Final

Interim Remedial Action Plan and Preconstruction Report
Towers Road Disposal Areas – Waste and Soil

Harvey Point Defense Testing Activity
Hertford, North Carolina

Contract Task Order 0017

April 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

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April 3, 2014

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Subject: IRAP for Towers Rd Disposal Area (NONCD0002893)

Hi Matt,
As discussed, for clarification, the IRAP and Preconstruction Report (CH2M HILL, April 2014) for waste and soil at the Towers Road Disposal Area is designed to meet the remedial goals for soil.
Please feel free to contact me if you need additional information.
Thank you,

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April 21, 2014

458605.PP.WP

Mr. Matt Aufman
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Subject: *Final Interim Remedial Action Plan and Preconstruction Report, Towers Road Disposal Areas – Waste and Soil*
Harvey Point Defense Testing Activity, Hertford, North Carolina
IHSB Site Name: Towers Road Disposal Area
IHSB Site ID No.: NONCD0002893

Dear Mr. Aufman:

On behalf of Harvey Point Defense Testing Activity, CH2M HILL is pleased to submit a CD containing the Interim Remedial Action Plan and Preconstruction Report for Towers Road Disposal Area Waste and Soil. The public comment period associated with the Interim Remedial Action will be initiated after receipt of the draft public notice from NCDENR and its subsequent distribution. If you have any questions or comments regarding the referenced document, please do not hesitate to contact me at (757) 671-6231.

Sincerely,

CH2M HILL

Kim Henderson
Registered Site Manager

cc: Ms. Dawn Hayes/NAVFAC (1 CD)
Mr. Brian Murphy/HPDTA (1 CD)
Ms. Janna Staszak/CH2M HILL (cover letter only)

REC PROGRAM DOCUMENT CERTIFICATION FORM - PAGE 1 OF 2

IHSB SITE NAME TOWERS ROAD DISPOSAL AREAS

DATE & NAME OF DOCUMENT Interim Remedial Action Plan and Preconstruction Report Towers Road Disposal Areas – Waste and Soil / April 2014

TYPE OF SUBMITTAL (circle all that apply): Report, Work plan, Work Phase Comp. Statement, Schedule Change

REMEDIATING PARTY DOCUMENT CERTIFICATION STATEMENT (.0306(B)(2))

"I certify under penalty of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

ERIK FREESTONE, DIAdmin HPDTA
Name of Remediating Party

Signature of Remediating Party

4/21/2014
Date

NOTARIZATION

North Carolina (Enter State)

Perquimans **COUNTY**

I, Deborah Lyman, a Notary Public of said County and State, do hereby certify that Erik Freestone did personally appear and sign before me this day, produced proper identification in the form of Drivers License, was duly sworn or affirmed, and declared that, to the best of his or her knowledge and belief, after thorough investigation, the information contained in the above certification is true and accurate, and he or she then signed this Certification in my presence.

WITNESS my hand and official seal this 21 day of April, 2014.

Deborah O. Lyman
Notary Public (signature)

(OFFICIAL SEAL)

DEBORAH O LYMAN NOTARY PUBLIC MY COMMISSION EXPIRES 24 July 2015 PERQUIMANS COUNTY, N.C.

My commission expires: 24 July 2015

Document Certification Form No. DC - I
(Revised 8/11)

REC PROGRAM DOCUMENT CERTIFICATION FORM - PAGE 2 OF 2
IHSB SITE NAME TOWERS ROAD DISPOSAL AREAS
DATE & NAME OF DOCUMENT Interim Remedial Action Plan and Preconstruction Report Towers Road Disposal Areas – Waste and Soil / April 2014
TYPE OF SUBMITTAL (circle all that apply): Report, Work plan, Work Phase Comp. Statement, Schedule Change

REGISTERED SITE MANAGER CERTIFICATION OF SIGNATURES

As the Registered Environmental Consultant for the Site for which this filing is made, I certify that the signatures included herewith are genuine and authentic original handwritten signatures and/or true, accurate, and complete copies of the genuine and authentic original handwritten signatures of the persons who purport to sign for this filing. I further certify that I have collected through reliable means the originals and/or copies of said signatures from the persons authorized to sign for this filing who, in fact, signed the originals thereof. Those persons and I understand and agree that any copies of signatures have the same legally binding effect as original handwritten signatures, and I certify that any person for whom I am submitting a copy of their signature has provided me with their express consent to submit said copy. Additionally, I certify that I am authorized to attest to the genuineness and authenticity of the signatures, both originals and any copies, being submitted herewith and that by signing below, I do in fact attest to the genuineness and authenticity of all the signatures, both originals and copies, being submitted for this filing.

KIM HENDERSON
Name of Registered Site Manager

Signature of Registered Site Manager

4/21/14
Date

REGISTERED SITE MANAGER DOCUMENT CERTIFICATION STATEMENT (.0306(b)(1))

"I certify under penalty of law that I am personally familiar with the information contained in this submittal, including any and all supporting documents accompanying this certification, and that the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete and complies with the Inactive Hazardous Sites Response Act N.C.G.S. 130A-310, et seq, and the remedial action program Rules 15A NCAC 13C .0300. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

KIM HENDERSON
Name of Registered Site Manager

Signature of Registered Site Manager

4/21/14
Date

NOTARIZATION

VIRGINIA (Enter State)

Virginia Beach **COUNTY**

I, Rebecca Singleton, a Notary Public of said County and State, do hereby certify that Kim Henderson did personally appear and sign before me this day, produced proper identification in the form of Drivers License, was duly sworn or affirmed, and declared that, he or she is the duly authorized environmental consultant of the remediating party of the property referenced above and that, to the best of his or her knowledge and belief, after thorough investigation, the information contained in the above certifications is true and accurate, and he or she then signed these Certifications in my presence.

WITNESS my hand and official seal this 21st day of April, 2014

Notary Public (signature)

(OFFICIAL SEAL)

REBECCA S SINGLETON NOTARY PUBLIC MY COMMISSION NUMBER 180890 COMMONWEALTH OF VIRGINIA

My commission expires: 12/31/16

Document Certification Form No. DC - II
(Revised 8/11)

Executive Summary

This Interim Remedial Action Plan (IRAP) and Preconstruction Report presents the strategy and technical approach for addressing waste and impacted soil at the Towers Road Disposal Areas, Harvey Point Defense Testing Activity (HPDTA), Hertford, North Carolina. The Towers Road Disposal Areas consists of the 2nd Street Disposal Area and the 5th Street Disposal Area. This document was prepared for Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic under Contract Number N62470-11-D-8012, Contract Task Order 0017, for submittal to NAVFAC Atlantic, HPDTA, and the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Waste Management, Inactive Hazardous Sites Branch (IHSB) – Registered Environmental Consultants (REC) Program.

The 2nd Street Disposal Area was unearthed by HPDTA on September 20, 2011. The 5th Street Disposal Area was subsequently identified as an area of concern based on employee interviews. Research concluded trash disposal reportedly occurred at the disposal areas until the early 1980s. The contents of the waste disposal areas are not fully documented but are reported to include paper, utensils, computer disks, broken dishes, glass, and ordnance items (not to include ammunition) and drums at the 2nd Street Disposal Area, and safes, metal cars, and polychlorinated biphenyls (PCBs) at the 5th Street Disposal Area. A PCB removal action was conducted in 1996 at the 5th Street Disposal Area to dispose of 2,544 tons of PCB-contaminated soil (OHM, 1997).

Following submittal of a notification package to the NCDENR Division of Waste Management IHSB and the completion of geophysical surveying and soil and groundwater sampling, the Towers Road Disposal Areas were entered into the North Carolina REC Program under Site Identification Number NONCD0002893. An Administrative Agreement for REC-directed voluntary assessment and remedial action was signed in April 2013.

The Phase I RI was conducted to identify waste disposal areas, characterize the chemical nature of releases and disposal activities, and to collect sufficient data to establish preliminary remediation goals. Based on the results of the Phase I Remedial Investigation (RI), the estimated extent of the waste and removal area covers approximately 0.7 acre at the 2nd Street Disposal Area and 0.6 acre at the 5th Street Disposal Area. The highest concentrations of constituents in soil from samples collected within the extent of waste included semivolatile organic compounds (SVOCs), PCBs, and metals in soil and volatile organic compounds (VOCs) and metals in groundwater. The primary fate and transport mechanisms consist of the potential for leaching of constituents from buried wastes to soil, infiltration through the vadose zone to groundwater, and dissolved constituent migration downgradient with groundwater flow (advection). Human exposure to waste and constituents in soil and groundwater have been identified as potential concerns at the 2nd Street Disposal Area and 5th Street Disposal Area. The Interim Remedial Action (IRA) is being conducted to address the potential human health risks associated with exposure to waste and constituents in soil. This IRA is "interim" because the RI for the site is still in progress and therefore the IRA does not address all potential site concerns. It is being initiated prior to completion of the RI to expedite the site remediation and closure process by addressing the waste, which is the presumed source of contamination to other site media.

- The remedial objectives of the IRA are to limit direct exposure to waste and impacted soil and reduce the potential for contaminant migration from the waste to soil and groundwater and from soil to groundwater. The three IRA alternatives evaluated are:
- Alternative 1: No action

- Alternative 2: Full Excavation and Disposal
- Alternative 3: Full Excavation, Mechanical Screening, and Partial Disposal

Alternative 1 does not meet the objectives of the IRA and is not protective of human health and the environment. However, this alternative is provided as a basis for comparison.

The recommend alternative for the IRA is Alternative 2, Full Excavation and Disposal. Alternatives 2 and 3 are comparable in their protection of human health and the environment, compliance with applicable federal, state, and local regulations, and short-term effectiveness. The cost of Alternative 3 is expected to be marginally lower than Alternative 2; however, Alternative 3 is less favorable with regards to long-term effectiveness and permanence, reduction of toxicity, mobility, and volume, and implementability. Alternative 3 has the potential to be less effective in the long-term and may result in leaving contamination in place due to the variability of chemical concentrations in soil and the potential soil reuse. Additionally, the quantity of material that is determined to be suitable for reuse may be minimal due to stringent REC Program criteria that will need to be met. As a result, the anticipated cost savings associated with the potential reuse of the comingled soil in Alternative 3 presents a greater cost uncertainty. Therefore, the potential cost savings for Alternative 3 do not offset the uncertainties with the material reuse with regard to long-term effectiveness and permanence, reduction of toxicity, mobility, and volume, and implementability. A 30-day public comment period will be held to determine public acceptance of the recommended alternative. If public comments are received, a Responsiveness Summary addressing significant comments will be prepared and included as an attachment with the final IRAP.

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Acronyms and Abbreviations

APP	Accident Prevention Plan
bgs	below ground surface
COPC	constituents of potential concern
DPT	direct-push technology
ESCP	Erosion and Sediment Control Plan
FS	Feasibility Study
HPDTA	Harvey Point Defense Testing Activity
IDW	investigation-derived waste
IHSB	Inactive Hazardous Sites Branch
IRA	Interim Remedial Action
IRAO	Interim Remedial Action Objective
IRAP	Interim Remedial Action Plan
NAVFAC	Naval Facilities Engineering Command
NCDENR	North Carolina Department of Environment and Natural Resources
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PSRG	preliminary soil remediation goal
QAPP	Quality Assurance Project Plan
REC	Registered Environmental Consultant
RI	Remedial Investigation
RSM	Registered Site Manager
SVOC	semivolatile organic compound
VOC	volatile organic compound
yd^3	cubic yard

SECTION 1
Introduction

This Interim Remedial Action Plan (IRAP) and Preconstruction Report presents the strategy and technical approach for addressing waste and impacted soil at the Towers Road Disposal Areas, Harvey Point Defense Testing Activity (HPDTA), Hertford, North Carolina (**Figure 1**). The Towers Road Disposal Areas consists of the 2nd Street Disposal Area and 5th Street Disposal Area (**Figure 2**). This IRAP and Preconstruction Report was prepared for Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic under Contract Number N62470-11-D-8012, Contract Task Order 017, for submittal to NAVFAC Atlantic, HPDTA, and the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Waste Management, Inactive Hazardous Sites Branch (IHSB) – Registered Environmental Consultants (REC) Program.

The following objectives have been identified for this document:

- Establish Interim Remedial Action Objectives (IRAOs)
- Complete a Feasibility Study (FS) to evaluate alternatives for conducting the Interim Remedial Action (IRA)
- Select the IRA alternative and document that it is supported by the results of the FS
- Provide a statute-required opportunity for the public to comment on the proposed IRA
- Provide the details for implementation of the IRA

This IRA is "interim" because the Remedial Investigation (RI) for the site is still in progress and therefore the IRA does not address all potential site concerns. It is being initiated prior to completion of the RI to expedite the site remediation and closure process by addressing the waste, which is the presumed source of contamination to other site media.

1.1 Site Identification

The 2nd Street Disposal Area was unearthed by HPDTA on September 20, 2011. The 5th Street Disposal Area was subsequently identified as an area of concern based on employee interviews. Research concluded trash disposal reportedly occurred at two locations, the 2nd Street Disposal Area and 5th Street Disposal Area, until the early 1980s. Combined, the disposal areas were estimated to extend over 2 acres and to a depth of up to 16 feet below ground surface (bgs). Disposal practices reportedly included digging pits and burying waste, pouring diesel on waste and burning it, and possible chemical dumping (from a nearby dry cleaning facility and photography shop). The contents of the waste disposal areas are not fully documented but are reported to include paper, utensils, computer disks, broken dishes, glass, and ordnance items (not to include ammunition) and drums at the 2nd Street Disposal Area, and safes, metal cars, and polychlorinated biphenyls (PCBs) at the 5th Street Disposal Area. A PCB removal action was conducted in 1996 at the 5th Street Disposal Area to dispose of 2,544 tons of PCB-contaminated soil (OHM, 1997). Based on known site history, no munitions and explosives of concern or radiological components were disposed of at the 2nd Street Disposal Area or 5th Street Disposal Area. Information from the facility indicates the concrete pad on the north side of the 5th Street Disposal Area was used to test breaching activities using various explosive charges. The typical explosives used for the detonations include Composition Four Explosive (commonly known as C4).

A notification package was submitted to the NCDENR Division of Solid Waste Management IHSB on November 28, 2011, within 90 days of discovery.

The Towers Road Disposal Areas was established as Site identification Number NONCD0002893 under the NCDENR Division of Waste Management IHSB. An Administrative Agreement for REC-

directed voluntary assessment and remedial action was signed in April 2013. The Administrative Agreement specifies that HPDTA (the remediating party) is responsible for the assessment and remediation of the areas contaminated through previous disposal practices. HPDTA selected CH2M HILL as the REC for the Towers Road Disposal Areas. A crosswalk table (**Table 1**) provides the location in this report of information required by the REC Program Implementation Guidance (NCDENR, 2013). **Figure 3** shows a timeline of site activities, reporting, and key milestones within the REC Program.

1.2 Phase I Remedial Investigation Activities and Results

The Phase I RI was conducted to identify waste disposal areas, characterize the chemical nature of releases and disposal activities, and to collect sufficient data to establish preliminary remediation goals. The Phase I RI activities consisted of a civil survey of existing site conditions, geophysical surveys, test pitting, surface and subsurface soil sampling, groundwater monitoring well installation, groundwater sampling, and management and disposal of investigation-derived waste (IDW).

Based on the results of the geophysical survey and test pitting activities, the extent of waste at the 2nd Street Disposal Area covers approximately 0.7 acre north of Flat Run Road and 0.6 acre north of Flat Run Road at the 5th Street Disposal Area, at depths generally ranging from surficial to 6 feet (**Figures 4 and 5**). Debris consisted of both metallic and non-metallic materials including, but not limited to, metal pipes, scrap metal, bottles, brick, and logs. In an isolated location at the 2nd Street Disposal Area, unlabeled 55-gallon drums that appeared to be empty were identified at a depth of 9 to 10 feet bgs, which was below the water table (4 to 5 feet bgs), indicating there is some uncertainty with the bottom depth of the waste and that it may extend below the water table in places. The highest concentrations of constituents in soil and groundwater were generally detected in samples collected within the extent of waste identified during the geophysical surveys. In soil, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, and metals were detected at concentrations above regulatory criteria and background levels (for metals) (**Figures 6 and 7**). In groundwater, VOCs and metals at the 2nd Street Disposal Area and VOCs, SVOCs, and metals at the 5th Street Disposal Area were detected at concentrations above regulatory criteria and background levels (for metals) (**Figure 8**). The primary fate and transport mechanisms consist of the potential for leaching of constituents from buried wastes to soil, infiltration through the vadose zone to groundwater, and dissolved constituent migration downgradient with groundwater flow (advection).

At the 2nd Street Disposal Area and 5th Street Disposal Area, human exposure to waste (subsurface) and constituents in soil (surface and subsurface) and groundwater have been identified as potential concerns. There are currently no complete vapor intrusion pathways and no ecological receptors of concern. A Phase II RI is currently being planned to further evaluate soil and groundwater. During the investigation, soil and groundwater samples will be collected to establish background polycyclic aromatic hydrocarbon levels and refine the constituents of potential concern (COPCs). Surface soil and subsurface soil samples will be collected around the perimeter of the waste areas to determine the extent of the soil COPCs. Groundwater COPC delineation will be conducted in phases, first using direct-push technology (DPT) to collect samples across the sites, then installing and sampling permanent monitoring wells at locations selected based on the results of the DPT sample analysis.

SECTION 2

Remedial Action Objectives and Applicable Regulations

This section identifies the IRAOs and identifies the applicable federal, state, and local regulations for the remedial actions considered in the FS.

2.1 Interim Remedial Action Objectives

The scope of this IRA is to address waste and impacted soil within the areas shown in **Figures 4 and 5**, as well as any additional areas that are identified during the pre-excavation horizontal delineation sampling.

The IRAOs for the waste and impacted soil are as follows:

- Limit direct exposure to waste and impacted soil.
- Reduce the potential for contaminant migration from soil to groundwater and from the waste to soil and groundwater.

Based on the results of the Phase I RI, adjusted health-based and protection-of-groundwater preliminary soil remediation goals (PSRGs) were calculated, in accordance with REC guidance. The resulting adjusted health-based and protection-of-groundwater PSRGs for the Phase I COPCs are provided in **Table 2**. Industrial health-based PSRGs were calculated in the Phase I RI report but are not included in **Table 2** since the current site closure strategy is to ultimately allow for unlimited use and unrestricted exposure. In accordance with REC guidance, both the residential health-based and protection-of-groundwater PSRGs must be met for unlimited use and unrestricted exposure. The list of COPCs in **Table 2** may be reduced based on the results of the background sampling that will be completed, prior to beginning the IRA, as part of the Phase II RI activities.

2.2 Applicable Federal, State, and Local Regulations

Remedial actions carried out under the REC Program must comply with the levels of standards of control for hazardous substances, pollutants, or contaminants specified by the applicable federal, state, and local environmental regulations and state facility-siting regulations, unless waivers are obtained. The applicable federal, state, and local environmental regulations and state facility-siting regulations are provided in **Appendix A**. The alternatives developed in the FS contained in this IRAP were analyzed for compliance with the applicable federal, state, and local environmental regulations and state facility-siting regulations provided in **Appendix A**. Achieving compliance with the applicable federal, state, and local environmental regulations and state facility-siting regulations provided in **Appendix A** would not require any waivers.

SECTION 3

Development of Remedial Alternatives

General response actions are broad responses, remedies, or technologies developed to meet site-specific IRAOs and address COPCs, migration pathways, and exposure routes. The general response actions listed as follows have been considered for the remediation of the Towers Road Disposal Areas:

- No Action – Baseline for evaluation of the response actions.
- *In situ* Treatment – Methods of reducing the toxicity, mobility, volume, or mass of contaminants. Treatment technologies include biological, chemical, or thermal processes.
- Containment – Methods to reduce the exposure to and/or mobility of contaminants. Containment technologies can be biological, physical, or chemical in nature.
- Removal – Reduces or removes the volume of contaminants.
- Administrative and Engineering Controls – Administrative land use controls include activities such as restricting land use through deed or access restrictions and regulations promulgated to require a permit for various activities (such as excavation). Engineering controls physically limit access or land use on a property or exposure to contaminated media through engineered structures.

3.1 Screening of Remedial Technologies

Technologies were screened prior to developing potential remedial alternatives to address waste and impacted soil at the Towers Road Disposal Areas. The screening process incorporated NAVFAC's preference to select a remedy that would minimize impacts to current land use, meet proposed IRAOs, and be consistent with the facility's long-term plan to allow unrestricted use of the site. Technologies were divided into process options and screened out for a variety of reasons depending on their effectiveness, implementability, and costs. **Table 3** summarizes the screening process. For the waste and soil, the following were retained:

- **No Action** – Retained for baseline comparison.
- **Full Excavation and Disposal** – Retained for the excavation and offsite disposal of waste and soil (impacted and comingled) based on its effectiveness in removing contaminant mass and reducing toxicity in a short timeframe.
- **Full Excavation, Mechanical Screening, and Partial Disposal** – Retained for the excavation and offsite disposal of waste and impacted soil based on its effectiveness in removing contaminant mass and reducing toxicity in a short timeframe, while minimizing offsite disposal through the reuse of comingled soil and more extensive material separation and characterization.

3.2 Description of Remedial Alternatives

3.2.1 Alternative 1: No Action

Alternative 1 is the no-action alternative. Under this scenario, no remedial action would be taken at the Towers Road Disposal Areas, and waste and contaminants in the soil would remain in place. Alternative 1 is required as a baseline for comparison of alternatives.

3.2.2 Alternative 2: Full Excavation and Disposal

Alternative 2 consists of the excavation and offsite transportation and disposal of waste, impacted soil (soil intermixed with or in the vicinity of the waste that exceeds the PSRGs), and comingled soil

(soil intermixed with or in the vicinity of the waste that does not exceed the PSRGs) at a Subtitle D disposal facility. Supporting activities, such as erosion and sediment control installation, clearing, geophysical and topographic surveying, confirmation sampling, and site restoration, are included.

For estimating purposes, the excavation depths were broken down into 50-x-50-foot grids to calculate the volume of material to be removed (**Figures 4 and 5**). The total volume of excavated waste, impacted soil, and comingled soil is estimated at 9,300 in-place cubic yards (yd^3). The cost estimate assumed that 25 percent, by volume, of excavated material will be waste. It also assumed that 25 percent of the confirmation samples will exceed the PSRGs and those areas will require an additional 1 foot of wall excavation and 0.5 foot of floor excavation. It is assumed that the excavation depth for the additional removal extent will be 4 feet. The additional excavation is assumed to generate approximately 390 yd^3 (included in the 9,300 in-place yd^3 total).The excavation and loading and backfill and restoration production rates are assumed to be 550 yd^3 per day and the transportation and disposal production rate is assumed to be 580 tons per day. It is anticipated that approximately 10,300 loose yd^3 of general backfill and 1,300 loose yd^3 of topsoil backfill material will be imported to restore the site to the pre-excavation elevations, assuming 25 percent extra to account for compaction during placement. **Figures 4 and 5** illustrate the estimated limits of the excavation and restoration areas, and **Figures 9 and 10** illustrate cross-sections of the excavation areas.

3.2.3 Alternative 3: Full Excavation, Mechanical Screening, and Partial Disposal

Alternative 3 is similar to Alternative 2. The primary difference is that excavated material will be mechanically screened to separate the soil from the waste for potential re-use. Alternative 3 includes the excavation of all of the waste and intermixed soil, mechanical screening to separate waste and soil, and offsite transportation and disposal of waste and impacted soil. The determination of whether or not soil is “impacted” will be made through sampling, analysis, and comparison to the PSRGs. Soil that does not exceed the PSRGs is considered suitable for reuse as backfill material (comingled soil) onsite. Supporting activities, such as erosion and sediment control installation, clearing, geophysical and topographic surveying, confirmation sampling, and site restoration, are included.

For estimating purposes, the excavation depths were broken down into 50-x-50-foot grids to calculate the volume of material to be removed (**Figures 4 and 5**). The total volume of excavated waste, impacted soil, and comingled soil is estimated at 9,300 in-place yd^3. The cost estimate assumed that 25 percent, by volume, of excavated material will be waste and 25 percent, by volume, of the excavated material will be comingled soil which will be suitable for re-use as backfill material. It also assumed that 25 percent of the confirmation samples will exceed the PSRGs and those areas will require an additional 1 foot of wall excavation and 0.5 foot of floor excavation. It is assumed that the excavation depth for the additional removal extent will be 4 feet. The additional excavation is assumed to generate approximately 390 yd^3 (included in 9,300 in-place yd^3 total). The excavation and loading production rate is assumed to be 250 yd^3 per day to account for the additional time required to mechanically screen the excavated material, as well as the additional material handling time associated with sorting the comingled soil from the impacted soil. The backfilling and site restoration production rate is assumed to be 550 yd^3 per day and the transportation and disposal production rate is assumed to be 580 tons per day. It is anticipated that approximately 8,100 loose yd^3 of general backfill and 1,300 loose yd^3 of topsoil backfill material will be imported to restore the site to the pre-excavation elevations. **Figures 4 and 5** illustrate the estimated limits of the excavation and restoration areas and **Figures 9 and 10** illustrate cross-sections of the excavation areas.

SECTION 4

Detailed Evaluation of Remedial Alternatives

In this section, the alternatives developed in the previous section are evaluated to provide a basis for selecting a remedy. Section 4.1 discusses the criteria used to evaluate the alternatives and Section 4.2 summarizes the evaluations of the alternatives.

4.1 Evaluation Criteria

Each remedial alternative that has been developed for the Towers Road Disposal Areas was evaluated with respect to the REC Program FS criteria and to one another. The purpose of this comparative analysis is to identify the relative advantages and disadvantages of each alternative and identify the best balance of trade-offs for remedy selection. The FS criteria used in the comparative analysis are as follows:

- Protection of human health and the environment, including attainment of cleanup levels
- Compliance with applicable federal, state, and local regulations
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Short-term effectiveness – that is, effectiveness at minimizing the impact of the site remedial action on the environment and local community
- Implementability – that is, technical and logistical feasibility, including an estimate of time required for completion
- Cost
- Community acceptance

4.2 Evaluation of Remedial Alternatives

Table 4 provides a summary of the alternative analysis with respect to the previously listed FS criteria. **Appendix B** provides cost-estimate details pertaining to each alternative discussed in the following sections.

4.3 Comparative Analysis of Remedial Alternatives

This section provides a comparative analysis of the remedial alternatives to assist in the decision-making process by which an alternative will be selected. From this analysis, it should become clear which alternative is preferable in each category and, consequently, which will be selected for implementation at the Towers Road Disposal Areas. **Table 5** summarizes the results of the alternative comparison.

4.3.1 Protection of Human Health and the Environment

All alternatives, with the exception of the Alternative 1, are protective of human health and the environment. Alternatives 2 and 3 result in the removal of waste and impacted soil from the site, thereby eliminating exposure to the waste streams.

4.3.2 Compliance with Applicable Regulations

All alternatives, with the exception of Alternative 1, are expected to comply with applicable federal, state, and local regulations. The applicable federal, state, and local regulations associated with the

alternatives are summarized in **Appendix A**. The alternatives would not require a waiver to ensure compliance. A state and/or county stormwater management permit is not required as a result of the IRA activities not creating any impervious surfaces. Compliance with the applicable regulations will be achieved through implementation of the approved erosion and sediment control plan (ESCP) (**Appendix C**) and ensuring the following:

- Prohibition of the destruction of the birds, nests, or eggs by site operations
- Onsite fuel and oil storage will not exceed 1,320 gallons
- Soil cleanup goals will be in accordance with the REC Program PSRGs
- Proper management, storage, characterization, transportation, and disposal of waste, both hazardous and non-hazardous, generated during the IRA

4.3.3 Long-term Effectiveness and Permanence

Once IRAOs are achieved, Alternative 1 has the highest magnitude of residual risk because it would not achieve the IRAOs. Alternative 3 has a higher magnitude than Alternative 2 of the potential for residual risks. The greater potential for residual risks is due to the potential of reusing site soil. Although testing will be performed to determine whether soil is suitable for reuse (comingled soil), variability in chemical concentrations in soil is expected. Composite samples would be collected to minimize the uncertainty associated with the variability of chemical concentrations; however, it is possible that soil classified for reuse could contain pockets of soil with higher chemical concentrations. Alternatives 2 and 3 would not require any additional engineering, planning, and/or implementation controls to monitor the continued effectiveness following completion of the IRA due to the removal of waste and impacted soil. Alternative 1 would leave the waste and impacted soil onsite and would have no controls in place to monitor site conditions.

4.3.4 Reduction in Toxicity, Mobility, and Volume

Alternative 1 does not result in the reduction in toxicity, mobility, and volume as the waste and impacted soil will remain onsite. Alternatives 2 and 3 are similarly effective in reducing toxicity, mobility, and volume as both alternatives result in the removal and offsite disposal of waste and impacted soil. However, Alternative 3 has a slightly higher potential for leaving contamination in place through the re-use of material. As discussed in Section 4.3.3, it is possible that soil that is re-used (comingled soil) could have pockets of soil with higher chemical concentrations that are not identified through the composite sampling and analysis.

4.3.5 Short-term Effectiveness

Alternative 1 would not involve any activities that would affect the community. Alternatives 2 and 3 have similar impacts to the community during implementation due to increased truck traffic passing through communities and traveling on public roads and highways as waste and impacted soil are transported offsite and fill material are transported to the site, though the material quantities are anticipated to be slightly lower for Alternative 3 than Alternative 2. Alternative 1 is the most protective of workers as it would not include any activities involving workers. Alternatives 2 and 3 have equal impacts on workers and, given the appropriate training and personal protective equipment (PPE), as well as implementation of health and safety programs, each alternative is protective of workers during construction. With the exception of Alternative 1, each alternative poses a potential environmental impact due to transportation of equipment, operation of equipment, and residual handling. Alternative 3 allows for the potential site reuse of comingled soil, which would decrease the quantity of soil that is disposed of offsite and fill material needed to be brought onsite; however, it requires more equipment use for material separation than

Alternative 2. Therefore, Alternatives 2 and 3 are very similar with regards to potential environmental impacts.

4.3.6 Implementability

Alternative 1 involves no action and therefore is easy to implement. However, it has the longest remedial timeframe of the alternatives since no area treatment or excavation of the potential source (that is, waste) is being conducted.

Alternatives 2 and 3 are technically and logistically feasible, and resources for implementing the alternatives are readily available. Alternatives 2 and 3 can be accomplished utilizing standard construction methods and readily available resources. However, Alternative 3 is more difficult to implement than Alternative 2 as it will require mechanical screening of the excavated material to separate the waste and soil, which will require construction of an onsite material staging area and additional material handling and sampling to separate the comingled soil from the impacted soil. Additionally, the REC Program PSRGs are relatively low and chemicals may be naturally present at concentrations that exceed them; therefore, limited soil may qualify for re-use. Alternative 3 will also result in a slower production rate during excavation activities due to the need to mechanically screen and test the excavated material and keep the impacted soil, comingled soil, and waste separated. Alternatives 2 and 3 would achieve the IRAOs in a moderate period of time with Alternative 2 being completed in a shorter timeframe.

4.3.7 Cost

Alternative 1 has no cost and is therefore the least expensive. The cost estimate for Alternatives 2 and 3 are provided in **Appendix B** and summarized in **Table 5**. Alternative 2 is estimated at $1,274,000 (-30 percent = $892,000; +50 percent = $1,911,000) and Alternative 3 is estimated at $1,334,000 (-30 percent = $934,000; +50 percent = $2,001,000).

4.3.8 Community Acceptance

A 30-day public comment period will be held to determine public acceptance of the recommended alternative. At the end of the public comment period, any comments from the public regarding the IRAP will be addressed.

4.4 Recommended Remedial Action Alternative and Justification

The recommend alternative for the IRA is Alternative 2, Full Excavation and Disposal. Alternatives 2 and 3 are comparable in their protection of human health and the environment, compliance with applicable federal, state, and local regulations, and short-term effectiveness. The cost of Alternative 3 is expected to be marginally lower than Alternative 2; however, Alternative 3 is less favorable with regards to long-term effectiveness and permanence, reduction of toxicity, mobility, and volume, and implementability. Alternative 3 has the potential to be less effective in the long-term and may result in leaving contamination in place due to the variability of chemical concentrations in soil and the potential soil reuse. Additionally, the quantity of material that is determined to be suitable for reuse may be minimal due to the conservative soil screening criteria that will need to be met. As a result, the anticipated cost savings associated with the potential reuse of the comingled soil in Alternative 3 presents a greater cost uncertainty. Therefore, the potential cost savings for Alternative 3 do not offset the uncertainties with the material reuse with regard to long-term effectiveness and permanence, reduction of toxicity, mobility and volume, and implementability.

4.5 Proposed Treatability Studies and Additional Site Characterization

The selected remedial action alternative does not require any treatability studies. Additional site characterization will be conducted as part of the Phase II RI activities and will be initiated prior to the start of IRA activities. The additional site characterization will include background sampling and pre-excavation horizontal delineation sampling. The background sampling results will be used to potentially reduce the list of COPCs in **Table 2** and the pre-excavation delineation sampling will be used to further evaluate the horizontal limits of the removal areas. The results of the background sampling and pre-excavation horizontal delineation sampling will be documented in the Phase II RI Report and incorporated in the IRA Construction Closeout Completion/Interim Remedial Action Report.

4.6 Protection of Surrounding Community

Based on the site location within the secure facility boundary and the protective measures that will be implemented, as described in this work plan and the Accident Prevention Plan (APP) (CH2M HILL, 2014a), there is no anticipated impact to the surrounding community from exposure to site contaminants during this investigation. Any waste transported offsite will be managed properly as described in Section 5.

SECTION 5

Interim Remedial Action Activities

All activities associated with the scope of work for the IRA will be in accordance with the approved site-specific Towers Road Disposal Area APP (CH2M HILL, 2014a). This section discusses the activities needed to complete the IRA in accordance with Program Implementation Guidance (NCDENR, 2013). The project schedule is presented on **Figure 11**.

5.1 Mobilization and Site Setup

Construction personnel, equipment, and materials will mobilize to the site to complete the project. Initially, key individuals will mobilize to receive equipment essential to complete the project activities. The support areas for the site, including sanitation facilities, a fuel and oil storage area, and material storage areas, will be setup at locations approved by the HPDTA Environmental Manager. Onsite fuel and oil storage will not exceed 1,320 gallons.

CH2M HILL will coordinate with the HPDTA Environmental Manager for access to the facility and to nearby buildings for office space. Additional personnel and equipment will mobilize to the site based on task resource demands, and will be subsequently released from the project when work assignments are completed. It is anticipated that a security escort will accompany CH2M HILL personnel and subcontractors at all times in each work area. CH2M HILL will communicate daily work plans to HPDTA on an ongoing basis to support security resource needs determinations and planning. The site escort will determine the appropriate route for trucks and equipment. Traffic control measures will be implemented in accordance with the APP (CH2M HILL, 2014a).

5.2 Site Preparation

5.2.1 Utility Location

Prior to conducting any intrusive work, a subsurface utility location will be completed to locate and mark out any underground utilities within the estimated boundaries of the 2nd Street Disposal Area and 5th Street Disposal Area and a surrounding buffer, to be conservative, in accordance with the applicable utility locating standard operating procedure (**Appendix D**). Utilities will be identified using non-intrusive subsurface detection equipment (magnetometers, ground penetrating radar, or similar devices), as well as opening manhole covers to verify pipe direction. Utilities will be marked on the ground with survey marking paint, or any other means necessary to ensure the safety of drilling, test pitting, and sampling personnel and the protection of the facility infrastructure.

5.2.2 Erosion and Sediment Control

Erosion and sediment controls will be installed for Alternatives 2 and 3. The IRA is anticipated to disturb approximately 1.3 acres (0.7 acre at the 2nd Street Disposal Area and 0.6 acre at the 5th Street Disposal Area). The previously submitted and approved ESCP (**Appendix C**) will be utilized for the IRA. The existing erosion and sediment controls will be inspected and repaired and/or re-installed, as necessary, prior to conducting any intrusive work, in accordance with the approved ESCP. All erosion and sediment controls will be established, inspected, and maintained as indicated in the approved ESCP and in accordance with the *North Carolina Erosion and Sediment Control Planning and Design Manual* (NCDENR et al., 2013) and North Carolina Sedimentation Pollution Control Act of 1973. Inspections of the erosion and sediment control measures will be performed after each run-off-producing rain event or at least once weekly, as specified in the approved ESCP, and documented on the Storm Water Pollution Prevention checklist (**Appendix E**). The inspections will

be completed by either a representative of CH2M HILL, the HPDTA Environmental Manager, or someone designated by the HPDTA Environmental Manager.

5.2.3 Vegetation Clearance

Vegetation clearance was completed as part of the Phase I RI. Additional clearing may be required and consists of selected removal of brush and small trees to within 6 inches of the ground surface, if necessary, to complete excavation activities. The cleared vegetation will be placed outside of the excavation area but within the boundaries of the erosion and sediment controls.

5.2.4 Materials Handling Area

A materials handling area will be constructed to stage material (such as excavated soil and debris) prior to offsite disposal. The location of the material handling area will be approved by the HPDTA Environmental Manager prior to construction. The materials handling area will be constructed in accordance with the ESCP (**Appendix C**) and will include a berm of hay bales overlain with 10-millimeter (minimum) polyethylene sheeting. Rather than install the material handling area at the location shown in the ESCP, the preferred location for the materials handling area is on the concrete pad on the north side of Flat Run Road at the 5th Street Disposal Area. This would keep the soil within the investigation area and would not require any vegetation clearance. If the material handling area needs to be constructed outside of the investigation area this would not require any additional permitting or create a Resource Conservation and Recovery Act-regulated waste pile based on the assumption that the material is non-hazardous and would be staged temporarily in preparation for offsite disposal. Excavated material that requires dewatering will be handled in accordance with the Excavation and Dewatering Controls section.

5.3 Excavation

Waste and soil within the removal areas, that were preliminarily delineated during the Phase I RI, will be excavated. The 2nd Street Disposal Area covers approximately 0.7 acre north of Flat Run Road (**Figure 4**) and at the 5th Street Disposal Area covers approximately 0.6 acre north of Flat Run Road (**Figure 5**). Based on the Phase I RI, waste at both the 2nd Street Disposal Area and the 5th Street Area is expected to range in thickness from surficial to 6 feet and ends near or above the water table (4 to 5 feet bgs). However, because of the empty drums encountered at a depth of 9 feet at the 2nd Street Disposal Area, it is anticipated that at least some of the waste will extend below the water table.

5.3.1 Excavation Extent

The horizontal and vertical extent of the excavation will be determined using the following methods:

- **Phase II RI soil sample results –** Additional pre-excavation horizontal delineation will be completed, prior to beginning the IRA, as part of Phase II RI activities. The minimum horizontal limits will be adjusted based on the Phase II RI pre-excavation delineation sample results.
- **Visual inspection –** The excavation will continue until all visible waste is removed. If the waste extends beyond the horizontal limits defined based on the Phase I RI and Phase II RI soil sample results, excavation will continue. Field personnel will continually observe the excavation to determine the visual extent of the waste.
- **Geophysical Surveying –** After the waste is removed to the visible limits, geophysical surveying will be completed across the excavation floor in an attempt to determine whether any suspected buried debris remains at depths below the excavation floor (**Appendix F**). This survey will be performed because of the empty drums encountered at 9 to 10 feet bgs at the 2nd Street Disposal Area. In that area, no waste was observed in the shallower depth interval,

indicating that waste may have been buried under soil. The results of the geophysical survey will be utilized to assist in determining if waste has been removed. If geophysical anomalies are identified, additional excavation will be performed to identify the source of the anomaly and, if it is determined to be waste, to remove it.

- **Confirmation Sampling –** Wall and potentially floor confirmation samples will be collected to confirm the horizontal and vertical extent of the excavations is sufficient after the geophysical survey is completed and waste is removed. Confirmation samples will be collected and analyzed for the COPCs, of which the preliminary list is included in **Table 2.** The COPCs may be reduced following completion of the Phase II RI background sampling.

To delineate the horizontal extent of contamination, wall samples will be collected approximately every 75 linear feet along the excavation perimeter. To delineate the vertical extent of contamination, floor confirmation samples will be collected based on 50-x-50-foot grids. However, if the floor of the excavation in a grid is at or below the water table and the soil is saturated, floor confirmation samples will not be collected in that grid. The proposed confirmation sampling locations are shown on **Figures 12** and **13,** but are subject to change based on the actual limits of the excavation area.

The confirmation sample results will be analyzed for the COPCs on an expedited turn-around time (7 days) to prevent production delays in the IRA activities and screened against the PSRGs (**Table 2**) in accordance with the Quality Assurance Project Plan (QAPP) (**Appendix G**). If all of the concentrations from the confirmation samples do not meet the PSRGs, additional removal and confirmation sampling may be required. If the results of a wall sample exceed the PSRGs, additional removal will consist of excavating 1 foot of material from the midpoint of the horizontal distance between the failed wall sample and the next passing wall sample on both sides of the failing wall sample followed by re-sampling. If the results of a floor sample exceed the PSRGs and the excavation floor is above the water table, 0.5 foot within the 50-x-50-foot grid for a failing floor sample will be excavated followed by re-sampling. If all waste and signs of contamination have been removed and soil results continue to exceed the PSRGs, it is possible that the chemicals are naturally present. The results will be evaluated by the REC Registered Site Manager (RSM), HPDTA Environmental Manager, and NAVFAC Remedial Project Manager with consideration of the type, frequency, and magnitude of the PSRG exceedances, and concurrence from NCDENR to stop excavation will be solicited.

5.3.2 Excavation Dewatering and Controls

To the extent possible, the IRA excavation will occur in a manner to allow the site to serve as its own detention basin and nuisance water encountered during excavation will be handled within the excavation. The primary mechanisms for draining nuisance water will be infiltration through the sidewalls and bottom of the excavation and creating berms and diversions within the excavation area to direct water.

Materials excavated from below the current water table at the time of the excavation may require dewatering. Excavated material will be stockpiled within the excavation, on a ground surface above the water table, and allowed to decant; it is anticipated that no dewatering additives will be necessary to sufficiently solidify the material prior to offsite disposal. The decant water will be allowed to infiltrate back into the ground within the excavation area. In the event extremely dry conditions are evident, dust control measures will be implemented to minimize visible dust emissions and will utilize street sweepers to remove soils from site roadways.

5.4 Waste Characterization, Transportation, and Disposal

Excavated material will be characterized, managed, and disposed of in accordance with all applicable regulations (**Appendix A**).

In general, wastes generated during the course of the project will be assessed to determine proper handling and final disposition through sampling and laboratory analysis. The exceptions are uncontaminated wastes (no contact with contaminated media or remediation chemicals) and trash. Samples of these waste streams will be taken and analyzed only if appropriate.

Environmental media will be analyzed for VOCs, SVOCs, metals, herbicides, and pesticides using the toxicity characteristic leaching procedure, ignitability, and corrosivity, along with any additional chemical analysis required by the disposal facility. Waste characterization samples will be collected at a rate of 1 sample per every 500 yd^3 of material excavated unless the disposal facility requires a more stringent sampling frequency. Samples will be collected in accordance with the general procedures in the QAPP (**Appendix G**) and sent to a contracted laboratory for analyses. The results will be reviewed by CH2M HILL and then forwarded to the HPDTA Environmental Manager and NAVFAC Remedial Project Manager for review, for comparison to hazardous waste criteria and transport, storage, and disposal facility acceptance criteria to determine whether the material is non-hazardous or hazardous and to ensure that the material meets the disposal facility requirements. The waste profile and manifest will be reviewed and signed by an HPDTA representative prior to any material being transported offsite.

Excavated materials will be loaded, either directly from the excavation area or from the materials handling area, into haul trucks and transported to an offsite facility for disposal. All material must be able to pass the paint filter test prior to being loaded into offsite haul trucks; material that is too wet will be handled in accordance with the Excavation and Dewatering Controls section. Each hauling vehicle will be filled to less than the maximum hauling capacity to avoid spillage on site and public roads.

5.5 Equipment Decontamination

All equipment involved in IRA activities will be decontaminated prior to being used for backfilling the site, if applicable, and before leaving the excavation areas. Dry decontamination methods, consisting of removing all excess soil from the heavy equipment will be utilized as the first means of equipment decontamination. For any remaining soil that cannot be removed via dry decontamination methods, the equipment will be decontaminated using high-pressure, low-volume steam cleaning at a designated staging area. Decontamination fluids will be contained in 55-gallon drums for staging and subsequent disposal.

Because samples will be collected with disposable equipment, sampling equipment decontamination will not be necessary. Disposable sampling equipment, including PPE and paper towels, will be disposed of as solid waste at the HPDTA waste management and recycling center. Excess soil will be placed in the material handling area with the stockpiled soil from the removal area.

5.6 Backfill and Restoration

5.6.1 Post-excavation Topographic Survey

Following completion of the excavation activities, a topographic survey of the site will be completed, under the direction of a professional land surveyor registered and in good standing in the state of North Carolina, to capture the lateral and vertical extent of the IRA. A topographic map at a scale of 1 inch = 50 feet with 1-foot contour intervals will be prepared and will document, at a

minimum, benchmarks, buildings, roads, all perennial and non-perennial surface water features, drainage ditches, dense vegetation, and storage vessels.

5.6.2 Placement of Backfill and Site Restoration

After confirming that the PSRGs have been achieved by the excavation activities through both visual observation and confirmation sampling and that the final excavation extent and depth has been surveyed to document the removal action, CH2M HILL will confer with the NAVFAC and HPDTA representative(s) to begin backfilling operations.

There is no known onsite borrow source. Therefore, it is assumed that all fill material will be brought from offsite. It is anticipated that approximately 10,300 loose yd^3 of general backfill and 1,300 loose yd^3 of topsoil backfill material will be required to restore the site to the pre-excavation elevations.

All backfill material, general fill, and topsoil will be delivered to the site from an offsite source that has been sampled to ensure that the backfill material is certified as clean through analytical testing for VOCs, SVOCs, pesticides, PCBs, and metals, and comparison to NCDENR PSRG Table values (http://portal.ncdenr.org/c/document_library/get_file?uuid=5539ecfb-739f-4345-9459-b514508135f1&groupId=38361) and maximum background subsurface soil values. Both health-based and protection-of-groundwater PSRGs will be used for the comparison of the selected offsite source.

The removal areas will be backfilled to the pre-excavation elevations. General fill will be used to bring the grade to within 6 inches of the final grade, followed by the placement of a 6-inch topsoil layer to support vegetation growth. The general fill will be placed in loose 10- to 12- inch lifts and will be compacted with a minimum of three passes of the placing equipment or until there are no visible signs of rutting, pumping, or displacement of soil due to soft areas. Compaction of topsoil will be incidental to its placement and spreading into the excavation by the equipment.

Grade stakes will be placed throughout the removal area to allow the site personnel performing the backfill activities to see the final elevations at the site. The grade stakes will be surveyed and marked to show the top of the general fill layer and the top of the topsoil layer and final grade. A topographic survey of the site will be conducted as part of the Phase II RI. Once the backfill activities are completed and confirmed to be consistent with pre-existing grade, vegetative stabilization will be conducted in accordance with the approved ESCP (**Appendix C**) and will consist of the application of seed and straw to all disturbed areas.

5.7 Demobilization

In preparation for demobilization, all equipment will be decontaminated and area clean-up activities will occur. All support equipment, staging areas, waste materials, and heavy equipment will be removed. All equipment will be free of solid material(s) and decontaminated prior to demobilization. The material processing area will be removed, and the area will be seeded in accordance with the ESCP (**Appendix C**). Following completion of the IRA, an inspection of the site will be conducted by HPDTA. Once HPDTA has approved of the current site conditions, all materials used during the performance of the IRA will be removed and properly disposed offsite. Upon approval from HPDTA that final site stabilization has been achieved, erosion and sediment controls will be removed and disposed offsite.

5.8 Reporting

At the conclusion of IRA field activities, a combined IRA Construction Closeout Completion/ Interim Remedial Action Report will be prepared. This report will include a survey of the excavation limits and confirmation sample results, summarize major variances from this plan, summarize any problems encountered during construction, summarize the IRA and project costs, and provide details regarding the management of excavated material and IDW.

