FL LEACHABILITY OF GROUNDWATER CRITERIA mg/kg	LAB REPORTING LIMIT - SOIL µg/kg
METHYL tert-BUTYL ETHER (MTBE)	8260B	35	5	3200	0.2	5
METHYL ACETATE	8260B	5000	5	4100	26	10
METHYLCYCLOHEXANE	8260B	***	5	***	***	10
METHYLENE CHLORIDE	8260B	5	1	16	0.02	5
SYTRENE	8260B	100	1	1700	4.1	5
1,1,1-TRICHLOROETHANE	8260B	200	1	420	2.1	5
TRICHLOROFLUOROMETHANE	8260B	2100	5	200	33	10
1,1,2,2-TETRACHLOROETHANE	8260B	0.5	1*	0.7	0.004	5
1,1,2-TRICHLOROETHANE	8260B	5	1	1.4	0.04	5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	8260B	500000	5	13000	27000	10
TETRACHLOROETHENE	8260B	3	1	10	0.05	5
TOLUENE	8260B	40	1	300	0.4	5
TRICHLOROETHENE	8260B	3	1	4.8	0.03	5
VINYL CHLORIDE	8260B	1	2*	0.04	0.007	10
XYLENES(TOTAL)	8260B	20	5	290	0.3	10
SEMIVOLATILE ORGANICS			**KATAHDIN**			**KATAHDIN**
ACENAPHTHENE	8270SIM	20	0.2	1900	4	20
ACENAPHTHYLENE	8270SIM	210	0.2	1100	22	20
ANTHRACENE	8270SIM	2100	0.2	18000	2000	20
BENZO(A)ANTHRACENE	8270C	0.2	0.2	1.4	3.2	20
BENZO(A)PYRENE	8270C	0.2	0.2	0.1	8	20
BENZO(B)FLUORATHENE	8270C	0.2	0.2	1.4	10	20
BENZO(g,h,i)PERYLENE	8270C	210	0.2	2300	32000	20
BENZO(K)FLUORANTHENE	8270C	0.5	0.2	15	25	20
CHRYSENE	8270C	4.8	0.2	140	77	20
DIBENZ(a,h)ANTHRACENE	8270C	0.2	0.2	0.1	30	20
FLUORANTHENE	8270C	280	0.2	2900	1200	20
FLUORENE	8270C	280	0.2	2200	160	20
INDENO(1,2,3-cd)PYRENE	8270C	0.2	0.2	1.5	28	20
2-METHYLNAPHTHALENE	8270C	20	0.2	83	6.1	20
NAPHTHALENE	8270C	20	0.2	40	1.7	20
PHENANTHRENE	8270C	210	0.2	2000	250	20
PYRENE	8270C	210	0.2	2200	880	20

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ORGANOCHLORINE PESTICIDES			**KATAHDIN**			**KATAHDIN**
ALDRIN	8081A	0.005	0.05*	0.07	0.5	1.7
alpha-BHC	8081A	0.006	0.05*	0.2	0.0003	1.7
beta-BHC	8081A	0.02	0.05*	0.6	0.001	1.7
delta-BHC	8081A	2.1	0.05	22	0.2	1.7
gamma-BHC	8081A	0.2	0.05	0.7	0.009	1.7
CHLORDANE alpha isomer	8081A	2	0.05	3.1	0.96	1.7
CHLORDANE gamma isomer	8081A	2	0.05	3.1	0.96	1.7
DIELDRIN	8081A	0.005	0.1*	0.07	0.004	3.3
4,4'-DDD	8081A	0.1	0.1	4.6	4	3.3
4.4'-DDE	8081A	0.1	0.1	3.3	18	3.3
4,4'-DDT	8081A	0.1	0.1	3.3	11	3.3
ENDRIN	8081A	2	0.1	21	1	3.3
ENDOSULFAN SULFATE	8081A	0.3	0.1	***	***	3.3
ENDRIN KETONE	8081A	***	0.1	***	***	3.3
ENDRIN ALDEHYDE	8081A	***	0.1	***	***	3.3
ENDOSULFAN I	8081A	42	0.05	410	3.8	1.7
ENDOSULFAN II	8081A	***	0.1	410	3.8	3.3
HEPTACHLOR	8081A	0.4	0.05	0.2	23	1.7
HEPTACHLOR EPOXIDE	8081A	0.2	0.05	0.1	0.6	1.7
METHOXYCHLOR	8081A	40	0.5	370	160	17
TOXAPHENE	8081A	3	2.5	1	31	33
PCBs						
AROCLOR 1016	8082	0.5	0.5	0.5	17	33
AROCLOR 1221	8082	0.5	0.5	0.5	17	33
AROCLOR 1232	8082	0.5	0.5	0.5	17	33
AROCLOR 1242	8082	0.5	0.5	0.5	17	33
AROCLOR 1248	8082	0.5	0.5	0.5	17	33
AROCLOR 1254	8082	0.5	0.5	0.5	17	33
AROCLOR 1260	8082	0.5	0.5	0.5	17	33
METALS	**KATAHDIN**	**µg/L**	**µg/L**	**mg/Kg**	**mg/Kg**	**mg/Kg**
ALUMINUM	6010B	200	10	72000	***	5
ANTIMONY	6010B	6	4	26	5	0.4

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ARSENIC	6010B/7000A	50	3	0.8	29	0.3
BARIUM	6010B	2000	0.5	110	1600	0.05
BERYLLIUM	6010B	4	0.2	120	63	0.02
CADMIUM	6010B	5	0.5	75	8	0.05
CALCIUM	6010B	***	50	***	***	5
CHROMIUM	6010B	100	1	***	***	0.1
COBALT	6010B	420	1	4700	***	0.1
COPPER	6010B	1000	1	110	***	0.1
IRON	6010B	300	20	23000	***	2
LEAD	6010B/7000A	15	2	400	***	0.2
MAGNESIUM	6010B	***	50	***	***	5
MANGANESE	6010B	50	0.4	1600	***	0.04
MERCURY	7470/7471	2	0.2	3.4	2.1	0.02
NICKEL	6010B	100	2	110	130	0.2
POTASSIUM	6010B	***	130	***	***	40
SELENIUM	6010B/7000A	50	2	390	5	0.4
SILVER	6010B	100	2	390	17	0.2
SODIUM	6010B	160000	300	***	***	30
THALLIUM	6010B/7000A	2	2	***	***	0.4
VANADIUM	6010B	49	1	15	980	0.1
ZINC	6010B	5000	5	23000	6000	0.5
CYANIDE	9010B/9012A	200	10	30	40	1

* - Denotes exceedance of groundwater criterion.
** - Denotes exceedance of groundwater leachability criterion.
*** - No guidance criterion established.
SIM – Selective Ion Monitoring.