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FINAL QUALITY ASSURANCE PROJECT PLAN FOR 1,4 DIOXANE GROUNDWATER INVESTIGATION AT SITE 16 NCBC DAVISVILLE RI

4/1/2006

TETRA TECH

Quality Assurance Project Plan Addendum

for

1,4-Dioxane Ground-Water Investigation at IR Program Site 16

Former Naval Construction Battalion Center Davisville

North Kingstown, Rhode Island

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62472-03-D-0057

Contract Task Order 049

April 2006

1.0 TITLE AND APPROVAL PAGE

Document Title: *Site 16 1,4-Dioxane Investigation Quality Assurance Project Plan Addendum*

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2.1 TABLE OF CONTENTS AND ACRONYMS AND ABBREVIATIONS

The Table of Contents and list of Acronyms and Abbreviations are provided in this section.

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LIST OF ACRONYMS

BCT	BRAC Closure Team
CA	Corrective Action
CCV	Continuing Calibration Verification
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CTO	Contract Task Order
CVOCs	Chlorinated Volatile Organic Compounds
DOT	Department of Transportation
DQO	Data Quality Objective
DQI	Data Quality Indicator
DVM	Data Validation Manager
EA	EA Engineering Science and Technology
EFANE	Engineering Field Activity Northeast
FOL	Field Operations Leader
GC/MS	Gas chromatograph/Mass Spectroscopy
GIS	Geographic Information System
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
IMRG	Information Management Resource Group
LAN	Local Area Network
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LQAP	Laboratory Quality Assurance Plan
MS	Matrix spike
MSD	Matrix spike duplicate
NAD	North American Datum
NAVD	North American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
NCBC	Naval Construction Battalion Center
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupation Safety and Health Administration
OWER	Office of Solid Waste and Emergency Response
PARCC	Precision, accuracy, representativeness, comparability, and completeness
PDF	Portable Document Format
PE	Performance Evaluation
PM	Project Manager
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal

QAPP	Quality Assurance Project Plan
QA	Quality assurance
QC	Quality control
RIDEM	Rhode Island Department of Environmental Management
RIEDC	Rhode Island Economic Development Corporation
RL	Reporting Limit
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
RT	Retention Time
SDG	Sample Delivery Group
SIM	Selective Ion Monitoring
SMC	Sample Management Coordinator
SOP	Standard Operating Procedures
SOW	Statement of Work
SVOC	Semivolatile organic compounds
ToNK	Town of North Kingstown
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
US F&W	United States Fish and Wildlife
µg/l	Micrograms per liter
%R	Percent recovery
°C	Degrees Celsius

2.2 INTRODUCTION

Tetra Tech NUS, Inc. (TtNUS) prepared this Quality Assurance Project Plan (QAPP) Addendum for the United States Department of the Navy Engineering Field Activity Northeast (EFANE), Naval Facilities Engineering Command (NAVFAC) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-03-D-0057, Contract Task Order (CTO) 049. This QAPP Addendum is a companion document to the "Final Quality Assurance Project Plan for Phase II Remedial Investigation for IR Program Site 16" which was prepared by EA Engineering Science and Technology (EA) (EA, 2002). This QAPP Addendum describes the collection of 10 ground-water samples and analysis of these samples for 1,4-dioxane at the Former Naval Construction Battalion Center (NCBC) Davisville, North Kingstown, Rhode Island (hereafter referred to as NCBC Davisville).

The objective of this investigation is to:

- Determine if 1,4-dioxane is a groundwater contaminant at Site 16. Ten Site 16 monitoring wells (shallow, intermediate, and deep) will be sampled and analyzed for the presence of 1,4-dioxane.

Some of these wells were previously sampled for 1,4-dioxane in the fall of 2004. Most of these wells are located in the vicinity or downgradient of Site 16 source areas (known or potential). The rationale for the selection of wells for monitoring is presented in Table 8-2.

2.3 SITE DESCRIPTION AND BACKGROUND

Refer to Section 2.2 of the Final QAPP (EA, 2002).