The draft report will be distributed for NAVFAC and HPDTA review within 90 days of the final inspection. Once comments are received and resolved, final versions of the report will be prepared and submitted to NCDENR within 30 days of completion (that is, within 30 days of certification by the RSM). Remedial actions for waste and soil are required to be initiated within 8 years of the effective date of the REC Administrative Agreement.

SECTION 6

References

This Section lists the documents consulted in the preparation of this report; not all references included herein are specifically cited in the text.

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OHM. 1997. Contractor's Closeout Report for Remediation of PCB-Contaminated Soil at Range Areas A, B and D, Harvey Point Defense Testing Activity, Hertford, North Carolina. May

Pyramid Environmental & Engineering, P.C. (PEE). 1999. Comprehensive Site Assessment Report, Department of Defense, HPDTA – Building 3-1, 2835 Harvey Point Road, Hertford, Perquimans County, NC. September.

Tables

TABLE 1

Crosswalk to Required Information

Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report

Harvey Point Defense Testing Activity

Hertford, North Carolina

REC Program Rules	Required Information	Location in this IRAP and Preconstruction Report
15A NCAC 13C .0306(j)	Public Notice	Section 4.3.8
15A NCAC 13C .0306(l)(1)	RI Results	Section 1.2
15A NCAC 13C .0306(l)(2)	Remedial Action Objectives	Section 2.1
15A NCAC 13C .0306(l)(3)	Feasibility Study	Sections 3 and 4
15A NCAC 13C .0306(l)	Branch Concurrence is Required for the Following Proposed Remedies*	not applicable*
15A NCAC 13C .0306(l)(4)	Detailed Description of Proposed Remedy	Section 3.2.2
15A NCAC 13C .0306(l)(5)	Justification for Selection of Proposed Remedy	Section 4.4
15A NCAC 13C .0306(l)(6)	Activities Necessary for Implementation	Section 5
15A NCAC 13C .0306(l)(7)	Proposed Treatability Studies and Additional Site Characterization	Section 4.5
15A NCAC 13C .0306(l)(8)	Procedures and Schedule for Remedial Action	Section 5 and Figure 8
15A NCAC 13C .0306(l)(9)	Proposed Criteria for Remedial Action Completion	Section 5.3.1
15A NCAC 13C .0306(l)(10)	Community Health and Safety Plan	Section 6.2.11
15A NCAC 13C .0306(l)(11)	Decontamination Procedures	Section 5.5
15A NCAC 13C .0306(q)	Removal of Hazardous Waste from Site	Section 6.2
15A NCAC 13C .0306(m)(1)	Treatability Studies and Site Characterization	Section 4.5
15A NCAC 13C .0306(m)(2)	Final Engineering Design Report	Section 5 and Figures 4 and 5
15A NCAC 13C .0306(m)(3)	Permits and Approvals	Appendices A and D

Note:

*Regulation 15A NCAC 13C .0306(l) is not applicable since the proposed remedy is not (1) conducted entirely onsite and a permit waiver is desired under N.C.G.S. 130A-310.3(e); (2) onsite containment or capping, including land-use restrictions; or (3) an exceedance of $3 million cost.

TABLE 2

Preliminary Soil Remediation Goals

Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report

Harvey Point Defense Testing Activity

Hertford, North Carolina

Chemicals of Potential Concern[1]	2nd Street Disposal Area		5th Street Disposal Area	
	Protection of Groundwater Soil Remediation Goal (mg/kg)	Adjusted Residential Health-Based Soil Remediation Goal (mg/kg)	Protection of Groundwater Soil Remediation Goal (mg/kg)	Adjusted Residential Health-Based Soil Remediation Goal (mg/kg)
VOCs				
1,2,3-Trichlorobenzene				10
1,2,4-Trichlorobenzene			2.2	60
1,3-Dichlorobenzene			2.4	
1,4-Dichlorobenzene			0.07	13.3
Benzene		7.3	0.01	8.5
Bromomethane		3.8		
Carbon disulfide				800
Chlorobenzene			0.43	58
Chloroform		1.9		
Chloromethane		24		
Cyclohexane				600
Dichlorodifluoromethane (Freon-12)	29	19	29	24
Ethylbenzene		36		30
Isopropylbenzene		270	1.3	270
m- and p-Xylene		120		150
Methane				
Methyl Acetate				16,000
Methylene chloride				70
Methyl-tert-butyl ether (MTBE)				
o-Xylene		140		
Styrene		870		870
Toluene		820	5.5	820
Trichlorofluoromethane (Freon-11)	24	160		
Xylene, total		130		
SVOCs				
2-Methylnaphthalene		230		
Acenaphthene		680		1,133
Acenaphthylene		340		340
Anthracene		17,000	660	17,000
Benzo(a)anthracene		1		1.2
Benzo(a)pyrene		0.1		0.1
Benzo(b)fluoranthene		1		1.2
Benzo(g,h,i)perylene		340		340
Benzo(k)fluoranthene		10		11.5
Carbazole				187
Chrysene		100		115
Dibenz(a,h)anthracene		0.1		0.12
Dibenzofuran		16		80
Fluoranthene		460		460
Fluorene		460	56	460
Indeno(1,2,3-cd)pyrene		1		1.15
Naphthalene		24		
Phenanthrene		340		340
Pyrene		340		340
Pesticide				
4,4'-DDD				11
PCBs				
Aroclor-1254		1		1
Aroclor-1260		1		1

TABLE 2

Preliminary Soil Remediation Goals

Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report

Harvey Point Defense Testing Activity

Hertford, North Carolina

Chemicals of Potential Concern[1]	2nd Street Disposal Area		5th Street Disposal Area	
	Protection of Groundwater Soil Remediation Goal (mg/kg)	Adjusted Residential Health-Based Soil Remediation Goal (mg/kg)	Protection of Groundwater Soil Remediation Goal (mg/kg)	Adjusted Residential Health-Based Soil Remediation Goal (mg/kg)
Metals				
Antimony	0.9	7.8		6.20
Arsenic	5.8	4.7	5.8	4.7
Barium		3,000	580	3,000
Cadmium		14		14
Chromium		120,000	360,000	120,000
Cobalt	**4.6**	23	**4.6**	12
Copper		1,550		
Iron		27,500	150	55,000
Lead		400	270	400
Manganese	**412**	1,800		
Mercury		23		23
Nickel		750	130	375
Silver		195		195
Vanadium		78		
Zinc	1,200	4,600	1,200	4,600

Notes:

[1] COPCs have been preliminarily identified based on the Phase I Remedial Investigation results. Additional background data is being collected in association with the Phase II Remedial Investigation and will be used to refine the COPCs list prior to implementation of this IRA.

Gray cells - No applicable criterion; not a media COPC or Protection of Groundwater SRG does not apply

Bold - Value is maximum background concentration rather than regulatory standard because metal is naturally-present

Source: CH2M HILL. 2014b. Final Phase I Remedial Investigation Report, Towers Road Disposal Area, Harvey Point Defense Testing Activity, Hertford, North Carolina. September.

TABLE 3
Screening of Remedial Technologies
Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report
Harvey Point Defense Testing Activity
Hertford, North Carolina

General Response Actions	Remedial Technology	Process Options	Descriptions	**Effectiveness** Protection of Human Health and the Environment Compliance with Applicable Federal, State, and Local Regulations Short-Term Effectiveness Long-Term Effectiveness and Permanence Reduction of Toxicity, Mobility, and Volume	**Implementability** Technical Implementability Administrative Implementability	Relative Cost Range	Primary Screening		
							Retain	Reject	Screening Comment
No Action	None	None	No action. May result in reduced contaminant concentrations over time as a result of naturally occurring processes.	**Low** • Ineffective in preventing contact with waste which is considered the primary contributor to the site contamination. • No evidence of natural degradation processes exists and time to achieve IRAOs may be decades or more. • Short-term risks to human health and environment from exposure to COPCs in site media until IRAOs are achieved. • Waste and impacted soil remain in place which is not protective of human health and the environment, does not comply with applicable regulations, provide short- and long-term protection, or result in the reduction of toxicity, mobility, and volume.	**High** No work required, so easily implementable.	**No Cost**	X		Retained for baseline comparison.
In Situ Treatment	Physical Treatment	Stabilization/ Solidification	Solidifying or stabilizing agents are mixed with contaminated soil to physically or chemically bind contaminants.	**Low to Moderate** • Not effective for waste. • Effective for inorganics. • Effectiveness for VOC, SVOCs, and pesticides may be minimal; leachability testing would be required to assess. • Excavation (required prior to solidification/ stabilization to remove waste) presents a short-term risk to site workers who may be exposed to contaminants.	**Low to Moderate** • Buried waste must be removed prior to mixing in stabilization/solidification materials. • Solidified soil may inhibit future site use since intrusive constructions activities would be very difficult to implement. • Reagent delivery and soil mixing can be difficult.	**High** • High cost associated with excavation of waste. • Additional costs for soil mixing and stabilizing/solidifying materials.		X	Rejected. Technology has high cost, limited effectiveness, and would be difficult to implement.
Containment	Cover	Cover (soil or impermeable)	Natural soils, soil admixtures, clay, and/or synthetic membranes are placed over contaminated area.	**Moderate** • Effective in preventing contact with waste, if soil cover is maintained, which is considered the primary contributor to the site contamination. • Protective of human health and the environment and complies with applicable regulations if soil cover is maintained. • Effective for all COPCs by removing direct contact risk pathways if cover is maintained. • Reduces/prevents infiltration into the subsurface. • Waste buried beneath the water table may still leach into groundwater. • Long-term effectiveness may decrease over time if cover is not maintained. • Does not result in the reduction of toxicity, mobility and volume since the waste and impacted soil will remain in place.	**High** • Backfill materials are readily available. • Inspections and long term monitoring of cover would be required. • Requires state concurrence since it is an onsite capping technology.	**Moderate to High** • No costs associated with disposal of waste and contaminated soil • Minimal O&M would be required.		X	Rejected. The technology would be effective for all COPCs; however, it is not consistent with the site closure strategy to allowe for unlimited use and unrestricted exposure at the site. Also, state concurrence would be required.
Removal	Excavation and Disposal	Full Excavation and Disposal	Contaminated waste and soil are removed and disposed of at an approved offsite landfill.	**High** • Effective in preventing contact with waste which is considered the primary contibutor to the site contamination. • Protective of human health and the environment, complies with applicable federal, state, and local regulations, provides short- and long-term protection and results in the reduction of toxicity, mobility, and volume by quickly removing the contaminant mass and exposure to human health and the environment due to waste and soil.	**Moderate** • Backfill materials are readily available. • Because contaminated media at the Towers Road Disposal Area extends below the water table, dewatering and shoring would be required. • Presence of underground utilities presents challenges. Work may need to be stopped if and when these challenges appear and continue slower than scheduled. Underground utilities might need to be re-located.	**Moderate** Moderate disposal and implementation costs associated with potential hazardous waste disposal, and water management.	X		Retained. Very effective at removing contaminated waste and soil quickly and cost-effectively.
	Excavation and Disposal	Full Excavation, Mechanical Screening, and Partial Disposal	Contaminated waste and soil are removed and screened to separate the waste from the soil. All waste disposed at an approved offsite landfill and soil sampled to determine if usable onsite and if not usable as fill material onsite disposed at an approved offsite landfill.	**High** • Effective in preventing contact with waste which is considered the primary contibutor to the site contamination • Protective of human health and the environment, complies with applicable federal, state, and local regulations, provides short- and long-term protection and results in the reduction of toxicity, mobility, and volume by quickly removing the contaminant mass and exposure to human health and the environment due to waste and soil.	**Moderate** • Backfill materials are readily available. • Because contaminated media at the Towers Road Disposal Area extends below the water table, dewatering and shoring would be required. • Presence of underground utilities presents challenges. Work may need to be stopped if and when these challenges appear and continue slower than scheduled. Underground utilities might need to be re-located.	**Moderate** High implementation costs associated with mechanical screening operation. Modeate disposal and implementation costs associated with potential hazardous waste disposal, and water management.	X		Retained. Very effective at removing contaminated waste and soil quickly and cost-effectively.
Administrative or Engineering Controls	Land Use Controls	Deed Notifications and Permits	Deed notifications are issued for property areas that don't meet the IRAOs to restrict groundwater and land use. Regulations are promulgated to require a permit for various activities (i.e., excavation, installation of wells, etc.).	**Moderate** • Effective in preventing contact with waste which is considered the primary contributor to the site contamination. • Relies on proper enforcement for administrative control to be effective. • No short-term risk to site workers. • Restrictions will not address potential human health risks from waste and impacted soil. • Complies with applicable regulations if land use controls ae maintained. • Does not result in the reduction of toxicity, mobility and volume since the waste and impacted soil will remain in place.	**High** • Easily implementable • Requires state concurrence since waste would reamin in place.	**Low**		X	Rejected. This remedy would be temporary as the site closure strategy is remediation to allow for unlimited use and unrestricted exposure. HPDTA controls land use and there is no imminent need for other administrative controls to ensure protection of human health and the environment.

Notes:
COPC - Chemical of Potential Concern
IRAO - Interim Remedial Action Objective
O&M - Operations and Maintenance
RAO - Remedial Action Objective
REC - Registered Environmental Consultant
SVOC - Semi-Volatile Organic Compounds
VOC - Volatile Organic Compound

TABLE 4

Evaluation of Remedial Alternatives

Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report

Harvey Point Defense Testing Activity

Hertford, North Carolina

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation, offsite disposal, and backfill with imported material	Alternative 3 Excavation, material sorting, offsite disposal, and backfill with native and imported material
Protection of human health and the environment	**Not Protective** Does not prevent exposure to waste and impacted soil or provide measures to reduce potential for contaminant migration from the waste to soil and groundwater and from soil to groundwater.	**Protective** Prevents exposure to waste and impacted soil and provides measures to reduce potential for contaminant migration from the waste to soil and groundwater and from soil to groundwater.	**Protective** Prevents exposure to waste and impacted soil and provides measures to reduce potential for contaminant migration from the waste to soil and groundwater and from soil to groundwater.
Compliance with applicable regulations	**Does not comply with all applicable regulations**	**Complies with all appplicable regulations**	**Complies with all appplicable regulations**
Long-term effectiveness and permanence	**Ineffective** Does not achieve IRAOs and no controls in place to monitor site conditions.	**Highly Effective** Achieves IRAOs and does not require additional control to monitor the continued effectiveness of the IRA.	**Effective** Achieves IRAOs and does not require additional control to monitor the continued effectiveness of the IRA. There is some potential for residual contamination to remain on site due to the planned reuse of soil; although testing would be performed to determine suitability for re-use, variability in chemical concentrations is expected so analytical results may not be truly representative of all re-used material..
Reduction of toxicity, mobility, and volume	**No treatment** Waste and impacted soil remain onsite.	**Treatment** Waste and impacted soil are disposed of offsite.	**Treatment** Waste and impacted soil are disposed of offsite.
Short-term effectiveness	**Easy** Construction and implementation phases do not present risk to the community, workers, or environment.	**Moderate** Risks to the community from increased traffic delivering fill material and tranporting waste and impacted soil offsite for disposal. Minimal risk to workers. Potential environmental impact due to transportation of equipment, operation of equipment, and residual handling of waste and impacted soil.	**Moderate** Risks to the community from increased traffic delivering fill material and tranporting waste and impacted soil offsite for disposal. Minimal risk to workers. Potential environmental impact due to transportation of equipment, operation of equipment, and residual handling of waste and impacted soil.
Implementability	**Difficult** No action is easy to operate; however, it is not a reliable technology and there is no way to monitor its effectiveness. Has an extended remedial timeframe since no area treatment or excavation of the potential source (i.e., waste) is being conducted. Per REC guidance, onsite containment remedies require branch concurrence and it not likely that the IHSB would approve of no action and leaving waste in place.	**Moderate** Technically and logisttically feasible, and resources for implementing are readily available. Can be accomplished utilizing standard construction methods and readily available resources. Achieves the IRAOs in a moderate period of time.	**Moderate to Slightly Difficult** Technically and logistically feasible, and resources for implementing are readily available. Can be accomplished utilizing standard construction methods and readily available resources. More difficult to implement as it will require mechanical screening of the excavated material to separate the waste and soil which will require construction of an onsite material staging area and additional material handling and sampling to separate the comingled soil from the impacted soil. Conservative REC Program PSRGs may be difficult to achieve and limit the amount of material that can be re-used. Will result in a slower production rate during excavation activities. Achieves the IRAOs in a moderate period of time.
Cost	**$0**	**$1,274,000**	**$1,334,000**
Community Acceptance	**Difficult** Do not anticipate community acceptance of no action and leaving waste in place.	**Easy** Do not anticipate having any issues with community acceptance since alternative results in the removal of waste and impacted soil.	**Easy** Do not anticipate having any issues with community acceptance since alternative results in the removal of waste and impacted soil.

TABLE 5

Remedial Alternatives Comparison

Towers Road Disposal Areas Interim Remedial Action Plan and Preconstruction Report

Harvey Point Defense Testing Activity

Hertford, North Carolina

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation, offsite disposal, and backfill with imported material	Alternative 3 Excavation, material sorting, offsite disposal, and backfill with native and imported material
Protection of human health and the environment	1	5	5
Compliance with applicable regulations	1	5	5
Long-term effectiveness and permanence	1	5	4
Reduction of toxicity, mobility, and volume	1	5	5
Short-term effectiveness	5	3	3
Implementability	1	4	2
Community Acceptance	1	5	5
Total Benefit	**11**	**32**	**29**
Cost	**$0.00**	**$1,274,000**	**$1,334,000**

Qualitative comparative analysis of alternatives using a rating scale of 1 through 5 (1 = lowest score, 5 = highest score)

Figures

12-112-005

Legend

HPDTA Boundary

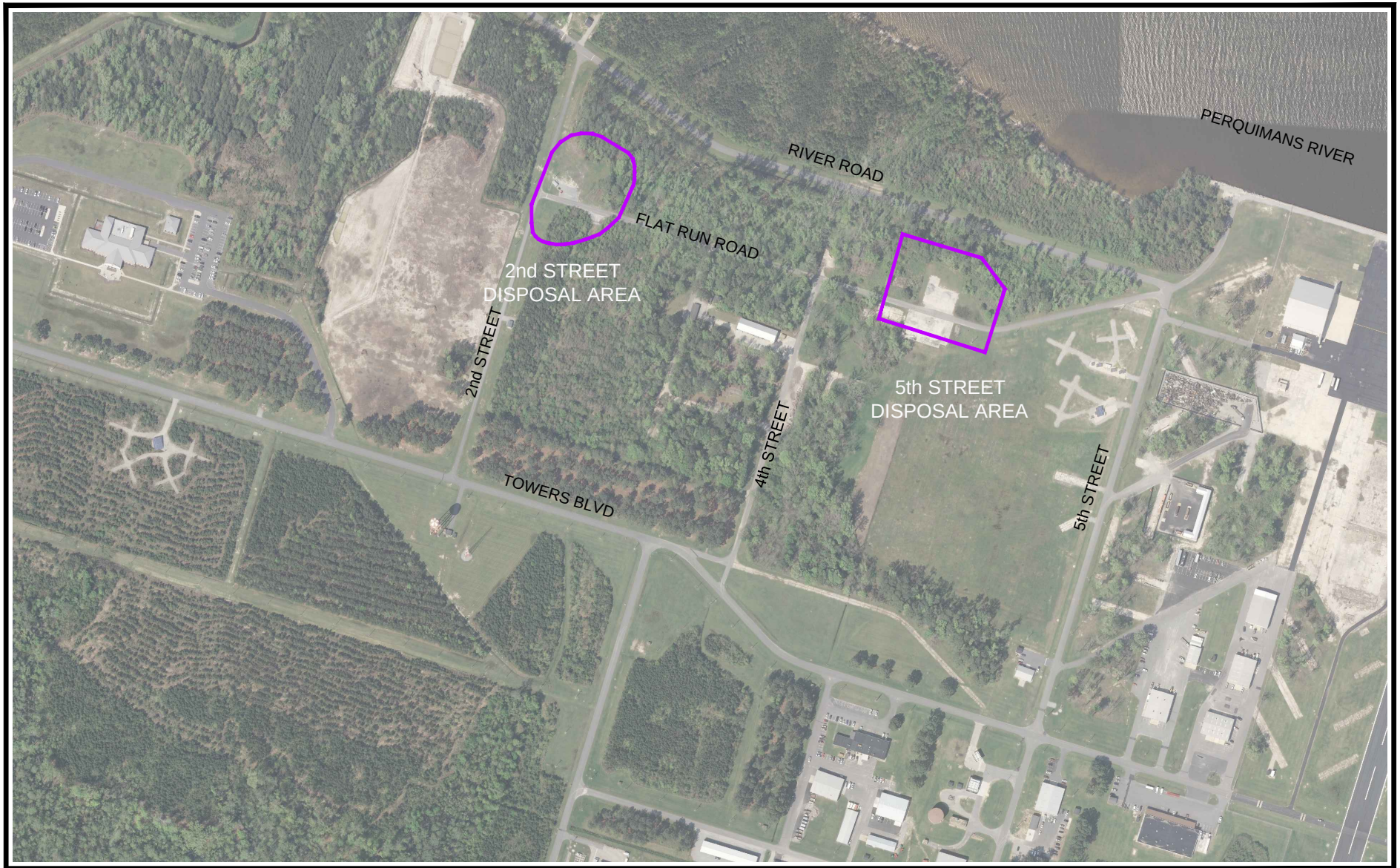
N
W E
S

0 6000 12000 Feet

Figure 1
HPDTA Location
Harvey Point Defense Testing Activity
Hertford, North Carolina

CUES MappingServices

12-112-003



Legend

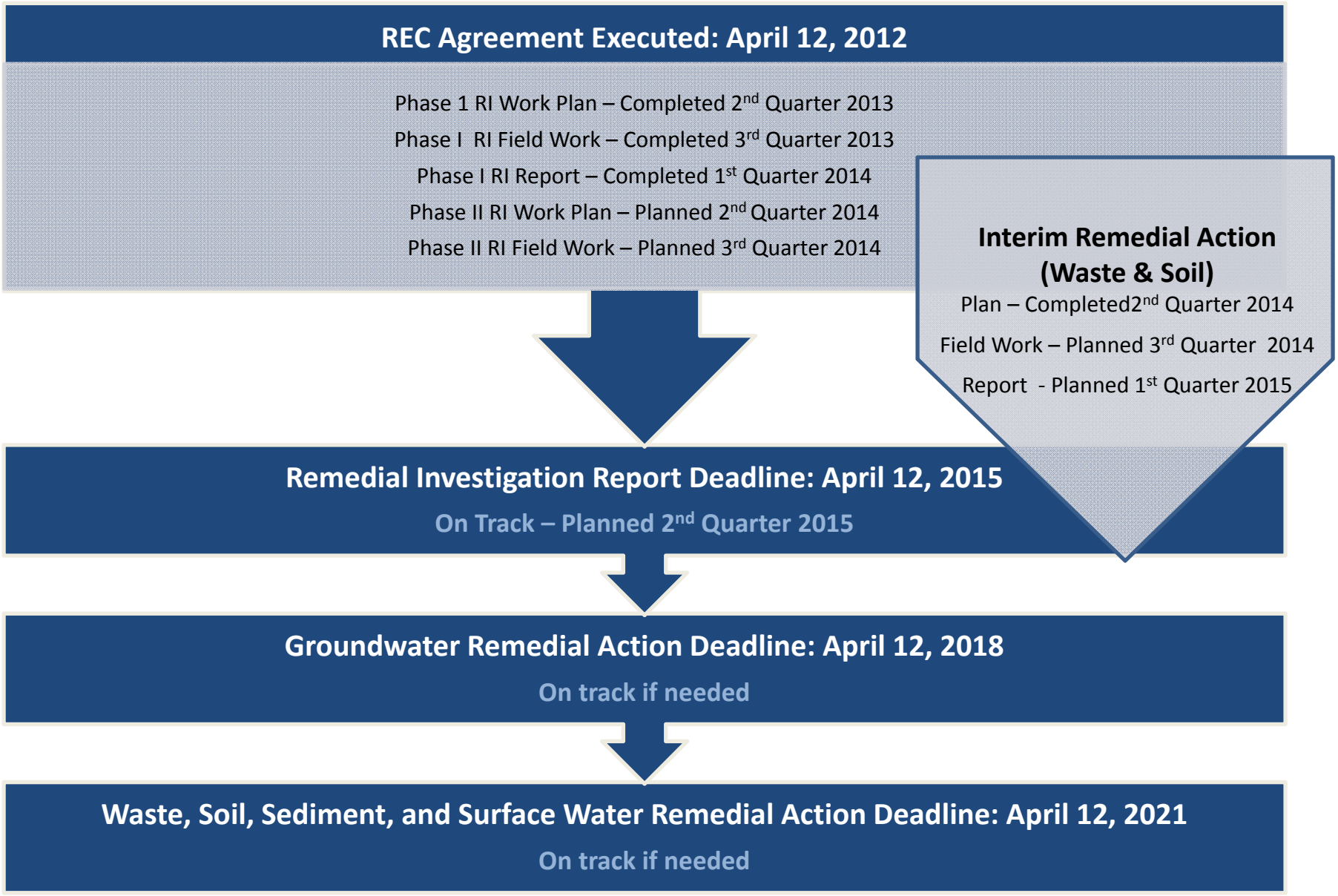
Investigation Area

N
W E
S

0 250 500 Feet

Figure 2
Site Location Map
Harvey Point Defense Testing Activity
Hertford, North Carolina

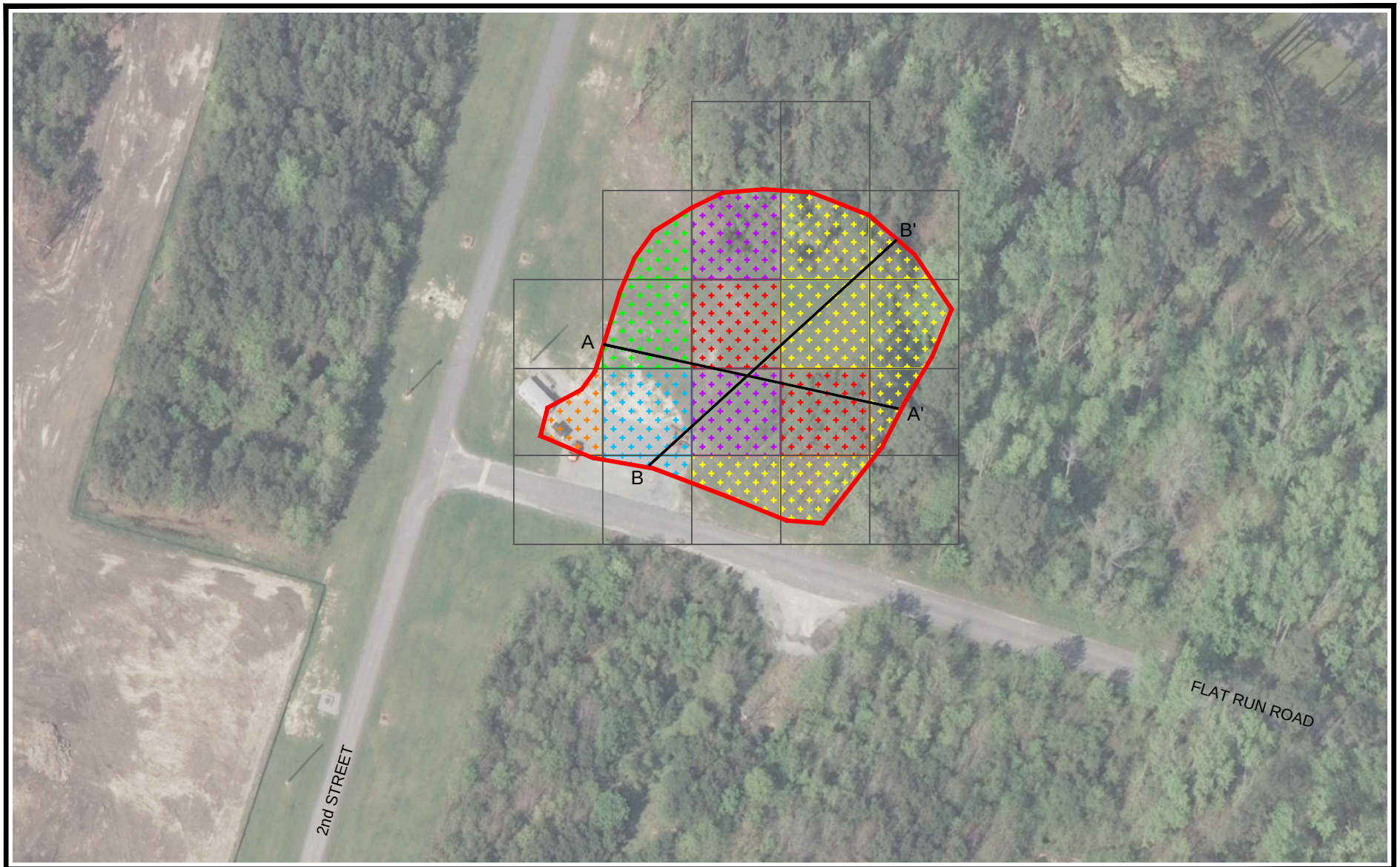
CUES MappingServices



Notes:
Quarters reflect calendar year quarters (e.g., first quarter is January through March)
Quarterly reports must be submitted on or before the 15th day of January, April, July, and October of each year.

Figure 3
REC Program Milestones Timeline for Towers Road Disposal Area
Harvey Point Defense Testing Activity
Hertford, North Carolina

12-112-003



Legend

- Estimated Extent of Waste/Removal Area
- 50' Grid
- A—A' Cross Section

Estimated Removal Depth of Waste/Soil

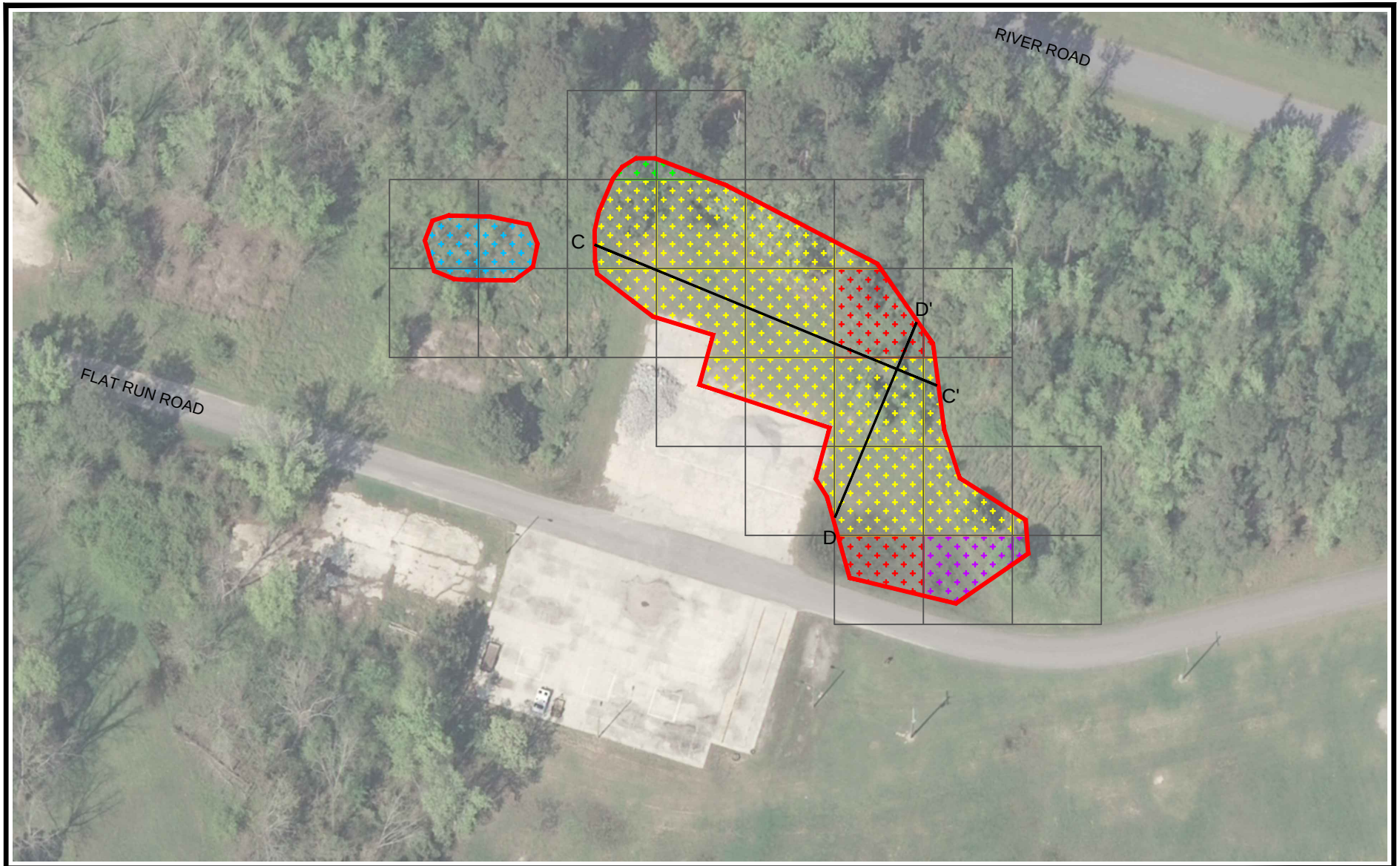
- 2'
- 3'
- 4'
- 5'
- 6'
- 10'

N
W E
S

0 40 80 Feet

Figure 4
2nd Street Disposal Area Estimated Extent and Depth of Waste/Removal Area
Harvey Point Defense Testing Activity
Hertford, North Carolina

CUES MappingServices



Legend

- Estimated Extent of Waste/Removal Area
- 50' Grid
- C—C' Cross Section

Estimated Removal Depth of Waste/Soil

- 2'
- 3'
- 4'
- 5'
- 6'

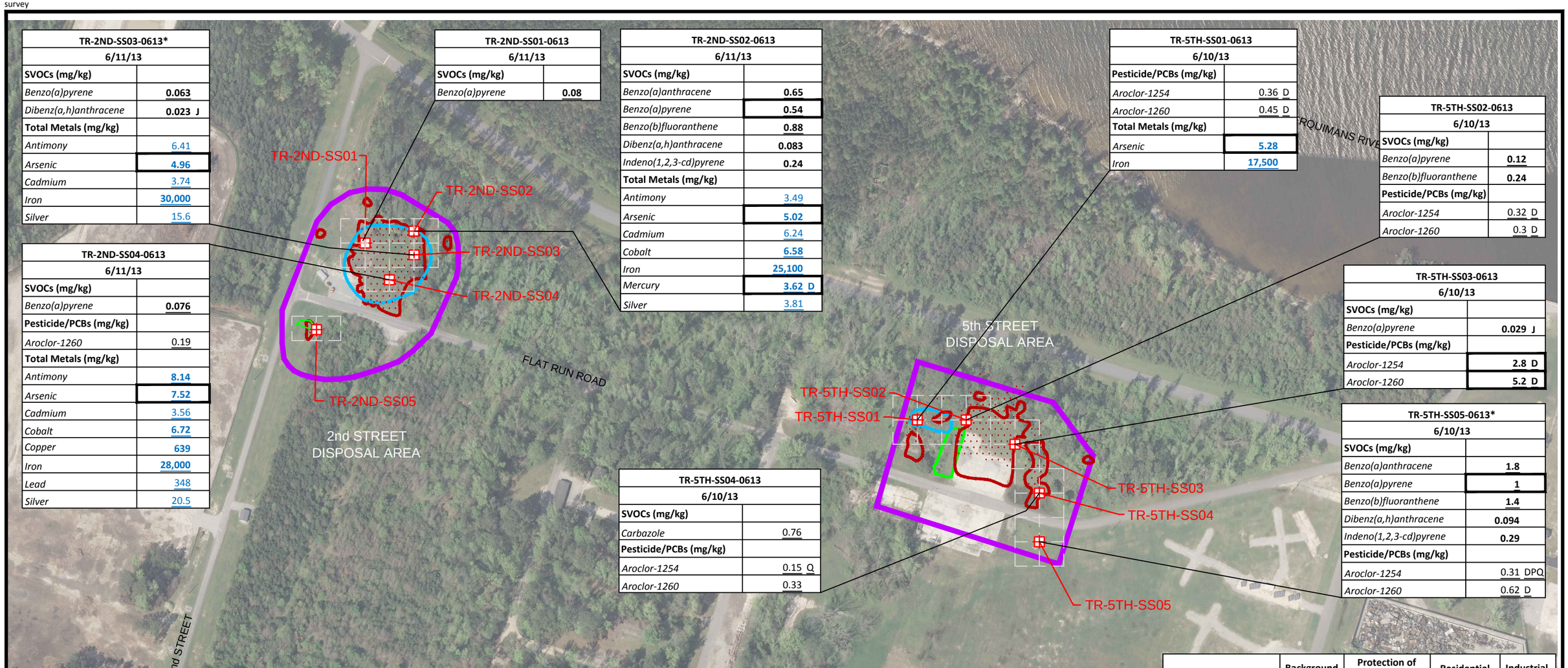
N
W E
S

0 40 80 Feet

Figure 5
5th Street Disposal Area Estimated Extent and Depth of Waste/Removal Area
Harvey Point Defense Testing Activity
Hertford, North Carolina

CUES MappingServices

survey



TR-2ND-SS03-0613*	
6/11/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.063
Dibenz(a,h)anthracene	0.023 J
Total Metals (mg/kg)	
Antimony	6.41
Arsenic	4.96
Cadmium	3.74
Iron	30,000
Silver	15.6

TR-2ND-SS01-0613	
6/11/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.08

TR-2ND-SS02-0613	
6/11/13	
SVOCs (mg/kg)	
Benzo(a)anthracene	0.65
Benzo(a)pyrene	0.54
Benzo(b)fluoranthene	0.88
Dibenz(a,h)anthracene	0.083
Indeno(1,2,3-cd)pyrene	0.24
Total Metals (mg/kg)	
Antimony	3.49
Arsenic	5.02
Cadmium	6.24
Cobalt	6.58
Iron	25,100
Mercury	3.62 D
Silver	3.81

TR-5TH-SS01-0613	
6/10/13	
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.36 D
Aroclor-1260	0.45 D
Total Metals (mg/kg)	
Arsenic	5.28
Iron	17,500

TR-5TH-SS02-0613	
6/10/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.12
Benzo(b)fluoranthene	0.24
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.32 D
Aroclor-1260	0.3 D

TR-2ND-SS04-0613	
6/11/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.076
Pesticide/PCBs (mg/kg)	
Aroclor-1260	0.19
Total Metals (mg/kg)	
Antimony	8.14
Arsenic	7.52
Cadmium	3.56
Cobalt	6.72
Copper	639
Iron	28,000
Lead	348
Silver	20.5

TR-5TH-SS03-0613	
6/10/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.029 J
Pesticide/PCBs (mg/kg)	
Aroclor-1254	2.8 D
Aroclor-1260	5.2 D

TR-5TH-SS05-0613*	
6/10/13	
SVOCs (mg/kg)	
Benzo(a)anthracene	1.8
Benzo(a)pyrene	1
Benzo(b)fluoranthene	1.4
Dibenz(a,h)anthracene	0.094
Indeno(1,2,3-cd)pyrene	0.29
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.31 DPQ
Aroclor-1260	0.62 D

TR-5TH-SS04-0613	
6/10/13	
SVOCs (mg/kg)	
Carbazole	0.76
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.15 Q
Aroclor-1260	0.33

Notes:
[1] Values are from the maximum values for the background samples collected during the June 2013 sampling event.
[2] Values are from the Inactive Hazardous Sites Branch Preliminary Soil Remediation Goals (PSRG) Table (NC DENR, July 2013). For carcinogenic PAHs without PSRG, the PSRG for benzo(a)pyrene was used. For non-carcinogenic PAHs without PSRG, the PSRG for pyrene was used. For PCBs, the unrestricted use residential/industrial PSRG of 1 mg/kg was used.
Underlined text indicates exceedance of the Protection of Groundwater PSRG criteria.
Bold text indicates exceedance of Preliminary Residential Health-Based Soil Remediation Goals.
Bold box indicates exceedance of Preliminary Industrial Health-Based Soil Remediation Goals.
Blue text indicates exceedance of maximum background value.
D - Compound identified in an analysis at a secondary dilution factor
J - Analyte present below the reporting limit
mg/kg - Milligrams per kilogram
NA - Not available/not applicable
P - Indicates a greater than 25% difference of detection between the primary and secondary column.
Q - One or more quality control criteria failed
*The highest concentration of the parent sample and duplicate sample.
For total metals figure only shows values that exceed both the maximum background level and at least one of the screening criteria.

	Background Value[1]	Protection of Groundwater PSRG[2]	Residential PSRG[2]	Industrial PSRG[2]
SVOCs (mg/kg)				
Benzo(a)anthracene	NA	0.18	0.15	2.1
Benzo(a)pyrene	NA	0.0590	0.0150	0.21
Benzo(b)fluoranthene	NA	0.6	0.15	2.1
Carbazole	NA	0.37	NA	NA
Dibenz(a,h)anthracene	NA	0.19	0.0150	0.21
Indeno(1,2,3-cd)pyrene	NA	2	0.15	2.1
Pesticide/PCBs (mg/kg)				
Aroclor-1254	NA	0.14	1	1
Aroclor-1260	NA	0.14	1	1

	Background Value[1]	Protection of Groundwater PSRG[2]	Residential PSRG[2]	Industrial PSRG[2]
Total Metals (mg/kg)				
Antimony	NA	0.9	6.2	82
Arsenic	3.74	5.8	0.61	2.4
Cadmium	0.8780	3	14	160
Cobalt	4.64	0.9	4.6	60
Copper	441	700	620	8200
Iron	14,100	150	11,000	100,000
Lead	47.9	270	400	800
Mercury	0.0366	1	2	3.1
Silver	NA	3.4	78	1,000
Vanadium	31.9	6	78	1,000

Legend
- Investigation Area
- Surface Soil Sample Location
- Surface Soil Composite Sample Location Grid
- Potential Waste / Debris Area (2013)
- Anomalous Area (2013)
- Elevated Electromagnetic Induction Response Area (2011)

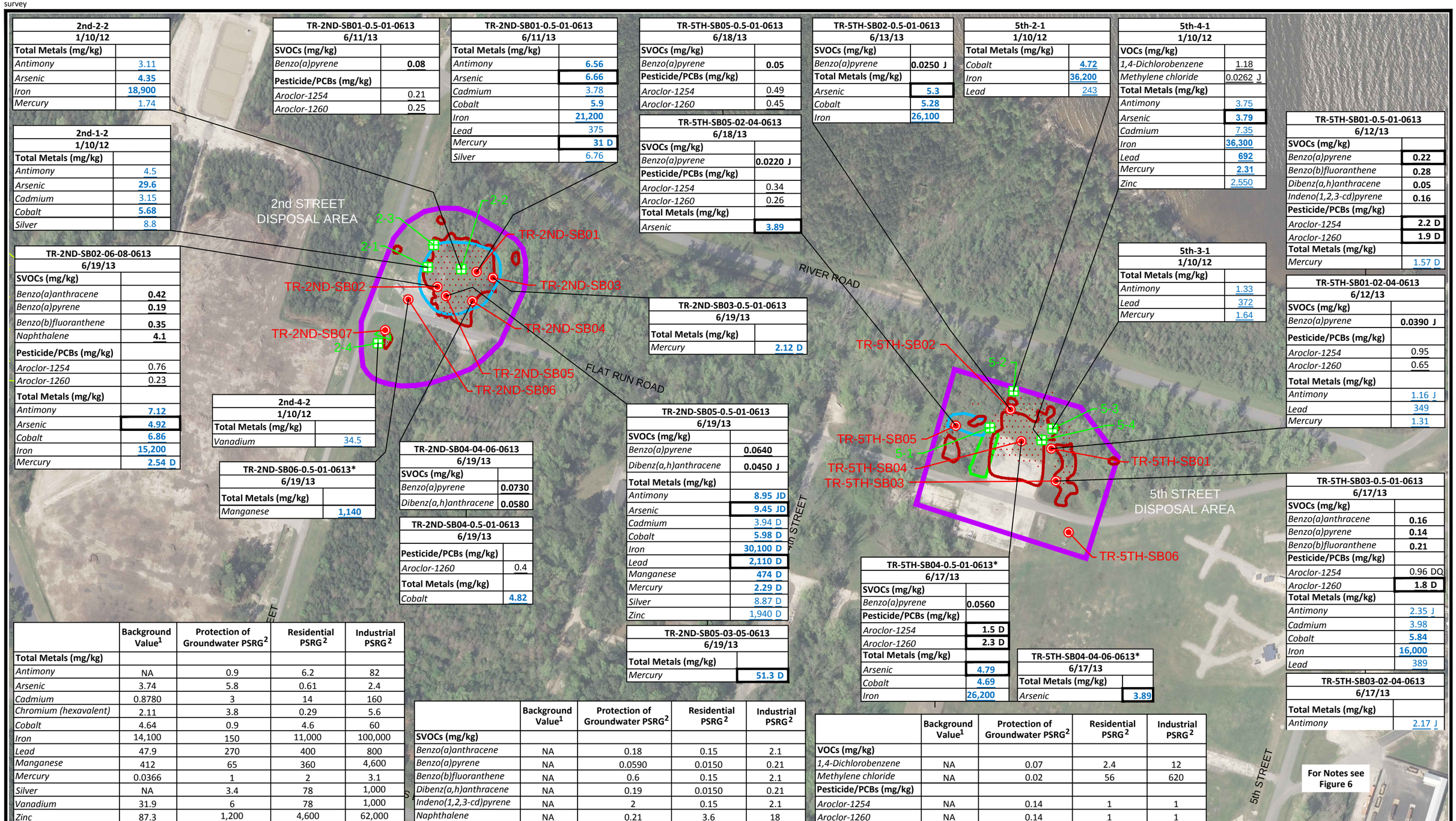
N W E S

0 100 200 Feet

Figure 6
Surface Soil Analytical Results - Exceedances Only
Harvey Point Defense Testing Activity
Hertford, North Carolina

CUES MappingServices

survey



2nd-2-2	
1/10/12	
Total Metals (mg/kg)	
Antimony	3.11
Arsenic	4.35
Iron	18,900
Mercury	1.74

2nd-1-2	
1/10/12	
Total Metals (mg/kg)	
Antimony	4.5
Arsenic	29.6
Cadmium	3.15
Cobalt	5.68
Silver	8.8

TR-2ND-SB01-0.5-01-0613	
6/11/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.08
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.21
Aroclor-1260	0.25

TR-2ND-SB01-0.5-01-0613	
6/11/13	
Total Metals (mg/kg)	
Antimony	6.56
Arsenic	6.66
Cadmium	3.78
Cobalt	5.9
Iron	21,200
Lead	375
Mercury	31 D
Silver	6.76

TR-5TH-SB05-0.5-01-0613	
6/18/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.05
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.49
Aroclor-1260	0.45

TR-5TH-SB05-02-04-0613	
6/18/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0220 J
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.34
Aroclor-1260	0.26
Total Metals (mg/kg)	
Arsenic	3.89

TR-5TH-SB02-0.5-01-0613	
6/13/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0250 J
Total Metals (mg/kg)	
Arsenic	5.3
Cobalt	5.28
Iron	26,100

5th-2-1	
1/10/12	
Total Metals (mg/kg)	
Cobalt	4.72
Iron	36,200
Lead	243

5th-4-1	
1/10/12	
VOCs (mg/kg)	
1,4-Dichlorobenzene	1.18
Methylene chloride	0.0262 J
Total Metals (mg/kg)	
Antimony	3.75
Arsenic	3.79
Cadmium	7.35
Iron	36,300
Lead	692
Mercury	2.31
Zinc	2,550

TR-5TH-SB01-0.5-01-0613	
6/12/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.22
Benzo(b)fluoranthene	0.28
Dibenz(a,h)anthracene	0.05
Indeno(1,2,3-cd)pyrene	0.16
Pesticide/PCBs (mg/kg)	
Aroclor-1254	2.2 D
Aroclor-1260	1.9 D
Total Metals (mg/kg)	
Mercury	1.57 D

5th-3-1	
1/10/12	
Total Metals (mg/kg)	
Antimony	1.33
Lead	372
Mercury	1.64

TR-5TH-SB01-02-04-0613	
6/12/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0390 J
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.95
Aroclor-1260	0.65
Total Metals (mg/kg)	
Antimony	1.16 J
Lead	349
Mercury	1.31

TR-2ND-SB02-06-08-0613	
6/19/13	
SVOCs (mg/kg)	
Benzo(a)anthracene	0.42
Benzo(a)pyrene	0.19
Benzo(b)fluoranthene	0.35
Naphthalene	4.1
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.76
Aroclor-1260	0.23
Total Metals (mg/kg)	
Antimony	7.12
Arsenic	4.92
Cobalt	6.86
Iron	15,200
Mercury	2.54 D

TR-2ND-SB03-0.5-01-0613	
6/19/13	
Total Metals (mg/kg)	
Mercury	2.12 D

2nd-4-2	
1/10/12	
Total Metals (mg/kg)	
Vanadium	34.5

TR-2ND-SB06-0.5-01-0613*	
6/19/13	
Total Metals (mg/kg)	
Manganese	1,140

TR-2ND-SB04-04-06-0613	
6/19/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0730
Dibenz(a,h)anthracene	0.0580

TR-2ND-SB04-0.5-01-0613	
6/19/13	
Pesticide/PCBs (mg/kg)	
Aroclor-1260	0.4
Total Metals (mg/kg)	
Cobalt	4.82

TR-2ND-SB05-0.5-01-0613	
6/19/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0640
Dibenz(a,h)anthracene	0.0450 J
Total Metals (mg/kg)	
Antimony	8.95 JD
Arsenic	9.45 JD
Cadmium	3.94 D
Cobalt	5.98 D
Iron	30,100 D
Lead	2,110 D
Manganese	474 D
Mercury	2.29 D
Silver	8.87 D
Zinc	1,940 D

TR-2ND-SB05-03-05-0613	
6/19/13	
Total Metals (mg/kg)	
Mercury	51.3 D

TR-5TH-SB04-0.5-01-0613*	
6/17/13	
SVOCs (mg/kg)	
Benzo(a)pyrene	0.0560
Pesticide/PCBs (mg/kg)	
Aroclor-1254	1.5 D
Aroclor-1260	2.3 D
Total Metals (mg/kg)	
Arsenic	4.79
Cobalt	4.69
Iron	26,200

TR-5TH-SB04-04-06-0613*	
6/17/13	
Total Metals (mg/kg)	
Arsenic	3.89

TR-5TH-SB03-0.5-01-0613	
6/17/13	
SVOCs (mg/kg)	
Benzo(a)anthracene	0.16
Benzo(a)pyrene	0.14
Benzo(b)fluoranthene	0.21
Pesticide/PCBs (mg/kg)	
Aroclor-1254	0.96 DQ
Aroclor-1260	1.8 D
Total Metals (mg/kg)	
Antimony	2.35 J
Cadmium	3.98
Cobalt	5.84
Iron	16,000
Lead	389

TR-5TH-SB03-02-04-0613	
6/17/13	
Total Metals (mg/kg)	
Antimony	2.17 J

	Background Value[1]	Protection of Groundwater PSRG[2]	Residential PSRG[2]	Industrial PSRG[2]
Total Metals (mg/kg)				
Antimony	NA	0.9	6.2	82
Arsenic	3.74	5.8	0.61	2.4
Cadmium	0.8780	3	14	160
Chromium (hexavalent)	2.11	3.8	0.29	5.6
Cobalt	4.64	0.9	4.6	60
Iron	14,100	150	11,000	100,000
Lead	47.9	270	400	800
Manganese	412	65	360	4,600
Mercury	0.0366	1	2	3.1
Silver	NA	3.4	78	1,000
Vanadium	31.9	6	78	1,000
Zinc	87.3	1,200	4,600	62,000

	Background Value[1]	Protection of Groundwater PSRG[2]	Residential PSRG[2]	Industrial PSRG[2]
SVOCs (mg/kg)				
Benzo(a)anthracene	NA	0.18	0.15	2.1
Benzo(a)pyrene	NA	0.0590	0.0150	0.21
Benzo(b)fluoranthene	NA	0.6	0.15	2.1
Dibenz(a,h)anthracene	NA	0.19	0.0150	0.21
Indeno(1,2,3-cd)pyrene	NA	2	0.15	2.1
Naphthalene	NA	0.21	3.6	18

	Background Value[1]	Protection of Groundwater PSRG[2]	Residential PSRG[2]	Industrial PSRG[2]
VOCs (mg/kg)				
1,4-Dichlorobenzene	NA	0.07	2.4	12
Methylene chloride	NA	0.02	56	620
Pesticide/PCBs (mg/kg)				
Aroclor-1254	NA	0.14	1	1
Aroclor-1260	NA	0.14	1	1

Legend

- Investigation Area
- Previous Sample Location (2012)
- Subsurface Soil Sample Location
- Potential Waste / Debris Area (2013)
- Anomalous Area (2013)
- Elevated Electromagnetic Induction Response Area (2011)

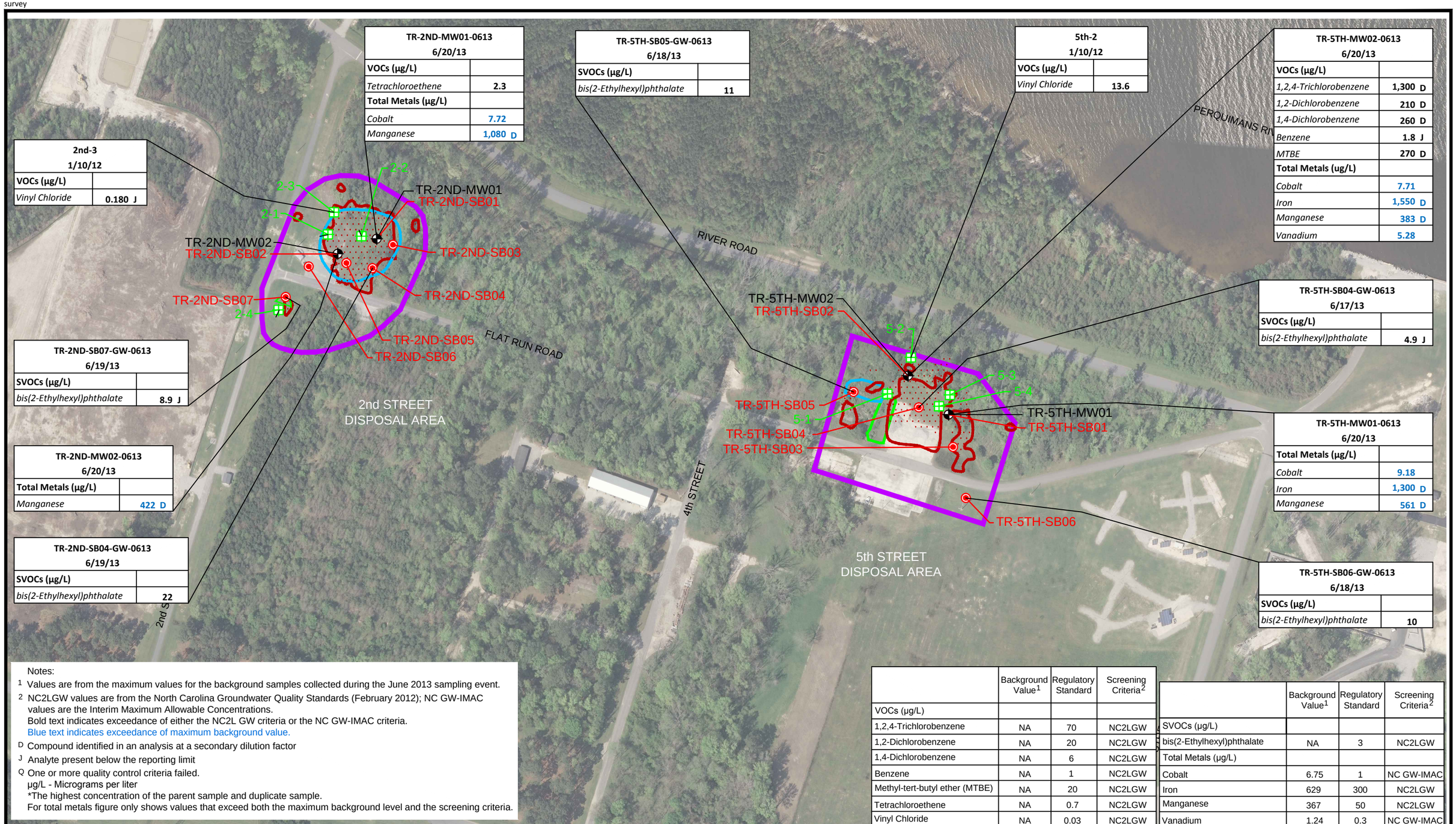
N W E S

0 100 200 Feet

Figure 7
Subsurface Soil Analytical Results - Exceedances Only
Harvey Point Defense Testing Activity
Hertford, North Carolina

CUES MappingServices

survey



Notes:

1 Values are from the maximum values for the background samples collected during the June 2013 sampling event.

2 NC2LGW values are from the North Carolina Groundwater Quality Standards (February 2012); NC GW-IMAC values are the Interim Maximum Allowable Concentrations.
Bold text indicates exceedance of either the NC2L GW criteria or the NC GW-IMAC criteria.
Blue text indicates exceedance of maximum background value.

D Compound identified in an analysis at a secondary dilution factor

J Analyte present below the reporting limit

Q One or more quality control criteria failed.

µg/L - Micrograms per liter

*The highest concentration of the parent sample and duplicate sample.

For total metals figure only shows values that exceed both the maximum background level and the screening criteria.

	Background Value[1]	Regulatory Standard	Screening Criteria[2]
VOCs (µg/L)			
1,2,4-Trichlorobenzene	NA	70	NC2LGW
1,2-Dichlorobenzene	NA	20	NC2LGW
1,4-Dichlorobenzene	NA	6	NC2LGW
Benzene	NA	1	NC2LGW
Methyl-tert-butyl ether (MTBE)	NA	20	NC2LGW
Tetrachloroethene	NA	0.7	NC2LGW
Vinyl Chloride	NA	0.03	NC2LGW

	Background Value[1]	Regulatory Standard	Screening Criteria[2]
SVOCs (µg/L)			
bis(2-Ethylhexyl)phthalate	NA	3	NC2LGW
Total Metals (µg/L)			
Cobalt	6.75	1	NC GW-IMAC
Iron	629	300	NC2LGW
Manganese	367	50	NC2LGW
Vanadium	1.24	0.3	NC GW-IMAC

Legend

- Investigation Area
- Previous Sample Location (2012)
- Subsurface Soil Sample Location
- Monitoring Well Locations
- Potential Waste / Debris Area (2013)
- Anomalous Area (2013)
- Elevated Electromagnetic Induction Response Area (2011)

N W E S

0 100 200 Feet

Figure 8
Groundwater Analytical Results - Exceedances Only
Harvey Point Defense Testing Activity
Hertford, North Carolina

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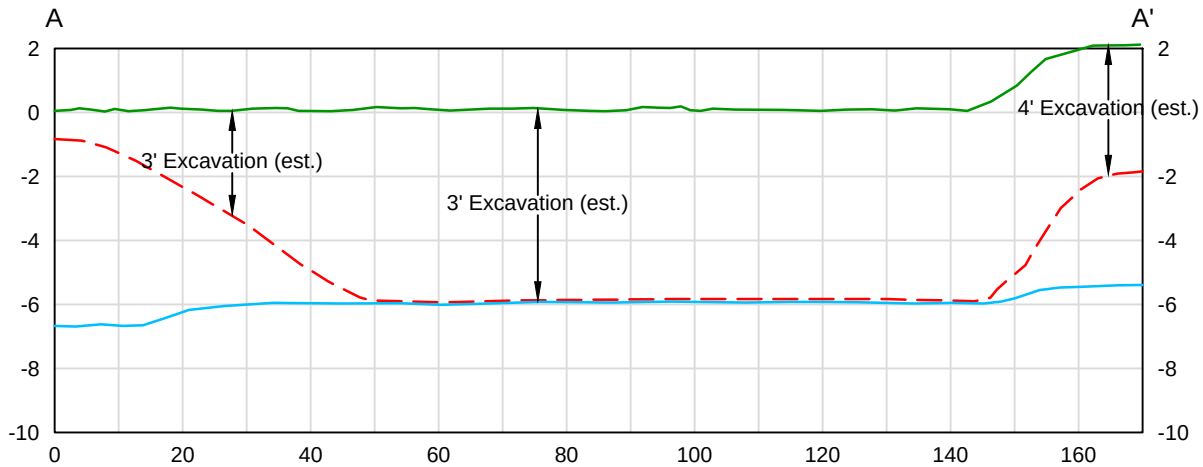

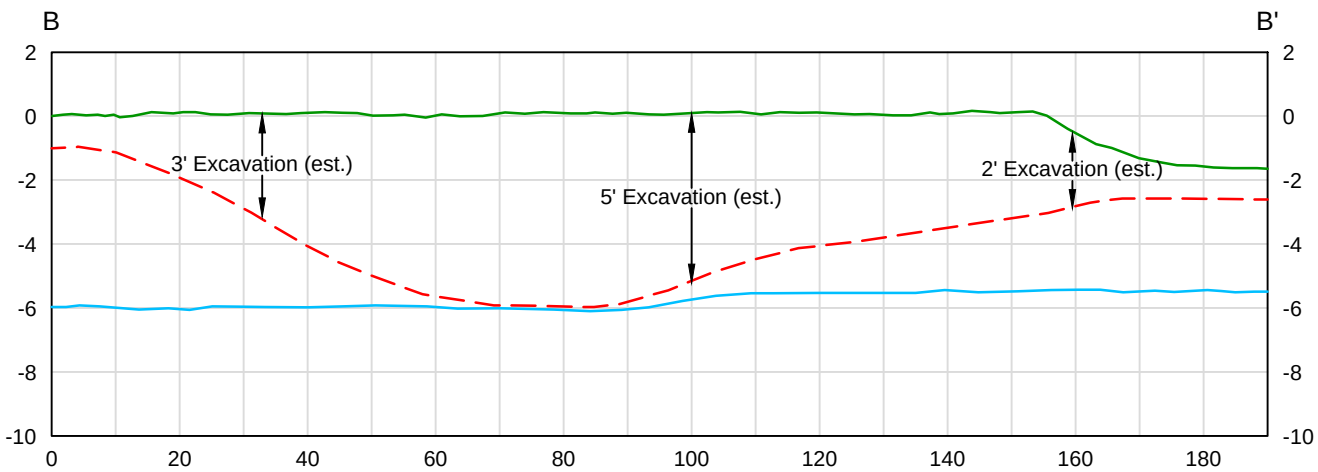

Legend

- Ground Surface
- Debris
- Groundwater

0 3 6 Feet
Vertical Scale

0 15 30 Feet
Horizontal Scale

Figure 9
2nd Street Disposal Area Cross Sections
Harvey Point Defense Testing Activity
Hertford, North Carolina

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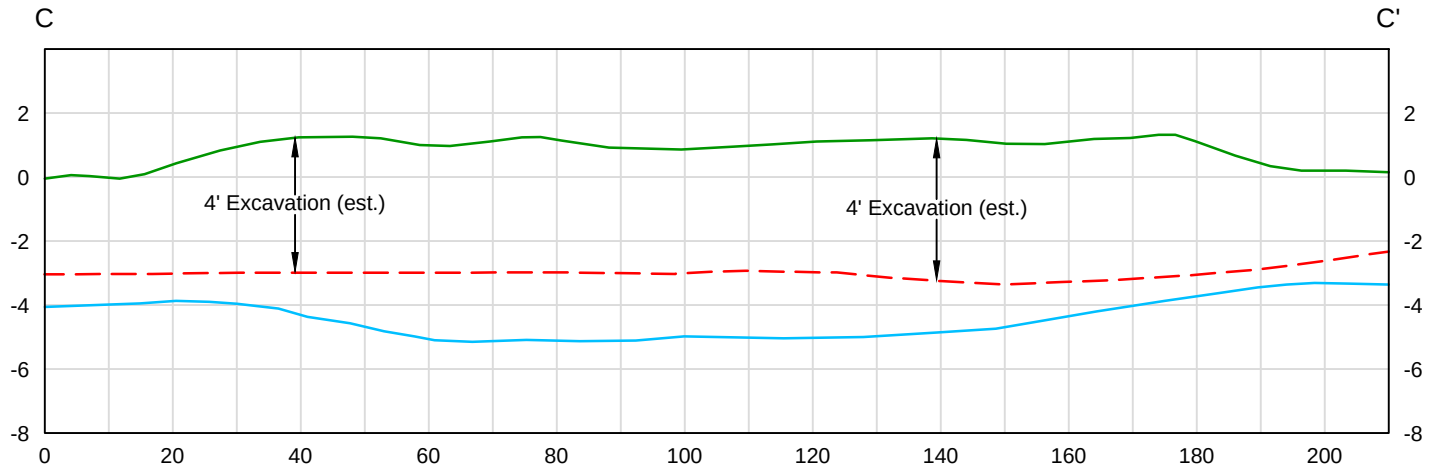

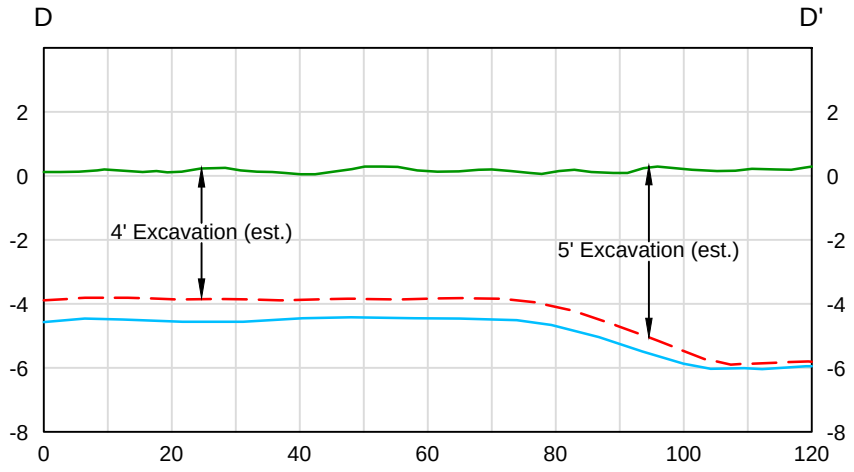

Legend

- Ground Surface
- Debris
- Groundwater

0 3 6 Feet
Vertical Scale

0 15 30 Feet
Horizontal Scale

Figure 10
5th Street Disposal Area Cross Sections
Harvey Point Defense Testing Activity
Hertford, North Carolina

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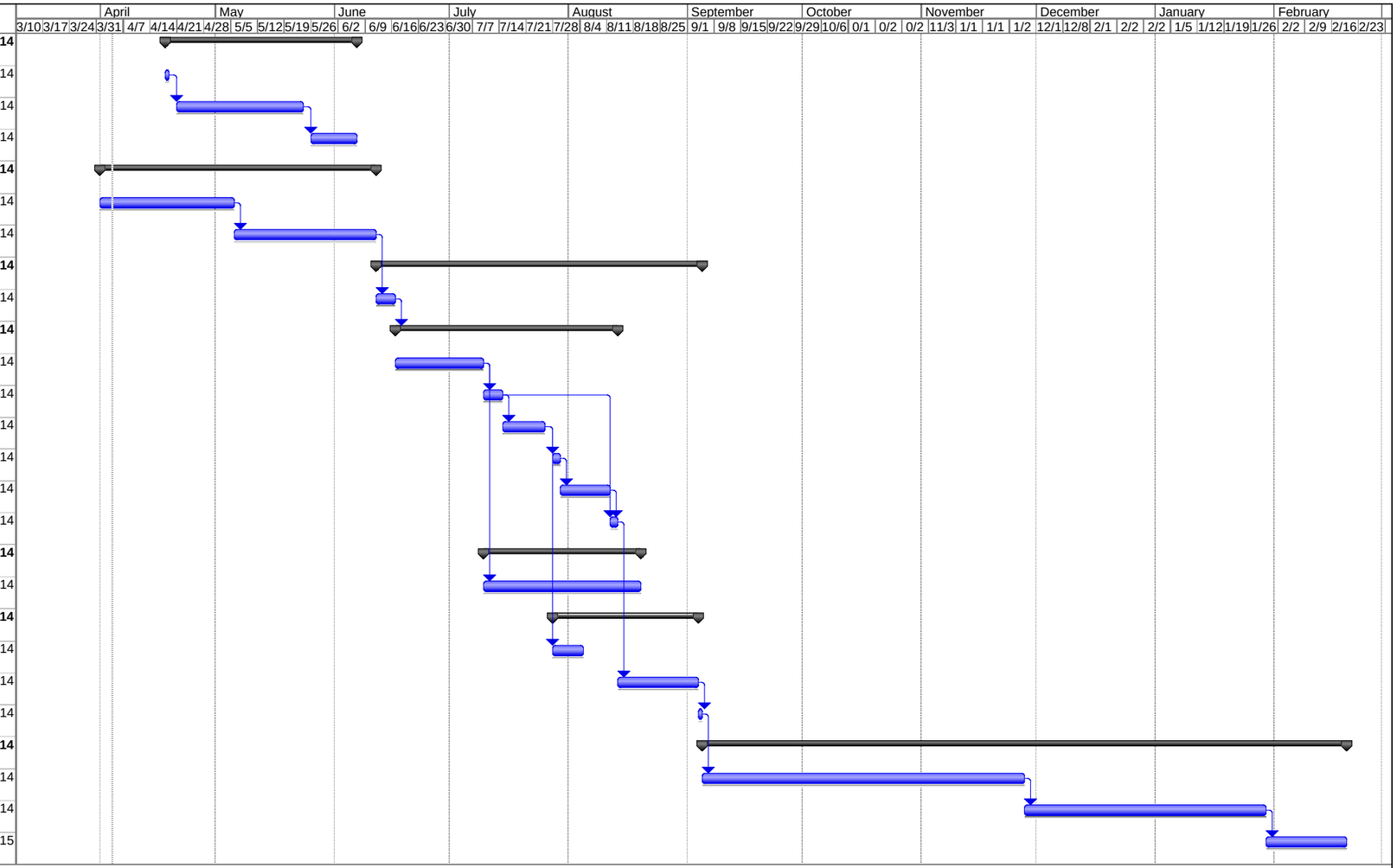
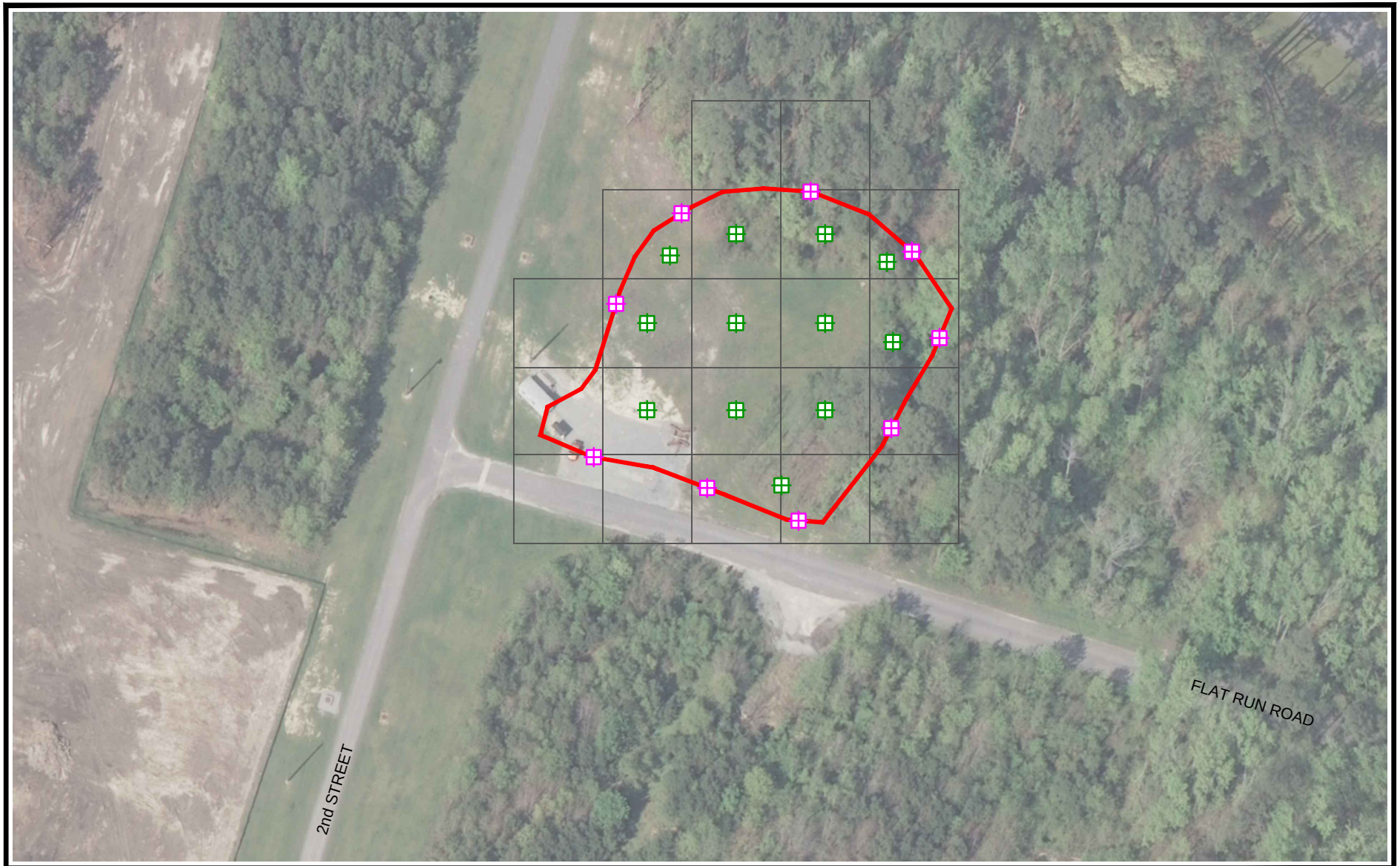
ID	Task Name	Duration	Start
1	**Public Outreach**	**36 days**	**Fri 4/18/14**
2	Public notification	1 day	Fri 4/18/14
3	Public Comment Period (ends 35 calendar days from notification date)	25 days	Mon 4/21/14
4	Public comment resolution (if needed) & IRAP Completion Cert.	10 days	Mon 5/26/14
5	**Fieldwork Support**	**52 days**	**Tue 4/1/14**
6	Subcontractor Procurement	25 days	Tue 4/1/14
7	Phase II RI Background Sampling & Analysis (separate plan)	27 days	Tue 5/6/14
8	**Interim Remedial Action (Test Pitting)**	**61 days**	**Thu 6/12/14**
9	Mobilization and Site Setup	3 days	Thu 6/12/14
10	**Excavation & Verification**	**42 days**	**Tue 6/17/14**
11	Excavation and Characterization of Material	17 days	Tue 6/17/14
12	Geophysical Survey	3 days	Thu 7/10/14
13	Confirmation Sample Collection, Analysis, and Evaluation	9 days	Tue 7/15/14
14	Contingency extra excacvation (if needed)	2 days	Mon 7/28/14
15	Contingency Sample Collection, Analysis, and Evaluation (if needed)	9 days	Wed 7/30/14
16	Post-Excavation Topographic Survey	2 days	Tue 8/12/14
17	**Transporation and Disposal**	**29 days**	**Thu 7/10/14**
18	Transportation and Disposal	29 days	Thu 7/10/14
19	**Backfill Import/Staging, Backfilling, and Site Restoration**	**28 days**	**Mon 7/28/14**
20	Importing and Staging Backfill	6 days	Mon 7/28/14
21	Backfill and Restoration	15 days	Thu 8/14/14
22	Demobilization	1 day	Thu 9/4/14
23	**Closeout Report**	**120 days**	**Fri 9/5/14**
24	Draft Interim Remedial Action Closeout Report	60 days	Fri 9/5/14
25	Navy/HPDTA Review	45 days	Fri 11/28/14
26	Final Interim Remedial Action Closeout Report	15 days	Fri 1/30/15



Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 11
Towers Road Disposal Area IRAP Project Schedule
Harvey Point Defense Testing Activity
Hertford, North Carolina

12-112-003



Legend

- Estimated Extent of Waste/Removal Area
- 50' Grid
- Wall Confirmation Sample
- Floor Confirmation Sample

N
W E
S

0 40 80 Feet

Figure 12
2nd Street Disposal Area Proposed
Confirmation Sample Locations
Harvey Point Defense Testing Activity
Hertford, North Carolina

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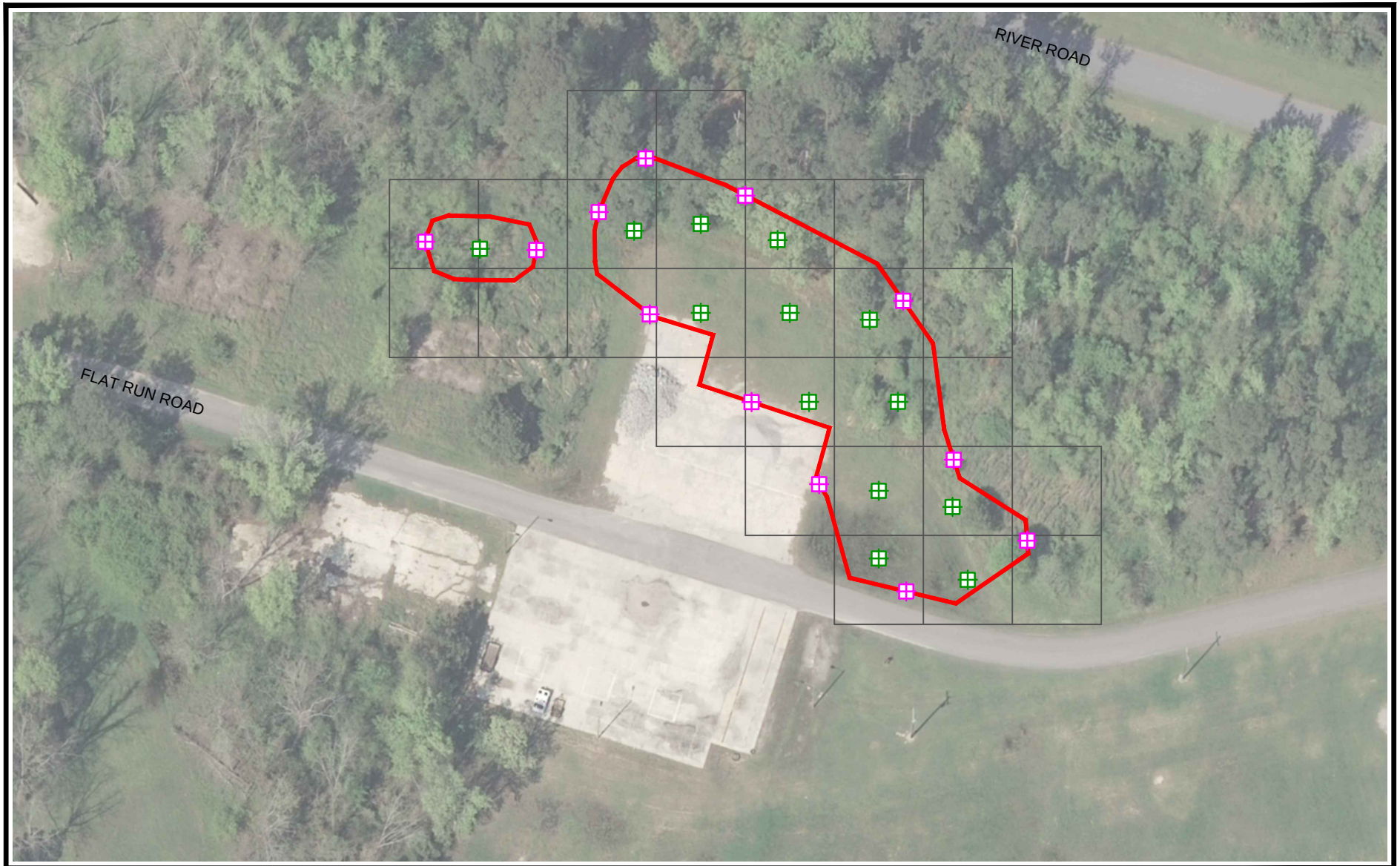
12-112-003



Legend

- Estimated Extent of Waste/Removal Area
- 50' Grid
- Wall Confirmation Sample
- Floor Confirmation Sample

N
W E
S

0 40 80 Feet

Figure 13
5th Street Disposal Area Proposed
Confirmation Sample Locations
Harvey Point Defense Testing Activity
Hertford, North Carolina

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Appendix A
Applicable Regulations

Table A-1
Applicable Requirements
Towers Road Disposal Area Interim Remedial Action Plan and Preconstruction Report
Harvey Point Defense Testing Activity
Hertford, North Carolina

Classification	Media/Action/Location	Requirement	Prerequisite	Citation
Chemical-Specific	Soil	North Carolina Preliminary Soil Remediation Goals (PSRGs) - RECs shall ensure that the Department's ascertainment of the most nearly applicable cleanup standards as would be applied under CERCLA/SARA are met. Characterization of risks to health, safety, public welfare, and the environment is not required under this Section for a disposal site, environmental medium, or chemical for which response actions have successfully reduced concentrations of hazardous substances to on-site natural background levels.	RECs shall ensure that the Department's ascertainment of the most nearly applicable cleanup standards as would be applied under CERCLA/SARA are met. Characterization of risks to health, safety, public welfare, and the environment is not required under this Section for a disposal site, environmental medium, or chemical for which response actions have successfully reduced concentrations of hazardous substances to on-site natural background levels. - **Applicable for alternatives 2 and 3**	15A NCAC 13C.0308 Inactive Hazardous Sites Branch PSRG Table; PCBs, the unrestricted use residential/industrial PSRG of 1 mg/kg will be used
Location-Specific	Migratory Flyway	Almost all species of native birds in the United States are protected from unregulated taking.	Any activity taking place within a migratory flyway. **Applicable for alternatives 2 and 3**	Migratory Bird Treaty Act, 16 USC 703
Action-Specific	***General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)***			
	Managing storm water runoff from land-disturbing activities	Must obtain coverage under the general pemit, develop a Stormwater Pollution Prevention Plan/Sedimentation and Erosion Control Plan as described in the permit, and implement the plan during construction.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-53) of more than 1 acre of land- **Applicable to alternatives 2 and 3**	NC General Permit - NCG 010000
	Coastal county stormwater management	Refer to Items (1), (2), and (3) for stormwater management requirements for Coastal Counties of North Carolina.	Activities within a Coastal County that require a Sedimentation and Erosion Control Plan (land-disturbing activity of more than 1 acre of land or a CAMA Major Development Permit) - **Applicable to alternatives 2 and 3**	15A NCAC 02H .1005
	Waste Characterization and Storage — Primary Wastes (i.e., excavated contaminated soils)			
	Characterization of hazardous waste	Incorporates the requirements for generators at 40 CFR 262 with noted exceptions. The generator must determine if solid waste that has been generated is a hazardous waste using the procedure outlined at 40 CFR 262.11	Generation of RCRA-hazardous waste for storage, treatment or disposal -**Applicable to alternatives 2 and 3**	15A NCAC 13A.0107
	Management of hazardous wastes	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste. These include but are not limited to the requirements to apply for a hazardous waste generator number; submit hazardous waste reports; maintain generation, shipment, and disposal records; and to meet the prescribed design and operation standards for hazardous waste facilities.	Generation of solid waste which is determined to be hazardous- **Applicable to alternatives 2 and 3**	40 CFR 262.11(d)
	Storage of solid waste	All solid waste must be stored in accordance with these requirments that include but are not limited to: • All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard. • Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. • Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.	Generation of solid waste which is determined *not* to be hazardous - **Applicable to alternatives 2 and 3**	15A NCAC 13B .0104

Table A-1
Applicable Requirements
Towers Road Disposal Area Interim Remedial Action Plan and Preconstruction Report
Harvey Point Defense Testing Activity
Hertford, North Carolina

Classification	Media/Action/Location	Requirement	Prerequisite	Citation
Action-Specific	Design crieria for a hazardous waste staging pile	If hazardous wastes will be staged in piles outside the Area of Contamination then a permit must be obtained. Standards for the design and operation of the pile will consider the following factors: • Length of time pile will be in operation; • Volumes of waste you intend to store in the pile; • Physical and chemical characteristics of the wastes to be stored in the unit; • Potential for releases from the unit; • Hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and • Potential for human and environmental exposure to potential releases from the unit.	Storage of remediation waste in a staging pile – **Applicable to alternatives 2 and 3**	15A NCAC 13A .0109 (s) [40 CFR 264.554]; 15A NCAC 13A .0113
	Temporary accumulation of hazardous waste in containers	If hazardous wastes will be temporarily accumulated in containers the generator must apply for a hazardous waste generator number; submit hazardous waste reports; maintain generation, shipment, and disposal records; and to meet the prescribed design and operation standards for hazardous waste accumlation in accordance with the amount of hazardous waste generated within a calendar month. A large quantity generator may accumulate hazardous waste at the facility for 90 days provided that: • waste is placed in containers that comply with 40 CFR 265.171-173; and	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10- **Applicable to alternatives 2 and 3**	15A NCAC 13A.0107
		• the date upon which accumulation begins is clearly marked and visible for inspection on each container		
		• container is marked with the words "hazardous waste"; or		
		• container may be marked with other words that identify the contents.		
	Transportation of Wastes			
	Transportation of hazardous waste	If hazardous waste will be offered for transport the generator must comply with the generator standards of Part 262 including 40 CFR 262.20-23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect 262.32 for marking, Sect. 262.33 for placarding.	Offering hazardous waste for shipment–**applicable alternatives 2 and 3**	15A NCAC 13A.0106 [40 CFR 262.10(h)]
	Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171-180 related to marking, labeling, placarding, packaging, emergency response, etc.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material -**applicable alternatives 2 and 3**	49 CFR 171.1(c)
	Transportation of samples (i.e. contaminated soils)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: · The sample is being transported to a laboratory for the purpose of testing; or	Samples of solid waste <u>or</u> a sample of water, soil for purpose of conducting testing to determine its characteristics or composition -**applicable alternative 2 and 3**	40 CFR 261.4(d)(1)(i)-(iii)
		· The sample is being transported back to the sample collector after testing. · The sample is being stored by sampled collector before transport to a lab for testing		15A NCAC 13A.0106
		In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: · Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements		40 CFR 261.4(d)(2)(i)(A) and (B)
		· Assure that the information provided in (1) thru (5) of this section accompanies the sample. · Package the sample so that it does not leak, spill, or vaporize from its packaging.		15A NCAC 13A.0106
	Storage of Oils			
	Storage of fuels and oils (petroleum and non-petroleum) onsite including ERD substrate	If storage capacity limits are exceeded a Spill, Prevention, Control, and Countermeasures Plan must be prepared and implemented with procedures, methods, equipment, and other requirements to prevent the discharge of into or upon the navigable waters of the United States.	Total onsite storage capacity exceeding 1,320 gallons in containers that are 55 gallons or larger in size. **Applicable for alternatives 2 and 3.**	40 CFR 112

Appendix B
Cost Estimate

Table B-1
Engineer's Cost Estimate for Alternative 2: Excavation, offsite disposal, and backfill with imported material
Towers Road Disposal Area Interim Remedial Action Plan and Preconstruction Report
Harvey Point Defense Testing Activity
Hertford, North Carolina

Description: Alternative 2 consists of excavation, offsite disposal, and backfill with imported material. The 2nd Street Disposal Area, assumed to cover 0.7 acres, and 5th Street Disposal Area, assumed to cover 0.6 acres, will be excavated to the visible limits of waste and backfilled. The total volume of excavated soil and waste is assumed to be 9,286 cy (8,895 cy within the initial excavation area plus 391 cy assuming that 25% of the confirmation samples fail and additional excavation is required in those areas). The production rates are assumed to be 550 cy per day for excavation/loading and backfilling/restoration and 580 tons per day for transportation and disposal.

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
Mobilization/Demobilization and Site Setup					
Mobilization/Demobilization	Each	2	$3,500.00	$7,000.00	Includes mobilization and demobilization of all equipment and materials necessary to perform the work.
Construction Entrance Temporary Road	square yard	0	$14.20	$0.00	Assumes existing construction entrances will be utilized.
Silt Fence	Linear Feet	500	$4.25	$2,125.00	Consists of additional silt fence for any repairs and to shift the limits of disturbance at the 5th Street Disposal Area. Assumes 25% of existing silt fence surrounding the removal areas will need to be replaced.
Material Handling Area for Excavated Material	Lump Sum	1	$2,500.00	$2,500.00	Assumes 100' x 100' area. Includes impermeable liner, straw bales, silt fence, and sandbags; setup and removal included (based on project similar in nature).
Mobilization/Demobilization and Site Setup Total				***$11,625***	
Construction Crew					
Heavy Equipment Operator	Hour	800	$43.50	$34,800.00	Assumes 50 10-hour days and 5-day work weeks to complete work and 2 equipment operators.
Heavy Equipment Operator (Overtime)	Hour	200	$52.50	$10,500.00	Assumes 50 10-hour days and 5-day work weeks to complete work and 2 equipment operators.
Laborer	Hour	400	$25.20	$10,080.00	Assumes 50 10-hour days and 5-day work weeks to complete work and 1 laborer.
Laborer (Overtime)	Hour	100	$37.80	$3,780.00	Assumes 50 10-hour days and 5-day work weeks to complete work and 1 laborer.
Heavy Equipment					
Excavator	Month	1	$11,600.00	$11,600.00	Includes fuel [Hertz Equipment Rental = $6,600/month plus $1,250/week (250 gal. @ $5/gal)for diesel fuel]. For excavation and loading.
Dozer	Week	5	$2,575.00	$12,875.00	Includes fuel [Hertz Equipment Rental = $1,575/week plus $1,000/week (200 gal. @ $5/gal)for diesel fuel]. For backfilling.
Box Dump Truck	Month	1	$11,150.00	$11,150.00	12-14 cy capacity. Includes fuel and rental vehicle. [Hertz Equipment Rental = $6,150/month plus $1,250/week (250 gallons @ $5/gallon for diesel fuel). For transporting excavated material to material processing area.
Project Vehicle (Pickup Truck)	Month	2.5	$3,620.00	$9,050.00	Includes fuel and rental vehicle. Assumes 1 truck for Site Superintendent and 1 for Construction crew [Hertz Equipment Rental = 2 each @ $1,250/month plus 2 each @ $140/week (35 gallons @ $4/gallon for fuel).
Construction Crew and Heavy Equipment Total				***$103,835***	
Excavation					
Excavate and Load Material	Ton	10,679	$4.50	$48,055.50	Engineer's Estimate. Assumes 1.2 tons/cy for soil, 1.0 tons/cy for waste, and waste is 25% by volume.
Excavation Dewatering	Day	19	$100.00	$1,900.00	Includes all equipment and materials for 3" trash pump and associated hosing. Assumes dewatering will occur within excavation limits.
Waste Disposal					
T&D of Excavated Soil	Ton	10,679	$49.95	$533,416.05	Assumes 1.2 tons/cy for soil, 1.0 tons/cy for waste, waste is 25% by volume, and non-hazardous. Based on recent pricing from Subtitle D Disposal Facility.
Excavation and Waste Disposal Total				***$583,372***	
Material Delivery and Site Restoration					
Topsoil material and delivery	cubic yard	1286	$23.00	$29,573.63	Includes 6" topsoil layer over removal area; assume 1.25 cy loose/in-place
General fill material and delivery	cubic yard	10322	$19.00	$196,112.11	Includes general fill to within 6" of original grade; assume 1.25 cy loose/in-place.
Site Restoration	Lump Sum	1	$1,250.00	$1,250.00	Includes seed and straw for 2nd Street Disposal Area, 5th Street Disposal Area, and all other disturbed areas. Assumes the area to be restored is less than 2 acres.
Material Delivery and Site Restoration Total				***$226,936***	
Subtotal of Construction Costs				$925,767	
Construction Contractor Overhead/Profit and Contingency (30%)				$277,730	
Total of Construction Costs				**$1,203,497**	
Site Setup					
Portable Toilet and Handwash Station	Week	10	$340.00	$3,400.00	Based on recent quote from project similar in nature. Assumes 2 portable toilets.
Trimble GPS	Day	19	$75.00	$1,425.00	For identifying removal areas and post-excavation horizontal and vertical delineation sample locations
Sampling and Surveying					
Confirmation Sampling (2nd Street Disposal Area)	each	27	$497.00	$13,419.00	Assumes 7 day TAT and 25% of the initial confirmation samples will exceed the PSRGs. Samples analyzed for select VOCs, SVOCs, PCBs, and metals. Includes duplicate samples at 1 per 10 samples. BOA rates
Confirmation Sampling (5th Street Disposal Area)	each	32	$593.00	$18,976.00	Assumes 7 day TAT and 25% of the initial confirmation samples will exceed the PSRGs. Samples analyzed for select VOCs, SVOCs, PCBs, metals, and pesticides. Includes duplicate samples at 1 per 10 samples. BOA rates
Waste Characterization Sampling	Each	19	$982.50	$18,667.50	Assumes 1 sample per 500 cy for full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), ignitability, and corrosivity with 7 day TAT. BOA rates.
Fill Material Source Sampling	Each	2	$593.00	$1,186.00	Assumes 7 day TAT and 1 sample per offsite borrow source. Samples analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. BOA rates
Confirmation Sampling Technician	Hour	20	$33.60	$672.00	Assumes 2 10-hour day to complete the confirmation sampling. Includes collecting waste characterization and fill material source samples.
Geophysical Survey	linear meter	3,387	$0.90	$3,048.30	Survey excavation floor prior to backfilling. Includes mobilization/demobilization, preparation of H&S and work planning documents, reporting, and all labor, equipment, and materials to conduct the geophysical survey.
Topographic Survey of Excavation Area	Day	2	$1,500.00	$3,000.00	Assumes 2 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials.
Subtotal of Site Setup and Sampling and Surveying Costs				***$63,794***	
Sampling and Surveying Contractor Overhead/Profit and Contingency (10%)				$6,379	
Total of Sampling and Surveying Costs				**$70,173**	
TOTAL CAPITAL COST				**$1,274,000**	
			+50%	**$1,911,000**	
			-30%	**$892,000**	

References and Source Notes
- Base costs used are 2014 dollars.
- Recent similar projects include the Towers Road Phase I RI and construction projects in JEB Little Creek in Virginia Beach, VA; NAS Oceana in Virginia Beach, VA; SJCA in Chesapeake, VA; and NSN in Norfolk, VA.
- USEPA and USACE, 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasiblity Study* , EPA 540-R-00-002 OSWER 9355.0-75. July

Assumptions and Exclusions
1. Mobilization includes utility clearance.
2. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the anticipated costs in the IRAP.

Table B-2
Engineer's Cost Estimate for Alternative 3: Excavation, material sorting, offsite disposal, and backfill with native and imported material
Towers Road Disposal Area Interim Remedial Action Plan and Preconstruction Report
Harvey Point Defense Testing Activity
Hertford, North Carolina

Description: Alternative 3 consists of excavation, material sorting, offsite disposal, and backfill with native and imported material. The 2nd Street Disposal Area, assumed to cover 0.7 acres, and 5th Street Disposal Area, assumed to cover 0.6 acres, will be excavated to the visible limits of waste and backfilled. The total volume of excavated soil and waste is assumed to be 9,286 cy (8,895 cy within the initial excavation area plus 391 cy assuming that 25% of the confirmation samples fail and additional excavation is required in those areas). It is assumed that 25% of the excavated soil will be suitable for reuse. The excavation/loading production rate is assumed to be 250 cy per day to account for the additional time required to mechanically screen the excavated material and the additional material handling that is needed to sort the reusable soil. The production rate for backfilling/restoration is assumed to be 550 cy per day and for transportation and disposal is assumed to be 580 tons per day .