2.3.1 Naval Construction Battalion Center Description and History

Refer to Section 2.2.1 of the Final QAPP (EA, 2002).

2.3.2 Site Description and History

Refer to Section 2.2.2 of the Final QAPP (EA, 2002). A summary of previous investigations of the site is provided in Section 5.2 of the Final QAPP (EA, 2002).

2.3.3 Climate

Refer to Section 2.2.3 of the Final QAPP (EA, 2002).

2.3.4 Site Hydrogeology

Refer to Section 3 of the TtNUS Supplemental Phase II RI Data Package (TtNUS, March 2006) for a detailed description of the site hydrogeology and Section 6 of this same document for the conceptual site model.

2.3.4.1 Hydrogeologic Zones

Refer to Section 2.2.4 of the Final QAPP (EA, 2002), Phase II Investigation Report (EA, 2003), and the Supplemental Phase II RI Data Package (TtNUS, March 2006) in which updated descriptions are provided.

3.0 DISTRIBUTION LIST

The following is the list of organization and agency representatives to whom the QAPP Addendum will be distributed. The QAPP is a dynamic document and should be revised or updated to reflect changes in organization and procedures needed to meet the quality objectives identified in the Final QAPP (EA, 2002). Whenever revisions are made or addenda are added to the QAPP, those listed below will receive the revisions/addenda. The distribution system does not preclude making and using copies of the QAPP Addendum. However, those listed below are responsible for distributing the QAPP Addendum and any additional material to update any copies within their organizations.

- EFANE
  Curtis Frye, Remedial Project Manager (RPM), (610) 595-0567, X142

- TtNUS
  Lee Ann Sinagoga, Project Manager (PM), (412) 921-8887

- United States Environmental Protection Agency (USEPA), Region I
  Christine Williams, RPM, (617) 918-1384

- Rhode Island Department of Environmental Management (RIDEM)
  Louis Maccarone, RPM, (401) 222-2797

- United States Fish and Wildlife Service (US F&W)
  Andrew Major, (603) 223-2541

- National Oceanic and Atmospheric Administration (NOAA)
  Ken Finkelstein, (617) 918-1499

- Town of North Kingstown (ToNK)
  Marilyn Cohen, (401) 294-3331, X233

- Rhode Island Economic Development Corporation (RIEDC)
  Steven King, (401) 295-0044

4.0 PROJECT ORGANIZATION

4.1 PROJECT ORGANIZATIONAL CHART

The updated project organizational chart is shown on Figure 4-1.

4.2 COMMUNICATION PATHWAYS

Pathways have been established to transfer information and to make alterations to project methods that may be required because of unforeseen circumstances. It will be the responsibility of the TtNUS PM to keep both the TtNUS project team and the Navy informed of the following:

- Schedule, deliverables, meetings, and milestones
- Recent data collected from the site
- Technical changes made to the plans and specifications
- Developments that will cause changes in the schedule

The TtNUS PM will be in frequent verbal and electronic mail communication with the Navy RPM. The project team will communicate any changes in the plans and specifications, field methodology, sampling protocol, or data objectives to the Navy in a timely manner. As appropriate, a field modification record will be used to identify the need for a change and a recommended course of action. The Navy will consult with USEPA and RIDEM on any major scope changes that may occur while the fieldwork is proceeding.

The TtNUS PM will, by telephone or electronic mail, communicate directly with the field team and indirectly with the designated laboratory (through the Lead Chemist). The Lead Chemist will provide technical guidance and assess data as they become available. The laboratories, by telephone or electronic mail, will notify the Navy immediately of any issues that develop with the data or quality assurance (QA)/quality control (QC) requirements. The Navy will be notified if significant issues arise with the laboratories regarding data, Data Quality Objective (DQOs), or schedule.

The Field Operations Leader (FOL) will be in daily contact with the PM and will verbally notify the TtNUS PM of the daily sample shipping information. The PM will provide sample shipping information to the sample shipping coordinator. The FOL and the required subcontractors will communicate directly on site. During site activities, project sample logsheets, logbook notations, and appropriate field forms will be completed in the field and maintained at the TtNUS office. The TtNUS Lead Chemist will be in contact with the laboratories during sample receipt, sample analysis, receipt of data, and data validation and verification.