Description of Service/Items	Unit	Quantity	Unit Price	Total	Assumptions
Mobilization/Demobilization and Site Setup					
Mobilization/Demobilization	Each	2	$5,715.00	$11,430.00	Includes mobilization and demobilization of all equipment and materials necessary to perform the work.
Construction Entrance Temporary Road	square yard	0	$14.20	$0.00	Assumes existing construction entrances will be utilized.
Silt Fence	Linear Feet	500	$4.25	$2,125.00	Consists of additional silt fence for any repairs and to shift the limits of disturbance at the 5th Street Disposal Area. Assumes 25% of existing silt fence surrounding the removal areas will need to be replaced.
Material Handling Area for Excavated Material	Lump Sum	1	$3,500.00	$3,500.00	Assumes 100' x 100' area. Includes impermeable liner, straw bales, silt fence, and sandbags; setup and removal included (based on project similar in nature).
Material Staging Area for Soil Reuse	Lump Sum	1	$1,000.00	$1,000.00	Assumes 50' x 50' area and placed within limits of existing silt fence. Includes 3 rolls of poly sheeting and removal
Mobilization/Demobilization and Site Setup Total				***$18,055***	
Construction Crew					
Site Superintendent (H&S/QC Manager)	Hour	700	$93.50	$65,450.00	Assumes 70 10-hour days to complete work.
Heavy Equipment Operator	Hour	1,120	$42.50	$47,600.00	Assumes 70 10-hour days and 5-day work weeks to complete work and 2 equipment operators.
Heavy Equipment Operator (Overtime)	Hour	280	$63.75	$17,850.00	Assumes 70 10-hour days and 5-day work weeks to complete work and 2 equipment operators.
Laborer	Hour	560	$30.60	$17,136.00	Assumes 70 10-hour days and 5-day work weeks to complete work and 1 laborer.
Laborer (Overtime)	Hour	140	$45.90	$6,426.00	Assumes 70 10-hour days and 5-day work weeks to complete work and 1 laborer.
Heavy Equipment					
Excavator	Month	2	$11,600.00	$23,200.00	Includes fuel [Hertz Equipment Rental = $6,600/month plus $1,250/week (250 gal. @ $5/gal)for diesel fuel]. For excavation and loading.
Front End Loader	Week	5	$2,945.00	$14,725.00	Includes fuel [Hertz Equipment Rental = $1,945/week plus $1,000/week (200 gal. @ $5/gal)for diesel fuel]. For loading reuseable soil into dump truck.
Dozer	Week	5	$2,575.00	$12,875.00	Includes fuel [Hertz Equipment Rental = $1,575/week plus $1,000/week (200 gal. @ $5/gal)for diesel fuel]. For backfilling
Box Dump Truck	Month	3.5	$11,150.00	$39,025.00	12-14 cy capacity. Includes fuel and rental vehicle. [Hertz Equipment Rental = $6,150/month plus $1,250/week (250 gallons @ $5/gallon for diesel fuel). For transporting excavated material to and reuseable soil from the material processing area.
Project Vehicle (Pickup Truck)	Month	3.5	$3,620.00	$12,670.00	Includes fuel and rental vehicle. Assumes 1 truck for Site Superintendent and 1 for Construction crew [Hertz Equipment Rental = 2 each @ $1,250/month plus 2 each @ $140/week (35 gallons @ $4/gallon for fuel).
Construction Crew and Heavy Equipment Total				***$256,957***	
Excavation					
Excavate and Load Material	Ton	10,679	$4.50	$48,055.50	Engineer's Estimate. Assumes 1.2 tons/cy for soil, 1.0 tons/cy for waste, and waste is 25% by volume.
Mechanical Screening	Month	2.00	$14,000.00	$28,000.00	$10,000/month for rental plus $1,000/week for fuel (200 gal. @$5/gal) for diesel fuel. Based on recent similar projects.
Excavation Dewatering	Day	37	$100.00	$3,700.00	Includes all equipment and materials for 3" trash pump, sediment bag, and associated hosing. Assumes dewatering will occur within excavation limits.
Waste Disposal					
T&D of Excavated Soil	Ton	8,590	$49.95	$429,045.53	Assumes 25% of soil excavated can be reused, 1.2 tons/cy for soil, 1.0 tons/cy for waste, waste is 25% by volume, and non-hazardous. Based on recent pricing from Subtitle D Disposal Facility.
Excavation and Waste Disposal Total				***$508,801***	
Material Delivery and Site Restoration					
Topsoil material and delivery	cubic yard	1286	$23.00	$29,573.63	Includes 6" topsoil layer over removal area; assume 1.25 cy loose/in-place
General fill material and delivery	cubic yard	8145	$19.00	$154,757.42	Includes general fill to within 6" of original grade; assume 1.25 cy loose/in-place. Assumes that 25% of soil excavated can be reused.
Site Restoration	Lump Sum	1	$1,250.00	$1,250.00	Includes seed and straw for 2nd Street Disposal Area, 5th Street Disposal Area, and all other disturbed areas. Assumes the area to be restored is less than 2 acres.
Material Delivery and Site Restoration Total				***$185,581***	
Subtotal of Construction Costs				$969,394	
Construction Contractor Overhead/Profit and Contingency (30%)				$290,818	
Total of Construction Costs				**$1,260,212**	
Site Setup					
Portable Toilet and Handwash Station	Week	14	$340.00	$4,760.00	Based on recent quote from project similar in nature. Assumes 2 portable toilets.
Trimble GPS	Day	37	$75.00	$2,775.00	For identifying removal areas and post-excavation horizontal and vertical delineation sample locations
Sampling and Surveying					
Confirmation Sampling (2nd Street Disposal Area)	each	27	$497.00	$13,419.00	Assumes 7 day TAT and 25% of the initial confirmation samples will exceed the PSRGs. Samples analyzed for select VOCs, SVOCs, PCBs, and metals. Includes duplicate samples at 1 per 10 samples. BOA rates
Confirmation Sampling (5th Street Disposal Area)	each	32	$593.00	$18,976.00	Assumes 7 day TAT and 25% of the initial confirmation samples will exceed the PSRGs. Samples analyzed for select VOCs, SVOCs, PCBs, metals, and pesticides. Includes duplicate samples at 1 per 10 samples. BOA rates
Waste Characterization Sampling	Each	11	$982.50	$10,807.50	Assumes 1 sample per 500 cy of soil for full TCLP (VOCs, SVOCs, metals, herbicides, and pesticides), ignitability, and corrosivity with 7 day TAT. Assumes 25% of soil excavated can be reused. BOA rates.
Soil Reuse Sampling	each	14	$593.00	$8,302.00	Assumes 7 day TAT and 1 sample per 500 cy. Samples analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. BOA rates
Fill Material Source Sampling	Each	2	$593.00	$1,186.00	Assumes 7 day TAT and 1 sample per offsite borrow source. Samples analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. BOA rates
Confirmation Sampling Technician	Hour	30	$36.40	$1,092.00	Assumes 3 10-hour day to complete the confirmation sampling. Includes collecting waste characterization, soil reuse, and fill material source samples.
Geophysical Survey	linear meter	3,387	$0.90	$3,048.30	Survey excavation floor prior to backfilling. Includes mobilization/demobilization, preparation of H&S and work planning documents, reporting, and all labor, equipment, and materials to conduct the geophysical survey.
Topographic Survey of Excavation Area	Day	2	$1,500.00	$3,000.00	Assumes 2 10-hour day to complete the survey. Includes mobilization/demobilization, survey data evaluation/reporting, and all labor, equipment, and materials.
Subtotal of Site Setup and Sampling and Surveying Costs				***$67,366***	
Sampling and Surveying Contractor Overhead/Profit and Contingency (10%)				$6,737	
Total of Sampling and Surveying Costs				**$74,102**	
TOTAL CAPITAL COST				**$1,334,000**	
			+50%	**$2,001,000**	
			-30%	**$934,000**	

References and Source Notes

- Base costs used are 2014 dollars.
- Recent similar projects include the Towers Road Phase I RI and construction projects in JEB Little Creek in Virginia Beach, VA; NAS Oceana in Virginia Beach, VA; SJCA in Chesapeake, VA; and NSN in Norfolk, VA.
- USEPA and USACE, 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasiblity Study,* EPA 540-R-00-002 OSWER 9355.0-75. July.

Assumptions and Exclusions

1. Mobilization includes utility clearance.

2. The enclosed Engineer's Estimate is only an estimate of possible construction costs for budgeting purposes. This estimate is limited to the conditions existing at its issuance and is not a guarantee of actual price or cost. Uncertain market conditions such as, but not limited to: local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events, and developing bidding conditions etc may affect the accuracy of this estimate. CH2M Hill is not responsible for any variance from this estimate or actual prices and conditions obtained. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the anticipated costs in the IRAP.

Appendix C
Erosion and Sediment Control Plan

PRELIMINARY DRAWINGS

EROSION AND SEDIMENT CONTROL PLAN

TOWERS ROAD DISPOSAL AREAS
HERTFORD, NORTH CAROLINA

PREPARED FOR

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC
NORFOLK, VIRGINIA

VICINITY MAP

INDEX TO DRAWINGS

SHEET NO	DRAWING NUMBER	TITLE
GENERAL		
1	G-1	COVER SHEET/INDEX OF DRAWINGS
CIVIL		
2	C-1	SITE EROSION AND SEDIMENT CONTROL PLAN
DETAILS		
3	EC-1	EROSION AND SEDIMENT CONTROLS DETAILS AND NOTES

FOR PROJECT INFORMATION, CONTACT:

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(757) 671-6256

CH2M HILL

CH2M HILL PROJECT NO. 439611
OCTOBER 2012

SYM | DESCRIPTION | DATE | APPR

NAVFAC

CH2MHILL

SEAL

A/E INFO

APPROVED

FOR COMMANDER NAVFAC

ACTIVITY

SATISFACTORY TO DATE

DES NP DRW DS CHK JS

PM/DM

BRANCH MANAGER

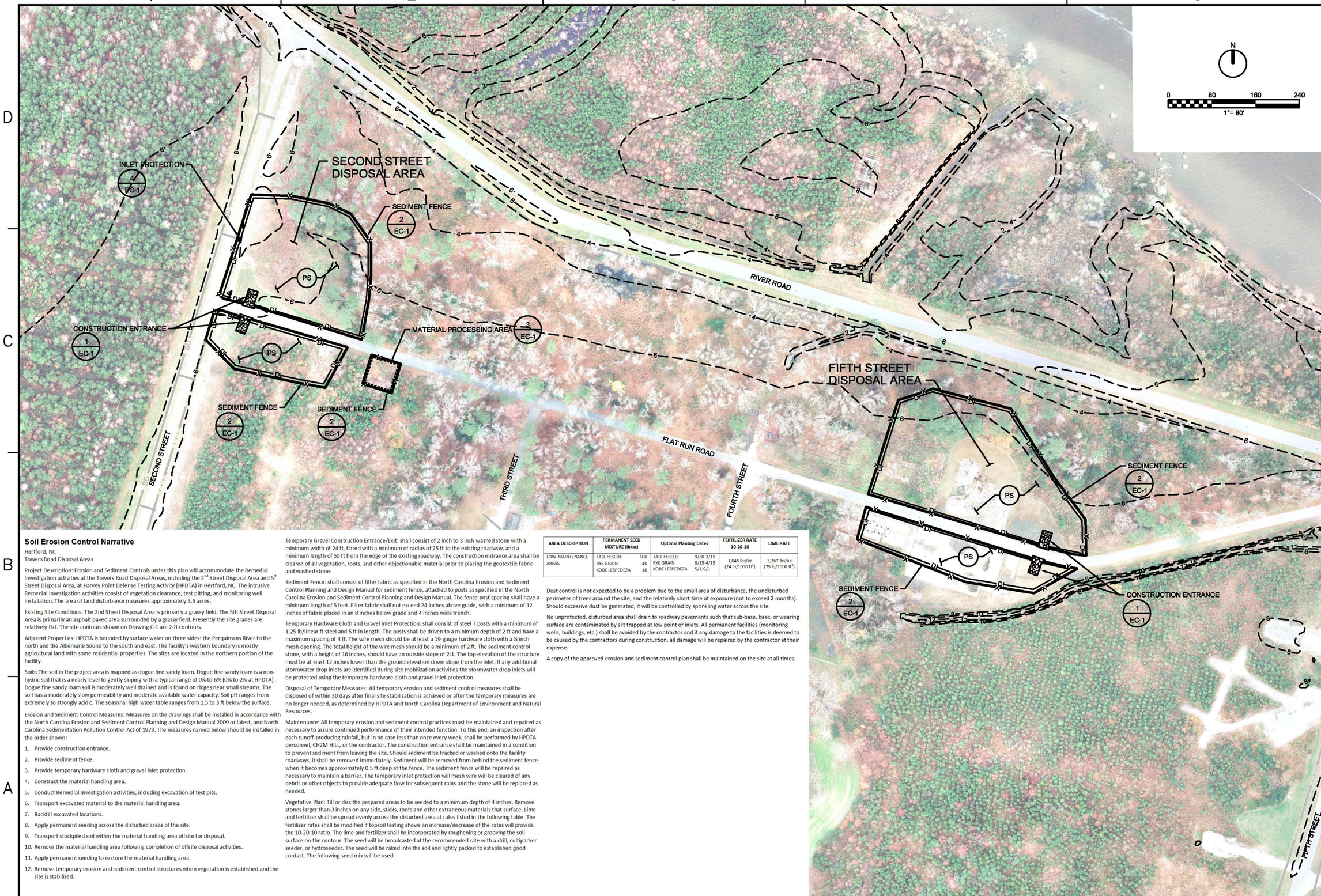
CHIEF ENG/ARCH

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC
TOWERS ROAD DISPOSAL AREAS
HERTFORD, NORTH CAROLINA
REMEDIAL INVESTIGATION
COVER SHEET/INDEX OF DRAWINGS

SCALE: AS NOTED
EPROJECT NO.: –
CONSTR. CONTR. NO. –
NAVFAC DRAWING NO.
SHEET 1 OF 3

G-1

PRELIMINARY DRAWING



Soil Erosion Control Narrative

Hertford, NC
Towers Road Disposal Areas

Project Description: Erosion and Sediment Controls under this plan will accommodate the Remedial Investigation activities at the Towers Road Disposal Areas, including the 2nd Street Disposal Area and 5th Street Disposal Area, at Harvey Point Defense Testing Activity (HPDTA) in Hertford, NC. The intrusive Remedial Investigation activities consist of vegetation clearance, test pitting, and monitoring well installation. The area of land disturbance measures approximately 3.5 acres.

Existing Site Conditions: The 2nd Street Disposal Area is primarily a grassy field. The 5th Street Disposal Area is primarily an asphalt paved area surrounded by a grassy field. Presently the site grades are relatively flat. The site contours shown on Drawing C-1 are 2-ft contours.

Adjacent Properties: HPDTA is bounded by surface water on three sides: the Perquimans River to the north and the Albemarle Sound to the south and east. The facility's western boundary is mostly agricultural land with some residential properties. The sites are located in the northern portion of the facility.

Soils: The soil in the project area is mapped as dogue fine sandy loam. Dogue fine sandy loam is a non-hydric soil that is a nearly level to gently sloping with a typical range of 0% to 6% (0% to 2% at HPDTA). Dogue fine sandy loam soil is moderately well drained and is found on ridges near small streams. The soil has a moderately slow permeability and moderate available water capacity. Soil pH ranges from extremely to strongly acidic. The seasonal high water table ranges from 1.5 to 3 ft below the surface.

Erosion and Sediment Control Measures: Measures on the drawings shall be installed in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual 2009 or latest, and North Carolina Sedimentation Pollution Control Act of 1973. The measures named below should be installed in the order shown:

1. Provide construction entrance.
2. Provide sediment fence.
3. Provide temporary hardware cloth and gravel inlet protection.
4. Construct the material handling area.
5. Conduct Remedial Investigation activities, including excavation of test pits.
6. Transport excavated material to the material handling area.
7. Backfill excavated locations.
8. Apply permanent seeding across the disturbed areas of the site.
9. Transport stockpiled soil within the material handling area offsite for disposal.
10. Remove the material handling area following completion of offsite disposal activities.
11. Apply permanent seeding to restore the material handling area.
12. Remove temporary erosion and sediment control structures when vegetation is established and the site is stabilized.

Temporary Gravel Construction Entrance/Exit: shall consist of 2 inch to 3 inch washed stone with a minimum width of 24 ft, flared with a minimum of radius of 25 ft to the existing roadway, and a minimum length of 50 ft from the edge of the existing roadway. The construction entrance area shall be cleared of all vegetation, roots, and other objectionable material prior to placing the geotextile fabric and washed stone.

Sediment Fence: shall consist of filter fabric as specified in the North Carolina Erosion and Sediment Control Planning and Design Manual for sediment fence, attached to posts as specified in the North Carolina Erosion and Sediment Control Planning and Design Manual. The fence post spacing shall have a minimum length of 5 feet. Filter fabric shall not exceed 24 inches above grade, with a minimum of 12 inches of fabric placed in an 8 inches below grade and 4 inches wide trench.

Temporary Hardware Cloth and Gravel Inlet Protection: shall consist of steel T posts with a minimum of 1.25 lb/linear ft steel and 5 ft in length. The posts shall be driven to a minimum depth of 2 ft and have a maximum spacing of 4 ft. The wire mesh should be at least a 19-gauge hardware cloth with a ¼ inch mesh opening. The total height of the wire mesh should be a minimum of 2 ft. The sediment control stone, with a height of 16 inches, should have an outside slope of 2:1. The top elevation of the structure must be at least 12 inches lower than the ground elevation down slope from the inlet. If any additional stormwater drop inlets are identified during site mobilization activities the stormwater drop inlets will be protected using the temporary hardware cloth and gravel inlet protection.

Disposal of Temporary Measures: All temporary erosion and sediment control measures shall be disposed of within 30 days after final site stabilization is achieved or after the temporary measures are no longer needed, as determined by HPDTA and North Carolina Department of Environment and Natural Resources.

Maintenance: All temporary erosion and sediment control practices must be maintained and repaired as necessary to assure continued performance of their intended function. To this end, an inspection after each runoff-producing rainfall, but in no case less than once every week, shall be performed by HPDTA personnel, CH2M HILL, or the contractor. The construction entrance shall be maintained in a condition to prevent sediment from leaving the site. Should sediment be tracked or washed onto the facility roadways, it shall be removed immediately. Sediment will be removed from behind the sediment fence when it becomes approximately 0.5 ft deep at the fence. The sediment fence will be repaired as necessary to maintain a barrier. The temporary inlet protection will mesh wire will be cleared of any debris or other objects to provide adequate flow for subsequent rains and the stone will be replaced as needed.

Vegetative Plan: Till or disc the prepared areas to be seeded to a minimum depth of 4 inches. Remove stones larger than 3 inches on any side, sticks, roots and other extraneous materials that surface. Lime and fertilizer shall be spread evenly across the disturbed area at rates listed in the following table. The fertilizer rates shall be modified if topsoil testing shows an increase/decrease of the rates will provide the 10-20-10 ratio. The lime and fertilizer shall be incorporated by roughening or grooving the soil surface on the contour. The seed will be broadcasted at the recommended rate with a drill, cultipacker seeder, or hydroseeder. The seed will be raked into the soil and lightly packed to established good contact. The following seed mix will be used:

AREA DESCRIPTION	PERMANENT SEED MIXTURE (lb/ac)		Optimal Planting Dates		FERTILIZER RATE 10-20-10	LIME RATE
LOW-MAINTENANCE AREAS	TALL FESCUE	100	TALL FESCUE	9/30-3/15	1,045 lbs/ac (24 lb/1000 ft^2)	3,267 lbs/ac (75 lb/1000 ft^2)
	RYE GRAIN	40	RYE GRAIN	8/15-4/15		
	KOBE LESPEDEZA	10	KOBE LESPEDEZA	5/1-9/1		

Dust control is not expected to be a problem due to the small area of disturbance, the undisturbed perimeter of trees around the site, and the relatively short time of exposure (not to exceed 2 months). Should excessive dust be generated, it will be controlled by sprinkling water across the site.

No unprotected, disturbed area shall drain to roadway pavements such that sub-base, base, or wearing surface are contaminated by silt trapped at low point or inlets. All permanent facilities (monitoring wells, buildings, etc.) shall be avoided by the contractor and if any damage to the facilities is deemed to be caused by the contractors during construction, all damage will be repaired by the contractor at their expense.

A copy of the approved erosion and sediment control plan shall be maintained on the site at all times.

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC
TOWERS ROAD DISPOSAL AREAS
HERTFORD, NORTH CAROLINA
REMEDIAL INVESTIGATION
SITE EROSION AND SEDIMENT CONTROL PLAN

SCALE: AS NOTED
EPROJECT NO.: –
CONSTR. CONTR. NO. –
NAVFAC DRAWING NO.
SHEET 2 OF 3
C-1

PRELIMINARY DRAWING

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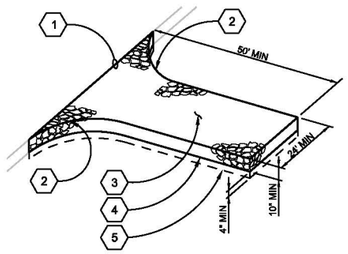


KEYNOTES:

1. EXISTING PAVEMENT OR APPROVED ACCESS POINT.
2. 25' R, MIN.
3. CLEAN PIT RUN OR 2 1/2" MINUS GRAVEL (OR LARGER IF REQUIRED).
4. FREE DRAINING EXCAVATED MATERIAL.
5. GEOTEXTILE.

GENERAL NOTES:

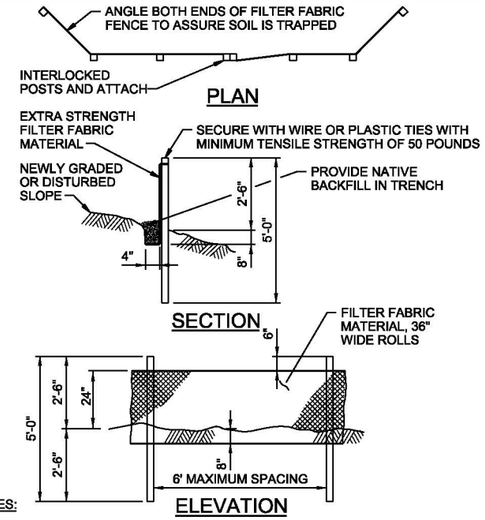
A. ADDITIONAL GRAVEL SHALL BE ADDED PERIODICALLY TO MAINTAIN PROPER FUNCTION OF THE PAD.

B. REMOVE GRAVEL ENTRANCE AND REPLACE WITH NEW BASE COURSE PRIOR TO COMPLETION OF ACCESS ROAD.

1 CONSTRUCTION ENTRANCE

NTS

C-1



NOTES:

1. BURY BOTTOM OF FILTER FABRIC 8" VERTICALLY BELOW FINISHED GRADE.
2. 4" DIAMETER PINE OR 1.33 LB/FT STEEL FENCE POSTS.
3. STITCHED LOOPS TO BE INSTALLED DOWNHILL SIDE OF SLOPE.
4. COMPACT ALL AREAS OF FILTER FABRIC TRENCH.
5. FILTER FABRIC WILL BE AT LEAST 95% BY WEIGHT POLYOLEFINS OR POLYESTER, CERTIFIED BY MANUFACTURER OR SUPPLIER AS COMPLYING WITH REQUIREMENTS IN ASTM D6461. FILTER FABRIC SHOULD CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS TO PROVIDE A MINIMUM OF 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT A TEMPERATURE OF 0 TO 120 DEGREES FAHRENHEIT.

2 SEDIMENT FENCE

NTS

C-1

GENERAL SITE NOTES:

SOURCE OF TOPOGRAPHY SHOWN ON THE CIVIL PLANS ARE BASE MAPS PROVIDED BY HPDTA.

EXISTING CONDITIONS MAY VARY FROM THOSE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND ADJUST WORK PLAN ACCORDINGLY PRIOR TO BEGINNING CONSTRUCTION.

EXISTING STRUCTURES AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED.
EXISTING TOPOGRAPHY, NEW STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED.

HORIZONTAL DATUM: NAD83

VERTICAL DATUM: NAVD88

MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTOR'S EXPENSE.

CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING AND MAINTAINING EROSION CONTROL DEVICES DURING CONSTRUCTION.

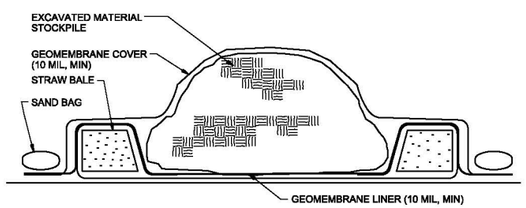
CONTRACTOR SHALL TAKE ALL OTHER MEASURES TO POSITIVELY PRECLUDE EROSION MATERIALS FROM LEAVING THE SITE.

INDICATED SCALES ARE BASED ON FULL-SIZE DRAWINGS, AND IF DRAWINGS ARE REDUCED, SCALES MUST BE ADJUSTED ACCORDINGLY.

LIMIT CONSTRUCTION OPERATIONS TO WITHIN THE RIGHT-OF-WAY, EASEMENTS AND ANY OTHER DESIGNATED WORK AREAS AS INDICATED. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ANY DAMAGES AS A RESULT OF CONSTRUCTION ACTIVITIES OUTSIDE OF RIGHT-OF-WAYS, EASEMENTS AND ANY OTHER DESIGNATED WORK AREAS SHOWN ON THE DRAWINGS.

RESTORE ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITIES AS INDICATED.

THERE ARE ADDITIONAL UTILITIES WITHIN THE VICINITY OF THE DISPOSAL AREAS THAT ARE NOT SHOWN ON DRAWING C-1. IN ADDITION TO CONDUCTING AN UNDERGROUND UTILITY SURVEY PRIOR TO BEGINNING INTRUSIVE ACTIVITIES, FIGURE 2-1 (SITE LOCATION) OF THE WORK PLAN SHOULD BE REFERENCED.



SPECIFICATIONS FOR STAGING OF EXCAVATED MATERIAL

1. THE MATERIAL PROCESSING AREA WILL HAVE EROSION AND SEDIMENT CONTROLS IN PLACE AND BE APPROVED BY HPDTA PRIOR TO BEGINNING EXCAVATION.
2. ALL EXCAVATED MATERIAL WILL EITHER BE REMOVED FROM THE SITE BY HPDTA PERSONNEL FOR OFF-SITE MANAGEMENT OR WILL BE PLACED INSIDE THE MATERIAL PROCESSING AREA.
3. ALL EXCAVATED MATERIAL WILL BE COVERED WITH A GEOMEMBRANE COVER AND SECURED WITH SAND BAGS DURING INCLIMENT WEATHER AND AT THE END OF EACH WORKING DAY. MATERIAL WILL BE COVERED UNTIL REMOVED FROM THE SITE.
4. EXCAVATED MATERIAL WILL NOT EXCEED 5 FT IN HEIGHT.
5. A CONTINUOUS GEOMEMBRANE COVER SHOULD COVER THE BOTTOM AREA OF THE MATERIAL PROCESSING AREA.
6. A BERM OF 18 INCH HIGH STRAW BALES SHALL BE PLACED ON THE BOTTOM GEOMEMBRANE LINER, AND THE GEOMEMBRANE LINER FOLDED OVER INTO THE MATERIAL PROCESSING AREA TO PREVENT FLOWS FROM INSIDE THE MATERIAL PROCESSING AREA FROM EXITING THE MATERIAL PROCESSING AREA.
7. CAUTION SHOULD BE TAKEN NOT TO RIP OR TEAR THE BOTTOM GEOMEMBRANE LINER WHEN HANDLING OR REMOVING MATERIAL.
8. ALL EXCAVATED MATERIAL WILL BE REMOVED FROM THE SITE AS SOON AS POSSIBLE OR WITHIN 90 DAYS.

NOTE: USE IF EXCAVATED SOIL MUST BE TEMPORARILY STOCKPILED OUTSIDE EXCAVATION

3 MATERIAL PROCESSING AREA

NTS

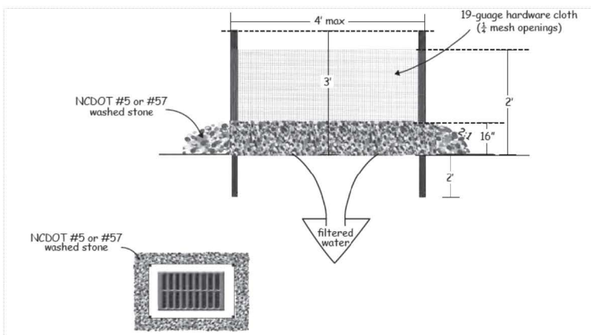
C-1

ABBREVIATIONS

AC	ACRE
FT	FOOT/FEET
HPDTA	HARVEY POINT DEFENSE TESTING ACTIVITY
LB	POUND
MIL	MILLIMETER
MIN	MINIMUM
N	NORTH/NORTHING
NAD	NORTH AMERICAN DATUM
NAVD	NORTH AMERICAN VERTICAL DATUM
NAVFAC	NAVAL FACILITIES ENGINEERING COMMAND
NTS	NOT TO SCALE
SF	SEDIMENT FENCE

EROSION CONTROL LEGEND

PRACTICES	SYMBOL
SEDIMENT FENCE	X——X
PERMANENT SEEDING AND PLANTING	PS
CONSTRUCTION ENTRANCE	
LIMITS OF DISTURBANCE	— DI ——— DI —
INLET PROTECTION	



CONSTRUCTION SPECIFICATIONS

1. UNIFORMLY GRADE A SHALLOW DEPRESSION APPROACHING THE INLET.
2. DRIVE 5-FT STEEL POSTS 2 FT INTO THE GROUND SURROUNDING THE INLET.
3. SPACE POSTS EVENLY AROUND THE PERIMETER OF THE INLET, A MAXIMUM OF 4 FT APART.
4. SURROUND THE POSTS WITH WIRE MESH HARDWARE CLOTH. SECURE THE WIRE MESH TO THE STEEL POSTS AT THE TOP, MIDDLE, AND BOTTOM. PLACING A 2-FT FLAP OF THE WIRE MESH UNDER THE GRAVEL FOR ANCHORING IS RECOMMENDED.
5. PLACE CLEAN GRAVEL (NC DOT #5 OR #57 STONE) ON A 2:1 SLOPE WITH A HEIGHT OF 16 INCHES AROUND THE WIRE, AND SMOOTH TO AN EVEN GRADE.
6. ONCE THE CONTRIBUTING DRAINAGE AREA HAS BEEN STABILIZED, REMOVE ACCUMULATED SEDIMENT, AND ESTABLISH FINAL GRADING ELEVATIONS.
7. COMPACT THE AREA PROPERLY AND STABILIZED IT WITH GROUNDCOVER.

4 INLET PROTECTION

NTS

C-1

SECTION / DETAIL DESIGNATIONS

ON DRAWING WHERE SECTION OR DETAIL IS TAKEN:

1 / C-3 — DRAWING NUMBER WHERE SHOWN

2 DETAIL

SCALE

C-3

ON DRAWING WHERE DETAIL IS SHOWN:

DRAWING NUMBER(S) WHERE TAKEN

CIVIL LEGEND

— — · 6 — —	CONTOUR
→ · · ·	STORMWATER OPEN DRAINAGE
—— SD ——	STORM WATER PIPE

STM	DESCRIPTION
DATE	
APPR	

NAVFAC

SEAL

CH2MHILL.

A/E INFO

APPROVED

FOR COMMANDER NAVFAC

ACTIVITY

SATISFACTORY TO DATE

DES NP DRW DS CHK JS

PM/DM

BRANCH MANAGER

CHIEF ENG/ARCH

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC
TOWERS ROAD DISPOSAL AREAS
HERTFORD, NORTH CAROLINA
REMEDIAL INVESTIGATION
EROSION AND SEDIMENT CONTROLS DETAILS AND NOTES

SCALE: AS NOTED

EPROJECT NO.: –

CONSTR. CONTR. NO. –

NAVFAC DRAWING NO.

SHEET 3 OF 3

EC-1

DRAWFORM REVISION: 10 MARCH 2006

PRELIMINARY DRAWING

FILENAME: 005-EC-01_439611.dgn PLOT DATE: 10/18/2012 PLOT TIME: 10:33:23 AM

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WATER QUALITY

GENERAL PERMIT – NCG 010000

TO DISCHARGE STORMWATER UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
for

CONSTRUCTION ACTIVITIES

In compliance with the provision of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by North Carolina Environmental Management Commission and the Federal Water Pollution Control Act as amended:

> All owners or operators of stormwater point source discharges associated with construction activities including clearing, grading or excavation activities resulting in the disturbance of land greater than or equal to one acre, or that are part of a common plan of development of that size, are hereby authorized to discharge stormwater to the surface waters of North Carolina or to a separate storm sewer system conveying stormwater to the surface waters in accordance with the terms and conditions set forth herein. Failure to receive coverage under this permit or violations of any of the conditions listed may result in assessment of state or federal civil or criminal penalties for each day of violation.

The General Permit shall become effective on August 3, 2011.
The General Permit shall expire at midnight on July 31, 2016.

Signed this day July 28th, 2011

Coleen H. Sullins, Director
Division of Water Quality
By the Authority of the Environmental Management Commission

Appendix D
Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Civil Surveying

I. Purpose and Scope

The SOP describes survey procedures to be used on CLEAN projects. Modified third-order survey procedures will be used for most surveying. Geographic Positioning System techniques will be used for measurement of some horizontal coordinates.

II. Records and Definitions

All field notes should be kept in bound books. Each book should have an index. Each page of field notes should be numbered and dated and should show the initials of all crew members. The person taking field notes will be identified in the log. Information on weather (wind speed/wind direction, cloud cover, etc.) and on other site conditions should also be entered in the notes. Notes should also include instrument field identification number and environmental settings. Graphite pencils or waterproof ballpoint pens should be used. Erasing is not acceptable; use a single-strike-through and initial it. The notekeeping format should conform to the *Handbook of Survey Notekeeping* by William Pafford. A survey work drawing with grid lines and at the scale of the topographic map should be prepared for all survey field work. Field notebooks will be available on site.

The following terms are defined to clarify discussion in this SOP:

- North American Datum (NAD) -The standard geodetic datum on the North American continent.
- National Geodetic Vertical Datum (NGVD) - The vertical-control datum used (1929 or later) by the National Geodetic Survey for vertical control.
- Horizontal Control - Horizontal location of an object from surveyed corners or other features on permanent land monuments in the immediate site area. Will be based on North American Datum (NAD) 1983 and state plane grid systems.
- Vertical Control - Vertical location of an object compared to the adjacent ground surface.
- Bench Mark - Precisely determined elevation above or below sea level. May also have horizontal control (northing, easting) determined for location.

III. Surveying

Horizontal Survey

Horizontal angular measurements shall be made with a 20-second or better theodolite or transit. When using a 20-second instrument the horizontal angles shall be turned four times (two each direct and inverted) with the mean of the fourth

angle being within 5 seconds of the mean of the second angle. When using a 10-second or better instrument the angles shall be doubled (once each direct and inverted), with the mean of the second angle within 5 seconds of the first angle. The minimum length of any traverse courses shall be 300 feet.

Distance measurements shall be made with a calibrated steel tape corrected for temperature and tension or a calibrated electronic distance meter (EDM). When using an EDM the parts per million (PPM), curvature and refraction corrections shall be made. Vertical angle measurements used for distance slope corrections shall be recorded to the nearest 20 seconds of arc deviation from the horizontal plane. Horizontal locations will be surveyed to within 0.05-foot of the true location.

Horizontal traverse stations shall be established and referenced for future use. All stations shall be described in the field notes with sufficient detail to facilitate their recovery at a later date. The station shall consist of a permanent mark scribed on facilities such as sidewalks, curbs, concrete slabs, or iron rod and cap.

The horizontal location will be referenced to NAD83 and the appropriate state plane grid system.

Some horizontal coordinates will be measured using Geographic Positioning System (GPS) equipment. This approach will be used in particular for determining the coordinates of surface-water and sediment sampling locations, and may be used also for determining the locations of piezometers and monitoring wells. The GPS survey will be performed by staff trained in the use of the equipment and will conform to guidance provided by the manufacturer.

Vertical Survey

When practical, vertical control will be referenced to the National Geodetic Vertical Datum (NGVD) of 1929, obtained from a permanent benchmark. If practical, level circuits should close on a known benchmark other than the starting benchmark. The following criteria shall be met in conducting the survey:

- Instruments shall be pegged weekly or after any time it is dropped or severely jolted.
- Foresight and backsight distances shall be reasonably balanced and shall not be greater than 250 feet in length.
- No side shot shall be used as a beginning or ending point in another level loop.
- Rod readings shall be made to 0.01-foot and estimated to 0.005-foot.
- Elevations shall be adjusted and recorded to 0.01-foot.

Temporary benchmarks (TBMs) shall be established and referenced for future use. All TBMs shall be described in the field notes with sufficient detail to facilitate their recovery at a later date. The TBMs shall consist of a permanent mark scribed on facilities such as sidewalks, curbs, concrete slabs, etc. or spikes set in the base of trees (not power poles), or tops of anchor bolts for transmission line towers, etc.

(Horizontal traverse stations will not be considered as a TBM, but may be used as a permanent turning point.)

Traverse Computations and Adjustments

Traverses will be closed and adjusted in the following manner:

- Step One—Coordinate closures will be computed using unadjusted bearings and unadjusted field distances.
- Step Two—Coordinate positions will be adjusted (if the traverse closes within the specified limits) using the compass rule.
- Step Three—Final adjusted coordinates will be labeled as "adjusted coordinates." Field coordinates should be specifically identified as such.
- Step Four—The direction and length of the unadjusted error of closure, the ratio of error, and the method of adjustment shall be printed with the final adjusted coordinates.

Level Circuit Computations and Adjustments

Level circuits will be closed and adjusted in the following manner:

- For a single circuit, elevations will be adjusted proportionally, provided the raw closure is within the prescribed limits for the circuit.
- In a level net where the elevation of a point is established by more than one circuit, the method of adjustment should consider the length of each circuit, the closure of each circuit, and the combined effect of all the separate circuit closures on the total net adjustments.

Piezometer and Monitoring-Well Surveys

Piezometer and monitoring-well locations will be surveyed only after the installation of the protective casing, which is set in concrete. The horizontal plane survey accuracy is ±0.05-foot and is measured to any point on the protective-casing cover. The vertical plane survey must be accurate to ±0.01-foot. The following two elevations will be measured at piezometers and monitoring wells:

- Top of the piezometer or well riser (not on the protective casing), preferably on the north side
- Ground surface, preferably on the north side of the well

If no notch or mark exists, the point at which the elevation was measured on the inner casing shall be described so that water-level measurements may be taken from the same location.

Grid Surveys

Selected soil boring locations may be located by the survey crew after the soil borings are complete. The selected borings will be staked in the field by the field team leader. The stake will be marked with the boring number for reference. The

horizontal plane survey accuracy is ± 1 foot and is measured to any point on the ground surface immediately adjacent to the stake.

Exhibit A
STANDARDS FOR MODIFIED THIRD-ORDER PLANE SURVEYS

Traverse	
Max Number of bearing courses between azimuth checks	30
Astronomical bearings: standard error of results	6"
Azimuth closure at azimuth checkpoint not to exceed	20" $\sqrt{N}$
Standard error of the mean for length measurements	1 in 50,000
Position closure per loop in feet before azimuth adjustment	1:10,000
Leveling	
Levels error of closure per loop in feet	0.05 $\sqrt{M}$

N = the number of stations for carrying bearing
M = the distance in miles

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water or lab-grade DI water)
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® (or Alconox®) and water solution
- Concentrated (V/V) pesticide grade isopropanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Personal Protective Equipment as specified by the Health and Safety Plan
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Spread plastic on the ground to keep equipment from touching the ground

3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.

4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.

5. Rinse with 1 gallon of 10% isopropanol solution pumped through the pump. (DO NOT USE ACETONE). (Optional)

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in either DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.
4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution.
5. Rinse with potable water.
6. Rinse with distilled or potable water and isopropanol solution (DO NOT USE ACETONE). (Optional)
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Liquinox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

F. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Facility

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of Liquinox®, methanol (optional), and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

STANDARD OPERATING PROCEDURE

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Paint Pens
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Paint Pens
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they

are filled in the field and labels indicating that the contents are pending analysis affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums (check with disposal facility to determine sample frequency) containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- Generator Contact Information
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C if the results indicate hazardous waste or labeled as non-hazardous if applicable.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting with a short berm wall (hay bales or 2 x 4 planks or equivalent) to capture small spills.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. However, prior to disposal to the sanitary sewer system, approval and contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

STANDARD OPERATING PROCEDURE

Sampling Contents of Tanks and Drums

I. Scope and Application

This procedure provides an overview approach and guidelines for the routine sampling of drums and tanks. Its purpose is to describe standard procedures and precautions which are applied in sampling drums and tanks. Procedures for opening drums with the individual instruments are included in Attachment D.

The samples obtained may be used to obtain physical chemical or radiological data. The resulting data may be qualitative or quantitative in nature, and are appropriate for use in preliminary surveys as well as confirmatory sampling.

II. Summary of Methods

Drums are generally sampled by means of sampling tubes such as glass sample tubes or COLIWASA samplers. In either case, the sampling tube is manually inserted into the waste material. A sample of the drum contents is withdrawn by the sampling device. Should a drum contain bottom sludge, a glass tube will be used to retrieve a sample of this as well.

Storage tank and tank trailers, because of their greater depths, require sampling devices that can be lowered from the top, filled at a particular depth, then withdrawn. Such devices are a COLIWASA, a Kemmerer depth sampler, or a Bacon Bomb. Where samples of bottom sludge are desired, a gravity corer can be utilized. This heavy tube with a tapered nose piece will penetrate the sludge as it free falls through the tank.

III. Comments

The sampling of tanks, containers, and drums present unique problems not associated with environmental samples. Containers of this sort are generally closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access limit the types of equipment and methods of collection that can be used.

When liquids are contained in sealed vessels, gas vapor pressure can build up, sludges can settle out, and density layerings (stratification) can develop. Bulging drums may be under pressure and extreme caution should be exercised. The potential exists for explosive reactions or the release of noxious gases when containers are opened. All vessels should be opened with extreme caution. Check the HSP for the level of personnel protection to be worn. A preliminary sampling of

any headspace gases is warranted. As a minimum, a preliminary check with a Multi RAE or equivalent may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

IV. Required Equipment and Apparatus

A. **Health and safety equipment/materials**: As listed in the site safety plan.

B. **Sampling equipment**: COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.

C. **Tools**: Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.

D. **Heavy equipment**: Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).

E. **Sample Containers**: As specified in the field sampling plan.

V. Procedures

A. Drums

NOTE: DO NOT open more than one drum at a time. Each drum must be handled and sampled as a separate entity to reduce vapors in the sampling area.

1. Drums will be sampled on an area-by-area basis. Drums will be sampled after they have been placed in overpack drums but before they are transferred from the excavation to the onsite storage area.

2. Record, in logbook, all pertinent information from visual inspection of drum (e.g., physical condition, leaks, bulges, and labels). Label each drum with a unique identifying number.

3. If possible, stage drums for easy access.

4. If necessary, attach ground strap to drums and grounding point.

5. Remove any standing material (water, etc.) from container top.

6. Using non-sparking tools, carefully remove the bung or lid while monitoring air quality with appropriate instruments. If necessary (and as a last resort), the non-sparking spike affixed to the backhoe can also be used to puncture the drum for sampling. See Attachment D for method of drum opening. Record air-quality monitoring results.

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.

8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.

9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be recorded in logbook, including number and thickness of the layers and a conceptualized sketch.

10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).

11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.

12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.

13. Wipe up spilled material with lab wipes. Wipe off sample containers.

14. Mark the drum with a unique sample identification number and date using a paint marker.

15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

1. A sampling team of at least two people is required for sampling—one will collect samples, the other will relay required equipment and implements.

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.

3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.

4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.

5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.

2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.

3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.

4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)

5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.

6. Sample each trailer compartment.

7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

D. Refer to Attachment B for procedures for sampling with appropriate devices as follows:

<u>Drum</u>

Glass tube — Procedure 1

COLIWASA	–	Procedure 2

<u>Storage Tank and Tank Trailer</u>

COLIWASA	–	Procedure 2
Bacon Bomb	–	Procedure 3
Gravity Corer (for bottom sludge)	–	Procedure 4

VI. Contamination Control

Sampling tools, instruments, and equipment will be protected from sources of contamination prior to use and decontaminated after use as specified in SOP *Decontamination of Personnel and Equipment*. Liquids and materials from decontamination operations will be handled in accordance with the waste management plan. Sample containers will be protected from sources of contamination. Sampling personnel shall wear chemical resistant gloves when handling any samples. Gloves will be decontaminated or disposed of between samples.

VIII. Attachments

A. Collection of Liquid-Containerized Wastes Using Glass Tubes

B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)

C. Sampling Containerized Wastes Using the Bacon Bomb Sampler

D. Gravity Corer for sampling Sludges in Large Containers

E. Construction of a Typical COLIWASA

F. Drum Opening Techniques and Equipment

IX. References

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X. Field Checklist

_____ Sampling Instruments

_____ Tools

_____ Rubber Mallet

_____ Logbook

_____ Safety Glasses or Monogoggles

_____ Safety Shoes

_____ Ice/Cooler, as required

_____ Custody Seals, as required

_____ Chain-of-Custody Forms

_____ Drum Labels, as required

_____ Paint Marker, if drum sampling

_____ Black Indelible Pen

_____ Monitoring Instruments

_____ Labels

_____ Sampling and Analysis Plan

_____ Health and Safety Plan

_____ Decontamination Equipment

_____ Lab Wipes

_____ Lab Spatulas or Stainless Steel Spoons

_____ Chemical Preservatives, as required

_____ Appropriate Containers for Waste and Equipment

_____ Duct Tape

_____ Plastic Sheeting

Attachment A Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

Liquid samples from opened containers (i.e., 55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 centimeters long and 6 to 16 millimeters inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss that is especially prevalent when sampling low-viscosity fluids. Splashing can also be a problem and proper protective clothing should always be worn.

Note: A flexible tube with an aspirator attached is an alternative method to the glass tube, and allows various levels to be sampled discretely.

Procedures for Use

1. Remove cover from sample container.
2. Insert glass tubing almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 centimeters extend above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Cap the top of the tube with a safety-gloved thumb or a stopper.
5. Carefully remove the capped tube from the drum. If the tube has passed through more than one layer, the boundary should be apparent in the glass tube.
6. Insert the bottom, uncapped end into the sample container.
7. Partially release the thumb or stopper on the top of the tube and allow the sample to slowly flow into the sample container. If separation of phases is desired, cap off tube before the bottom phase has completely emptied. It may be advisable to have an extra container for "waste," so that the fluid on either side of the phase boundary can be directed into a separate container, allowing collection of pure phase liquids in the sample containers. The liquid remaining after the boundary fluid is removed is collected in yet a third container. NOTE: It is not necessary to put phases in separate containers if analysis of separate phases is not desired.
8. Repeat steps 2 through 6 if more volume is needed to fill the sample container.
9. Remove the tube from the sample container and replace the tube in the drum, breaking it, if necessary, in order to dispose of it in the drum.

Optional Method (if sample of bottom sludge is desired)

1. Remove the cover from the container opening.
2. Insert glass tubing slowly almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 cm extends above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safety-gloved thumb or stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end into the sample container.
7. Release the thumb or stopper on the top of the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of the stainless steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.

Note:

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.
2. If the glass tube becomes cloudy or smoky after insertion into the drum, the presence of hydrofluoric acid maybe indicated, and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Attachment B: Sampling Containerized Wastes using the Composite Liquid Waste Sampler (COLIWASA)

Discussion

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials, including PVC, glass, or Teflon. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. See Attachment E: Construction of a COLIWASA.

Uses

The COLIWASA is primarily used to sample containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylforamide, mesityloxide, and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. Due to the unknown nature of many containerized wastes, it would therefore be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawback associated with using a COLIWASA is concern for decontamination and costs. The sampler is difficult, if not impossible, to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.

2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.

3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.

4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.

6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.

7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C: Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

The Bacon Bomb is designed for the withdrawal of samples from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger-sealing surface. Stainless steel versions are also available. The volumemetric capacity is 8, 16, or 32 oz (237, 473, or 946 ml).

Uses

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version would be used, or any of the samplers could be coated with Teflon.

Procedures for Use

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill for a sufficient length of time before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line, thereby accidentally opening the bottom valve.
6. Wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.

Attachment D: Gravity Corer for Sampling Sludges in Large Containers

Discussion

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples that represent the strata profile that may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 in.) can be attained. Exercise care when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed those of the substrate; this could result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5-mm (3/16-in.) nylon line is sufficient; however, 20-mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through the liquid to the bottom.
4. Retrieve corer with a smooth, continuous, up-lifting motion. Do not bump corer because this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan (preferred).
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or laboratory spatula.

Attachment E: Construction of a Typical COLIWASA

The sampling tube consists of a 1.52-m (5-ft) by 4.13-cm (1-5/8 in) I.D. translucent plastic pipe, usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of a short-length, channeled aluminum bar attached to the sampler's stopper rod by an adjustable swivel. The aluminum bar serves both as a T-handle and lock for the samplers' closure system. When the sampler is in the open position, the handle is placed in the T-position and pushed down against the locking block. This manipulation pushes out the neoprene stopper and opens at the sampling tube. In the closed position, the handle is rotated until one leg of the T is squarely perpendicular against the locking block. This tightly seats the neoprene stopper against the bottom opening of he sampling tube and positively locks the sampler in the closed position. The closure tension can be adjusted by shortening or lengthening the stopper rod by screwing it in or out of the T-handle swivel. The closure system of the sampler consists of a sharply tapered neoprene stopper attached to a 0.95-cm (3/8-in) O.D. rod, usually PVC. The upper end of the stopper rod is connected to the swivel of the aluminum T-handle. The sharply tapered neoprene stopper can be fabricated according to specifications by plastic-products manufacturers at an extremely high price, or it can be made in-house by grinding down the inexpensive stopper with a shop grinder.

COLIWASA samplers are typically made out of plastic or glass. The plastic type consists of translucent plastic (usually PVC) sampling tube. The glass COLIWASA uses borosilicate glass plumbing pipe as the sampling tube and a Teflon plastic stopper rod. For purpose of multiphase sampling, clear plastic or glass is desirable in order to observe the profile of the multiphase liquid.

The sampler is assembled as follows:

a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.

b. Attach the PFTE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.

c. Install the stopper and stopper rod assembly in the sampling tube.

d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.

e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips though the center hole of the block.

f. Attach the upper end of the stopper rod to the swivel of the T-handle.

g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F: Drum Opening Techniques and Equipment [1]

I. Introduction

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. The potential for vapor exposure, skin exposure due to splash or spraying, or even explosion resulting from sparks produced by friction of the tools against the drum, necessitate caution when opening any closed container. Both manual drum opening and remote drum opening will be discussed in the following paragraphs. When drums are opened manually risks are greater than when opened remotely; for this reason, the remote opening of drums is advised whenever possible.

Prior to sampling, the drums should be staged to allow easy access. Also, any standing water or other material should be removed from the container top so that the representative nature of the sample is not compromised when the container is opened. There is also the possibility of encountering a water-reactive substance.

II. Manual Drum Opening

A. Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium (a non-sparking alloy formulated to reduce the likelihood of sparks). The use of bung wrenches marked "NON SPARKING" is encouraged. However, the use of a "NON SPARKING" wrench does not completely eliminate the possibility of spark being produced. Such a wrench only prevents a spark caused by wrench-to-bung friction, but it cannot prevent sparking between the threads on the drum and the bung.

A simple tool to use, the fitting on the bung wrench matching the bung to be removed is inserted into the bung and the tool is turned counterclockwise to remove the bung. Since the contents of some drums may be under pressure (especially, when the ambient temperature is high), the bung should be turned very slowly. If any hissing is heard, the person opening the drum should back off and wait for the hissing to stop. Since drums under pressure can spray out liquids when opened, the wearing of appropriate eye and skin protection in addition to respiratory protection is critical.

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way

[1] Taken from EPA Training Course: "Sampling for Hazardous Materials," U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Support Division, March 24, 1987.

off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote pressure release method prior to using the deheader.

C. Hand Pick or Spike

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or spike. These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4- foot long poles with a pointed end. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods and therefore this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes used for drum opening have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, "sprayers" may result and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross contamination and/or adverse chemical reaction from incompatible materials.

III. Remote Opening

A. Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be "staged," or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is

used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

Recently, remotely operated hydraulic devices have been fabricated to open drums remotely. One such device is discussed here. This device uses hydraulic pressure to pierce through the wall of a drum. It consists of a manually operated pump that pressurizes oil through a length of hydraulic line. A piercing device with a metal point is attached to the end of this line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head/lid of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place, if desired, and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

C. Pneumatic Devices

Pneumatically-operated devices utilizing compressed air have been designed to remove drum bungs remotely. A pneumatic bung remover consists of a compressed air supply (usually SCBA cylinders) that is controlled by a heavy-duty, 2-stage regulator. A high pressure air line of desired length delivers compressed air to a pneumatic drill that is adapted to turn a bung fitting (preferably, a bronze-beryllium alloy) selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This attachment and removal procedure is time- consuming and is the major drawback of this device. This remote bung opener does not permit the slow venting of the container, and therefore appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

IV. Summary

The opening of closed containers is one of the most hazardous site activities. Maximum efforts would be made to ensure the safety of the sampling team. Proper protective equipment and a general wariness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

STANDARD OPERATING PROCEDURE

Electromagnetic Induction

I. Purpose

The purpose of this SOP is to provide general reference information for using electromagnetic induction (EM) methods.

II. Scope

This SOP provides a description of field procedures, equipment, and interpretation methods necessary to fully utilize this procedure.

III. Definitions

Conductivity - Ability of a material to transmit an electrical current. Inverse of resistivity.

Horizontal dipole mode - Transmitter and receiver coils oriented vertically.

Vertical dipole mode - Transmitter and receiver coils oriented horizontally.

Vertical sounding - Multiple EM measurements centered at a point with varying coil spacings.

Vertical profiling - EM measurements along a traverse with a fixed coil spacing and coil orientation.

IV. Procedures

A. Overview

Electromagnetic Induction (EM) methods are non-intrusive geophysical techniques of measuring the apparent conductivity of the subsurface materials. Electrical conductivity values of subsurface materials are determined by transmitting a high frequency electromagnetic (primary) field into the earth and measuring the secondary electromagnetic field produced by the eddy current. The transmitter and receiver coils do not require direct ground contact thus permitting continuous profiling and rapid data acquisition.

The strength of the secondary field is a function of the inter coil spacing, operating frequency and ground conductivity. The ratio of the secondary to the primary magnetic field is directly proportional to the terrain conductivity which enables direct instrument readout of apparent conductivity values (measured conductivity values are the bulk average conductivity for the area or volume of earth sampled).

EM conductivity values are usually expressed in units of milliohms per meter. Conductivity values are converted to resistivity values in ohm-meters by use of the following relationship:

$$\text{resistivity (ohm - meters)} \quad \frac{1{,}000}{\text{EM instrument readout (milliohms per meter)}}$$

The apparent conductivity of the subsurface materials is dependent upon subsurface conditions such as:

- Lithology
- Porosity
- Permeability
- Conductivity of subsurface pore fluids

Changes in these parameters causing measurable variations in electromagnetic conductivity can result from:

- Conductive contaminant plumes
- Abandoned trenches and lagoons
- Lateral changes such as backfill or landfill materials
- Bedrock fracture zones
- Lithological variations
- Buried metallic objects

The sampling depth or depth of investigation is related to the coil spacing and coil mode. The two coil modes used are the vertical dipole mode (coils horizontal) and the horizontal dipole mode (coils vertical).

Two common terrain conductivity meters are EM-31 and the EM-34-3. The EM-31 has a fixed intercoil spacing of 3.7 meters and an effective depth of penetration of approximately 6 meters. The EM-34-3 has two coils which can be separated by 10, 20, or 40 meters and can be oriented in either the horizontal or vertical dipole modes; Intercoil separations increase the effective depth-of investigation as shown below.

Intercoil Spacing (meters)	Depth of Investigation (meters)	
	Horizontal Dipoles	Vertical Dipoles
10	7.5	15
20	15	30
40	30	60

The coil orientation (horizontal or vertical) allows the EM-34-3 to respond to materials of different depths.

Vertical sounding and horizontal profiling are the two EM survey techniques. Vertical profiling is accomplished by multiple measurements about a point with varying coil spacing. Horizontal profiling is performed by making measurements along traverses with fixed coil spacing. General discussions of electromagnetic induction methods are presented in texts by Grant and West (1965), Telford and others (1976), and Griffiths and King (1981).

B. Applications and Uses

The measurement of subsurface conductivity at a hazardous waste site provides a valuable contribution to site characterization. The conductivity (resistivity) of the hydrogeologic section is predominantly influenced by the pore fluids. Consequently, conductivity measurements provide indirect information on the porosity and permeability of subsurface materials, the degree of saturation, and the conductivity of the pore fluids. The conductivity of the pore fluid is influenced by the presence of dissolved electrolytes. Contaminant plumes in the unsaturated and saturated zones can be mapped provided there is a sufficient change in the conductivity to be detected by the EM instrument. Generally, contaminant plumes of inorganic waste are easily detected because the pore fluids often have conductivity values as much as three orders of magnitude above background values. EM conductivity measurements can also be used to detect the presence of buried waste; filled disposal trenches, and buried metal objects such as drums, tanks or metal debris. Electromagnetic surveys can be used to locate conductive as well as and non-conductive bodies. The many applications include:

- Contaminant plume mapping
- Locating abandoned trenches and lagoons
- Delineating bedrock fracture zones
- Determining thickness of weathered layers
- Lithology mapping
- Locating buried metallic objects
- Lateral anomalies such as pockets or pits of different materials

Examples of EM applications at sites where groundwater is contaminated are presented by Duran (1982), Greenhouse (1983), and Greenhouse and Slaine (1983).

C. Equipment

The two-coil EM instrument and the VLF (very low frequency) instrument are basically the two different types of electromagnetic surveying instruments in use; each is capable of sensing to different depths. There are several models and manufacturers of this equipment.

The two-coil system consists of a transmitter coil and a receiver coil. The transmitter coil induces an electromagnetic field of known strength and the receiver coil measures the resulting quadrature, or ratio of primary to secondary fields resulting from subsurface features. Each instrument is read directly in units of milliohms per meter (conductivity). EM readings represent the average bulk conductivity at a point halfway between the two coils.

The VLF instrument is a receiver which relies on specialized, very low frequency communication antennas for induction of an electromagnetic field. Surveying with the VLF or equivalent instrumentation is commonly referred to as VLF surveying.

The VLF Instrumentation is a small, lightweight hand-held instrument which can be operated by one person. Principal components of the instrument are a pair of mutually perpendicular coils and a receiving crystal with a frequency specific to a transmitting antenna. The two receiving coils are used to measure local character-

istics of the primary induced field and any secondary fields emanating from bodies of variable conductivity. Typical sources of induced electromagnetic fields for VLF surveying are the very low frequency antennas used for submarine communications.

D. Data Acquisition

The advantage of the EM survey method is the speed and accuracy with which lateral changes of terrain conductivity can be measured. The EM conductivity data can be acquired using sounding and profiling techniques similar to those used in electrical resistivity. EM profiling is accomplished by traversing an area with a fixed coil spacing and orientation; EM sounding is accomplished by expanding the inter-coil spacings in a manner similar to that used by electrical resistivity soundings. Some commonly used EM equipment is limited in the number of available inter-coil spacings that can be used; however, there are other EM instruments available that can operate at many coil spacings and frequency ranges to provide numerous sounding data points necessary for accurate computer modeling and profiling.

The factors determining which instrument is used and what the grid spacing should be at particular sites are:

- Depth to target and size of target
- Accessibility of the site
- Effects of manmade structures and utilities, such as electric power lines
- Conductivity of the earth materials

EM induction instruments may have a depth of investigation of up to 200 feet depending upon coil spacing and orientations used. The very low frequency VLF device has the greatest depth of investigation and is generally used to evaluate large geologic structures.

In conducting a VLF survey, VLF readings should be acquired with the instrument oriented perpendicular to a straight line from the site to the transmitter antennas. This orientation is necessary to ensure optimum data quality. All readings from a particular VLF station must be obtained with the instrument oriented in the same direction.

For an EM induction survey, a regular pattern of survey stations will provide coverage of the area in question. Typically, use of a grid spacing which is approximately equal to the size of the target sought by the survey, and coil spacing with a maximum response for the depth of interest will produce satisfactory results. Specific needs for local detail, however, may require a refined coverage. The chosen spacing should always be site and target specific.

In conducting an EM survey, the field operator must avoid or note any potential sources of anomalous (noise) conductivity values such as power lines, buildings, fences, buried pipelines or any other large metal objects. Noise sources should be noted on the profiles or contour maps accounting for anomalies due to these known sources.

Important information that should be known for planning and before conducting an EM conductivity survey are: assumed hydrogeologic characteristics of the site,

potential source locations and migration paths, characteristics of the hazardous substance of interest, and depths of interest. The level of detail necessary (size of object of interest and detail of resolution) determines the number of lines and station spacings of readings required.

EM data, if not recorded on a strip chart or digital recording instrument, should be recorded on standardized data sheets. At a minimum all data (strip chart, digital disks, or standard forms) should have the following information listed:

- Project/site location identification
- Company
- Date and time
- Operators name
- Instrument make, model
- Coil spacings and configuration
- Line and station numbers
- Instrument reading scales
- Weather conditions/temperature

E. Interpretation

1. Data Analysis

In general, electromagnetic survey data require relatively little processing before they can be interpreted. This is especially true for fixed coil spacing surveys because the data are recorded in units of conductivity; preliminary interpretations are made by comparison of conductivity values. A contour map can be prepared from the data and compared with results of other surveys. EM instruments also can be used for vertical soundings similar to resistivity sounding. Vertical sounding with EM equipment, however, has lower resolution than that performed with the resistivity technique. As a result, EM data are generally more useful for continuous profiling surveys.

VLF instruments do not read directly in units of conductivity. The in-phase measurement (the tilt of primary induced field) is read in terms of the tangent to the angle of tilt and is given as a percentage. Quadrature measurements, which are the ratios of voltage required to equalize the primary to secondary signal strengths, are also given as percentages. For field interpretation these two sets of data can be plotted in profile form, percentage versus distance. Greenhouse and Slaine (1983) describe a simple mathematical conversion so that VLF data can be presented in contour format and compared to other available data such as resistivity and magnetics. Digital data acquisition systems are now available that allow calculation of conductivity.

2. Presentation of Results

Results of an EM conductivity survey can be presented in profile and/or contour map form. The orientation of the traverses should be indicated on profiles in lines of coverage on contour maps. Locations of observed surface metal and other cultural

features such as topography, buildings, fences, power lines etc. should be noted on both the profiles and the contour maps.

3. Interpretation

EM conductivity data can be analyzed qualitatively and quantitatively. Generally, profiling data are presented as a contour map or profiles. Profile lines should be stacked and aligned. A qualitative analysis of the contour map or aligned profiles usually can allow an interpreter to identify any conductivity trends that may be indicative of buried metal, groundwater flow and contaminant transport. A comparison of available geologic data, cultural ferrous metal and debris maps prepared during data acquisitions should be made to evaluate the causes of any conductivity trends observed.

Computer or chart comparisons of EM sounding data with available theoretical models can be made. This type of interpretation is similar to that used in electrical resistivity, but in EM sounding it is limited to relatively simple hydrogeologic conditions.

F. Advantages and Limitations

Advantages of the electromagnetic induction method include:

- No ground contact required
- Rapid data acquisition (faster than resistivity)
- Lightweight, one or two man operation
- Wide range of applications
- High lateral resolution
- Field interpretation possible

Limitations of the electromagnetic induction method include:

- Limited dynamic range l-1,000 milliohm/meter
- Susceptible to effects of man-made structures, utilities, etc.
- Less vertical resolution than resistivity
- Limited penetration
- Does not distinguish even simple layering without more complex application and interpretation
- Setting and maintaining instrument at zero

V. Quality Assurance Records

Field data will be recorded in log books and/or data recording sheets accompanying the monitoring equipment. Data recorded in a field log book will be entered with the following data: date, site location, Contract Task Order number, personnel conducting the investigation, time (military time), start time and end time, and weather.

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STANDARD OPERATING PROCEDURE

Ground-Penetrating Radar (GPR)

I. Purpose

The purpose of this SOP is to provide general reference information and technical guidance on the methods and techniques of ground-penetrating radar (GPR).

II. Scope

These procedures provide overall technical guidance.

III. Definitions

Bistatic Antenna - An antenna system in which transmitting and receiver coils are housed in separate antenna units.

Deconvolution - A computer processing method. The process of undoing the effect of another filter (in this instance the "earth"). A process that removes ringing, multiples, ghosts, and some background noise (Sheriff, 1973).

Dielectric Permittivity - (Also known as the relative dielectric permittivity): 1. A complex number consisting of a real and imaginary part, which uniquely describes the propagation and attenuation of electromagnetic energy in every material. The real dielectric permittivity (dielectric constant) characterizes the propagation and reflection of electromagnetic (EM) waves, while the imaginary part (dielectric loss) characterizes the attenuation of EM signal (Kutrubes and Olhoeft, 1987). 2. A measure of the capacity of a material to store charge when an electric field is applied (Sheriff, 1973).

Electromagnetic Waves - One of the waves that are propagated by simultaneous periodic variations of electric and magnetic field intensity and that include radio waves, infrared, visible light, ultraviolet, X-rays and gamma rays (Webster's New Collegiate Dictionary. 1979).

Migration - here velocity varies laterally, data will migrate (relative to the time versus antenna distance plot), and ray tracing is used to determine migrated positions (Sheriff, 1973).

IV. Procedures

A. Overview

Ground penetrating radar (GPR) is an active geophysical system which transmits high frequency electromagnetic (EM) waves into the ground and detects the energy

reflected back to the -surface. GPR operates on a similar principle as seismic reflection, except, instead of acoustic waves, electromagnetic waves of radio and microwave frequencies (80 MHz to 1,000 MHz) are utilized. Electromagnetic signals are reflected back to the surface from interfaces with differing electrical properties, such as dielectric permittivity and conductivity. The greater the contrast in the real dielectric permittivity (dielectric constant) between two materials, the more energy is reflected to the surface. Reflections typically occur at lithologic changes, subsurface discontinuities, and internal soil structures such as:

- Top of bedrock surfaces
- Soil and rock stratification
- Water table
- Seepage and leachate zones
- Buried metal objects such as drums and utilities
- Open and water filled voids
- Bedrock fractures
- Archaeological structures

The depth of penetration of GPR is site specific, being limited by the attenuation of the electromagnetic energy. Signal attenuation is controlled by four different mechanisms listed below, any or all of which may be present at a site.

- Scattering losses
- Conduction losses
- Water losses
- Clay losses

Energy losses due to scattering occur when signals are dispersed in random directions, away from the receiving antenna, by large irregularly shaped objects, such as boulders and tree stumps.

Signal attenuation due to conduction is a function of the conductivity of a material, which varies with mineral composition, the amount of water, and the total dissolved solids (salt, heavy metals) within the water. The greater the electrical conductivity values of materials at a site, the more signal attenuation (hence less penetration) there will be.

Energy losses attributed to water occur when water molecules polarize in the presence of the applied electromagnetic field. Electromagnetic energy is lost to the radar system when it is converted to kinetic and thermal energy as a result of the rotation of water molecules.

Signal attenuation due to clay losses occurs when electrochemically charged ions polarize along clay surfaces in the presence of the electromagnetic field induced by the radar system. The migration and subsequent collision of these charged particles causes electromagnetic energy to be converted to kinetic and thermal energy, which is lost to the radar system.

Signal penetration is also dependent on the frequency of the transmitting antenna used in the radar system. Higher frequency antennas produce waves with shorter wave lengths, which are attenuated more rapidly with depth, but give better

resolution. Specially designed 2 MHz antennas have been used to detect the ice-rock boundary of a 2 km thick glacier. Penetration of up to 75 feet has been reported for water saturated, clean sands in a Massachusetts glacial delta using a commercial antenna. Signal penetration in saturated clays, on the other hand, is on the order of magnitude of a few inches. Olhoeft (1986a) determined that even 5% clay added to clean sand and gravel will cause a decrease in penetration by a factor of 20. Salt water is also a high loss substance, as signal penetration in sea water is less than a foot. It is important to note that in a layered medium a single, highly reflective layer alone can limit signal penetration by preventing the propagation of energy through it. In this instance the apparent loss of energy is caused by reflection rather than by signal attenuation.

B. Applications and Uses

Ground penetrating radar (GPR) is a shallow penetrating geophysical profiling system used where rapid and accurate surveys are desired. GPR can be used for both area and source detection studies. GPR has been used to locate underground pipes, buried drums, foundations, voids in rock and concrete, lithologic contacts, determine stratigraphy, depth to the water table, and depth to bedrock, locate buried archaeological artifacts, excavations, filled pits and lagoons, and numerous other site specific applications. GPR has been used successfully to delineate the lateral extent of plumes. Haeni et al. (1985) used GPR to investigate the thickness, type, and extent of sediments beneath a frozen lake with a 80 MHz antenna. The information acquired with GPR was used to help map the lateral extent of an aquiclude, and better estimate inputs to the mass balance equation for water budget calculations.

A GPR system can be used to determine depths to reflecting discontinuities by conducting a depth calibration. Typically, calibration is performed by moving the radar antenna over a metal target of known depth, such as a buried metal plate. Also, if transmitting and receiving antennas are housed in different units, designated as a bistatic antenna system, a common depth- point (CDP) survey, identical to surveys conducted with seismic reflection, can be used to calculate the velocity of the medium, and hence depth to the reflector. Sakayama and others (1988) describe another method to calculate velocity from bistatic antennas where the receiving antenna is continually moved away from the stationary transmitting antenna. The velocities of the direct arrival and the first strong reflector are recalculated from the inverse slope of the time-distance display (antenna separation) on the GPR record in a similar manner as seismic refraction.

To verify GPR results, other geophysical or ground truth methods can be utilized. Haeni et al. (1985) utilized seismic refraction to correlate calculated depths of stratigraphic horizons and water tables with radar reflections. Magnetometry and electromagnetic induction methods have been utilized to verify the presence of buried drums and fuel tanks. Electromagnetic induction and electrical resistivity have been utilized to verify the lateral extent of conductive plumes. The depth to a particular reflector or target can also be verified by boreholes and/or test pit excavation.

C. Equipment

A ground penetrating radar system consists of:

- AC/DC power supply
- Control unit (pulse transmitter)
- Antenna(s)
- Graphic recorder
- Digital recorder (optional)
- Magnetic tape recorder (optional)
- Coaxial cable which connects the control unit to the antenna

Typically, radar antennas contain both the transmitter and receiver within one fiberglass unit. Once a radar impulse is transmitted, the antenna switches to the receiver mode and records reflected radar impulses. The pulse receiver contains an amplifier which increases the amplitude of reflected signals. Bistatic antennas (transmitter-receiver are separate) allow the coverage of larger areas with one pass, and multi-receiver combinations allow the "stacking" of radar data which increases the signal to noise ratio.

Field data are generally printed by a graphic recorder and simultaneously can be stored on magnetic tape or diskette. The graphic recorder produces a continuous time (vertical) versus distance (horizontal) profile of the subsurface for field quality control and qualitative interpretations. Radar impulses are synchronized with the swept-stylus type graphic recorder, producing a dark band proportional to the amplitude of reflected radar signal. Because the antenna is moving, each pass of the stylus represents a slightly different antenna position. Gradually, as the recorder paper advances under the moving stylus, a pattern of reflective interfaces emerges.

Storage of data on diskette or magnetic tape allows opportunity of additional printing and/or computer processing for the refinement of data. Deconvolution of stored data enhances stratigraphic reflections from the water table and soil structures (Olhoeft, 1988). Migration of data allows easier resolution of metallic targets, such as buried drums, and delineation of excavations and sinkholes (Hogan, 1988).

Radar systems are designed to use antennas of various electrical characteristics. Selection of the antenna is dictated by the requirements of the survey. If high resolution, near-surface data are desired, a small, high frequency antenna is used; if the survey requires deeper probing, a larger, lower frequency antenna is used (80, 120, 250, 300, 400, 500, 900, and 1,000 MHz antennas are commercially available). The drawback of using the lower frequency antennas is that resolution of data is sacrificed for penetration. Also, the low frequency antennas (less than 250 MHz) are generally not shielded, making them susceptible to overhead power line noise and spurious reflections from passing cars. The 900 and 1,000 MHz antennas are used almost exclusively for short penetration projects such as the detection of rebar in concrete, as their penetration is generally limited to 2 to 3 feet.

D. Field Procedures

The majority of time involved with any GPR survey is spent establishing survey lines in the area of investigation so that detected anomalies can be easily located and excavated. Survey lines should be set to maximize coverage, while maintaining a grid spacing proportional to the presumed target dimensions. A minimum survey line spacing of 10 feet is desired when looking for a 1,000 gallon fuel tank, while a larger spacing of 50 feet or more may be used to define the lateral extent of a conductive plume.

At the onset of any GPR survey the radar control unit should be adjusted for the anticipated depth of penetration. Adjustments of the time window of exploration should be made by estimating the velocity of the medium and desired depth of penetration. Most surveys can be effectively conducted with a minimum time window of 50 nanoseconds.

Accurate determination of the depth to any layer requires calibration of the radar system. The easiest way of calibrating the GPR system to specific settings is by burying a plate at a measured depth, and moving the antenna slowly along the survey line. The plate will produce on the GPR record a thick, dark band, parabolic or flat in shape, with many multiple reflections beneath it. Once a certain confidence level is attained from depth calibration, the survey is conducted by slowly pulling the antenna along survey lines. A slow walking pace increases the horizontal resolution as radar signals are propagated in a 15 to 45 degree cone from the bottom of the antenna. A slow walking pace is recommended for hazardous waste investigations as targets are better defined and easier to resolve. On the other hand, the radar antenna can be towed from the back of a car or truck at speeds up to 10 miles an hour if the "target" is a continuous reflector, such as the water table.

E. Interpretation

A representation of a single GPR signal pulse is shown along the side of the record. The horizontal scale of the record is maintained by marking on the record the locations of survey stations as they are reached by the antenna. Accurate determination of the vertical scale (i.e., conversion of a time into a depth) requires calibration of the radar system. If the depth to a known reflector can not be determined through calibration or verification using boreholes and test pits, the velocity of the medium can be approximated from relationships involving the velocity of the medium, and the dielectric constant (real dielectric permittivity) of the medium. Values of the dielectric constant can be found in GSSI (1974), and Kutrubes (1986). It is important to note that the relationship is no longer valid when signal losses are great. The depth to the reflector can be calculated from time and velocity values.

Interpretation of GPR data is subjective, even among experienced interpreters. The strength of a reflected signal and/or the continuity of that reflector across the record may be indicative of a stratigraphic contact. The water table in an unconfined sand and gravel aquifer may also produce a similar signature on the GPR record. Point targets, such as buried drums, pipes, boulders, tree stumps, etc., create a distinctive

parabolic feature on GPR-records. Positive identification of point targets is subjective, as the GPR signature of a pipe is similar to that of a large boulder.

Underground storage tanks, which are situated in clean sand and gravel deposits show the characteristic parabolic signal created by a point target. Metallic objects, such as buried drums and pipes, also produce a characteristic parabolic signal on the record, and sometimes produces a "ringing" noise, denoted by the heavy, dark banding.

Recorded data from diskettes or magnetic tapes can be enhanced using numerous computer processing methods to remove constant noise problems, such as ringing, or to sharpen up geologic contact features and point target boundaries. Such methods are described in detail by Hogan (1988) and Olhoeft (1988). Computer processing is costly and generally not necessary in most instances.

F. Advantages/Disadvantages

Advantages of ground penetrating radar systems include:

- Rapid coverage of an area
- GPR is a non-destructive technique
- Portable equipment
- Provides high vertical resolution **profiles** in the field for immediate interpretation

Ground penetrating radar provides a cost effective way of evaluating a large site in a short amount of time. One day of work coverage completed by GPR may be equivalent to four or five days of work with seismic refraction or electrical resistivity. The GPR method is "nondestructive" in that it does not require any excavation or probing of the overburden materials, although verification of anomalies should be conducted.

Equipment can be easily loaded in the back of a truck as most pieces comprising the radar system weigh less than 40 pounds. The 80 MHz antenna weighs about 100 pounds and is less portable as it is approximately 4 feet wide.

Limitations of radar systems include:

- Survey lines must be cleared to ground level
- Multiple receiver antennas are generally required to stack and process radar data
- Penetration is site specific, requiring data corroboration using alternative geophysical methods and/or verification
- Interpretations are subjective

To maximize resolution and minimize scattering losses, survey lines must be as level as possible to prevent the bouncing and jarring of the radar antenna. Survey lines cleared of debris also allow the antenna to be pulled at an even, continuous pace, permitting the easy determination of horizontal scale.

Application of GPR to a site is limited by soil type and presence of high loss materials. In New England, the presence of glacial tills, and lacustrine and marine clays limit the depth of penetration. Delineation of buried drums beneath a conductive plume also may not be possible. The unpredictability of radar effectiveness requires that site investigations be conducted with alternative geophysical methods, such as electromagnetic induction, seismic refraction, magnetometry, and/or electrical resistivity.

V. Quality Assurance Records

All data will be recorded in field log books with the following information: date, location, personnel on site, start and finish times (in military time), instrument gain and time settings, and Contract Task Order number.

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STANDARD OPERATING PROCEDURE

Trenching for Landfill Delineation

I. Purpose

To provide reference material and general guidance on test pitting using a backhoe during landfill boundary confirmation activities.

II. Equipment and Materials

- Backhoe
- Shovels, picks, scoops
- Camera, slate (or other erasable material) board
- Plastic sheeting and stakes and/or sand bags to cover test pits and excavated soil
- Barricades to secure area around excavation
- Onsite decontamination pad
- Level D personnel protection equipment and onsite site safety officer

III. Procedures and Guidelines

A. General Considerations

Test pits will be excavated along the landfill boundary as indicated by the results of soil borings and/or geophysical surveys.

The onsite crew will photograph any significant features exposed by the test pit. Photographs will include a slate board (or other marker) marked with (at a minimum) test pit number, date and time of photograph, description of feature. Other observations (including soil descriptions) will be recorded in the logbook and/or the test-pit log.

Once test pitting is complete, the pits will be backfilled with the stockpiled soil and re-graded to mimic the original ground surface contour.

B. Trenching Activities

1. Establish work zone according to the site safety plan
2. Calibrate all air quality monitoring instruments
3. Using a clean backhoe (decontaminated following SOP *Decontamination of Personnel and Equipment*), begin excavating perpendicular to and just

outside of the area defined as the landfill boundary during the geophysical survey. Carefully excavate towards the boundary, recording all observations in the logbook, until buried material is encountered. Remove only enough soil to identify the landfill boundary.

4. Monitor the air quality in the breathing zone at 5-minute intervals during trenching activities to ensure the proper level of respiratory protection in being worn by all field team members.

5. Photograph and document the trenching activities as appropriate. Backfill and regrade the test pit, discard plastic sheeting, decontaminate the backhoe, and set up at the next trenching location.

IV. Attachments

Test pit or trenching log (TESTPIT_DIAGRAM.XLS)

V. Key Checks and Items

Ensure that personnel are not allowed to enter the trench when it exceeds depth limitations specified by OSHA.

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

This SOP provides general guidelines for entering field data into log books during site investigation and remediation activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement for much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, hard-cover logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.
2. On the inside cover of the log book the following information should be included:
    - Company name and address
    - Log-holders name if log book was assigned specifically to that person
    - Activity or location

- Project name
- Project manager's name
- Phone numbers of the company, supervisors, emergency response, etc.

3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."

4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.

5. Daily entries will be made chronologically.

6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.

7. Each page of the log book will have the date of the work and the note takers initials.

8. The final page of each day's notes will include the note-takers signature as well as the date.

9. Only information relevant to the subject project will be added to the log book.

10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.

2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.

3. Scope: Describe the general scope of work to be performed each day.

4. Weather: Record the weather conditions and any significant changes in the weather during the day.

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified,

and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.

7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.

8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.

9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.

10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.

11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.

12. Heath and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.

13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.

14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.

15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.

16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:

- Description of the general sampling area – site name, buildings and streets in the area, etc.
- Station/Location identifier
- Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
- Sample matrix and type
- Sample date and time
- Sample identifier
- Draw a box around the sample ID so that it stands out in the field notes
- Information on how the sample was collected – distinguish between "grab," "composite," and "discrete" samples
- Number and type of sample containers collected
- Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
- Parameters to be analyzed for, if appropriate
- Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).

2. Use tables to record sampling information and field data from multiple samples.

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

0715 ARRIVE ON SITE AT XYZ SITE.
CH2M HILL STAFF:
John Smith: FIELD TEAM LEADER
Bob Builder: SITE SAFETY COORD.
WEATHER: OVERCAST + COOL, 45°F
CHANCE OF LATE SHOWERS
SCOPE: • COLLECT GROUNDWATER SAMPLES for LTM work at SITE 14
• SUPERVISE SURVEY CREW AT SITE 17
0725 BB ~~Con~~ ~~JS~~ (JS) Calibrates PID: 101 ppm/100 ppm ok
PID Model #, SERIAL #
0730 BB Calibrates HORIBA METER
Model #, SERIAL #
→ List calibration Results
0738 Survey CREW ARRIVES on SITE
→ List NAMES
0745 BB Holds H+S TALK on Slips, Trips, Falls, Ticks + AIR MONITORING
JS + SURVEY CREW ATTEND
No H+S ISSUES IDENTIFIED as CONCERNS. All work is in "Level D."
0755 JS Conducts site-WIDE AIR Monitoring
All readings = 0.0 ppm in

JS 5-12-03

SITE 14 LTM
BREATHING ZONE (BZ)
0805 Mobilize to well MW-22 to SAMPLE, surveyors SETTING UP AT SITE 17
0815 PM (PAUL PAPER PUSHER) CALLS AND INFORMS JS to collect GW SAMPLE AT well MW-44 today for 24 hour TAT ANALYSIS OF VOC'S
0820 Purging MW-22
→ RECORD WATER QUALITY DATA
JS 5-12-03
0843 Collect SAMPLE AT MW-22 for total TAL Metals and VOC'S. No Dissolved Metals Needed PER PM.
0905 JS + BB Mobilize to SITE 17 to show surveyors wells to Survey.
0942 Mobilize to well MW-22 to Collect SAMPLE
0950 CAN not ACCESS WELL MW-22 due to BASE OPERATIONS; CONTACT PAUL PAPERPUSHER AND HE STATED he will check on GAINING ACCESS with BASE contact.
0955 Mobilize to well MW-19

JS 5-12-03

STANDARD OPERATING PROCEDURE

Mini RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Mini RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Mini RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Volatile Organic Compound (VOC) – Expresses the VOC concentration in ppm

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Procedures

The Mini RAE utilizes the principle of a detecting sensor. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called photo ionization potential (PIP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For

environments where background readings are high, factory zero calibration gas should be used.

Note: For volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, an FID is required.

The following subsections will discuss Mini RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

These instructions are for the Mini RAE 2000. If using the Mini RAE 3000, please see the operator's manual for instructions.

Start up Instrument

- Press **Mode** button
- Observe displays:

On!……..

Version X.XX

Model Number SN XXXX

Date Time Temp

- After the monitor is turned on and it runs through the startup menus, the display will read "Ready". Press the **[Y/+]** key to start the pump.
- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key also and depress both keys for 5 seconds.
- Display will read:

Calibrate Monitor?

- Press the **[Y/+]** key
- Display will read:

Fresh Air Calibration?

- Perform the Fresh Air Calibration in an area free of any detectable vapor near your work zone.
- Press the **[Y/+]** key
- Display will read:

Zero…. In progress…

Wait…

Update data…

Zeroed…

Reading = X.X ppm

- Press any key and the display will go back to:

Fresh Air Calibration?

- Press the **[N/+]** key
- Display will read:

Span/Cal?

- Press the **[Y/+]** key
- Display will read:

Isobutylene = 100 ppm

Apply Gas Now!

- Press the **[Y/+]** key
- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.

Wait…30

- The display will count down showing the number of remaining seconds:

Reading = 100

Update data, span cal done. Turn off gas!

- Calibration readings between 99 and 102 ppm are within the acceptable range.
- Display will read:

Span/Cal?

- **CALIBRATION IS COMPLETE!**
- Press any key to return to operational mode.

B. Operation

Due to the Mini RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual from pages 2-5 to 2-14.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

V. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Mini RAE had wide range fluctuations during air monitoring activities.)

VI. References

Mini RAE 2000 Portable VOC PGM-7600, RAE Systems, Revision E, May 2005.

STANDARD OPERATING PROCEDURE

Multi RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Multi RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Multi RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Carbon Monoxide Sensor (CO) - Expresses the Carbon Monoxide concentration in ppm.

Volatile Organic Compound (VOC) – Expresses the VOC concentration in ppm

Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.

Hydrogen Sulfide Sensor (H_2S) - Expresses the Hydrogen Sulfide concentration in ppm.

Oxygen Sensor (OXY) - Expresses the Oxygen concentration as a percentage.

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Procedures

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called photo ionization potential (PIP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is

greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

Note: for volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, an FID is required.

The following subsections will discuss Multi RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start up Instrument

- Press **Mode** button
- Observe displays:

On!……..

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids….

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

XX XX.X XX TWA

Battery = X.XV Shut off at 4.2V

User Mode=

Alarm Mode=

Datalog Time Left

Datalog Mode

Datalog Period

Unit ready in….. 10 Seconds

- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key also and depress both keys for 5 seconds.
- Display will read:

Calibrate Monitor?

- Press the **[Y/+]** key
- Display will read:

Fresh Air Calibration?

- If "Zero Air" is necessary, attach the calibration adapter over the inlet port of the Multi RAE Monitor and connect the other end of the tube to the gas regulator (HAZCO loaner regulator LREG.5, RAE Systems P/N 008-3011 or suitable .5 LPM regulator) on the Zero Air bottle (HAZCO P/N SGZA, RAE P/N 600-0024). If no Zero Air is available, perform the Fresh Air Calibration in an area free of any detectable vapor.
- Press the **[Y/+]** key
- Display will read:

Zero…. In progress…

CO Zeroed! Reading = X

VOC Zeroed! Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H_2S Zeroed! Reading = X

In each of the above screens, "X" is equal to the reading of the sensor before it was zeroed.

- Display will then read:

Multiple Sensor Calibration?

- Press the **[Y/+]** key
- The display shows all of the pre-selected sensors and the "OK?" question:

CO H_2S
LEL OK? OXY

- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.
- Press the **[Y/+]** key. Display will read:

Apply Mixed gas

Calibration
In progress …

- The display will count down showing the number of remaining seconds:

CO cal'ed
Reading=50

H_2S cal'ed
Reading=25

LEL cal'ed
Reading=50

OXY cal'ed
Reading=20.9

Calibration done
Turn off gas!

- Display will read:

Single Sensor
Calibration?

- Press the **[Y/+]**.
- Display will read:

CO VOC H_2S
LEL pick? OXY

- Attach 100 ppm Isobutylene (HAZCO P/N r-SGISO or Rae P/N 600-0002) using a 1.0 LPM regulator (HAZCO P/N LR10HS or Rae P/N 008-3021). Open regulator.
- Press the **[Mode]** key once, the V of VOC will be highlighted.

- Press the **[Y/+]**. The display will read:

Apply VOC Gas

Calibration In progress…

- The display will count down showing the number of remaining seconds:, then display:

VOC cal'd Reading=100

Calibration done Turn off gas!

Single Sensor Calibration?

- Press **[Mode]** key twice to return to main screen.
- **CALIBRATION IS COMPLETE!**

B. Operation

Due to the Multi RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual from pages 9 to 14.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

V. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Multi RAE had wide range fluctuations during air monitoring activities.)

VI. References

Multi RAE Plus Multiple Gas Monitor User Manual, RAE Systems, Revision B1, November 2003.

STANDARD OPERATING PROCEDURE

Shallow Soil Sampling

I. Purpose

To provide general guidelines for the collection and handling of surface soil samples during field operations.

II. Scope

The method described for surface soil sampling is applicable for loosely packed earth and is used to collect disturbed-soil samples.

III. Equipment and Materials

- Sample jars.
- A hand auger or other device that can be used to remove the soil from the ground. Only stainless steel, Teflon, or glass materials should be used. The only exception is split spoons, which are most commonly available in carbon steel; these are acceptable for use only if they are not rusty.
- A stainless steel spatula or disposable plastic scoop should be used to remove material from the sampling device.
- Unpainted wooden stakes or pin flags
- Fiberglass measuring tape (at least 200 feet in length)
- GPS Unit (if available)

IV. Procedures and Guidelines

A. Wear protective gear, as specified in the Health and Safety Plan.

B. To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

1. For samples on a grid:

a. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the logbook.

b. Proceed to sample the points on the grid line.

c. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.

d. Proceed to sample the points on the grid line as described in Section C below.

e. Repeat 1c and 1d above until all samples are collected from the area.

f. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

2. For non-grid samples:

a. Use steel measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).

b. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.

c. Proceed to sample as described in Section C below.

d. Repeat 2a through 2c above until all samples are collected from the area.

e. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

C. To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point will be deleted from the program. The FTL will contact the CH2M HILL project manager (PM) immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

D. To collect samples:

1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoop to scrape away surficial organic material (grass, leaves, etc.) adjacent to

the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks.

2. If sampling:

   a. Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.

   b. Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.

3. Take a photo ionization detector (PID) reading of the sampled soil if organics are anticipated to be present and record the response in the field notebook. Also record lithologic description and any pertinent observations (such as discoloration) in the logbook.

4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.

5. Repeat this procedure until sufficient soil is collected to meet volume requirements.

6. For TCL VOC and field GC aliquots, fill sample jars directly with the trowel or scoop or specialized sampling equipment (i.e. Encore® or Terra Core® sampler) and cap immediately upon filling. DO NOT HOMOGENIZE.

7. For TCL pesticides/PCBs and SVOCs, TAL metals, and field XRF aliquots, homogenize cuttings in the pan using a decontaminated stainless steel utensil in accordance with SOP *Decontamination of Drilling Rigs and Equipment*.

8. Transfer sample for analysis into appropriate containers with a decontaminated utensil.

9. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible

10. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

V. Attachments

None.

VI. Key Checks and Items

- Use phthalate-free latex or surgical gloves and other personal protective equipment.
- Transfer volatiles first, avoid mixing.
- Decontaminate utensils before reuse, or use dedicated, disposable utensils.

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided

by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from $500 to several $1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities /clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in **Appendix C.**

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These "dig permit" requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. ***The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.***
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. ***This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.***

- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

A- Example SOW for Utility Location Subcontractor Procurement
B - Services Available for Identifying and Marking Underground Utilities
C – Equipment Used for Identifying Underground Utilities
D – Utility Clearance Documentation Form
E – Utility Marking Color Codes

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within **(CHOOSE 1)** ***a 20-ft radius of the XX proposed soil boring locations*** **(OR)** ***within the boundary of the site(s)*** as identified on the attached figure(s) will be marked using **paint** ***(some Bases such as the WNY may have restrictions on the use of permanent paint)*** and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the ***Buried Utility Location Tracking Form*** (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) ***The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.***

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA and any required mapping. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B - Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	Phone	Website	Comments
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

1. Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At

sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately $200 per day for a simple EM effort (usually one crew member and one instrument) to approximately $1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment[1]					Other Services[2]		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

[1]Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.

B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.

C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper "locator" strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between "time-domain" and "frequency-domain" instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the "congestion" of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in "real time". This method is most commonly used by "dig-safe" contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the

receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects

ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Buried Utility Location Tracking Form

(Submit to CH2M HILL PM within 24 hrs of location activities)

Project Location:
CH2M HILL Project No.:
CH2M HILL Project Manager: Name/Phone:
Fax:
Email:
CH2M HILL Field Team Leader: Name/Phone:

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

Check each box using an "X" if a buried utility is present within 5 feet of a marked Station ID. If color of the flag or paint differs from listed color, note change in color on the form.

Station ID	Gas (Yellow)	Electric (Red)	Fiber optic (Orange)	Cable (Orange)	Water (Blue)	San. Sewer (Green)	Storm Sewer (Green)	Steam (Yellow)	Petroleum (Yellow)	Compressed air (Yellow)	Other ___	Other ___	Other ___	Other ___	Date completed	Technician initials	Notes (methods/tools used)

The findings of the buried utility location activities summarized herein were conducted in strict accordance with the CH2M HILL scope of work.

Subcontractor's _____ Date _____

PMS 219

PMS 1795*

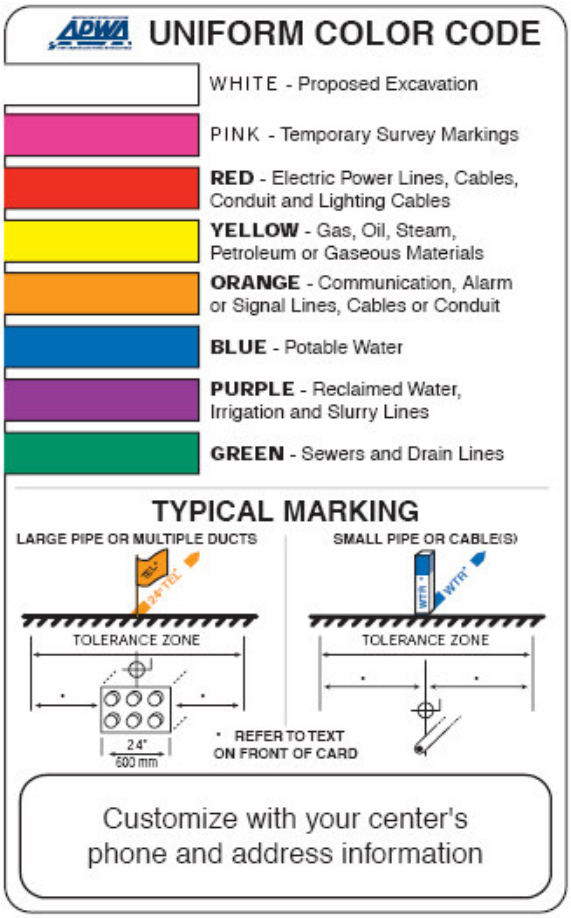
PMS 108

PMS 144*

13.5 parts process
2.5 parts reflex

PMS 253

PMS 3415



GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

Contractors that do Non-Contact Excavating

VACMASTERS is the leader in Air-Vacuum Excavation Systems, having pioneered the use of high-pressure air delivered through our proprietary nozzles to expose underground utilities. Our underground utility locating equipment is designed to make a 12" x 12" by 5 ft. hole or deeper (called a pothole) in any kind of soil. http://www.vacmasters.com/

SoftDig http://www.softdig.com/

Taylor Wiseman Taylor (Raleigh, Charlotte, and PA/NJ offices) offers the air-vacuum excavation services for SUE as well. http://taylorwiseman.com/site/sue.html

Appendix E
Field Forms

FIELD CHANGE REQUEST FORM

CH2MHILL

CONTRACT NO. **PROJECT NO.**

PROJECT TITLE & LOCATION:

BRIEF DESCRIPTION OF FCR:

TO:	NAME	TITLE
FROM:	NAME	TITLE

Date Submitted:		FCR No	
Please Respond By:		Page:	of

REFERENCES	
Document *(Work Plan, APP, SOW, etc.)*	
Drawing(s)/Specs *(Drawing no., Spec. No., etc)*	
Detail/Section *(Page No., Section No., Paragraph, No., etc.)*	

Schedule Impact? **Yes** ☐ **No** ☐ **Cost Impact?** **Yes** ☐ **No** ☐

1) REQUEST:

NAME/COMPANY TITLE

2) REPLY:

NAME/COMPANY	TITLE	DATE OF RESPONSE

3) RESPONSE/DISPOSITION CONCURRENCE:

NAME/COMPANY	TITLE	DATE OF RESPONSE/DISPOSITION CONCURRENCE

REVIEW DISTRIBUTION			FINAL DISTRIBUTION		
☐ CLIENT RPM	☐ JVII PROJ ENG	☐ Project Files	☐ CLIENT RPM	☐ JVII PROJ ENG	☐ Project Files
☐ CLIENT CM	☐ SITE SUPER	☐ Other	☐ CLIENT CM	☐ SITE SUPER	☐ Other
☐ JVII PM	☐ SITE QC	☐	☐ JVII PM	☐ SITE QC	☐

Storm Water Pollution Prevention Plan Inspection List
Date: _____ Time: _____ Inspector Name: _____

Inspections will include evaluation of the following standard criteria:

- ☐ Inspection performed as part of routine maintenance?
- ☐ Inspection performed following precipitation? Date and amount of precipitation: _____
- ☐ Have all denuded areas requirement temporary or permanent stabilization been stabilized? Seeded? yes / no Mulched ? yes/no Graveled? Yes/no
- ☐ Are soil stockpiles adequately stabilized with seeding and/or sediment trapping measures?
- ☐ Does permanent vegetation provide adequate stabilization?
- ☐ Have sediment trapping facilities been constructed as a first step in land disturbing activities?
- ☐ Are silt fences and diversion berm installed where needed?
- ☐ Are finished cut and fill slopes adequately stabilized?
- ☐ Is in-stream construction conducted using measures to minimize channel damage?
- ☐ Are temporary stream crossing of non erodible material installed where applicable?
- ☐ Is necessary re-stabilization of in-stream construction complete?
- ☐ Are soil and mud kept off public roadways at intersections with site access roads?
- ☐ Have all temporary control structures that are no longer needed been removed?
- ☐ Have all control structure repairs and sediment removal been performed?
- ☐ Are properties and waterways downstream from development adequately protected from erosion and sediment deposition due to increases in peak stormwater runoff?