4.2.1 Modifications to the Approved Quality Assurance Project Plan Addendum

This section documents the procedures that will be followed when any project activity described in the approved QAPP requires real-time modification to achieve the project goals.

TtNUS will present proposed changes to the Navy and follow up with a field modification record for significant changes. The documentation will describe why the change is necessary, the nature of the proposed change, and the impacts of the change on the project. The change will be implemented after Navy concurrence. Minor changes will be documented in the field logbook.

When changes require immediate action, the proposed change will be briefly discussed internally by TtNUS and approved, as appropriate, by the TtNUS PM or designee (i.e., QA officer). The Navy RPM will be notified as soon as possible. Concurrence from USEPA and RIDEM will be sought for any major scope changes, as determined by the Navy. In the event of conditions requiring a major scope change, the investigation will be put on hold until concurrence is obtained. The Navy will consult with USEPA and RIDEM on any major scope changes that may occur while fieldwork is proceeding.

4.3 PROJECT ROLES AND RESPONSIBILITIES

John Trepanowski is the TtNUS EFANE CLEAN Program Manager. He is responsible for the overall management and implementation of the CLEAN contract for TtNUS. Lee Ann Sinagoga will serve as the TtNUS PM for the 1,4-dioxane ground-water investigation with primary responsibility for the implementation and execution of the work assignment, including technical quality, oversight and review, control of costs and schedule, and implementation of appropriate QA procedures during all phases.

The TtNUS FOL (to be determined) is the primary person who implements the field work activities outlined in this QAPP Addendum. Responsibilities include supervising TtNUS field staff and field operations, coordinating with the various subcontractors on site ensuring the procedures specified in the QAPP Addendum are properly implemented, identifying and documenting necessary field changes, maintaining daily schedules, and reporting to the Facility Coordinator on a regular basis regarding the status and progress of the field activities. Before starting field work, the FOL will ensure that field Standard Operating Procedures (SOPs) are consistent with the QAPP Addendum and that any questions affecting the quality of planned field work are resolved. The FOL will also be responsible for ensuring that the field staff adhere to the primary duties of the Health and Safety Plan (HASP), reporting any health and safety issues to the TtNUS Health and Safety Officer and reporting any hazards, injuries, or decisions to stop work to the TtNUS PM.

The TtNUS QA officer will provide input on all aspects of adherence to the QAPP Addendum to the PM as needed. The Sample Management Coordinator (SMC) will be responsible for ensuring that the laboratory supplies the appropriate sample containers and preservatives to the field, for verifying receipt of samples and their integrity at the laboratory, for ensuring that the data supplied by the laboratory are complete, and for providing liaison with the laboratory contact to obtain data in a format that is suitable for validation.

The Natural Resources Trustees and Base Closure Team (BCT) (the members of which are shown in the organizational chart) will review and provide input on this QAPP Addendum and successive reports.

Table 4-1 lists the TtNUS 1,4-dioxane ground-water investigation personnel and includes their respective roles, names, and titles. Resumes of the TtNUS personnel are available on request.

4.4 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Field activities that require special training are summarized in Table 4-2. The HASP in Appendix A provides updated and additional information.

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TABLE 4-1

**PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND**

Name	Organizational Affiliation	Responsibilities	Location	Education and Experience Qualifications
John Trepanowski/ Garth Glenn	TtNUS	Program Manager/Deputy	TtNUS, King of Prussia, PA	Available on request
Lee Ann Sinagoga	TtNUS	PM	TtNUS, Pittsburgh, PA	Available on request
To Be Determined	TtNUS	FOL	TtNUS, Wilmington, PA	
Kelly Carper	TtNUS	QA Officer and Lead Chemist	TtNUS, Pittsburgh, PA	Available on request
Scott Anderson	TtNUS	Lead Hydrogeologist	TtNUS, Pittsburgh, PA	Available on request
Matt Soltis	TtNUS	Health & Safety Manager	TtNUS, Pittsburgh, PA	Available on request
Tom Johnston	TtNUS	QA Advisor	TtNUS Pittsburgh, PA	Available on request