Inspection Notes:

***Add additional pages of notes / observations/ and action items as required.

Appendix F
Geophysical Survey Work Plan

Final

Geophysical Survey Work Plan
Interim Remedial Action Plan and Preconstruction Report
Towers Road Disposal Areas – Waste and Soil

Harvey Point Defense Testing Activity
Hertford, North Carolina

Contract Task Order 0017

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Contract N62470-11-D-8012

Prepared by

CH2MHILL

Virginia Beach, Virginia
NC Engineering License #F-0699

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Table

1 Project Measurement Quality Objectives

Acronyms/Abbreviations

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
DGPS	Differential Global Positioning System
EM	Electromagnetic
FTP	File Transfer Protocol
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IRA	Interim Remedial Action
IRAP	Interim Remedial Action Plan
MEC	Munitions and Explosives of Concern
MPC	Measurement Performance Criteria
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objective
mS/m	milliSiemens/meter
PPE	Personal Protective Equipment
ppt	Parts Per Thousand
QC	Quality Control
RI	Remedial Investigation
RTK	Real-Time Kinematic

1 Geophysical Survey Work Plan

1.1 Introduction

This wok plan presents the approach to conduct a follow-up geophysical survey at the Towers Road Disposal Areas located in Hertford, North Carolina. The geophysical survey is being conducted in support of an interim remedial action (IRA) to address wastes and impacted soils. A geophysical survey was conducted in May 2013 as part of the Phase I Remedial Investigation (RI) in an attempt to delineate the lateral extent (i.e. footprint) of potential buried metallic and non-metallic wastes, debris, and obstructions (e.g. former building foundations). An IRA is planned to remove the waste. A geophysical survey will be performed after the waste is removed in an attempt to determine whether waste remains in place below the excavation floor. This work plan provides details of the investigation objectives, equipment, approach, operational procedures, quality control (QC), and reporting requirements associated with the follow-up geophysical survey at the Towers Road Disposal Areas.

Additional details on the IRA are presented in the Interim Remedial Action Plan (IRAP) and Preconstruction Report.

1.2 Objective

The IRA includes planned excavation and removal of the wastes in locations that are above the water table to the visible limits. The follow-up geophysical survey will be conducted in an attempt to determine whether potential buried wastes, debris, or obstructions remain below the excavation floor. The results of the follow-up geophysical survey will be used to assist in determining whether additional excavation and removal of wastes is needed during the IRA.

1.3 Site Description and Background

The geophysical survey will be conducted at two separate sites within the Towers Road Disposal Areas: the 2nd Street Disposal Area and the 5th Street Disposal Area. Maps depicting the planned excavation areas are included as **Figures 4 and 5** in the IRAP and Preconstruction Report.

These two sites underwent initial geophysical surveying in May 2013 across the accessible portions of each site. With the exception of one test pit that contained wastes below the groundwater table (wastes were encountered at depths of approximately 9 to 10 feet [ft]), the depth of the wastes generally ranged from surficial to 6 ft based on Phase I RI test pitting results. Depth to groundwater is approximately 4 to 5 ft.

The combined survey area for the follow-up geophysical survey is estimated at 1.3 acres. This includes 0.7 acres at the 2nd Street Disposal Area and 0.6 acres at the 5th Street Disposal Area. These areas comprise the planned excavation footprint. The surface within the excavation may be loose, rough, and uneven.

Munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) are assumed to not be a factor for the geophysical survey at these sites. Additional details on the Phase I RI efforts are presented in the IRAP and Preconstruction Report.

2 Geophysical Survey

2.1 Approach

The geophysical survey will be conducted using the same approach as the initial survey. The survey will be conducted using the Geonics, Ltd. EM31-MK2 operated in vertical dipole mode. Terrain conductivity (i.e. quadrature) and in-phase response data will be recorded and analyzed for the presence of potential waste. Data will be collected along profiles with a nominal spacing of 5 ft and extending across the accessible portions of the survey area.

2.2 Project Personnel

Work will be performed by a geophysical subcontractor under the supervision of a CH2M HILL field representative. Specific personnel roles are listed below:

- **CH2M HILL Project Manager** – The CH2M HILL Project Manager will liaise directly with the client and will be responsible for project delivery within the established schedule and budget. The CH2M HILL Project Manager will coordinate with the CH2M HILL Field Representative and/or CH2M HILL Geophysicist and provide final review of the results and report submitted by the geophysical subcontractor.
- **Geophysical Subcontractor Project Geophysicist** –The Project Geophysicist will direct the field work being conducted under the supervision of the geophysical subcontractor Field Geophysicist/Geophysical Technician and will review all acquired data. The Project Geophysicist will have experience in the analysis and interpretation of EM31-MK2 data and will be responsible for the survey being completed in accordance with the work plan. The Project Geophysicist will be responsible for delivering data and results to CH2M HILL in accordance with the work plan and as detailed in the contracting scope of work between CH2M HILL and the geophysical subcontractor.
- **Geophysical Subcontractor Field Geophysicists** – The geophysical subcontractor Field Geophysicists will be responsible for data collection, compiling data and submitting data for daily review by the geophysical subcontractor Project Geophysicist. The geophysical subcontractors field personnel will have experience in the safe and proper operation of the geophysical instruments. Field personnel will also have experience working on industrial sites and will conduct the geophysical survey in accordance with the work plan and project health and safety requirements.
- **CH2M HILL Geophysicist** – The CH2M HILL Geophysicist will liaise with the geophysical subcontractor on technical matters and perform QC of the geophysical survey. The CH2M HILL Geophysicist will review the geophysical subcontractors data, as necessary, and draft and final reports.
- **CH2M HILL Field Representative** – The CH2M HILL Field Representative will provide in-field oversight of the geophysical subcontractor and liaise with installation personnel, the CH2M HILL Project Manager, and the CH2M HILL Geophysicist. The Field Representative will provide site access for the geophysical subcontractor, conduct daily safety briefings, provide safe behavior observations, document existing field conditions, and ensure that the field work is conducted in accordance with the work plan and project health and safety requirements.

2.3 Geonics, Ltd. EM31-MK2

The EM31-MK2 measures the electrical conductivity of subsurface materials by inducing a time-varying magnetic field and measuring the amplitude and phase shift of an induced secondary magnetic field. Variations in subsurface conductivity may be caused by the presence of buried metal objects, presence of non-metallic wastes and debris, or by changes in geologic conditions that alter the conductive signature of subsurface materials.

Quadrature and in-phase are the two components of the EM31-MK2 induced magnetic field. The quadrature phase (measured in milliSiemens/meter [mS/m]) component is generally indicative of the bulk soil and groundwater properties, whereas the in-phase component (measured in parts per thousand [ppt]) is generally indicative of buried metal objects. By recording both the in-phase and quadrature-phase components and comparing the results from these two components, it is possible to evaluate whether a detected change in bulk conductivity is due to the presence of buried metallic objects or to the presence of non-metallic materials that may impact subsurface soil or pore fluid conductivity. The effective survey depth of the EM31-MK2 is approximately 20 ft in the vertical dipole orientation, although actual depth if investigation is dependent largely on site-specific conditions.

2.4 Positional Data

The geophysical survey will be collected using a real-time differential Global Positioning System (DGPS). Positional data will be recorded at 1 Hertz, with an accuracy of 3.3 ft (sub-meter) or better. Elevations do not need to be reported with the geophysical results.

The locations of relevant site features (e.g. obstructions, sources of interference) will be recorded using GPS for overlay on the geophysical results.

No site-specific location control exists at the survey areas. If NAEVA elects to utilize real-time kinematic GPS (RTK GPS) with the EM31-MK2, NAEVA will be responsible for establishing local site control under the current scope of work.

The project coordinate system is North Carolina State Plane Coordinate System, North American Datum 1983 (NAD 83) CONUS, and the units are feet.

3 Measurement Quality Objectives

Table 1 (at the end of this document) presents the measurement quality objectives (MQOs), measurement performance criteria (MPC), and test methods for the follow-up geophysical survey at the Towers Road Disposal Areas.

4 Quality Control

The geophysical and GPS instruments will be field tested to confirm proper operating conditions. Several basic QC tests will be performed as part of this investigation.

- **EM31-MK2 Warm-up and Functional Checks –** This is an instrument-specific activity, although standard warm-up time is generally 10 to 15 minutes to allow for minimization of sensor drift. Longer warm-up periods may be needed in cold weather. EM31-MK2 functional checks will be conducted in accordance with the instrument manufacturer specifications. Equipment warm-up will be performed the first time an instrument is turned on for the day or after it has been turned off for an extended period of time.

- **EM31-MK2 Static Background Tests –** Static background tests will be performed at the start and end of each survey day. The test will be conducted in an area that is free of sources of interference with the EM31-MK2 kept stationary. Data will be collected for at least one minute with the instrument placed on the ground surface. The instrument will then be raised to the intended height for the production survey, a new survey line within the data file will be started, and the process will be repeated. The purpose of these tests is to assess background conditions (i.e. effect of the ground component) and determine whether unusual levels of instrument or ambient noise exist in the data from the start of the day through the end of the day. GPS data do not have to be logged with these tests. The results of this test will be qualitatively evaluated.
- **EM31-MK2 Vibration Test –** A vibration (i.e. cable shake) test will be performed at the start of each survey day. The test will be conducted by recording data for at least 1 minute with the EM31-MK2 either on the ground surface or at the intended survey height. During data collection, the operator will shake the instrument cables and connections while observing for noise spikes. If spikes are observed, the malfunctioning part or component will be repaired or replaced prior to starting the production survey. The purpose of this test to identify potential malfunctioning parts in order to avoid unwanted noise in the data as the operator is walking around the site with the instrument. The results of this test will be qualitatively evaluated.
- **EM31-MK2 Dynamic Response Test –** The dynamic test will be performed at the start and end of each survey day by collecting data over a subsurface object capable of producing a response in the instrument (e.g. culvert metal drain pipe). If no such feature exists within close proximity to the survey area, a large metallic surface feature (e.g., drop inlet, manhole) may be used. The object will be sufficiently large to register a response with the EM31-MK2 because relatively small objects, such as flush-mount monitoring well caps, may not produce a detectable response in the EM31-MK2. The purpose of the dynamic test is to verify that the instrument can consistently detect the feature. The dynamic test will be conducted at the beginning and end of each survey day and GPS data will be logged with the EM31-MK2 data for this test. The results of this test will be qualitatively evaluated.
- **EM31-MK2 Repeat Data –** This test is performed to verify repeatability of the data and will be performed at the end of each survey day. Approximately 2% of the survey area collected with the EM31-MK2 will be repeated at the end of each survey day. Because of the intrinsic difficulty of following the exact path for collecting repeat data, this test will also be qualitatively evaluated. Repeat data will be recorded in a separate data file from the production survey and will be recorded with GPS data.

5 Data Acquisition, Processing, and Reporting

5.1 Field Notes

The geophysical subcontractor will be responsible for keeping a daily log book. Field notes will include, at a minimum, the following information:

- Field team leader name
- Field team members' names
- Date(s) of data collection
- Working hours onsite
- Instrument used
- Positioning method used (e.g. DGPS, RTK, fiducial)
- Production and QC data file names

- Data collection sampling rate
- Weather conditions
- Terrain conditions (including obstructions and data gaps)
- Other relevant field notes and observations

These field data will be reviewed on a daily basis and archived at the conclusion of the fieldwork by the CH2M HILL Field Representative. Pertinent field data will be compiled and summarized in support of the data summary report (described below).

5.2 Data Processing

Data processing will be system specific, but the general final processing steps that may be performed on the EM data include the following:

- Sensor bias, background leveling, and/or standardization adjustment
- Sensor drift removal
- Latency or lag correction
- Geophysical noise identification and removal (spatial, temporal, motional, terrain induced)
- Contour level selection with background shading
- Digital filtering and enhancement (low pass, high pass, band pass, convolution, correlation, nonlinear, etc.)

5.3 Interpretation

The geophysical subcontractor will provide interpretation of the geophysical results by annotating the final contour maps to indicate the lateral extent of suspected buried wastes, if they appear to be present beneath the floor of the planned excavation. Annotations will also be provided depicting inaccessible survey areas (i.e. data gaps) and inferred sources of interference.

5.4 Final Maps

The results of the geophysical investigation will be presented as a series of plan-view, color-contoured maps depicting instrument response across the survey areas. Interpretations will be made directly on the maps as well as addressed in the accompanying report. The results maps will contain the following:

- Client name
- Project number
- Subcontractor name
- Map creator
- Map approver
- Date of map creation
- Scale bar
- Color bar for geophysical data (with units)
- Displayed map coordinates in project-specific coordinate system and units
- North arrow, legend, title block

5.5 Records Management

CH2M HILL will create and manage a project-specific file transfer protocol (FTP) or Share Point site prior to mobilization. Raw data files will be posted to the FTP site at the end of each survey day (or emailed to CH2M HILL as zip files if individual files are less than 3 megabytes in size).

Relevant field notes will be uploaded to the FTP site within one week of completion of the field survey. Upon project completion and submission of the final deliverable, all data and information (original and copies) of any type whatsoever shall be surrendered to the CH2M HILL Project Manager.

5.6 Deliverables and Schedule

The geophysical survey fieldwork as outlined in this work plan is tentatively planned for June 2013. The following provides a summary of the deliverable schedule.

The geophysical subcontractor will provide draft results within **48 hours** of completion data collection because the results will be used as guidance for planned follow-up intrusive investigations.

Final processed production and QC data, GPS features files, final maps and a draft report will be placed on the FTP or Share Point site within **three weeks** of demobilization from the site. The report will present a description of the survey methods, survey execution, encountered site conditions, data processing steps and data adjustments, results and interpretation, QC results, limitations and any other relevant information pertaining to the interpretation of the results. The geophysical subcontractor will issue a final report within **one week** of receipt of comments from CH2M HILL on the draft report.

The final processed data delivery package submitted to CH2M HILL will include the following:

- Raw EM31-MK2 and GPS (if applicable) files
- Processed survey and QC files in a format that can be directly read by Geosoft (.XLS, .GDB, .XYZ format)
- PDF maps depicting final results
- Native files for results maps (note: if Geosoft .MAP files provided, files must be packed .MAP files)
- Grid (.GRD) files
- PDF and native files depicting QC test results

Processed data files will include, at a minimum, eastings and northings (in the specified project coordinate system), raw instrument channels, time stamp, pre-processed and processed data channels.

TABLE 1
Project Measurement Quality Objectives
Geophysical Survey Work Plan

Measurement Quality Objective	Measurement Performance Criteria	Test Method
General System Operation		
System Operation – Geophysical instrument is operating properly.	No excessive instrument drift will be observed throughout survey day. No excessive data spikes (>5 milliSiemens/meter [mS/m] above the mean for quadrature; >2 ppt above the mean for inphase) will be present in QC test files. Instruments will be free of obvious defects. Cables and system components will be in good working order. System responds consistently to known subsurface or surface metallic object	Battery level will be periodically checked throughout surveys. Instrument will undergo sufficient warm-up period and functional checks before use. Cables, connections, and system components will be inspected daily prior to use. Static background, dynamic response, and vibration QC tests will be conducted in accordance with **Section 4** of this work plan**.**

6

TABLE 1
Project Measurement Quality Objectives
Geophysical Survey Work Plan

Measurement Quality Objective	Measurement Performance Criteria	Test Method
Geophysical Survey		
Data Quantity and Spacing – Down line data density is sufficient to achieve project objective.	Maximum permissible spacing between data points will be 2 ft unless an obstruction or hazard is present. A spacing greater than this will not meet the MQO.	Results of survey will be quantitatively evaluated to ensure compliance.
Survey Coverage (Lane Spacing)	Lane spacing varies by no more than 2x the intended lane spacing of 5 ft, unless an obstruction or hazard is present. This results in a maximum permissible lane spacing of 10 ft for the EM31-MK2 survey.	Results of survey will be quantitatively evaluated to ensure compliance.
Repeatability	Repeat data depict general agreement with production survey data.	Repeat data collection will be conducted in accordance with **Section 4** of this work plan and qualitatively evaluated for compliance**.**
Data Handling		
Data must be made available to the project team in accordance with the project schedule.	Geophysical data are presented in accordance with **Section 5.6** of this work plan.	Results will be evaluated based on actual delivery of data.

Appendix G
Quality Assurance Project Plan

Quality Assurance Project Plan
Towers Road Disposal Areas – Waste and Soil

Harvey Point Defense Testing Activity
Hertford, North Carolina

Contract Task Order 017

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract No. N62470-11-D-8012

Prepared by

CH2MHILL

Virginia Beach, VA

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2-5 Reference Limits and Evaluation Table: Matrix – Soil, Analytical Group - VOC
2-6 Reference Limits and Evaluation Table: Matrix – Soil, Analytical Group – SVOC/PAH
2-7 Reference Limits and Evaluation Table: Matrix – Soil, Analytical Group - Pesticide
2-8 Reference Limits and Evaluation Table: Matrix – Soil, Analytical Group - PCB
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3 Sample Analysis Summary Table
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5 Analytical SOP Reference Table
6 Analytical SOP Requirements Table
7 Analytical Services Table
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9-1 Laboratory QC Samples Table: Matrix - Soil, Analytical Group – VOC
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9-3 Laboratory QC Samples Table: Matrix - Soil, Analytical Group – Pesticide
9-4 Laboratory QC Samples Table: Matrix – Soil, Analytical Group – PCB
9-5 Laboratory QC Samples Table: Matrix – Soil, Analytical Group – Metal (excluding Mercury)
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10 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table
11 Analytical Instrument Calibration Table
12 Field Performance Audit Checklist
13 Project Documents and Records

II DoD ELAP Accreditation Letters – Analytical Laboratory

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Acronyms and Abbreviations

A2LA	American Association of Laboratory Accreditation
APP	Accident Prevention Plan
ASTM	American Society for Testing And Materials
°C	degrees Celsius
CA	corrective action
CCV	continuing calibration verification
CLEAN	Comprehensive Long-term Environmental Action, Navy
COC	chain of custody
CTO	Contract Task Order
DI	deionized
DL	detection limit
DoD	Department of Defense
DQE	data quality evaluation
DQO	data quality objective
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ERB	equipment rinsate blank
FTL	Field Team Leader
g	gram
GC	gas chromatography
H&S	health and safety
HPDTA	Harvey Point Defense Testing Activity
HSM	Health and Safety Manager
ICS	interference check sample
IDL	instrument detection limit
IDW	investigation-derived waste
IRAP	Interim Remedial Action Plan
IS	internal standard
LCS	laboratory control spike
LOD	limit of detection
LOQ	limit of quantitation
mL	milliliter
mm	millimeter
M&TE	measuring and test equipment
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCDENR	North Carolina Department of the Environment and Natural Resources
NIST	National Institute of Standards and Technology
oz	ounce

PAH	polycyclic aromatic hydrocarbons
PAL	project action limit
PARCC	precision, accuracy, representativeness, comparability, and completeness
PC	Project Chemist
PCB	polychlorinated biphenyl
PM	Project Manager
POC	point of contact
PQO	project quality objective
QA	quality assurance
QAM	Quality Assurance Manual
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	quality control
REC	Registered Environmental Consultant
RPD	relative percent difference
RPM	Remedial Project Manager
RSM	Registered Site Manager
SA	spike added
SAP	sampling and analysis plan
SOP	standard operating procedure
SR	sample result
SSC	Site Safety Coordinator
SSR	spiked sample result
STC	Senior Technical Consultant
SVOC	semivolatile organic compound
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

QAPP Identifying Information

Site Name/Number: Harvey Point Defense Testing Activity (HPDTA)

Operable Unit: Not Applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012

Contract Title: Naval Facilities Engineering Command (NAVFAC), Comprehensive Long-term Environmental Action, Navy (CLEAN) 8012

Work Assignment Number (optional): Contract Task Order (CTO) 017

1. This Quality Assurance Project Plan (QAPP) was prepared in accordance with the requirements of:
   - *Uniform Federal Policy for Quality Assurance Project Plans* [United States Environmental Protection Agency (USEPA), 2005]
   - *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5 QAMS* (USEPA, 2002).
   - Identify any additional guidance used to prepare the Sampling and Analysis Plan (SAP): *Registered Environmental Consultant Program Implementation Guidance* [North Carolina Department of Environment and Natural Resources (NCDENR), 2011]
2. Identify regulatory program:
   - North Carolina Registered Environmental Consultant (REC) Program
3. This QAPP is project-specific.
4. List dates of scoping sessions that were held:
   - Formal scoping sessions were not used as they are not a requirement of the REC program.
5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.
   - F*inal Remedial Investigation Work Plans, Towers Road Disposal Areas, Harvey Point Defense Testing Activity, Hertford, North Carolina* (CH2M HILL, 2013) – Appendix H
6. List organizational partners (stakeholders) and connection with lead organization:
   - NCDENR, governing body of REC program
7. Lead organization
   - Department of the Navy (Navy) –NAVFAC Mid-Atlantic
8. If any required SAP elements or required information are N/A to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion, as follows:
   - The following crosswalk table references the location of all 37 required elements of the Uniform Federal Policy (UFP)-SAP. They are either provided in this QAPP or Interim Remedial Action Plan (IRAP) and Preconstruction Report.

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Crosswalk to Related Information

UFP-SAP Worksheet #	Required Information	Crosswalk to Related Information
A. Introduction and Project Organization		
Documentation		
1	Title and Approval Page	Page 1
2	Table of Contents Acronym and Abbreviation List QAPP Identifying Information	Pages 3-6
3	Distribution List	Attachment I, Table 1
4	Project Personnel Sign-off Sheet	Attachment I, Table 1
Project Organization		
5	Project Organizational Chart	Attachment I, Table 1
6	Communication Pathways	Attachment I, Table 1Section 1.3.1
7	Personnel Responsibilities and Qualifications Table	Attachment I, Table 1
8	Special Personnel Training Requirements Table	Section 1.6
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	N/A
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	Section 1.4 Figure 1 and 2 of the IRAP and Preconstruction Report
11	Site-Specific Project Quality Objectives (PQOs)	Section 1.5.4P
12	Measurement Performance Criteria Table	Attachment I, Table 4-1 through 4-5
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations	Table 2 and 4 of the IRAP and Preconstruction Report
14	Summary of Project Tasks	Section 1.4 Section 5.0 of the IRAP and Preconstruction Report
15	Reference Limits and Evaluation Table	Attachment I, Table 2-1 through 2-9
16	Project Schedule/Timeline Table	Figure 10 of the IRAP and Preconstruction Report
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	IRAP and Preconstruction Report
18	Sample Location Map	Figure 8 and 9 of the IRAP and Preconstruction Report
19	Analytical Methods/Standard Operating Procedure (SOP) Requirements Table	Attachment I, Table 6
20	Field Quality Control (QC) Sample Summary Table	Attachment I, Table 3

UFP-SAP Worksheet #	Required Information	Crosswalk to Related Information
21	Project Sampling SOP References Table Sampling SOPs	Appendix C of the IRAP and Preconstruction Report
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Section 2.7.1
Analytical Tasks		
23	Analytical SOP References Table	Attachment I, Table 5
24	Analytical Instrument Calibration Table	Attachment I, Table 11
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Attachment I, Table 10
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal	Section 2.3
27	Sample Custody Requirements, Procedures/SOPs, Sample Container Identification	Section 2.3
Quality Control Samples		
28	QC Samples Table	Attachment I, Table 9-1 through 9-6 Section 2.5
Data Management Tasks		
29	Project Documents and Records	Section 1.7 Attachment I, Table 8 Attachment I, Table 13
30	Analytical Services Table Analytical and Data Management SOPs	Attachment I, Table 7 Attachment I, Table 5 Section 1.7
C. Assessment Oversight		
31	Planned Project Assessments Audit Checklists	Section 3.0 Attachment I, Table 12
32	Assessment Findings and Corrective Action Responses	Section 3.1
33	Quality Assurance (QA) Management Reports	Section 3.2
D. Data Review		
34	Verification Process	Section 4.2.1
35	Validation Process	Section 4.2.2
36	Validation Summary	Section 4.2.2
37	Usability Assessment	Section 4.3

SECTION 1

Introduction and Project Organization

1.1 Introduction

This QAPP presents the sampling and analysis plan for the planned Interim Remedial Action at Towers Road Disposal Area. It identifies the data quality objectives (DQOs) and the laboratory activities necessary to achieve the DQOs of the project. It provides QA and QC requirements for sampling activities, sample analyses, and other tests that will generate data as part of the activities performed for the Phase I Remedial Investigation. This QAPP is a component of the IRAP and Preconstruction Report and has been prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA, 2001).

The requirements of this document apply to contractors and subcontractors. Subcontractors will be required to review the site-specific QAPP and will be expected to adhere to the procedures specified in these documents. Deviations from these procedures will be documented. All field activities will be conducted by CH2M HILL or subcontractors to CH2M HILL.

1.2 Project Organization Roles and Responsibilities

Key project team information associated with the planned sampling work and the responsibilities associated with each position are identified in **Attachment I, Table 1**. The organizational structure and responsibilities are designed to provide project control and QA for the proposed investigation.

1.3 Distribution List and Project Personnel Sign-off Sheet and Communication Pathways and Procedures

1.3.1 Project Communication

Effective communication among all project personnel will be established and maintained throughout the course of the project and is essential for effective implementation of field activities.

Attachment I, Table 1 provides the following information:

- Distribution list and Project Personnel Sign-off Sheet: A list of all recipients of the QAPP. This project-specific list is not exclusively for CH2M HILL personnel and includes regulatory stakeholder and subcontractor (laboratory) information. Returned signed copies of this table will be kept in project files as documentation that project personnel have read the QAPP.
- Communication pathways and procedures for each specific project personnel.

Before field activity begins, a CH2M HILL project team meeting will be held to review the project objectives. Periodic meetings will be held to review data validity, technical evaluations, major decisions, and overall progress toward completing the project. Additionally, a team kickoff meeting will be held before work on each task is started. Senior personnel may participate in the meetings to help focus the project approach and to define specific issues.

During the field sampling phases of this project, the field team will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the FTL will meet individually with field personnel or other stakeholders to resolve problems.

During the field effort, the FTL will be in regular telephone or face-to-face contact with the project team. When significant problems or decisions requiring additional authority occur, the FTL will immediately

contact the PM for assistance. The PC will coordinate communication with the laboratory through sample collection, sample analysis, and will consult with the PM as needed. The PC will perform a data quality analysis of the final data which will be included in the report.

All analytical laboratory QA/QC issues will be reported the same day the issue is identified to the PC. Should analytical corrective actions (CAs) be warranted, they will be communicated to the PC on a same day basis. The PC will facilitate resolution to ensure work plan requirements are met by the laboratory. Communications with subs shall be by phone, followed up with e-mail to document decisions and actions as soon as issues are identified.

The PC will track data from sample collection through upload to the database. Issues will be reported to the PM as they are identified.

1.3.2 Laboratory Work Group

The selected laboratories are responsible for analyzing samples collected during field activities, in accordance with this QAPP, the IRAP and Preconstruction Report , and the most current version of the *Department of Defense Quality Systems Manual for Environmental Laboratories* [Department of Defense (DoD), 2010].

The laboratory PM or Client Service Manager acts as a liaison between the PC and the field and laboratory operations and is responsible for the following:

- Receipt of sample custody from the field team members, verification of sample integrity, and transfer of sample fractions to the appropriate analytical departments
- Coordination of sample analyses to meet project objectives
- Preparation of analytical reports
- Review of laboratory data for compliance with method requirements
- Review of any QC deficiencies reported by the analytical department manager
- Coordination of any data changes resulting from review by the project QA supervisor or the PM
- Completion of data package deliverables
- Communication with the PC pertaining to analytical and QC issues
- Response to questions from the project team during the data quality evaluation (DQE) process

1.4 Problem Definition, Project Background and Project Scope

The interim remedial action is being conducted to address the potential human health risks associated with exposure to waste and constituents in soil. Confirmation samples are required in order to determine that the IRA meets its objective.

Refer to **Section 1.0** of the IRAP and Preconstruction Report for the site background and **Section 5.0** of the IRAP and Preconstruction Report for the IRA activities.

1.5 Quality Objectives and Criteria for Measurement Data

QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities are planned and performed according to accepted standards and practices. This process ensures that the resulting data are valid and retrievable. QC is an integral part of the overall QA function

and is composed of all those actions necessary to control and verify that project activities and resulting data meet established requirements.

To ensure that a minimum level of certainty about the quality of field data is being met, the following elements will be addressed to meet the requirements specified by the client and regulatory agencies:

- Field operations will be conducted in accordance with field SOPs included in the IRAP and Preconstruction Report.
- To maintain accuracy within necessary limits, measuring and test equipment (M&TE) used in field investigations will be calibrated against traceable standards at specific intervals, using approved SOPs or manufacturer's instructions.
- When M&TE is found to be out of specification, the previous inspection or test results will be evaluated for validity and acceptability. This evaluation will be documented.
- Before project field work begins, all project staff will be trained to ensure that they are familiar with project work plans and associated documents.
- Internal audits may be performed to assess the quality of project activities and to evaluate compliance with established QA requirements.
- QC samples will be used to monitor the quality of field and laboratory techniques and of the data.

1.5.1 Levels of Data Quality

The following subsection lists the levels of data. The level of data quality is dependent on the objective use of the results supported by the data.

The data use determines the required levels of data quality. The two categories of data quality established by the United States Environmental Protection Agency (USEPA), ***screening*** and ***definitive***, are defined as follows:

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration, and/or QC requirements, as compared to the requirements for producing definitive data. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise unless USEPA reference methods are used. Depending on the DQOs, screening methods may require confirmation samples that generate definitive data. Confirmation samples will be selected to include both detected and non-detected results from the screening technique.

Definitive data are generated using rigorous analytical methods such as approved USEPA reference methods. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements. Definitive data are not restricted in their use unless quality problems require data qualification.

Only definitive data is applicable to this investigation, as there will be no screening data generated.

Three levels of data reporting will be performed as part of this field effort, with each level having different supporting QA/QC documentation. The four levels correspond to QC Levels I, II, and IV.

- Level I – Field Surveys: Encompasses field monitoring or screening activities and does not require formal data package deliverables. Level I activities are focused on easily measured bulk characteristics of a sample such as pH, conductivity, ORP, and DO. Monitoring results, as well as pertinent data concerning the sampling event, will be documented in the bound field book. Level I documentation will consist of the following:

  - Instrument identification
  - Calibration information (standards used and results)
  - Date and time of calibration and field measurements
  - Field measurement results

  The logbooks will be reviewed daily by the FTL for completeness and correctness. No additional documentation or DQE is required.

- Level II – Screening Activities, Physical Parameters, and Investigation-derived Waste Analyses: includes the analyses submitted to the laboratories for screening, physical parameter testing, and analyses associated with the characterization of the investigation-derived waste (IDW) samples.

- Samples submitted for analysis under Level II will require the delivery of an analytical data package. Level II documentation will consist of the following:

- Case narrative
- Sample results
- Selected QC information such as surrogate recovery
- Associated blank results
- Completed chain of custody (COC) and any sample receipt information
- Level IV – Laboratory Analysis: This level provides the most stringent level of documentation, and allows the data reviewer or data validator to recreate the analytical sequence and evaluate raw data such as quantitation reports generated from the instrumentation used in the analyses. The list of methods and the corresponding target analytes have been designed to evaluate the potential for contamination at the site.

1.5.2 Data Quality Objective Development

DQOs are both qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support the decision-making process during project activities. The intended final use of the data determines the DQOs, which are developed before QAPPs.

The credibility of the data is strengthened by the level of the supporting QA/QC documentation. The greater the importance of the data or the resulting decision, the more QA/QC information is needed to validate the data. This reasoning must be applied to the data collected for any project. The DQO process used for this project follows the *USEPA Guidance for the Data Quality Objectives Process (QA/G-4)* (USEPA, 2000).

1.5.3 Quality of Data

Analytical performance requirements are expressed in terms of Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC).

1.5.3.1. Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under identical conditions. Precision can be estimated by comparing duplicate matrix spike concentrations and field duplicate sample results. The precision of a duplicate determination can be expressed as the relative percent difference (RPD), calculated as:

$$\text{RPD} = \left\{ \frac{|X_1 - X_2|}{\frac{(X_1 + X_2)}{2}} \right\} x100$$

Where X_1 is the result from the native sample, and X_2 is the result from the duplicate sample.

1.5.3.2. Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy is estimated through the use of known reference materials and matrix spikes. It is calculated from analytical data and is not measured directly. Spiking of reference materials into a sample matrix provides a measure of the matrix effects on analytical accuracy. Spiking of reference materials into a "non-matrix", such as deionized (DI) water or Ottawa sand, provides a measure of the accuracy of the analytical method itself. Accuracy, defined as percent recovery (P), is calculated as:

$$\text{P} = \left[\frac{(\text{SSR - SR})}{\text{SA}} \right] \text{x } 100$$

Where SSR is the spiked sample result, SR is the sample result (native), and SA is the spike concentration added to the spiked sample.

1.5.3.3. Representativeness

Representativeness is a measure of the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness is demonstrated by providing full descriptions in the project planning documents of the sampling techniques and by making certain that the sampling locations are selected and the number of samples collected such that the accuracy and precision criteria are met.

1.5.3.4. Comparability

Comparability is another qualitative measure designed to express the confidence with which one data set may be compared to another. Sample collection and handling techniques, sample matrix type, and analytical method all affect comparability. Comparability is limited by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. Data from one phase of an investigation can be compared to others when similar methods are used and similar data packages are obtained.

1.5.3.5. Completeness

Completeness is defined as the percentage of measurements judged to be valid, compared to the total number of measurements made for a specific sample matrix and analysis. Completeness is calculated using the formula:

$$Completeness = \frac{Valid\ Measurements}{Total\ Measurements} x100$$

Experience on similar projects has shown that laboratories typically achieve approximately 95 percent completeness. During the QC process, an assessment will be made of whether the data are sufficient to meet project objectives.

1.5.4 Project Quality/Systematic Planning Process Statements and Data Quality Objectives

The data will be used by the Navy andCH2M HILL. Within each organization, the data will be used by staff scientists, engineers, and PMs.

What are the Project Action Limits (PALs)?

PAL values are provided in **Attachment I**, **Tables 2-1 through 2-9.** They were calculated in the Phase I Remedial Investigation Report for COPCs identified during that phase, in accordance with REC Program Implementation guidance (NCDENR, 2012). During the Phase II Remedial Investigation, prior to implementation of this project, additional background samples will be collected to establish background polycyclic aromatic hydrocarbon (PAH) values. The COPCs may be reduced based on the new data. If a COPC is eliminated based on the Phase II data, it will be removed from the analyte list and its PAL will be no longer applicable.

What will the data be used for?

The analytical results will be used to confirm that the horizontal and vertical limits of the interim remedial action result in soil remaining onsite that is below the protection of groundwater and health-based preliminary soil remediation goals.

What types of data are needed?

Matrixes and analytical groups for the sampling activities are defined in **Attachment I**, **Table 3**.

- Field activities will be recorded in a field notebook to document adherence to the approved IRAP and Preconstruction Report. The CH2M HILL SOP entitled *Preparing Field Log Books* describes the necessary documentation required for log book completion.

How "good" must the data be to support the environmental decision?

- The data need to be of sufficient quality for determining the concentration of constituents in media collected such that the project objectives can be achieved.
- During the investigation, field QA/QC samples will be collected per **Attachment I, Tables 4-1 through 4-5**, as a check on sampling and analytical protocol.

How much data should be collected (number of samples for each analytical group, matrix, and concentration)? Where, when, and how should the data be collected/ generated?

- Sample quantities, including QA/QC samples, for each chemical analysis are discussed in **Attachment I, Table 3**.
- The laboratory will generate data in accordance with the SOPs presented in **Attachment I, Table 5**.
- Sample locations are presented on **Figures 8** and **9** of the IRAP and Preconstruction Report.

Who will collect and generate the data? How will the data be reported?

- Samples will be collected by CH2M HILL field team members.
- Chemical analyses will be performed by ENCO Laboratories in Orlando and Jacksonville, Florida. Both are DoD Environmental Laboratory Accreditation Program (ELAP)-certified laboratories under subcontract to CH2M HILL. Refer to **Attachment II** for a copy of the laboratories' DoD ELAP Acceptance letter.
- All chemical data will be presented in a combined Construction Completion/Interim Soil Remedial Action Report

How will the data be archived?

- All data and information (original and copies) of any type whatsoever shall be surrendered to the HPDTA Environmental Manager upon completion of the project.

Project quality objectives (PQOs) listed in the form of if/then qualitative and quantitative statements:

- If the floor or wall soil sample exceeds either the protection of groundwater or residential adjusted health-based soil remediation goal then additional excavation will be performed and the area will be re-sampled. The additional volume to be excavated will be determined by the RSM, HPDTA Environmetnal Manager, and NAVFAC RPM.
- If the floor or wall sample does not exceed either the protection of groundwater or residential adjusted health-based soil remediation goal then no additional excavation will be required.

1.6 Special Training, Requirements, and Certifications

The PM works with the project delivery manager to assemble a project team that has the necessary experience and technical skills. Part of the work planning process is to identify special training requirements or certifications necessary to execute the project successfully.

1.7 Documentation and Records

This subsection defines which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures. It is imperative for the defensibility of critical decisions made at the site that proper documents and records be maintained for the field and offsite data gathering activities, so that specific events can be recreated or independently evaluated. The PM and RSM will be responsible for organizing, storing, and cataloging all project information. The PM and RSM are also responsible for collecting records and support data from all project team members. All project documents and records, both original and copies, will be forwarded to the HPDTA Environmental Manager upon completion of the project.

1.7.1 Field Documentation

- Field logbook to record data collection activities and observations (including date and time, sample locations, depth, health and safety measures, weather conditions, sampling personnel, analyses requested, and sketches)
- Sample collection field sheets or COC documentation
- Field instrument calibration and maintenance logs
- Additionally, field QC and CA documents may be generated as a result of field audits

Field documentation will be stored with the project records.

1.7.2 Laboratory Documentation

Calculations to be used for data reduction are specified in the referenced analytical methods. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be stored electronically, and a hard copy file will be maintained. Laboratory data entered will be sufficient to document information used to arrive at reported values. Electronic data storage will be utilized when possible. All electronic data will be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration. Raw data will be examined to assess compliance with QC guidelines. Deviations from guidelines will call for corrective action. Deviations determined to be caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. Calculations will be checked and the report reviewed for errors and oversights.

Upon completion, a report will be reviewed for discrepancies, errors, or omissions. Data will then be submitted to the laboratory Quality Assurance Manual (QAM), however named, for review and approval. The laboratory QAM will review the package, ensure that any necessary corrections are made, and give the package to the laboratory PM for review. A copy of the data package will be filed in the project file. Mailed data packages, along with applicable electronic data deliverables (EDDs), will be sealed in an appropriate shipping container and logged into a document mailing log.

The requested turn-around time for definitive data will be 7 calendar days from the time of sample receipt at the laboratory.

SECTION 2

Measurement and Data Acquisition

Section 2 describes the measurement and data acquisition procedures and the analytical methods to be performed in support of this monitoring. It addresses the following aspects of measurement and data acquisition:

- Sampling process design
- Sampling method requirements
- Sample handling and custody requirements
- Analytical method requirements
- QC requirements
- Instrument and equipment testing, inspection, and maintenance requirements
- Instrument calibration and frequency
- Inspection and acceptance requirements for supplies and consumables
- Data acquisition requirements

2.1 Sampling Process Design

Refer to the IRAP and Preconstruction Report for details pertaining to sampling design and rationale.

2.2 Sampling Method Requirements

Refer to ***Sections 5.0*** of the IRAP and Preconstruction Report.

2.3 Sample Handling and Custody Requirements

Proper sample handling, preservation, shipment, and maintenance of a COC are key components to building the documentation and support for data within the evidentiary process in order that the data can be used for decision-making. It is essential that all sample handling and sample COC requirements be performed in a complete, accurate, and consistent manner. Sample handling and custody requirements must be followed for all samples collected as part of the investigation.

The FTL is responsible for proper sampling, labeling, preserving, and shipping samples to the laboratory to meet the required holding times.

2.3.1 Sample Identification

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, preservative, analysis group or method, and sampler's initials. A standardized nomenclature system will be used to ensure accurate data retrieval of all samples collected. Each sample will be designated by an alphanumeric code that will identify the facility, site, station ID, matrix sampled, and/or date and depth sampled. QA/QC samples will have a unique sample designation. Nomenclature for samples and field QA/QC is specified on **Attachment I, Table 3**.

The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested.

2.3.2 Sample Custody

The sample custody and documentation procedures described in this subsection will be followed throughout all sample collection activities. Components of sample custody procedures include the use of field logbooks, sample labels, custody seals, and COC forms. Each person involved with sample

handling must be trained in COC procedures before the start of the field project. The COC form must accompany the samples during shipment from the field to the laboratory.

A sample is under custody under the following conditions:

- It is in one's actual possession
- It is in one's view, after being in one's physical possession
- It was in one's physical possession and that person locks it up to prevent tampering
- It is in a designated and identified secure area

2.3.3 Field Custody

The following procedures must be used to document, establish, and maintain custody of field samples:

- Sample labels must be completed for each sample with waterproof ink, ensuring that the labels are legible and affixed firmly on the sample container.
- All sample-related information must be recorded in the project logbook.
- The field sampler must retain custody of samples until they are transferred or properly dispatched.
- One individual from the field sampling team should be designated as the individual responsible for all sample transfer activities. This field investigator will be responsible for the care and custody of samples until they are properly transferred to another person or facility.
- All samples will be accompanied by a COC record. This record documents the transfer of custody of samples from the field investigator to another person, to the laboratory, or to other organizational entities. Each change of possession must be accompanied by an authorized signature for relinquishment and receipt of the samples.
- Completed COC forms will be enclosed in a "sealed" plastic Zip-Lock® bag (or its equivalent) and placed inside the shipping container used for sample transport from the field to the laboratory.
- When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the COC form.
- Custody seals must be affixed on shipping containers when samples are shipped to the laboratory to prevent sample tampering during transportation. If seals are numbered, record the numbers on the chain of custody and in the field log book.

2.3.4 Laboratory Sample Custody

Each laboratory receiving samples must comply with the laboratory sample custody requirements outlined in the subcontract document and its own QAP. The PC will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped and the expected date of arrival.

The following procedures will be used by the laboratory sample custodian, once the samples have arrived at the laboratory:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check the original chain of custody and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian will sign the chain of custody and

record the date and time received. The sample custodian also will assign a unique laboratory sample number to each sample.

- Cooler temperature (temperature blank) will be checked and recorded.
- Care will be exercised to annotate any labeling or descriptive errors. If discrepancies occur in the documentation, the laboratory will immediately contact the PC as part of the CA process. A qualitative assessment of each sample container will be performed to note anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain of custody procedure.
- If all data and samples are correct and there has been no tampering with the custody seals, the "Received by Laboratory" box will be signed and dated.
- Samples will be stored in a secured area and at a temperature of approximately 4 degrees Celsius (°C), if necessary, until analyses are to begin.
- The laboratory will send a sample acknowledgment letter to the PC as a record that the shipment arrived and noting the conditions of the containers upon arrival. Any discrepancy will be identified and CAs performed. These remarks will be documented on a "sample receipt checklist" or its equivalent. The PC may need to be contacted to provide guidance concerning additional CAs or guidance. The PM and PC will retain copies of the sample acknowledgment with the COC.
- All samples will be accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person or to the laboratory. Overnight carriers will be treated as a single entity, and a single signature will be required when samples are delivered to the laboratory.
- A laboratory chain of custody form will accompany the sample or sample fraction through final analysis for control.
- Copies of the COC and request-for-analysis forms will accompany the laboratory report and will become a permanent part of the project records.
- Samples must be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC form enclosed in each sample box or cooler.
- All packages must be accompanied by a chain of custody form identifying the contents. The original record must accompany the shipment, and the FTL must retain a copy. Additional details about laboratory sample custody are included in the laboratories' sample receipt SOP which can be made available upon request.

2.3.5 Sample Packing and Shipping

Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 6 °C until they are received by the laboratory. The chain of custody will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the chain of custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian).

All volatile organic compound (VOC), semi-volatile organic compound (SVOC), pesticide, and polychlorinated biphenyl (PCB) samples will be shipped to ENCO laboratories in Orlando, Florida, and all metal and mercury samples will be shipped to ENCO laboratories in Jacksonville, Florida.

2.4 Analytical Methods Requirements

Samples will be analyzed using USEPA-approved methods or other recognized standard methods (USEPA, 1992). The principal source for analytical methods is:

- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA, 1998)
- Methods for Chemical Analysis of Water and Wastes (USEPA, 1983)

Refer to **Attachment I, Table 6** for analytical methods to be used for the analysis of the target compounds and the containers needed for sampling, including preservation requirements and maximum holding times.

2.4.1 Analytical Methods

Refer to **Attachment I, Table 7,** for the list of analytical methods to be used.

Refer to **Attachment I, Table 5**, for the list of analytical SOPs to be followed during analysis. Copies of laboratory SOPs will be made available upon request.

2.4.2 Detection, Quantitation, and Reporting Limits

2.4.2.1. Detection Limits

The detection limit (DL) is the minimum amount of an analyte that can be routinely identified using a specific method and instrument measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

2.4.2.2. Limit of Detection

The limit of detection (LOD) is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a 99 percent confidence level. All non-detects are to be reported at the LOD. The LOD is equal to or greater than the DL and is verified quarterly.

2.4.2.3. Limit of Quantitation

Quantitative results can only be achieved at or above the limit of quantitation (LOQ). The LOQ is defined as the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. For results falling between the DL and the LOQ, a "J" flag will be applied to the results, indicating the variability associated with the result.

2.4.3 Target Analytes and Reporting Limits

Refer to **Attachment I, Tables 2-1 through 2-9,**.

2.4.4 Data Package Deliverables

Refer to **Attachment I, Table 8**.

2.5 Quality Control Requirements

Refer to **Attachment I, Tables 9-1 through 9-6** and **Table 4-1 through 4-5**.

The following text describes this project's QC requirements:

2.5.1 Field QC Blank Samples

For the purposes of this project, field QC samples will be utilized.

The type and frequency of field QC samples should be evaluated as part of the project planning process. In the following subsections, typical field QC blank samples and duplicate field samples are defined.

Blank samples should not contain any target parameter of interest. There are certain organic compounds known to be common laboratory contaminants, such as acetone, methylene chloride, and the common

phthalates. However, the laboratory must make all efforts to eliminate these compounds as contaminants.

Equipment Rinsate Blank Samples

Equipment rinsate blanks (ERBs) are samples of American Society for Testing And Materials (ASTM) Type II water passed through and over the surface of decontaminated sampling equipment. The rinse water is collected in sample bottles, preserved, and handled in the same manner that is used when collecting aqueous samples, even if the ERBs are being collected for soil samples. ERBs are used to monitor the effectiveness of the decontamination process. One ERB will be collected per type of sampling equipment lot and analyzed for the same parameters as the corresponding samples.

Trip Blanks

Trip blanks are sent with each cooler shipped to the offsite laboratory containing samples requiring VOCs analysis. Trip blanks consist of a sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of VOC samples. One trip blank will be shipped with each cooler containing VOC samples.

Temperature Blanks

Temperature blanks are sent with each cooler shipped to the offsite laboratory containing samples requiring preservation at 4°C. Temperature blanks consist of a non-preserved volatile organic compounds (VOC) vial, or similar laboratory container, filled with ASTM reagent grade water. Temperature blanks are measured at the laboratory upon receipt to verify the temperature of the samples contained in the cooler. One temperature blank will be shipped with each cooler to each offsite laboratory.

Duplicate Field Samples

Duplicate field samples are collected to monitor the precision of the field sampling process. The FTL will choose at least 10 percent (per matrix) of the total number of sample locations known or suspected to contain moderate contamination, and duplicate field samples will then be collected at these locations. The identity of the duplicate samples will be recorded in the field sampling logbook, and this information will be forwarded to the DQE team to aid in reviewing and evaluating the data.

2.5.2 Laboratory QC Blank and Matrix Spike Samples

Method Blanks

Laboratory method blanks are blank matrices (such as ASTM Type II water or Ottawa sand) that are treated as environmental samples, being prepared and analyzed along with the field samples. Laboratory method blanks are used to monitor laboratory performance and to check for contamination introduced during the preparation and analytical procedures. A method blank is required for every 20 field samples or for each analytical batch, whichever is more frequent.

Blank samples should not contain any target parameter of interest. There are certain organic compounds known to be common laboratory contaminants, such as acetone, methylene chloride, and the common phthalates. However, the laboratory must make all efforts to eliminate these compounds as contaminants. The concentration of all target compounds must be less than the RL, except for the common contaminants; the concentration of the common contaminants must be less than five times the RL.

Surrogate Spikes

Surrogate spike compounds are added to each sample for the organic analytical methods. Surrogate spike compounds are structurally similar (but not identical) to target compounds and should behave in a similar manner during analysis. Surrogate spike recoveries are used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks are used to evaluate laboratory performance because these blanks represent an ideal sample matrix. Surrogate spike recoveries for field samples are used to evaluate the potential for matrix interferences. When surrogate spike recoveries for field samples fall outside the method target acceptance windows, the samples are re-extracted if appropriate, then re-analyzed. If the surrogate spike recovery is still outside the acceptance window for the re-analyzed sample, then the sample results are qualified as affected by matrix interferences.

Laboratory Control Samples

The laboratory control samples (LCSs) are analyte-free water (for aqueous analyses) or Ottawa sand (for soil analyses) (except metals where glass beads of 1-millimeter [mm] diameter or smaller may be used) spiked with all target analytes. The appropriate spiking concentration will be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte.

The LCS will be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each preparation and analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification (CCV). One LCS will be included in every preparation and analytical batch. If more than on LCS is analyzed in an analytical batch, results from all LCSs analyzed will be reported.

Whenever an analyte in a LCS is outside the acceptance limit, CA will be performed. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch will be reanalyzed for the out-of-control analyte(s). When an analyte in a LCS exceeds the upper or lower control limit and no CA is performed or the CA was ineffective, the laboratory should discuss the issue with the PC or QAM personnel.

Interference Check Samples

The interference check sample (ICS), used in ICP analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and interelement correction factors and is run at the beginning and end of each run sequence.

When the ICS results are outside of the acceptance limits as prescribed in the method, CA will be performed. After the system problems have been resolved and system control has been re-established, re-analyze the ICS. If the ICS result is acceptable, re-analyze all affected samples.

Internal Standards

Internal standards (ISs) are known amounts of certain compounds added after preparation or extraction of a sample. These compounds are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. ISs will be added to environmental samples, control samples, and blanks in accordance with the method requirements.

When the IS results are outside of the acceptance limits, CAs will be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning will be reanalyzed.

Dilution Test (for metals analysis)

The dilution test is a comparison between the results of a sample and a 5x dilution of the original sample.

It is only applicable to samples whose concentrations are a factor of 50x above the instrument detection limit (IDL) but less than ~90% of the linear range. The results should agree within +/- 10%. If the results do not agree, a chemical or physical interference effect (ie a matrix interferant) is suspected and the specific analytes should be flagged.

Post Spike (for metals analysis)

The post spike is an addition of a known amount of standard solution to a portion of a prepared sample digestate. The addition is added "post digestion" and compared to a set of method recovery criteria. If the recovery is not within the specified limits, a matrix effect is suspected and the specific analytes should be flagged.

2.5.3 Retention Time Windows

Retention time windows are established to compensate for minor shifts in absolute retention times resulting from normal chromatographic variability. Absolute retention times are used for analyte identification in all gas chromatography (GC) methods that do not employ IS calibration. Retention time windows are used in GC analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. If the analyte retention time is outside the established window, new retention windows must be established.

2.5.4 Confirmation of Identification

Quantitative confirmation of results at or above the RL for samples analyzed by GC will be required and will be completed within the method-required holding times. For GC methods, a second column is used for confirmation. The result from the lowest quantitation between the primary and secondary column/detector will be used for reporting purposes. The lowest quantitation will be reported to minimize the reporting of bias high results arising from co-elution of non-target analytes with the analyte of interest.

2.5.5 Standard Materials

Standard materials, including second source materials, used in calibration and to prepare samples will be traceable to National Institute of Standards and Technology (NIST), USEPA, American Association of Laboratory Accreditation (A2LA) or other equivalent approved source, if available. If an NIST, USEPA, or A2LA standard material is not available, the standard material proposed for use will be included in an addendum to the QAPP and approved before use. The standard materials will be current, and the following expiration policy will be followed: The expiration dates for ampulated solutions will not exceed the manufacturer's expiration date or 1 year from the date of receipt, whichever comes first. Expiration dates for laboratory-prepared stock and diluted standards will be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first. Expiration dates for pure chemicals will be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. Expired standard materials will be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory will label standard and QC materials with expiration dates.

A second source standard is used to independently confirm initial calibration. A second source standard is a standard purchased from a different vendor than the vendor supplying the material used in the initial calibration standards. The second source material can be used for the continuing calibration

standards or for the LCS (but will be used for one of the two). Two different lot numbers from the same vendor do not constitute a second source.

2.6 Field and Laboratory Corrective Action

The procedures that will be followed in identifying problems and performing CAs in the field and in the laboratory are described below.

2.6.1 Field Corrective Action

The PM is responsible for overseeing the CA process, but any team member may initiate it. The CA process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the CA, verifying that the problem has been eliminated, and documenting the CA.

Examples of CA are correcting COC forms; problems associated with sample collection, packaging, shipping, or field record keeping; or additional training in sampling and analysis. Additional approaches may include re-sampling or evaluating and amending sampling procedures.

2.6.2 Laboratory Corrective Action

The laboratory department supervisors will review the data generated to verify that all QC samples have been run as specified in the procedure. Laboratory personnel are alerted that CAs may be necessary under the following conditions:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples.
- Blanks contain contaminants at concentrations above the levels specified in the laboratory QA plan for any target compound.
- Deficiencies are detected by the laboratory QA director during internal or external audits, or from the results of performance evaluation samples.

CAs are implemented immediately when non-conformances in QC sample results are identified by the bench analyst. CA procedures are handled initially at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks such parameters as instrument calibration, spike and calibration mixes, and instrument sensitivity.

The analyst immediately notifies his or her supervisor of the problem and the investigation being conducted. If the problem persists or cannot be identified, the matter must be referred to the laboratory supervisor and the QA/QC officer for further investigation. At this point, the PC and the PM must be notified about the non-conformance. All laboratory QC problems that will affect the final data must be discussed with the PC as part of the CA process. Once resolved, full documentation of the CA procedure must be filed with the laboratory supervisor, and the QA/QC officer must be provided with a CA memorandum for inclusion in the project file if data are affected. A copy of the CA memorandum must be included in the laboratory data package deliverable.

CAs may include the following:

- Reanalyzing suspect samples
- Recalibration with new standards
- Eliminating blank contamination
- Resampling and analyzing new samples
- Evaluating and amending sampling and analytical procedures
- Accepting data with an acknowledged level of uncertainty

- Recalibrating analytical instruments
- Qualifying or rejecting the data

After implementation of the required CA measures, data that are deemed unacceptable may not be accepted by the PM, and follow-up CAs may be explored. Details of laboratory CAs are provided in the laboratory QAM.

2.7 Instrument and Equipment Testing, Inspection, and Maintenance Requirements

2.7.1 Field Instruments

All equipment used for field measurements will be maintained in accordance with the manufacturer's instructions. Routine maintenance and all equipment repairs will be documented in the site logbook. Whenever a piece of equipment fails to operate properly, the instrument will either be repaired in-house, if possible, or sent out for repair. Another instrument equivalent to the original will be substituted, if possible. Other than solutions and standards for calibrating the equipment, the field team keeps only a limited amount of supplies on hand. Parts are ordered on an as-needed basis.

2.7.2 Analytical Laboratory Instruments

Preventive maintenance for laboratory instruments is detailed in **Attachment I, Table 10**.

It is required that designated laboratory personnel will be trained in routine maintenance procedures for all major instrumentation. Either trained staff or trained service engineers or technicians employed by the instrument manufacturer will make repairs. The laboratory should have multiple instruments that will serve as back-up to minimize potential downtime. All maintenance will be documented and kept in permanent logs. These logs will be available for review by auditing personnel.

Laboratory equipment testing, inspection, and maintenance will be in accordance with the laboratory's QAP. The laboratory QAP should discuss the schedule, procedures, criteria, and documentation for verifying that all analytical equipment is operating in an accurate and precise manner. To minimize instrument downtime, each laboratory should have an internal instrument repair department or have a contract with a local instrument repair company. The laboratory keeps an inventory of certain supplies and consumables, as described in the laboratory's QAP. Additional parts or supplies are ordered on an as-needed basis.

2.8 Instrument Calibration and Frequency

Because instruments used during field investigation activities may be of several models and manufacturers, it is not feasible to present instrument-specific details in this subsection. Instead, instrument-specific calibration will be performed in accordance with the manufacturer's instructions, as provided in the instrument's SOP.

Refer to **Attachment I, Table 11**.

2.9 Inspection and Acceptance Requirements for Supplies and Consumables

All services, including subcontracted services and supplies received from vendors, must meet the project scope, specified levels of quality, and the submittal schedule. Field and laboratory personnel must evaluate the vendor's ability to provide the services and specify acceptance requirements for supplies and consumables. For example, laboratories rely on suppliers for solvents, gases, consumables, and

analytical equipment, including instrument maintenance. The laboratory should have and maintain adequate contracts with its vendors to receive uninterrupted supplies, parts, and services.

2.10 Data Acquisition Requirements

In addition to the electronic data, the laboratory provides hard-copy deliverables of the analytical results. The hard-copy data packages are filed onsite until the project is completed. At that time, the data packages are sent to the PM for inclusion in the project files.

SECTION 3

Assessment and Oversight

Section 3 describes the assessment and oversight activities that will be followed to determine whether the QC measures identified in the IRAP and Preconstruction Report and this QAPP are being implemented and documented as required.

Audits and reviews are the tools used to implement this process. For example, during a review, the auditor may check that a monitoring well has been correctly sampled or that the field QC samples were collected at the appropriate frequency. During an audit or review, the auditor may check for:

- Adherence to the Environmental Protection Plan included in **Section 6.0** of the IRAP and Preconstruction Report
- Documentation of the process or system
- Proper identification, resolution, and documentation of non-conformance with the process or system
- Correction of identified deficiencies

3.1 Assessments and Response Actions

The need for an audit can be determined independently by the PM. Assessment activities may include surveillance, inspection, peer review, management system review, readiness review, technical systems audit, performance evaluation, and data quality assessment. The PM will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. For the fieldwork, a monthly audit will be conducted throughout the duration of sampling activities. The laboratories to be used for this investigation will not be audited by CH2M HILL however both ENCO Orlando and ENCO Jacksonville have, as required by DoD, undergone audits by third-party accrediting bodies and possess DoD-ELAP certification. Refer to **Attachment II** for a copy of each laboratory's DoD ELAP Acceptance letter.

Field audits may be conducted by a review team member, as designated by the PM. One field audit, if requested, will be performed during the first week of sampling.

3.1.1 Field Team Performance and System Audits

The PC or other member of the review team, as designated by the PM, may conduct an audit of the field activities in accordance with the program requirements. The audit will address at least the following issues:

- Are sampling operations being performed as stated in the Work Plan?
- Are the sample labels being filled out completely and accurately?
- Are the chain-of-custody records complete and accurate?
- Are the field notebooks being filled out completely and accurately?
- Are the sampling activities being conducted in accordance with the Work Plan and approved SOPs?
- Are the documents generated in association with the field effort being stored as described in the Work Plan?

The generation and documentation of field data may also be audited. Audits will focus on verifying that proper procedures are followed so that subsequent sample data will be valid. Any non-conformance noted during an audit will result in a corrective action.

The results of the assessment and oversight activities will be reported back to the PM, who has ultimate responsibility for ensuring that the corrective action response is completed, verified, and documented.

See **Attachment I, Table 12,** for a copy of the Field Performance Audit Checklist.

3.2 Reports to Management

Reports to the PM include project status reports, the results of evaluation and system audits, data quality assessments, and significant QA problems and recommended solutions. The status reports, submitted in accordance with the requirements of the Work Plan, will discuss at least current activities, problems encountered and their resolution, and planned work.

QA reports will be submitted in accordance with the Work Plan. QA reports document implementation of the QAPP and the results of the site-specific QA/QC audits. A final QA report must be submitted as part of each project's final report. The topics to be covered are outlined in the Work Plan, but each will include at least the following information:

- Identification of non-conformances that required corrective action and resolution of the non-conformance
- Data quality assessment in terms of precision and accuracy and how they affect the usability of the analytical results
- Limitations of the qualified results and a discussion of rejected results
- Discussion of the field and laboratory QA/QC sample results
- The results of external laboratory audits

The FTL will provide feedback to the PM discussing all field activities, changes to field procedures, problems encountered, and corrective actions taken.

SECTION 4

Data Review, Validation, and Verification Requirements

This subsection addresses the QA activities that occur after the data collection has been completed. Implementation of these elements, which include data review, validation, and reconciliation to DQOs, will determine the extent to which the data conform to the specified criteria and satisfy the project objectives.

4.1 Data Verification and ReviewRequirements

The data are evaluated for precision, accuracy, and completeness against the analytical protocol requirements. Non-conformances or deficiencies that could affect the usability of data are identified as noted.

All analytical data will be supported by a data package. The data package will contain the supporting QC data for the associated field samples. Before the laboratory will release each data package, the laboratory QAM (or the analytical section supervisor) must carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

4.2 Verification and Validation Methods

4.2.1 Data Verification – Step 1

Step 1 data verification includes verifying compliance with analytical methods, procedures, and contracts. Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

As discussed previously, the data are also verified to assess whether the EDDs and the hard-copy data deliverables are consistent with one another to ensure an accurate database.

4.2.2 Data Verification – Step 2

The PC will ensure that the laboratory achieved the measurement performance criteria and quantitiation limits included in this QAPP, and that the laboratory and field QA/QC were analyzed, all of which can be found in Attachment 1. .

All non-analytical field data will be reviewed by the FTL. Non-analytical field data will be compared against QAPP requirements for completeness and accuracy based on the field calibration records.

4.2.3 Data Review

Analytical data review will be performed by the PC and will include a review of the following: CoC forms, laboratory sample receipt logins, the laboratory case narrative, all QA/QC forms, and a comparison of Form I result pages to the EDD . Recalculation of results is not required for this project, and all laboratory qualifiers will be retained. Data validation qualifiers will not be applied.

4.3 Usability Assessment

Data usability assessment comprises critical assessment of the data with respect to the project objectives. The data usability process and procedures are summarized below, including interim steps and any statistics, equations, and computer algorithm that will be used:

- Non-detected site contaminants will be evaluated to ensure that project required quantitation limits (**Attachment I**, **Tables 2-1 through 2-9)** were achieved. If project quantitation limits were achieved and the verification and -review steps yielded acceptable data, then the data is considered usable.
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Analytical data will be checked to ensure the values and qualifiers are consistent between the hardcopy data and the electronic data deliverable.
- Field and laboratory precision will be compared as RPD between the two results.
- Deviations from the QAPP will be reviewed to assess whether corrective action is warranted and to assess impacts to achievement of project objectives.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

To assess whether a sufficient quantity of acceptable data are available for decision making, the data will be reconciled with measurement performance criteria following a review of data quality indicator. If significant biases are detected with laboratory QA/QC samples it will be evaluated to assess impact on decision making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present at the site. If significant deviations are noted between lab and field precision the cause will be further evaluated to assess impact on decision making.

Identify the personnel responsible for performing the usability assessment:

- PC – Bianca Kleist/CH2M HILL
- PM – Janna Staszak /CH2M HILL

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

All the results will be assembled and statistically reported for an overall quality assessment provided in the final project event report. Discussion will cover completeness and representativeness.

Data tables will be produced to reflect detected and non-detected site contaminants and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation. Figures will be produced representing concentrations of contamination.

4.3.1 Data Quality Evaluation

The PC or designee will perform the DQE. The DQE process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements. It is a straight-forward examination–either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

The entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the DQE may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory.

4.3.2 Reconciliation with Data Quality Objectives

The final activity of the data evaluation process is to assess whether the data meet the planned DQOs for the project. The final results, as adjusted for the findings of any data evaluation, will be checked against the DQOs, and an assessment will be made as to whether the data are of sufficient quality to support the DQOs. The decision as to data sufficiency may be affected by the overall precision, accuracy, and completeness of the data. The main project objective should be met assuming the 90 percent completeness goal is obtained after all of the data have undergone sufficient data validation. If the data, after evaluation, are sufficient to achieve project objectives, the data quality manager and project manager will release the data and work may proceed.

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SECTION 5

References

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USEPA. 2001. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations.*

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Attachment I
Tables

TABLE 1

COMMUNICATION PATHWAY AND PROCEDURES, DISTRIBUTION LIST, AND PROJECT PERSONNEL SIGN-OFF SHEET

Name of Quality Assurance Project Plan (QAPP) Recipient	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Communication Drivers	Procedure, Pathway, etc	QAPP Section Reviewed	Date QAPP Read
Dawn Hayes	NAVFAC Remedial Project Manager (RPM)	NAVFAC Atlantic	(757) 322-4792	dawn.hayes@navy.mil	Communication HPDTA	Oversees project. Primary points of contact (POCs) for NAVFAC; can delegate communication to other internal or external POCs. RPM will notify USEPA and NCDENR via email or telephone call within 24 hours for field changes affecting the scope or implementation of the design. Navy will have 30 days for Work Plan review. All sampling data will be presented and discussed during partnering meetings.		
Brian Murphy	Environmental & Safety Program Manager	HPDTA	(252) 426-4360	hpdta.env.saf@us.army.mil	Communication with HPDTA	Oversees project. POC for HPDTA; can delegate communication to other internal or external POC. Will notify RPM via email or telephone call within 24 hours for field changes effecting the scope or implementation of design. HPDTA will have 30 days for Work Plan review.		
Matt Aufman	NCDENR Environmental Representative	NCDENR IHSB REC Program	(919) 707-8348	Matt.Aufman@ncdenr.gov	Communication with NCDENR	Primary POC for NCDENR; can delegate communication to other internal or external POCs.	Not applicable per REC Program Requirements	Not applicable per REC Program Requirements
Kim Henderson	Registered Site Manager (RSM)	CH2M HILL	(757) 671-6231	kimberley.henderson@ch2m.com	Communication regarding overall project status and implementation and primary POC with Navy RPM and HPDTA	Oversees project and ensures that the investigation is conducted in accordance with the Inactive Hazardous Sties statute and the REC Program rules. Will be informed of project status by the PM. If field changes occur RSM will work with the Navy RPM and HPDTA to communicate in field changes to the team via email within 24hrs.		
Kim Henderson	Senior Technical Consultant (STC)	CH2M HILL	(757) 671-6231	kimberley.henderson@ch2m.com	Communication regarding questions/issues encountered in the field, input on data interpretation, as needed.	Responsible for technical content of the deliverables, and will provide technical guidance throughout the project in order to effectively implement quality and technical risk management. All deliverables will be reviewed by the STC prior to submittal for client review. The STC is responsible for oversight of all site related documents.		
Janna Staszak	Project Manager (PM)	CH2M HILL	(757) 671-6256	janna.staszak@ch2m.com	Communications regarding project management and implementation/ Field corrective actions (CAs)	Manages project. All information and materials about the project will be forwarded to the Navy, HPDTA, Activity Mangers, and Senior Consultants as soon as possible, as necessary. POC for field sampling team, field and analytical issues requiring CA will be determined by the FTL and/or PM on an as needed basis; the PM will ensure QAPP requirements are met by field staff for duration of project.		
Howard Gordon	CH2M HILL Health and Safety (H&S) Manager (HSM)	CH2M HILL	(720)286-0240	howard.gordon@ch2m.com	H&S	Responsible for generation of the Accident Prevention Plan (APP) and approval of the activity hazard analyses (AHAs) prior to the start of field work. The PM will contact the H&S Manager as needed regarding questions/issues encountered in the field.	Not applicable. Signature is maintained on the APP.	Not applicable. Signature is maintained on the APP.
Nate Price	Field Team Leader (FTL)	CH2M HILL	(757) 671-6280	nathaniel.price@ch2m.com	Work Plan changes in field/ QAPP Field Changes/ Field Progress Reports/ Field CAs	Coordinates all field activities and sampling. Documentation of deviations from the Work Plan will be made in the field logbook and the PM will be notified immediately. Deviations will be made only with approval from the PM. Documentation of field activities and work plan deviations (made with the approval of RSM and/or PM) in field logbooks; provide daily progress reports to PM. Field and analytical issues requiring CA will be determined by the FTL and/or PM on an as needed basis; the PM will ensure QAPP requirements are met by field staff for duration of project.		
Nate Price	Site Safety Coordinator (SSC)	CH2M HILL	(757) 671-6280	nathaniel.price@ch2m.com	Overseeing staff health and safety in the field	Responsible for daily safety tailgates, weekly observations, and real-time discussions of observations and changes to be implemented with field staff. Refines and implements the project APP in the field. The SSC is responsible for stopping any investigation-related operation that threatens the health and safety of the field team or surrounding populace.		
Anita Dodson	Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com	Release of Analytical Data	No analytical data can be released until validation of the data is completed and has been approved by the Program Chemist. The PC will review analytical results within 7 days of receipt for release to the project team. The PC will immediately notify the PM and Program Chemist of any data quality issues that might cause the project quality objectives to not be obtained. The PM and Program Chemist shall also be notified is there are significant delays by the laboratory that would cause significant project delivery issues.		
Bianca Kleist	Project Chemist (PC)	CH2M HILL	(704) 543-3274	bianca.kleist@ch2m.com	Field and analytical CAs; Data tracking from field collection to database upload	Any CAs for field and analytical issues will be determined by the FTL and/or the PC and reported to the PM within 4hrs; Data management. On a daily basis, tracks data from sample collection through database upload.		

TABLE 1

COMMUNICATION PATHWAY AND PROCEDURES, DISTRIBUTION LIST, AND PROJECT PERSONNEL SIGN-OFF SHEET

Name of Quality Assurance Project Plan (QAPP) Recipient	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Communication Drivers	Procedure, Pathway, etc	QAPP Section Reviewed	Date QAPP Read
Marcia Colon	Laboratory Project Manager	ENCO	(407) 826-5314	mcolon@encolabs.com	Reporting lab data quality issues	Manages sample tracking and maintains communication with PC. All QA/QC issues with project field samples will be reported within 2 days to the PC by the laboratory.		

TABLE 2-1

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: VOC
2nd Street

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Benzene	71-43-2	NA	7.3	7.3	3.67	0.0020	0.0010	0.0004	75	125	30
Bromomethane	74-83-9	NA	3.8	3.75	1.88	0.0020	0.0010	0.0003	30	160	30
Chloroform	67-66-3	NA	1.9	1.9	0.97	0.0020	0.0010	0.0004	70	125	30
Chloromethane	74-87-3	NA	24	24	12	0.0020	0.0010	0.0006	50	130	30
Dichlorodifluoromethane	75-71-8	29	19	19	9.5	0.0020	0.0010	0.0006	35	135	30
Ethylbenzene	100-41-4	NA	36	36	18	0.0020	0.0010	0.0006	75	125	30
Isopropylbenzene	98-82-8	NA	270	270	135	0.0020	0.0010	0.0005	75	130	30
m,p-Xylene	179601-23-1	NA	120	120	60	0.0040	0.0020	0.0010	80	125	30
o-Xylene	95-47-6	NA	140	140	70	0.0020	0.0010	0.0005	75	125	30
Styrene	100-42-5	NA	870	870	435	0.0020	0.0010	0.0004	75	125	30
Toluene	108-88-3	NA	820	820	410	0.0020	0.0010	0.0005	70	125	30
Trichlorofluoromethane	75-69-4	24	160	24	12	0.0020	0.0010	0.0005	25	185	30
Xylene, total	1330-20-7	NA	130	130	65	0.0040	0.0020	0.0010	NA	NA	NA

Notes:
[1] PALs were developed based on screening values to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.6.4 of the QAPP for a detailed discussion on development of PALs.
NC – No Criteria. If a constituent is detected that does not have applicable criteria, in accordance with the REC Program Implementation Guidance (NCDENR, 2012), NCDENR will be consulted to determine how the data should be evaluated.

TABLE 2-2

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: SVOC/PAH
2nd Street

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
2-Methylnaphthalene	91-57-6	NA	230	230	115	0.035	0.027	0.018	45	105	30
Acenaphthene	83-32-9	NA	680	680	340	0.035	0.027	0.015	45	110	30
Acenaphthylene	208-96-8	NA	340	340	170	0.035	0.027	0.018	45	105	30
Anthracene	120-12-7	NA	17,000	17000	8500	0.035	0.027	0.014	55	105	30
Benzo(a)anthracene	56-55-3	NA	1	1	0.50	0.035	0.027	0.014	50	110	30
Benzo(a)pyrene	50-32-8	NA	0.1	0.1	0.05	0.035	0.027	0.015	50	110	30
Benzo(b)fluoranthene	205-99-2	NA	1	1	0.50	0.035	0.027	0.017	45	115	30
Benzo(g,h,i)perylene	191-24-2	NA	340	340	170	0.035	0.027	0.015	40	125	30
Benzo(k)fluoranthene	207-08-9	NA	10	10	5	0.035	0.027	0.019	45	125	30
Chrysene	218-01-9	NA	100	100	50	0.035	0.027	0.012	55	110	30
Dibenzo(a,h) anthracene	53-70-3	NA	0.1	0.1	0.05	0.035	0.027	0.016	40	125	30
Fluoranthene	206-44-0	NA	460	460	230	0.035	0.027	0.017	55	115	30
Fluorene	86-73-7	NA	460	460	230	0.035	0.027	0.017	50	110	30
Indeno(1,2,3,-cd) pyrene	193-39-5	NA	1	1	0.50	0.035	0.027	0.015	40	125	30
Naphthalene	91-20-3	NA	24	24	12	0.035	0.027	0.018	40	105	30
Phenanthrene	85-01-8	NA	340	340	170	0.035	0.027	0.015	50	110	30
Pyrene	129-00-0	NA	340	340	170	0.035	0.027	0.016	45	125	30

Notes:
[1] PALs were developed in the Phase I Remedial Investigation report based on COPCs identified during that phase. During the Phase II Remedial Investigation (prior to implementation of this project) background
PAHs data will be collected. The COPCs will be reduced based on the new background data and the list of analytes will be reduced to remove chemicals that are no longer COPCs. .
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
NA – Not Applicable.

TABLE 2-3

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: PCB
2nd Street

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Aroclor-1254	11097-69-1	NC	1	1	0.5	0.040	0.020	0.015	29	185	30
Aroclor-1260	11096-82-5	NC	1	1	0.5	0.040	0.020	0.011	60	130	30

Notes:
[1] PALs were developed based on screening values to be protective of human health and the environment. If the site data indicate concentrations of pesticides at levels greater than screening values at site sample locations, additional collection of background data for these chemicals may be completed for the purpose of determining any widespread anthropogenic sources which may be unrelated to the areas. The PALs may be adjusted based on the results of the background data collection.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
Nevaluated – Not Applicable.

TABLE 2-4

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: Metal
2nd Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Antimony	7440-36-0	0.9	7.8	0.9	0.45	2.00	1.00	0.490	80	120	20
Arsenic	7440-38-2	5.8	4.7	4.7	2.35	2.00	1.00	0.280	80	120	20
Barium	7440-39-3	NA	3,000	3000	1500	0.500	0.250	0.0220	80	120	20
Cadmium	7440-43-9	NA	14	14	7	0.200	0.100	0.0180	80	120	20
Chromium	7440-47-3	NA	120,000	120000	60000	0.500	0.250	0.0360	80	120	20
Cobalt	7440-48-4	4.6	23	4.6	2.30	0.500	0.250	0.0350	80	120	20
Copper	7440-50-8	NA	1,550	1550	775	0.500	0.250	0.0790	80	120	20
Iron	7439-89-6	NA	27,500	27500	13750	5.00	2.50	1.70	80	120	20
Lead	7439-92-1	NA	400	400	200	2.00	1.00	0.110	80	120	20
Manganese	7439-96-5	412	1,800	412	206	1.00	0.500	0.0110	80	120	20
Mercury	7439-97-6	NA	23	23	11.50	0.0480	0.0240	0.00700	80	120	20
Nickel	7440-02-0	NA	750	750	375	0.500	0.250	0.0340	80	120	20
Silver	7440-22-4	NA	195	195	97.5	0.500	0.250	0.0920	80	120	20
Vanadium	7440-62-2	NA	78	78	39	1.00	0.500	0.0390	80	120	20
Zinc	7440-66-6	1,200	4,600	1200	600	1.00	0.500	0.210	80	120	20

Notes:
[1] PALs were developed in the Phase I Remedial Investigation Report.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
NA – Not Applicable.
Shading represents instances where the PAL is lower than the LOD. Non-detects will not be treated as exceedances though they will be reported at a value greater than the PAL.

TABLE 2-5

REFERNCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: VOC
5th Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
1,2,3-Trichlorobenzene	87-61-6	NA	10	9.8	4.90	0.0020	0.0010	0.0009	60	135	30
1,2,4-Trichlorobenzene	120-82-1	2.2	60	2.2	1.10	0.0020	0.0010	0.0008	65	130	30
1,3-Dichlorobenzene	541-73-1	2.4	NA	2.4	1.20	0.0020	0.0010	0.0005	70	125	30
1,4-Dichlorobenzene	106-46-7	0.07	13.3	0.07	0.04	0.0020	0.0010	0.0004	70	125	30
Benzene	71-43-2	0.01	8.5	0.0073	0.00	0.0020	0.0010	0.0004	75	125	30
Carbon disulfide	75-15-0	NA	800	800	400	0.010	0.0050	0.0021	45	160	30
Chlorobenzene	108-90-7	0.43	58	0.43	0.22	0.0020	0.0010	0.0005	75	125	30
Cyclohexane	110-82-7	NA	600	600	300	0.0020	0.0010	0.0005	70	130	30
Dichlorodifluoromethane	75-71-8	29	24	23.75	11.88	0.0020	0.0010	0.0006	35	135	30
Ethylbenzene	100-41-4	NA	30	30	15	0.0020	0.0010	0.0006	75	125	30
Isopropylbenzene	98-82-8	1.3	270	1.3	0.65	0.0020	0.0010	0.0005	75	130	30
m,p-Xylene	179601-23-1	NA	150	150	75	0.0040	0.0020	0.0010	80	125	30
Methyl acetate	79-20-9	NA	16,000	16000	8000	0.010	0.0050	0.0016	70	130	30
Methylene chloride	75-09-2	NA	70	70	35	0.010	0.0050	0.0007	58	123	30
Styrene	100-42-5	NA	870	870	435	0.0020	0.0010	0.0004	75	125	30
Toluene	108-88-3	5.5	820	5.5	2.75	0.0020	0.0010	0.0005	70	125	30

Notes:
[1] PALs were developed in the Phase I Remedial Investigation Report.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
NA – Not Applicable.

TABLE 2-6

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: SVOC/PAH
5th Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Acenaphthene	83-32-9	NA	1,133	1133	566.5	0.035	0.027	0.015	45	110	30
Acenaphthylene	208-96-8	NA	340	340	170	0.035	0.027	0.018	45	105	30
Anthracene	120-12-7	660	17,000	660	330	0.035	0.027	0.014	55	105	30
Benzo(a)anthracene	56-55-3	NA	1.2	1.15	0.58	0.035	0.027	0.014	50	110	30
Benzo(a)pyrene	50-32-8	NA	0.12	0.11	0.058	0.035	0.027	0.015	50	110	30
Benzo(b)fluoranthene	205-99-2	NA	1.2	1.15	0.58	0.035	0.027	0.017	45	115	30
Benzo(g,h,i)perylene	191-24-2	NA	340	340	170	0.035	0.027	0.015	40	125	30
Benzo(k)fluoranthene	207-08-9	NA	11.5	11.5	5.75	0.035	0.027	0.019	45	125	30
Carbazole	86-74-8	NA	187	186	93	0.33	0.10	0.068	45	115	30
Chrysene	218-01-9	NA	115	115	57.5	0.035	0.027	0.012	55	110	30
Dibenzo(a,h)anthracene	53-70-3	NA	0.12	0.11	0.058	0.035	0.027	0.016	40	125	30
Dibenzofuran	132-64-9	NA	80	80	40	0.33	0.10	0.066	50	105	30
Fluoranthene	206-44-0	NA	460	460	230	0.035	0.027	0.017	55	115	30
Fluorene	86-73-7	56	460	56	28	0.035	0.027	0.017	50	110	30
Indeno(1,2,3,-cd) pyrene	193-39-5	NA	1.15	1.15	0.58	0.035	0.027	0.015	40	125	30
Phenanthrene	85-01-8	NA	340	340	170	0.035	0.027	0.015	50	110	30
Pyrene	129-00-0	NA	340	340	170	0.035	0.027	0.016	45	125	30

Notes:
[1] PALs were developed based on screening values to be protective of human health and the environment. In instances where no criteria are available, the PAL is defaulted to the LOD of the contracted laboratory.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.6.4 of the QAPP for a detailed discussion on development of PALs.
NC – No Criteria. If a constituent is detected that does not have applicable criteria, in accordance with the REC Program Implementation Guidance (NCDENR, 2012), NCDENR will be consulted to determine how the data should be evaluated.

TABLE 2-7

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: Pesticide
5th Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
4,4'-DDD	72-54-8	NA	11	11	5.5	0.0017	0.0017	0.00048	30	135	30

Notes:
[1] PALs were developed in the Phase I Remedial Investigation Report.[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
N A – Not Applicable.

TABLE 2-8

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: PCB
5th Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Aroclor-1254	11097-69-1	NA	1	1	0.5	0.040	0.020	0.015	29	185	30
Aroclor-1260	11096-82-5	NA	1	1	0.5	0.040	0.020	0.011	60	130	30

Notes:
[1] PALs were developed in the Phase I Remedial Investigation Report.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
N A – Not Applicable.

TABLE 2-9

REFERENCE LIMITS AND EVALUATION TABLE

Matrix: Soil
Analytical Group: Metal
5th Street Disposal Area

Analyte	CAS #	Protection of Groundwater Soil Remediation Goal (MG/KG)	Adjusted Residential Health-based Soil Remediation Goal (MG/KG)	Project Action Limit[1] (MG/KG)	Project Quantitation Limit Goal[2] (MG/KG)	Laboratory-Specific (MG/KG)			LCS, %R Limits		
						LOQ	LOD	DL	LCL	UCL	RPD
Antimony	7440-36-0	NA	6.20	6.2	3.10	2.00	1.00	0.490	80	120	20
Arsenic	7440-38-2	5.8	4.7	4.7	2.35	2.00	1.00	0.280	80	120	20
Barium	7440-39-3	580	3,000	580	290	0.500	0.250	0.0220	80	120	20
Cadmium	7440-43-9	NA	14	14	7	0.200	0.100	0.0180	80	120	20
Chromium	7440-47-3	360,000	120,000	120000	60000	0.500	0.250	0.0360	80	120	20
Cobalt	7440-48-4	4.6	12	4.6	2.3	0.500	0.250	0.0350	80	120	20
Iron	7439-89-6	150	55,000	150	75	5.00	2.50	1.70	80	120	20
Lead	7439-92-1	270	400	270	135	2.00	1.00	0.110	80	120	20
Mercury	7439-97-6	NA	23	23	11.5	0.0480	0.0240	0.00700	80	120	20
Nickel	7440-02-0	130	375	130	65	0.500	0.250	0.0340	80	120	20
Silver	7440-22-4	NA	195	195	97.5	0.500	0.250	0.0920	80	120	20
Zinc	7440-66-6	1,200	4,600	1200	600	1.00	0.500	0.210	80	120	20

[1] PALs were developed in the Phase I Remedial Investigation Report.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Refer Section 1.5.4 of the QAPP for a detailed discussion on development of PALs.
N A – Not Applicable.

TABLE 3
SAMPLE ANALYSIS SUMMARY TABLE

Sample Location	Sample ID	VOC	SVOC/PAH	Pesticide	PCB	Metal	Mercury
2nd Street Disposal Area Soil Samples – Wall Samples							
TR-2ND	TR-2ND-CSW01-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW02-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW02D-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW03-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW04-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW05-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW05-MMYY-MS	X	X		X	X	X
TR-2ND	TR-2ND-CSW05-MMYY-SD	X	X		X	X	X
TR-2ND	TR-2ND-CSW06-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW07-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW08-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSW09-MMYY	X	X		X	X	X
2nd Street Disposal Area Soil Samples – Floor Samples							
TR-2ND	TR-2ND-CSF01-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF02-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF03-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF03D-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF04-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF05-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF06-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF07-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF08-MMYY	X	X		X	X	X
TR-2ND	TR-2ND-CSF08-MMYY-MS	X	X		X	X	X
TR-2ND	TR-2ND-CSF08-MMYY-SD	X	X		X	X	X
TR-2ND	TR-2ND-CSF09-MMYY	X	X		X	X	X
5th Street Disposal Area Soil Samples – Wall Samples							
TR-5TH	TR-5TH-CSW01-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW02-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW03-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW04-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW05-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW06-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW07-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW07D-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW08-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW09-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW10-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW10-MMYY-MS	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW10-MMYY-SD	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW11-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW11D-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW12-MMYY	X	X	X	X	X	X
5th Street Disposal Area Soil Samples – Floor Samples							
TR-5TH	TR-5TH-CSF01-MMYY	X	X	X	X	X	X

TABLE 3
SAMPLE ANALYSIS SUMMARY TABLE

Sample Location	Sample ID	VOC	SVOC/PAH	Pesticide	PCB	Metal	Mercury
TR-5TH	TR-5TH-CSF02-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF03-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF04-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF05-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF05D-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF06-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF07-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF08-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF09-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF10-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF11-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF12-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF12D-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF13-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF14-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF15-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF15-MMYY-MS	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF15-MMYY-SD	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF16-MMYY	X	X	X	X	X	X
5th Street Disposal Area Contingency Soil Samples							
TR-5TH	TR-5TH-CSW13-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW14-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW15-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSW16-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF17-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF18-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF19-MMYY	X	X	X	X	X	X
TR-5TH	TR-5TH-CSF20-MMYY	X	X	X	X	X	X
QA/QC Samples (Aqueous Blanks)							
TR-2ND	TR2-CSW-EB-MMDDYY	X	X		X	X	X
TR-2ND	TR2-CSF-EB-MMDDYY	X	X		X	X	X
TR-5TH	TR5-CSW-EB-MMDDYY	X	X	X	X	X	X
TR-5TH	TR5-CSF-EB-MMDDYY	X	X	X	X	X	X
TB	TB01-MMDDYY	X					
TB	TB02-MMDDYY	X					
TB	TB03-MMDDYY	X					

Notes:
TR – Towers Road
CSW = Confirmation Samples – Wall
CSF = Confirmation Samples - Floor
QA/QC counts are dependent on the total number of samples collected and therefore will be adjusted as the number of sampling locations is adjusted.
QA/QC sample IDs include additional identifiers; D = Duplicate; EB = Equipment Blank; TB = Trip Blank
General QA/QC approach: duplicates (1 per 10 samples per media), trip blanks (1 per VOA shipment), and equipment blanks (1 per equipment lot, assuming 1 lot of trowels and 1 lot of tubing).
Analyte lists are site-specific

TABLE 4-1

FIELD QC SAMPLES

Matrix: Soil
Analytical Group: VOC

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	VOC	One per 10 samples per matrix	Precision	Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinsate Blank		One per equipment lot	Accuracy / Bias (contamination)	No analyte detected > ½ LOQ	S
Trip Blank		One per cooler containing VOCs	Accuracy / Bias (contamination)	No target analytes > ½ LOQ	S & A
Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	2 to 6°C	S

TABLE 4-2

FIELD QC SAMPLES

Matrix: Soil
Analytical Group: SVOC/PAH

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	SVOC/PAH	One per 10 samples per matrix	Precision	RPD ≤30%	S & A
Equipment Rinsate Blank		One per equipment lot	Accuracy / Bias (contamination)	No analyte detected > ½ LOQ	S
Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	2 to 6°C	S

TABLE 4-3

FIELD QC SAMPLES

Matrix: Soil
Analytical Group: Pesticide

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Pesticide	One per 10 samples per matrix	Precision	RPD ≤30%	S & A
Equipment Rinsate Blank		One per equipment lot	Accuracy / Bias (contamination)	No analyte detected > ½ LOQ	S
Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	2 to 6°C	S

TABLE 4-4

FIELD QC SAMPLES

Matrix: Soil
Analytical Group: PCB

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	PCB	One per 10 samples per matrix	Precision	RPD ≤30%	S & A
Equipment Rinsate Blank		One per equipment lot	Accuracy / Bias (contamination)	No analyte detected > ½ LOQ	S
Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	2 to 6°C	S

TABLE 4-5

FIELD QC SAMPLES

Matrix: Soil
Analytical Group: Metal

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Metal	One per 10 samples per matrix	Precision	RPD ≤30%	S & A
Equipment Rinsate Blank		One per equipment lot	Accuracy / Bias (contamination)	No analyte detected > ½ LOQ	S
Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	2 to 6°C	S

TABLE 5
ANALYTICAL SOP REFERENCE TABLE

Lab SOP Number	Title, Revision Date, and Number	Date reviewed if not revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work?
LOGINS-03	Receiving Samples (Rev. 11, Effective 07/31/2012)	06/11/2013	NA	NA	NA	ENCO	NA	No
ADMIN-14	Waste Disposal and Characterization (Rev. 6, 09/16/2011)	05/30/2013	NA	NA	NA	ENCO	NA	No
MET-05	Metals Analysis by ICP-AES (Rev. 12, 12/20/2013)	NA	Definitive	Soil, Metals	ICP	ENCO	Y - ENCO does not perform MSA	No
Met-15	Metals Analysis by ICP-MS (Rev. 6, 08/01/2013)	NA	Definitive	Soil, Metals	ICP-MS	ENCO	Y - ENCO does not perform MSA	No
MET-16	Mercury in Soils By Digestion/CVAA (Rev. 5, 03/12/2012)	03/14/2013	Definitive	Soil, Metals	CVAA	ENCO	Y - ENCO does not perform MSA	No
EXMT-09	Acid Digestion of Soil and Waste Samples for Analysis by ICP and (Rev. 7, 08/03/2012) ICP-MS	06/03/2013	NA	Soil Extraction, Metals	NA	ENCO	None	No
VGCMS-05	Analysis of Volatile Organic Compounds by GC/MS (Rev. 17, 08/26/2011)	07/08/2013	Definitive	Soil, Volatile Organics	GCMS	ENCO	None	No
SVGCMS-03	Semivolatile Organic Compounds by GC/MS (Rev. 17, 08/15/2011)	03/11/2013	Definitive	Soil, Semivolatile Organics	GCMS	ENCO	See footnote[1]	No
SVGC-04	Organochlorine Pesticides by GC/ECD (Rev. 10, 09/21/2011)	02/01/13	Definitive	Soil, Pesticides	GC	ENCO	See footnote[2]	No
SVCG-07	Polychlorinated Biphenyls by GC/ECD (Rev.5, 03/22/2012)	02/25/2013	Definitive	Soil, PCB	GC	ENCO	See footnote[3]	No
EXSV-16	Extraction of Soil/Solid Samples Using Sonication (Rev. 8, 08/16/2013)	NA	NA	Soil Extraction, Semivolatiles	NA	ENCO	None	No
EXSV-27	Extraction of Samples Using Separatory Funnel Techniques (Rev. 5, 09/15/2011)	08/17/2013	NA	Aqueous Extraction, Semivolatiles	NA	ENCO	None	No

Notes:

[1] ENCO routinely utilizes SW846 8270D criteria allowing 20% RSD for calibration. ENCO will utilize in-house limits for Benzaldehyde, Caprolactam, 1,1-biphenyl, and Atrazine (these analytes readily breakdown in multi-component spike mixes).

[2] ENCO will utilize SW846 Method 8000 internal standard procedures for performing Method 8081B. A 12 hour clock opening with Continuing Calibration Verficiation (CCV) and Performance Evaluation Mixture will be utilized.

[2] Toxaphene and Chlordane are not included in LCS/Matrix Spikes/CCVs. All chromatograms are examined for the presence of Toxaphene and Chlordane. In the event Toxaphene or Chlordane are identified, the sample extracts are re-analyzed with Toxaphene/Chlordane-specific calibrations.