TABLE 4-2

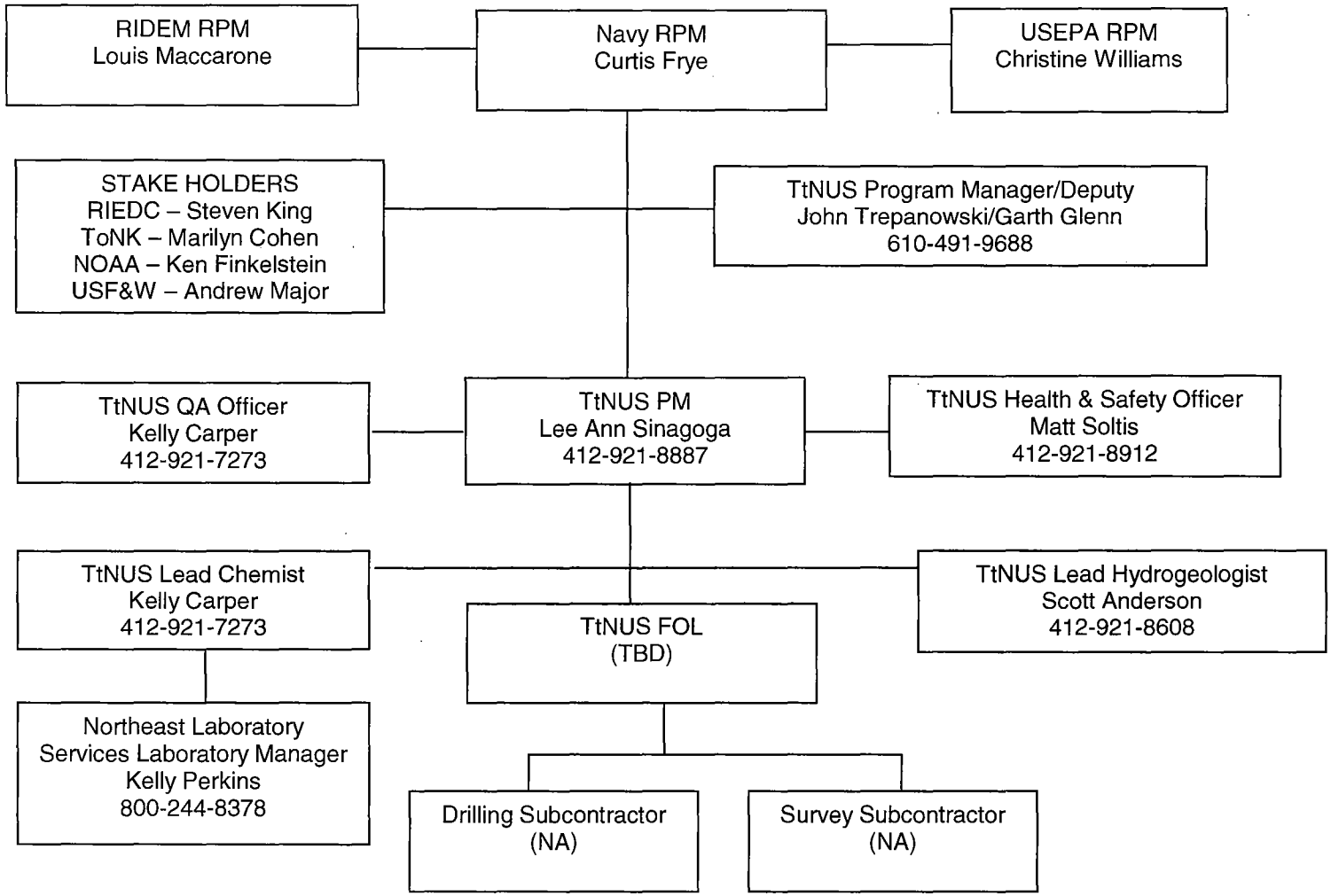
SPECIAL PERSONNEL TRAINING REQUIREMENTS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Project Function	Specialized Training Title of Course or Description	Training Provided By	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Ground-water Sampling	• 40-hour OSHA training, 8-hour annual refresher training	Health and safety training specialists	Various	• All field (on-site) personnel	FOL and field sampling team members	Training records are maintained by the Navy or its contractor