[3] ENCO will spike QC samples with Aroclors 1016 & 1260

TABLE 6

ANALYTICAL SOP REQUIREMENTS TABLE

Matrix	Analytical Group	Prep Method/Analytical Method / SOP Reference	Containers	Minimum Sample Amount Required for Analysis	Preservation Requirements	Maximum Holding Time
Soil	VOC	SW846 8260B / VGCMS-05	3 x 40mL VOA Vials + stir bar (tared)	5g	Store in 5mL water (2 vials), store in methanol (1 vial),	48 hours to freeze (for water-preserved only) / 14 day to analysis
	SVOC/PAH	EXSV-16/SW846 8270D and 8270D-SIM/ SVGCMS-03	4 x 4 oz Glass Jar	40g	Cool to <6°C	14 days/40 days
	Pesticide	SW846 8081B / SVGC-04		40g		14 days/40 days
	PCB	SW846 8082A / SVGC-07				14 days/40 days
	Metal	EXMT-09/SW846 6010C / MET-15		10g		180 days
	Mercury	SW846 7471A / MET-16		10g		28 days
Aqueous (Blanks)	VOC	SW846 8260B/VGCMS-05	3 x 40mL Vials, Glass	3 X 40mL (no headspace)	HCl to pH<2, Cool to <6°C	14 days
	SVOC/PAH	EXSV-27/SW846 8270D and 8270D-SIM/ SVGCMS-03	1 x 1 Liter, Amber Glass	500 mL	Cool to <6°C	7 days/40 days
	Pesticide	SW846 8081B and SW846 8082A/SVGC-04 and SVGC-07	2 x 1 Liter, Amber Glass	1000mL		
	PCB					
	Metal	SW846 6020A / MET-05	1 x 250mL Plastic	100mL	HNO3 to pH<2 Cool to <6°C	180 days
	Mercury	SW846 7470B / MET-03				28 days

TABLE 7

ANALYTICAL SERVICES TABLE

Matrix	Analytical Group	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory/ Organization
Soil, Aqueous (blanks)	VOC	SW846 8270D/8270D-SIM	14 calendar days	ENCO 10775 Central Port Drive Orlando, FL 32824 (407) 826-5314	TBD
	SVOC/PAH	SW846 8081B			
	Pesticide	SW846 8082A			
	PCB	SW846 8260B			
	Metal	SW846 6020A		ENCO 4810 Executive Park Court, Suite 111 Jacksonville, FL 32824 (904) 296-3007	
	Mercury	SW846 7470			

TABLE 8

DATA PACKAGE DELIVERABLES

All Analytical Fractions			
Case Narrative – A detailed case narrative per analytical fraction is required and will include explanation of any non-compliance and/or exceptions and CA. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.			•
Sample Identification (ID) Cross Reference Sheet (Lab IDs and Client IDs)			•
Completed COC and any sample receipt information			•
Sample preparation (extraction/digestion) logs			•
Copies of non-conformance memos and CAs			•
Form	**GC/GCMS Organic Fractions**	**Level II**	**Level IV**
1	Sample results	•	• + raw
2	Surrogate Recovery Summary (with applicable control limits)	•	•
3	Precision Summary	•	• + raw
3	LCS Accuracy Summary	•	• + raw
4	Method Blank Summary	•	• + raw
6	Initial Calibration Summary (including concentration levels of standards)		• + raw
7	Continuing Calibration Summary		• + raw
8	Degradation Summary (Organochlorine Pesticides only)		• + raw
9	Internal Standard Summary (VOA and SVOA/PAH only)		• + raw
10	Analytical Sequence (including internal standard area performance where applicable)		•
11	Compound Identification Summary (where confirmation required)		•
Form	**Inorganic Fractions**	**Level II**	**Level IV**
1	Sample Results	•	• + raw
2A	Initial and Continuing Calibration Summary		• + raw
3	Initial and Continuing Calibration Blanks and Method Blanks Summary	•	• + raw
4	Interference Check Standard Summary		• + raw
5A	Pre-digestion Matrix Spike Recoveries Summary	•	• + raw
5B	Post-digestion Spike Recoveries Summary		• + raw
6	Native Duplicate	•	• + raw
7	LCS Recovery Summary	•	• + raw
8	Method of Standard Addition (if necessary)		• + raw
9	Serial Dilution		• + raw
10	Instrument or Method Detection Limit Summary		•
11	ICP Interelement Correction Factors		•
12	Linear Range Summary		•
13	Preparation Log Summary		• + raw
14	Analytical Run Sequence and GFAA Post-spike Recovery Summary		• + raw

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TABLE 9-1

Laboratory QC Samples Table

Matrix: Soil
Analytical Group: VOC
Analytical Method/SOP Reference: SW846 8260B / VGCMS-05

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ.	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ.
LCS		Refer to Table 6-11	LCS is reanalyzed. If still fails, samples along with QC, are re-prepped and re-analyzed. Client will be contacted for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Refer to Table 6-11
IS	Spiked in Every Sample	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.
Surrogate Spikes		Dibromofluoromethane 74-133%, Toluene-d_8 85-115%, 1,2-Dichloroethane-d4 59-133%, 4-Bromofluorobenzene 85-120%	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Dibromofluoromethane 74-133%, Toluene-d_8 85-115%, 1,2-Dichloroethane-d4 59-133%, 4-Bromofluorobenzene 85-120%

DoD-QSM v 4.2 is the basis for this table.

TABLE 9-2

LABORATORY QC SAMPLES TABLE

Matrix: Soil
Analytical Group: SVOC/PAH
Analytical Method/SOP Reference: SW846 8270D & 8270D-SIM / SVGCMS-03

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ	Correct problem, then see criteria in Box D-1of the DOD QSM. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ
LCS		Refer to Table 6-12	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.		Precision and Accuracy/Bias	Refer to Table 6-12
Surrogate Spike	Spiked in every sample.	2-Fluorobiphenyl 45-105%, Terphenyl-d14 30-125%, Nitrobenzene-d5 35-100%, 2-Fluorophenol 35-105%, Phenol-d5 40-100%, 2,4,6-Tribromophenol 35-125%	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	2-Fluorobiphenyl 45-105%, Terphenyl-d14 30-125%, Nitrobenzene-d5 35-100%, 2-Fluorophenol 35-105%, Phenol-d5 40-100%, 2,4,6-Tribromophenol 35-125%
IS	Spiked in every sample.	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory re-analysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.

DoD-QSM v 4.2 is the basis for this table.

TABLE 9-3

LABORATORY QC SAMPLES TABLE

Matrix: Soil
Analytical Group: Pesticide
Analytical Method/SOP Reference: SW846 8081B / SVGC-04

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ Contamination	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).
LCS		Refer to Table 6-13	Correct problem, then re-prep and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	Refer to Table 6-13
Surrogate Spikes	Spiked in every sample.	Decachlorobiphenyl 30-135%	For QC and field samples, correct problem then re-prep and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	Decachlorobiphenyl 30-135%

DoD-QSM v 4.2 is the basis for this table.

TABLE 9-4

LABORATORY QC SAMPLES TABLE

Matrix: Soil
Analytical Group: PCB
Analytical Method/SOP Reference: SW846 8082A / SVGC-07

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ Contamination	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).
LCS		Refer to Table 6-14	Correct problem, then re-prep and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	Refer to Table 6-14
Surrogate Spikes	Spiked in every sample.	Decachlorobiphenyl 60-125%, *2,4,5,6-TCMX 20-137%*.	For QC and field samples, correct problem then re-prep and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	Decachlorobiphenyl 40-135%, *2,4,5,6-TCMX 38-142%*.[1]

DoD-QSM v 4.2 is the basis for this table.

TABLE 9-5

LABORATORY QC SAMPLES TABLE

Matrix: Soil
Analytical Group: Metal (excluding Mercury)
Analytical Method/SOP Reference: SW846 6010C / MET-15

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst	Bias/ Contamination	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.
LCS		Refer to Table 6-15	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch.		Precision and Accuracy/Bias	Refer to Table 6-15
Dilution Test		Recovery within ±10% of true value.	Perform Post Spike		Precision and Accuracy/Bias	Recovery within ±10% of true value.
Post Spike	One is performed when dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ± 25% of true value.	If dilution test recoveries are outside of QC acceptance limits but post spike meets QC acceptance criteria, and matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	Recovery within ± 25% of true value.

DoD-QSM v 4.2 is the basis for this table.

TABLE 9-6

LABORATORY QC SAMPLES TABLE

Matrix: Soil
Analytical Group: Mercury
Analytical Method/SOP Reference: SW846 7471A / MET-16

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; re-prep and re-analyze all samples processed with contaminated blank.	Analyst	Bias/Contamination	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.
LCS		Refer to Table 6-15	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch.		Precision and Accuracy/Bias	Refer to Table 6-15

DoD-QSM v 4.2 is the basis for this table.

TABLE 10

ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS (VOC)	Clean sources, maintain vacuum pumps.	Tuning	Instrument performance and sensitivity.	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst	VGCMS-05
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, re-analyze CCV, and re-calibrate instrument.		
GC/MS (SVOC/PAH)	Clean sources, maintain vacuum pumps.	Tuning	Instrument performance and sensitivity.	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst	SVGCMS-03
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, re-analyze CCV, and re-calibrate instrument.		
GC-ECD (Pesticide)	Injection port maintenance.	Degredation check run every 12 hrs	DDT and Endrin breakdown <15%.	Beginning of each 12 hour 8081B sequence.	DDT and Endrin breakdown <15%.	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port and repeat degredation check.	Analyst	SVGC-04
GC-ECD (PCB)	Injection port maintenance.	NA.	Evaluate baseline and peak shapes.	As needed.	Analyst judgment of excessive tailing or baseline fluctuation.	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port		SVGC-07
ICP-MS (Metal)	Clean, inspect, change cones	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Re-calibrate	Analyst	MET-15
	Clean, inspect, change spray chamber, injector, torch							
	Replace pump windings					Replace windings, re-calibrate and re-analyze		
CVAA (Mercury)	Replace disposables, flush lines	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	MET -03 and MET-16
	Clean lens				Method Blank pass criteria			
	Replace pump tubing	Flow Rate Check		As needed	Monitor flow rate for variation	Replace windings, recalibrate and re-analyze		

TABLE 11
ANALYTICAL INSTRUMENT CALIBRATION TABLE

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC-MS (VOC)	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Analyst	VGCMS-05
	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: VOCs ≥0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; VOCs ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. RSD for RFs for CCCs: VOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression coefficient of determination (COD) r2 ≥ 0.990 (6 points shall be used for second order; 7 points shall be used for third order).	Correct problem then repeat ICAL.		
	Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Retention time window position establishment for each analyte and surrogate.	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.		
	Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. %Difference/Drift for all target compounds and surrogates: VOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
GC-MS (SVOC/PAH)	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Analyst	SVGCMS-03
	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: SVOCs≥ 0.050. 2. RSD for RFs for CCCs: SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995; Option 3: non-linear regression coefficient of determination (COD) r2 ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.		
	Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Retention time window position establishment for each analyte and surrogate.	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.		
	Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: SVOCs ≥ 0.050. 2. %Difference/Drift for all target compounds and surrogates: SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
GC/ECD (Pesticide)	Breakdown Check	At the beginning of each 12 hour sequence, prior to analysis of samples.	Degradation ≤15% for both DDT and Endrin.	Correct the problem, repeat breakdown check.	Analyst	SVGC-04
	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the following options: Option 1: RSD for each analyte ≤20% Option 2: Linear regression fit, r≥0.995.	Correct the problem, repeat ICAL.		
	Retention time window position establishment	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Second Source Calibration Verification (SCV)	Immediately following the ICAL.	Within 80-120% of true value.	Correct the problem: rerun SCV. If that fails, repeat ICAL.		
	Continuing Calibration Verification (CCV)	At the beginning of every 12-hour sequence, after the pesticide breakdown check.	Within 80-120% of true value.	Correct the problem, then rerun CCV. If that fails, repeat ICAL. Re-analyze all samples since the last successful calibration verification.		

TABLE 11
ANALYTICAL INSTRUMENT CALIBRATION TABLE

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/ECD (PCB)	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the following options: Option 1: RSD for each analyte ≤20% Option 2: Linear regression fit, r≥0.995.	Correct the problem, repeat ICAL.	Analyst	SVGC-07
	Retention time window position establishment	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Second Source Calibration Verification (SCV)	Immediately following the ICAL.	Within 80-120% of true value.	Correct the problem, rerun SCV. If that fails, repeat ICAL.		
	Continuing Calibration Verification (CCV)	Prior to any samples in sequences that do not include ICAL, after every 10th sample, and at the end of the sequence.	Within 80-120% of true value.	Correct the problem, then rerun CCV. If that fails, repeat ICAL. Re-analyze all samples since the last successful calibration verification.		
ICP-MS (Metal)	Tuning	Prior to ICAL.	Mass calibration ≤ 0.1 amu from the true value; resolution < 0.9 amu full width at 10% peak height; For stability, RSD≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst	MET-15
	ICAL for all analytes (minimum 2 point calibration)	Daily ICAL prior to sample analysis.	More than one calibration standard is used, R≥ 0.995.	Correct problem, then repeat ICAL.		
	Second source calibration verification	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes within ± 10% of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.		
CVAA (Mercury)	ICAL - minimum 5 standards and a calibration blank	Initial calibration daily prior to sample analysis.	Correlation coefficient >0.995; accepted if the second-source calibration verification passes.	Correct problem, then repeat initial calibration.	Analyst	MET-16
	Second-source Calibration Verification	Once per initial calibration, prior to beginning a sample run.	Less than 10% difference from expected concentration for all target analytes.	Correct problem, then repeat. If still fails, repeat initial calibration.		
	CCV	Following SCV, after every 10 samples and the end of the sequence.	Within +/- 20% of true value.	Correct problem, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.		
	Calibration blank	Daily after initial calibration and every ten samples.	No analytes detected > LOD.	Correct problem, re-prep and reanalyze calibration blank. Re-analyze all samples following the last acceptable calibration blank.		

TABLE 12

FIELD PERFORMANCE AUDIT CHECKLIST

Project Responsibilities

Project No.: _____ Date: _____

Project Location: HPDTA _____ Signature: _____

Team Members: _____

_____

Yes No 1) Is the approved work plan being followed?

Comments _____

_____

Yes No 2) Was a briefing held for project participants?

Comments _____

_____

Yes No 3) Were additional instructions given to project participants?

Comments _____

_____

Sample Collection

Yes No 1) Is there a written list of sampling locations and descriptions?

Comments _____

_____

Yes No 2) Are samples collected as stated in the Master SOPs?

Comments _____

_____

Yes No 3) Are samples collected in the type of containers specified in the work plan?

Comments _____

_____

Yes No 4) Are samples preserved as specified in the work plan?

Comments _____

_____

Yes No 5) Are the number, frequency, and type of samples collected as specified in the work plan?

Comments _____

_____

Yes No 6) Are quality assurance checks performed as specified in the work plan?

Comments _____

_____

Yes No 7) Are photographs taken and documented?

Comments _____

_____

Document Control

Yes No 1) Have any accountable documents been lost?

Comments _____

_____

Yes No 2) Have any accountable documents been voided?

Comments _____

_____

Yes No 3) Have any accountable documents been disposed of?

Comments _____

_____

Yes No 4) Are the samples identified with sample tags?

Comments _____

_____

Yes No 5) Are blank and duplicate samples properly identified?

Comments _____

_____

Yes No 6) Are samples listed on a chain-of-custody record?

Comments _____

_____

Yes No 7) Is chain-of-custody documented and maintained?

Comments _____

_____

TABLE 13

PROJECT DOCUMENTS AND RECORDS

Document	Where Maintained
Field Notebooks	Electronic .pdf copies in the project file. Hardcopy (bound notebook) in the project file.
Chain-of-Custody Records	Electronic .pdf copies in the project file. Hardcopy in the project file.
Air Bills	Hardcopy in the project file.
Telephone Logs	Hardcopy in the project file.
Corrective Action Forms	Electronic .pdf copies in the project file. Hardcopy in the project file.
PID/FID readings	Recorded in Field Notebook.
Water quality parameters collected during sediment sampling	Recorded in Field Notebook.
OVM/OVA readings	Recorded in Field Notebook.
Various field measurements	Recorded in Field Notebook.
All equipment calibration information	Recorded in Field Notebook.
Pertinent telephone conversations	Recorded in Field Notebook.
Equipment maintenance records	Inspected by Field Team Leader. Not maintained.
Sample Receipt, Custody, and Tracking Records	Electronic .pdf copies in the project file. Hardcopy in the full data package.
Standard Traceability Logs	Hardcopy in the full data package.
Equipment Calibration Logs	Hardcopy in the full data package.
Sample Prep Logs	Hardcopy in the full data package.
Run Logs	Hardcopy in the full data package.
Equipment Maintenance, Testing, and Inspection Logs	Hardcopy in the full data package.
Reported Field Sample Results	Electronic .pdf copies in the project file. Hardcopy in the data package.
Reported Results for Standards, QC Checks, and QC Samples	Hardcopy in the full data package.
Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples	Hardcopy in the full data package.
Data Package Completeness Checklists	Hardcopy in the data validation report.
Sample Disposal Records	Maintained by the laboratory.
Extraction/Clean-up Records	Maintained by the laboratory.
Raw Data	Hardcopy in the full data package.
Field Sampling Audit Checklists	Hardcopy in the project file.
Fixed Laboratory Audit Checklists	If completed, hardcopy in the project file

Note:
All project documents and records, original and copies, shall be surrendered to the hpdta environmental manager upon completion of the project.

Attachment II
DoD ELAP Accreditation Letters – Analytical Laboratory

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
10775 Central Port Drive
Orlando, FL 32824
Russell Macomber Phone: 407 826 5314
rmacomber@encolabs.com

ENVIRONMENTAL

Valid To: March 31, 2014 Certificate Number: 3000.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals	EPA 6020A/200.8	EPA 6020A
Aluminum	EPA 6020A/200.8	EPA 6020A
Antimony	EPA 6020A/200.8	EPA 6020A
Arsenic	EPA 6020A/200.8	EPA 6020A
Barium	EPA 6020A/200.8	EPA 6020A
Beryllium	EPA 6020A/200.8	EPA 6020A
Cadmium	EPA 6020A/200.8	EPA 6020A
Calcium	EPA 6020A/200.8	EPA 6020A
Chromium	EPA 6020A/200.8	EPA 6020A
Cobalt	EPA 6020A/200.8	EPA 6020A
Copper	EPA 6020A/200.8	EPA 6020A
Hardness	SM 2340 B	----------
Iron	EPA 6020A/200.8	EPA 6020A
Lead	EPA 6020A/200.8	EPA 6020A
Magnesium	EPA 6020A/200.8	EPA 6020A
Manganese	EPA 6020A/200.8	EPA 6020A
Mercury	EPA 245.1/7470A	EPA 7471B
Molybdenum	EPA 6020A/200.8	EPA 6020A
Nickel	EPA 6020A/200.8	EPA 6020A
Potassium	EPA 6020A/200.8	EPA 6020A
Selenium	EPA 6020A/200.8	EPA 6020A
Silver	EPA 6020A/200.8	EPA 6020A
Sodium	EPA 6020A/200.8	EPA 6020A
Thallium	EPA 6020A/200.8	EPA 6020A
Tin	EPA 6020A/200.8	EPA 6020A
Titanium	EPA 6020A/200.8	EPA 6020A
Vanadium	EPA 6020A/200.8	EPA 6020A

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B	----------
Fecal Coliforms	SM 9222D	----------
General Chemistry		
Acidity, as $CaC0_3$	EPA 305.1/SM 2310 B (4A)	----------
Alkalinity as $CaC0_3$	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as $CaC0_3$	EPA 310.2	EPA 310.2
Biochemical oxygen demand	EPA 405.1/SM 5210 B	----------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	----------
Chemical oxygen demand	EPA 410.4	----------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	----------
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Cyanide, Reactive	----------	SW-846 7.3.3
Ferric iron (calculated)	SM 3500-Fe D	----------
Ferrous iron	SM 3500-Fe D	----------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	----------
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO_2 B	EPA 9056A/ SM 4500-NO_2 B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	----------
Orthophosphate as P	EPA 365.3	----------
pH	EPA 150.1/9040C/SM 4500-H^+-B	EPA 9045D
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	----------
Residue-nonfilterable (TSS)	SM 2540 D	----------
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	EPA 9030B/9034
Sulfide, Reactive	----------	SW-846 7.3.4
Surfactants -MBAS	SM 5540 C	----------
Total nitrate-nitrite	EPA 9056 A/SM 4500-$N0_3$ H	EPA 9056 A/SM 4500-$N0_3$ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	----------
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
Extractable Organics		
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Diphenylhydrazine	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1- Methylnaphthalene	EPA 8270D/625/ Scan-Sim	EPA 8270D/ Scan-Sim
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/ Scan-Sim	EPA 8270D
2,6-Dichlorophenon	EPA 8270D/625	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Acenaphthylene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(a)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(b)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(g,h,i)perylene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(k)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzyl alcohol	EPA 8270D/625	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270D/625	EPA 8270D
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Fluorene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
n-Nitrosopyrrolidine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Pyridine	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
Volatile Organics		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,3-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,3-Dichloropropane	EPA 8260B/624	EPA 8260B
1,4-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,4-Dioxane (1,4-Diethylencoxide)	EPA 8260B/8260C SIM/624	EPA 8260B/8260C SIM
2,2-Dichloropropane	EPA 8260B/624	EPA 8260B
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B/624	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B/624	EPA 8260B
2-Chlorotoluene	EPA 8260B/624	EPA 8260B
2-Hexanone	EPA 8260B/624	EPA 8260B
4-Chlorotoluene	EPA 8260B/624	EPA 8260B
4-Methyl-2-pentanone (MIBK)	EPA 8260B/624	EPA 8260B
Acetone	EPA 8260B/624	EPA 8260B
Acetonitrile	EPA 8260B/624	EPA 8260B
Acrolein (Propenal)	EPA 8260B/624	EPA 8260B
Acrylonitrile	EPA 8260B/624	EPA 8260B
Allyl chloride (3-Chloropropene)	EPA 8260B/624	EPA 8260B
Benzene	EPA 8260B/624	EPA 8260B
Bromobenzene	EPA 8260B/624	EPA 8260B
Bromochloromethane	EPA 8260B/624	EPA 8260B
Bromodichloromethane	EPA 8260B/624	EPA 8260B
Bromoform	EPA 8260B/624	EPA 8260B
Carbon tetrachloride	EPA 8260B/624	EPA 8260B
Carbon disulfide	EPA 8260B/624	EPA 8260B
Chlorobenzene	EPA 8260B/624	EPA 8260B
Chloroethane	EPA 8260B/624	EPA 8260B
Chloroform	EPA 8260B/624	EPA 8260B
Chloroprene	EPA 8260B/624	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
Cyclohexane	EPA 8260B/624	EPA 8260B
Dibromochloromethane	EPA 8260B/624	EPA 8260B
Dibromomethane	EPA 8260B/624	EPA 8260B
Dichlorodifluoromethane	EPA 8260B/624	EPA 8260B
Ethyl methacrylate	EPA 8260B/624	EPA 8260B
Hexachlorobutadiene	EPA 8260B/624	EPA 8260B
Ethylbenzene	EPA 8260B/624	EPA 8260B
Iodomethane (Methyl iodide)	EPA 8260B/624	EPA 8260B
Isobutyl alcohol (2-Methyl-l-propanol)	EPA 8260B/624	EPA 8260B
Isopropylbenzene	EPA 8260B/624	EPA 8260B
m+p-Xylenes	EPA 8260B/624	EPA 8260B
Methacrylonitrile	EPA 8260B/624	EPA 8260B
Methyl acetate	EPA 8260B/624	EPA 8260B
Methyl bromide (Bromomethane)	EPA 8260B/624	EPA 8260B
Methyl chloride (Chloromethane)	EPA 8260B/624	EPA 8260B
Methyl methacrylate	EPA 8260B/624	EPA 8260B
Methyl tert-butyl ether (MTBE)	EPA 8260B/624	EPA 8260B
Methylcyclohexane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
Methylene chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
Pentachloroethane	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl acetate	EPA 8260B/624	EPA 8260B
Vinyl chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
Pesticides-Herbicides-PCBs		
2,4,5-T	EPA 8151A /615	EPA 8151A
2,4-D	EPA 8151A /615	EPA 8151A
2,4-DB	EPA 8151A /615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A /615	EPA 8151A
4.4'-DDD	EPA 8081B/608	EPA 8081B
4.4'-DDE	EPA 8081B/608	EPA 8081B
4,4'·DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifluorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Aroclor-1262 (PCB-1262)	EPA 8082A/608	EPA 8082A
Aroclor-1268 (PCB-1268)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B	EPA 8141B
Chloramben	EPA 8151A/615	EPA 8151A

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Chlordane (tech.)	EPA 8081B/608	EPA 8081B
Chlorpynfos	EPA 8141B	EPA 8141B
Coumaphos	EPA 8141B	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton, Total	EPA 8141B	EPA 8141B
Diazinon	EPA 8141B	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtorvos)	EPA 8141B	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B	EPA 8141B
Ethion	EPA 8141B	EPA 8141B
Ethoprop	EPA 8141B	EPA 8141B
fensulfothion	EPA 8141B	EPA 8141B
fenthion	EPA 8141B	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
MCPP	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion. methyl)	EPA 8141B	EPA 8141B
Mevinphos	EPA 8141B	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B	EPA 8141B
Naled	EPA 8141B	EPA 8141B
Parathion, ethyl	EPA 8141B	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B
Stirofos	EPA 8141B	EPA 8141B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Sulfotepp	EPA 8141B	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B	EPA 8141B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014 EPA 335.2 /SM 4500-CN E	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal water prep	EPA 6020A/200.8	EPA 3005A
Metals soil prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable organics and Pesticides water prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3510C
Extractable organics and Pesticides waste prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3580A
Extractable organics and Pesticides soil prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3550C
Organics water and mid-level soil prep	EPA 8260B/624	EPA 5030B
Organics low-level soil prep	EPA 8260B/624	EPA 5035
Soil/water leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals	EPA 1312
TCLP	Wets, Organics, and Metals	EPA 1311

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World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 29th day of May 2012.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

ENVIRONMENTAL CONSERVATION LABORATORIES – JACKSONVILLE
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ENVIRONMENTAL

Valid To: April 30, 2014 Certificate Number: 3000.02

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Isopropyl alcohol (2-Propanol)	EPA 8015C	NA	ENCO VGCMS-07
4-Ethyltoluene	NA	NA	ENCO VGCMS-07
Cyclohexane	EPA 8260B	EPA 8260B	ENCO VGCMS-07
1,1,1-Trichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,2,2-Tetrachloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	EPA 8260B	EPA TO-14A
1,1,2-Trichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1-Dichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1-Dichloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichloro-1,1,2,2-tetrafluoroethane	NA	NA	EPA TO-14A
1,3-Butadiene	NA	NA	EPA TO-15
1,4-Dioxane	EPA 8260B	EPA 8260B	EPA TO-15
2,2,4-Trimethylpentane	NA	NA	EPA TO-15
Benzyl chloride	NA	NA	EPA TO-15
n-Hexane	NA	NA	EPA TO-15
2-Hydroxy isobutyric acid	ENCO VGC-13	NA	NA
Acetic acid	ENCO VGC-13	NA	NA
Butyric acid (Butanoic acid)	ENCO VGC-13	NA	NA
Hexanoic acid	ENCO VGC-13	NA	NA
Isohexanoic acid (4-methyl-pentanoic acid)	ENCO VGC-13	NA	NA
Isopentanoic acid (3-methyl-butanoic acid)	ENCO VGC-13	NA	NA
Lactic acid	ENCO VGC-13	NA	NA
Pentanoic acid	ENCO VGC-13	NA	NA

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Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Propionic acid (Propanoic acid)	ENCO VGC-13	NA	NA
Pyruvic acid	ENCO VGC-13	NA	NA
Propylene glycol	ENCO VGC-18	NA	NA
Ethyl acetate	EPA 8015C	NA	ENCO VGCMS-07
Ethylene glycol	EPA 8015C	NA	NA
Diesel range organics (DRO)	EPA 8015C	EPA 8015C	NA
Gasoline range organics (GRO)	EPA 8015C	EPA 8015C	NA
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C, 8260B	EPA 8260B	NA
Methanol	EPA 8015C	EPA 8015C	NA
n-Butyl alcohol	EPA 8015C	NA	NA
n-Propanol	EPA 8015C	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504, 504.1, 8011, 8260B	EPA 8260B	NA
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504, 504.1, 8011, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2-Dichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichloropropane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,3-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,4-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
2-Chloroethyl vinyl ether	EPA 624, 8260B	EPA 8260B	NA
Acrolein (Propenal)	EPA 624, 8260B	EPA 8260B	NA
Acrylonitrile	EPA 624, 8260B	EPA 8260B	NA
Benzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Bromodichloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Bromoform	EPA 624, 8260B	EPA 8260B	EPA TO-15
Carbon tetrachloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chlorobenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroform	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
cis-1,3-Dichloropropene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromochloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Ethylbenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl bromide (Bromomethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl chloride (Chloromethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methylene chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Tetrachloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Toluene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
trans-1,2-Dichloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-15
trans-1,3-Dichloropropylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichloroethene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichlorofluoromethane	EPA 624, 8260B	EPA 8260B	EPA-TO-14A
Vinyl chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Xylene (total)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	NA
1,1-Dichloropropene	EPA 8260B	EPA 8260B	NA
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	NA
1,2,4-Trichlorobenzene	EPA 8260B, 625, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	NA
2,2-Dichloropropane	EPA 8260B	EPA 8260B	NA
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B, 8015C	EPA 8260B	EPA TO-15
2-Chlorotoluene	EPA 8260B	EPA 8260B	NA
2-Hexanone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
4-Chlorotoluene	EPA 8260B	EPA 8260B	NA
4-Methyl-2-pentanone (MIBK)	EPA 8260B, 8015C	EPA 8260B	EPA TO-15
Acetone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
Acetonitrile	EPA 8260B	EPA 8260B	NA
Allyl chloride (3-Chloropropene)	EPA 8260B	EPA 8260B	EPA TO-15
Bromobenzene	EPA 8260B	EPA 8260B	NA
Bromochloromethane	EPA 8260B	EPA 8260B	NA
Carbon disulfide	EPA 8260B	EPA 8260B	EPA TO-15
Chloroprene	EPA 8260B	EPA 8260B	NA
cis-1,2-Dichloroethylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromomethane	EPA 8260B	EPA 8260B	NA
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	EPA TO-14A
Diethyl ether	EPA 8260B	EPA 8260B	NA
Ethanol	EPA 8260B, 8015C	EPA 8260B	NA
Ethyl methacrylate	EPA 8260B	EPA 8260B	NA
Hexachlorobutadiene	EPA 8260B, 625, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
Iodomethane (Methyl iodine)	EPA 8260B	EPA 8260B	NA
Isopropylbenzene	EPA 8260B	EPA 8260B	NA
Isopropyl ether	EPA 8260B	EPA 8260B	NA
Methacrylonitrile	EPA 8260B	EPA 8260B	NA
Methyl Acetate	EPA 8260B	EPA 8260B	NA
Methyl Cyclohexane	EPA 8260B	EPA 8260B	NA
Methyl methacrylate	EPA 8260B	EPA 8260B	NA
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	EPA TO-15
m.p-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Naphthalene	EPA 8260B, 625 Scan-Sim, 8270D Scan-Sim	EPA 8260B, 8270D Scan-Sim	NA
n-Butyl benzene	EPA 8260B	EPA 8260B	NA
n-Propyl benzene	EPA 8260B	EPA 8260B	NA
o-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
p-Isopropyltoluene	EPA 8260B	EPA 8260B	NA
Propionitrile (Ethyl cyanide)	EPA 8260B	EPA 8260B	NA
sec-Butylbenzene	EPA 8260B	EPA 8260B	NA
Styrene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
tert-Butylbenzene	EPA 8260B	EPA 8260B	NA
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B	NA
Vinyl acetate	EPA 8260B	EPA 8260B	EPA TO-15
4,4'-DDD	EPA 608, 8081B	EPA 8081B	NA
4,4'-DDE	EPA 608, 8081B	EPA 8081B	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
4,4'-DDT	EPA 608, 8081B	EPA 8081B	NA
Aldrin	EPA 608, 8081B	EPA 8081B	NA
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Aroclor-1016(PCB-1016)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1221(PCB-1221)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1232(PCB-1232)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1242(PCB-1242)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1248(PCB-1248)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1254(PCB-1254)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1260(PCB-1260)	EPA 608, 8082A	EPA 8082A	NA
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Chlordane(tech.)	EPA 608, 8081B	EPA 8081B	NA
delta-BHC	EPA 608, 8081B	EPA 8081B	NA
Dieldrin	EPA 608, 8081B	EPA 8081B	NA
Endosulfan I	EPA 608, 8081B	EPA 8081B	NA
Endosulfan II	EPA 608, 8081B	EPA 8081B	NA
Endosulfan sulfate	EPA 608, 8081B	EPA 8081B	NA
Endrin	EPA 608, 8081B	EPA 8081B	NA
Endrin aldehyde	EPA 608, 8081B	EPA 8081B	NA
gamma-BHC (Lindane,gamma-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Heptachlor	EPA 608, 8081B	EPA 8081B	NA
Heptachlor epoxide	EPA 608, 8081B	EPA 8081B	NA
Toxaphene (Chlorinated camphene)	EPA 608, 8081B	EPA 8081B	NA
alpha-Chlordane	EPA 8081B	EPA 8081B	NA
Endrin ketone	EPA 8081B	EPA 8081B	NA
gamma-Chlordane	EPA 8081B	EPA 8081B	NA
Isodrin	EPA 8081B, 8270D	EPA 8081B, 8270D	NA
Methoxychlor	EPA 8081B	EPA 8081B	NA
Mirex	EPA 8081B	EPA 8081B	NA
Kepone	EPA 8270D	EPA 8270D	NA
o,o,o-Triethylphosphorothioate	EPA 8270D	EPA 8270D	NA
Parathion,ethyl	EPA 8270D	EPA 8270D	NA
Phorate	EPA 8270D	EPA 8270D	NA
Sulfotepp	EPA 8270D	EPA 8270D	NA
Thionazin (Zinophos)	EPA 8270D	EPA 8270D	NA
Dalapon	EPA 615, 8151A	EPA 8151A	NA
3,5-DCBA	EPA 615, 8151A	EPA 8151A	NA
4-Nitrophenol	EPA 615, 8151A, 625, 8270D	EPA 8270D, 8151A	NA
Dicamba	EPA 615, 8151A	EPA 8151A	NA
MCPP	EPA 615, 8151A	EPA 8151A	NA
MCPA	EPA 615, 8151A	EPA 8151A	NA
Dichlorprop	EPA 615, 8151A	EPA 8151A	NA
2,4-D	EPA 615, 8151A	EPA 8151A	NA
Pentachlorophenol	EPA 615, 8151A, 625, 8270D	EPA 8151A, 8270D	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
2,4,5-TP (Silvex)	EPA 615, 8151A	EPA 8151A	NA
Chloramben	EPA 615, 8151A	EPA 8151A	NA
2,4,5-T	EPA 615, 8151A	EPA 8151A	NA
2,4-DB	EPA 615, 8151A	EPA 8151A	NA
Bentazon	EPA 615, 8151A	EPA 8151A	NA
Picloram	EPA 615, 8151A	EPA 8151A	NA
Dinoseb	EPA 615, 8151A, 625, 8270D	EPA 8151A, 8270D	NA
Dacthal	EPA 615, EPA 8151A	EPA 8151A	NA
Acifluorfen	EPA 615, EPA 8151A	EPA 8151A	NA
2,4-DCAA	EPA 615, EPA 8151A	EPA 8151A	NA
Total coliforms	SM9222B	NA	NA
Fecal coliforms	SM9222D	NA	NA
Aluminum	EPA 200.7, 6010C	EPA 6010C	NA
Antimony	EPA 200.7, 6010C	EPA 6010C	NA
Arsenic	EPA 200.7, 6010C	EPA 6010C	NA
Barium	EPA 200.7, 6010C	EPA 6010C	NA
Beryllium	EPA 200.7, 6010C	EPA 6010C	NA
Boron	EPA 200.7, 6010C	EPA 6010C	NA
Cadmium	EPA 200.7, 6010C	EPA 6010C	NA
Calcium	EPA 200.7, 6010C	EPA 6010C	NA
Chromium	EPA 200.7, 6010C	EPA 6010C	NA
Cobalt	EPA 200.7, 6010C	EPA 6010C	NA
Copper	EPA 200.7, 6010C	EPA 6010C	NA
Hardness (calc.)	SM2340B	NA	NA
Iron	EPA 200.7, 6010C, SM18 3500-Fe D	EPA 6010C	NA
Lead	EPA 200.7, 6010C	EPA 6010C	NA
Lithium	EPA 200.7, 6010C	EPA 6010C	NA
Magnesium	EPA 200.7, 6010C	EPA 6010C	NA
Manganese	EPA 200.7, 6010C	EPA 6010C	NA
Molybdenum	EPA 200.7, 6010C	EPA 6010C	NA
Nickel	EPA 200.7, 6010C	EPA 6010C	NA
Potassium	EPA 200.7, 6010C	EPA 6010C	NA
Selenium	EPA 200.7, 6010C	EPA 6010C	NA
Silver	EPA 200.7, 6010C	EPA 6010C	NA
Sodium	EPA 200.7, 6010C	EPA 6010C	NA
Strontium	EPA 200.7, 6010C	EPA 6010C	NA
Thallium	EPA 200.7, 6010C	EPA 6010C	NA
Tin	EPA 200.7, 6010C	EPA 6010C	NA
Titanium	EPA 200.7, 6010C	EPA 6010C	NA
Vanadium	EPA 200.7, 6010C	EPA 6010C	NA
Zinc	EPA 200.7, 6010C	EPA 6010C	NA
Mercury	EPA 245.1, 7470A	EPA 7471B	NA
Sulfate	ASTM D516-90	NA	NA
Ignitability	EPA 1010A	EPA 1010A, EPA 1030	NA
Conductivity	EPA 120.1, SM18 2510B	NA	NA
Turbidity	EPA 180.1, SM18 2130B	NA	NA
Orthophosphate as P	EPA 365.3	NA	NA
Color	SM2120B	NA	NA
Alkalinity as CaC03	SM2320B	NA	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Hardness	SM2340C	NA	NA
Residue-nonfilterable (TSS)	SM2540D	NA	NA
Residue-total	SM2540B	NA	NA
Residue-filterable (TDS)	SM2540C	NA	NA
Chromium VI	SM3500-CrD(18th/19th Ed.)/UV-VIS	NA	NA
Chloride	SM4500-Cl-C	NA	NA
Total residual chlorine	SM4500-Cl-G	NA	NA
pH	SM18 4500-H+-B, EPA 9040C	EPA 9040C, 9045D	NA
Corrosivity (pH)	NA	EPA 9040C	NA
Paint Filter Liquids Test	NA	EPA 9095B	NA
Nitrite	SM4500-NO2 B	NA	NA
Biochemical oxygen demand	SM5210B	NA	NA
Carbonaceous BOD(CBOD)	SM5210B	NA	NA
Chemical oxygen demand	SM5220D, EPA 410.4	NA	NA
Total Organic Carbon	SM18 5310B, EPA 9060A	NA	NA
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO	NA
Oil & Grease (HEM)	EPA 1664A	EPA 9071B	NA
Total Petroleum Hydrocarbons (TPH) (HEM-SGT)	EPA 1664A	NA	NA
Carbon dioxide	RSK-175	NA	NA
Ethane	RSK-175	NA	NA
Ethylene	RSK-175	NA	NA
Methane	RSK-175	NA	NA
2,4,6-Trichlorophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dichlorophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dimethylphenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dinitrophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dinitrotoluene (2,4-DNT)	EPA 625, 8270D	EPA 8270D	NA
2,6-Dinitrotoluene (2,6-DNT)	EPA 625, 8270D	EPA 8270D	NA
2-Chloronaphthalene	EPA 625, 8270D	EPA 8270D	NA
2-Chlorophenol	EPA 625, 8270D	EPA 8270D	NA
2-Methyl-4,6-dinitrophenol	EPA 625, 8270D	EPA 8270D	NA
2-Nitrophenol	EPA 625, 8270D	EPA 8270D	NA
3,3'-Dichlorobenzidine	EPA 625, 8270D	EPA 8270D	NA
4-Bromophenyl phenylether	EPA 625, 8270D	EPA 8270D	NA
4-Chloro-3-methylphenol	EPA 625, 8270D	EPA 8270D	NA
4-Chlorophenyl phenylether	EPA 625, 8270D	EPA 8270D	NA
Acenaphthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Acenaphthylene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Aniline	EPA 625, 8270D	EPA 8270D	NA
Anthracene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzidine	EPA 625, 8270D	EPA 8270D	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Benzo(a)anthracene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(a)pyrene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(b)fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(g,h,i)perylene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(k)fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
bis(2-Chloroethoxy)methane	EPA 625, 8270D	EPA 8270D	NA
bis(2-Chloroethyl) ether	EPA 625, 8270D	EPA 8270D	NA
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane)	EPA 625, 8270D	EPA 8270D	NA
bis(2-Ethylhexyl) phthalate(DEHP)	EPA 625, 8270D	EPA 8270D	NA
Butylbenzylphthalate	EPA 625, 8270D	EPA 8270D	NA
Chrysene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Dibenzo(a,h)anthracene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Diethyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Dimethyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Di-n-butyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Di-n-octyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Fluorene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Hexachlorobenzene	EPA 625, 8270D	EPA 8270D	NA
Hexachlorocyclopentadiene	EPA 625, 8270D	EPA 8270D	NA
Hexachloroethane	EPA 625, 8270D	EPA 8270D	NA
Indeno(1,2,3-cd)pyrene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Isophorone	EPA 625, 8270D	EPA 8270D	NA
Nitrobenzene	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodimethylamine	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodi-n-propylamine	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodiphenylamine	EPA 625, 8270D	EPA 8270D	NA
Phenanthrene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Phenol	EPA 625, 8270D	EPA 8270D	NA
Pyrene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Pyridine	EPA 625, 8270D	EPA 8270D	NA
1,1-Biphenyl	EPA 8270D	EPA 8270D	
1,2,4,5-Tetrachlorobenzene	EPA 8270D	EPA 8270D	NA
1,2-Diphenylhydrazine	EPA 8270D	EPA 8270D	NA
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	EPA 8270D	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	EPA 8270D	NA
1,4-Naphthoquinone	EPA 8270D	EPA 8270D	NA
1,4-Phenylenediamine	EPA 8270D	EPA 8270D	NA
1-Methylnaphthalene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
1-Naphthylamine	EPA 8270D	EPA 8270D	NA
2,3,4,6-Tetrachlorophenol	EPA 8270D	EPA 8270D	NA
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D	NA
2,6-Dichlorophenol	EPA 8270D	EPA 8270D	NA
2-Acetylaminofluorene	EPA 8270D	EPA 8270D	NA
2-Methylnaphthalene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
2-Methylphenol (o-Cresol)	EPA 8270D	EPA 8270D	NA
2-Naphthylamine	EPA 8270D	EPA 8270D	NA
2-Nitroaniline	EPA 8270D	EPA 8270D	NA
2-Picoline (2-Methylpyridine)	EPA 8270D	EPA 8270D	NA
3,3'-Dimethylbenzidine	EPA 8270D	EPA 8270D	NA
3-Methylcholanthrene	EPA 8270D	EPA 8270D	NA
3-Methylphenol (m-Cresol)	EPA 8270D	EPA 8270D	NA
3-Nitroaniline	EPA 8270D	EPA 8270D	NA
4-Aminobiphenyl	EPA 8270D	EPA 8270D	NA
4-Chloroaniline	EPA 8270D	EPA 8270D	NA
4-Dimethyl aminoazobenzene	EPA 8270D	EPA 8270D	NA
4-Methylphenol (p-Cresol)	EPA 8270D	EPA 8270D	NA
4-Nitroaniline	EPA 8270D	EPA 8270D	NA
4-Nitroquinoline-n-oxide	EPA 8270D	EPA 8270D	NA
5-Nitro-o-toluidine	EPA 8270D	EPA 8270D	NA
7,12-Dimethylbenz(a)anthracene	EPA 8270D	EPA 8270D	NA
a-a-Dimethylphenethylamine	EPA 8270D	EPA 8270D	NA
Acetophenone	EPA 8270D	EPA 8270D	NA
Aramite	EPA 8270D	EPA 8270D	NA
Atrazine	EPA 8270D	EPA 8270D	NA
Benzaldehyde	EPA 8270D	EPA 8270D	NA
Benzoic acid	EPA 8270D	EPA 8270D	NA
Benzyl alcohol	EPA 8270D	EPA 8270D	NA
Caprolactam	EPA 8270D	EPA 8270D	NA
Carbazole	EPA 8270D	EPA 8270D	NA
Chlorobenzilate	EPA 8270D	EPA 8270D	NA
Cresol, Total	EPA 8270D	EPA 8270D	NA
Diallate	EPA 8270D	EPA 8270D	NA
Dibenzo(a,h)pyrene	EPA 8270D	EPA 8270D	NA
Dibenzofuran	EPA 8270D	EPA 8270D	NA
Dimethoate	EPA 8270D	EPA 8270D	NA
Diphenylamine	EPA 8270D	EPA 8270D	NA
Disulfoton	EPA 8270D	EPA 8270D	NA
DPH (as Azobenzene)	EPA 8270D	EPA 8270D	NA
Ethyl methanesulfonate	EPA 8270D	EPA 8270D	NA
Famphur	EPA 8270D	EPA 8270D	NA

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Hexachlorophene	EPA 8270D	EPA 8270D	NA
Hexachloropropene	EPA 8270D	EPA 8270D	NA
Isosafrole	EPA 8270D	EPA 8270D	NA
Methapyrilene	EPA 8270D	EPA 8270D	NA
Methyl methane sulfonate	EPA 8270D	EPA 8270D	NA
Methyl parathion (Parathion,methyl)	EPA 8270D	EPA 8270D	NA
Nitroquinoline-1-oxide	EPA 8270D	EPA 8270D	NA
n-Nitrosodiethylamine	EPA 8270D	EPA 8270D	NA
n-Nitroso-di-n-butylamine	EPA 8270D	EPA 8270D	NA
n-Nitrosomethylethylamine	EPA 8270D	EPA 8270D	NA
n-Nitrosomorpholine	EPA 8270D	EPA 8270D	NA
n-Nitrosopiperidine	EPA 8270D	EPA 8270D	NA
n-Nitrosopyrrolidine	EPA 8270D	EPA 8270D	NA
o-Toluidine	EPA 8270D	EPA 8270D	NA
Pentachlorobenzene	EPA 8270D	EPA 8270D	NA
Pentachloroethane	EPA 8270D	EPA 8270D	NA
Pentachloronitrobenzene	EPA 8270D	EPA 8270D	NA
Phenacetin	EPA 8270D	EPA 8270D	NA
Pronamide (Kerb)	EPA 8270D	EPA 8270D	NA
Safrole	EPA 8270D	EPA 8270D	NA
C9-C18 Aliphatic Hydrocarbons	MAEPH	MAEPH	NA
C19-C36 Aliphatic Hydrocarbons	MAEPH	MAEPH	NA
C11-C22 Aromatic Hydrocarbons	MAEPH	MAEPH	NA
C5-C8 Aliphatic Hydrocarbons	MAVPH	MAVPH	NA
C9-C12 Aliphatic Hydrocarbons	MAVPH	MAVPH	NA
C9-C10 Aromatic Hydrocarbons	MAVPH	MAVPH	NA
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311	NA
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312	NA

Analytical method	Prep Method			
	Soil	Water	Air	Waste
EPA 8260B	EPA 5035	EPA 5030B	NA	EPA 5035
EPA 624	NA	EPA 5030B	NA	NA
EPA 625	NA	EPA 3510C	NA	NA
EPA 8270D	EPA 3545A	EPA 3510C	NA	EPA 3580A
EPA 200.7	NA	EPA 200.7	NA	NA
EPA 6010C	EPA 3050B	EPA 3005A	NA	EPA 3050B
EPA 608	NA	EPA 3510C	NA	NA
EPA 8081B	EPA 3545A	EPA 3510C	NA	EPA 3580A
EPA 8082A	EPA 3545A, EPA 3540C	EPA 3510C	NA	EPA 3580A
EPA 615	NA	EPA 615	NA	NA

Analytical method	Prep Method			
EPA 8151A	EPA 8151A	EPA 8151A	NA	EPA 8151A
MA VPH, May 2004 Revision 1.1	EPA 5035	EPA 5030B	NA	NA
MA EPH, May 2004 Revision 1.1	EPA 3545A	EPA 3510C	NA	NA
FLPRO	EPA 3545A	EPA 3510C	NA	NA
8015C – GRO	EPA 5035	EPA 5030B	NA	NA
8015C – DRO	EPA 3545A	EPA 3510C	NA	NA
TO14A	NA	NA	TO14A	NA
TO15	NA	NA	TO15	NA
SPLP	EPA 1312	EPA 1312	NA	EPA 1312
TCLP	EPA 1311	EPA 1311	NA	EPA 1311

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World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - JACKSONVILLE

Jacksonville, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 1st day of May 2012.

President & CEO
For the Accreditation Council
Certificate Number 3000.02
Valid to April 30, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.