OSHA – Occupational Safety and Health Administration

FIGURE 4-1

PROJECT ORGANIZATIONAL CHART
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND



* All contact with TtNUS personnel and subcontractors by nonfield personnel should be made through Mr. Fred Evans.

5.0 PROJECT PLANNING AND PROJECT DEFINITIONS

5.1 PROJECT PLANNING MEETINGS

Refer to Section 5.1 of the Final QAPP (EA, 2002).

5.2 PREVIOUS INVESTIGATIONS

5.2.1 Studies Prior to the Remedial Investigation

Refer to Section 5.2.1 of the Final QAPP (EA, 2002) and the Supplemental Phase II RI Data Package (TtNUS, March 2006).

5.2.2 Phase I Remedial Investigation

Refer to Section 5.2.2 of the Final QAPP (EA, 2002) and the Supplemental Phase II RI Data Package (TtNUS, March 2006).

5.2.2.1 Results of the Human Health Risk Assessment

Refer to Section 5.2.2.1 of the Final QAPP (EA, 2002) and the Supplemental Phase II RI Data Package (TtNUS, March 2006).

5.2.2.2 Results of the Screening Level Ecological Risk Assessment

Refer to Section 5.2.2.2 of the Final QAPP (EA, 2002) and the Supplemental Phase II RI Data Package (TtNUS, March 2006).

5.2.3 Phase II Hydrogeological Investigation

Refer to Chapter 6 of the Phase II Remedial [Hydrogeological] Investigation Report (EA 2003) and the Supplemental Phase II RI Data Package (TtNUS, March 2006).

6.0 PROJECT DESCRIPTION AND SCHEDULE

6.1 PROJECT OVERVIEW

The objective of this investigation is stated in Section 2.2 of this QAPP Addendum.

6.2 PROJECT SCHEDULE

Refer to Table 6-1 for the project schedule.

6.3 REPORTS AND DATA PRESENTATION

The 1,4-dioxane ground-water investigation schedule is included in Table 6-1. As available, a summary of the field findings will be presented during BCT meetings.

6.3.1 1,4-Dioxane Ground-water Investigation Report

A letter report will be prepared summarizing the results of the 1,4-dioxane sampling and analysis of ground-water samples in the spring of 2006 and the fall of 2004. The report will focus on the extent of the 1,4-dioxane contamination (if any) and the potential need for further sampling at Site 16 for 1,4-dioxane (if any). The report will not include a quantitative risk assessment but will include the results of the data validation conducted for the analytical data, a tabular presentation of the analytical data, and a qualitative comparison of 1,4-dioxane concentrations to current, relevant federal and State of Rhode Island risk-based concentrations or other relevant standards/criteria. The letter report will also include figures displaying the analytical results compared to relevant standards/criteria and suggested future monitoring locations (if necessary). The final version of the letter report will incorporate regulatory review comments as necessary.

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TABLE 6-1

**PROJECT SCHEDULE TIMELINE TABLE
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND**

Activity	Deliverable	Deliverable Due Date
Submit Draft QAPP Addendum	1,4-Dioxane Ground-Water Investigation QAPP Addendum	December 28, 2005
Submit Final QAPP Addendum	1,4-Dioxane Ground-Water Investigation QAPP Addendum	April 28, 2006
Field Investigation May 2006	Submit e-mail of progress	Weekly
Submit Draft Letter Report	1,4-Dioxane Ground-Water Letter Report	August 7, 2006
Submit Final Letter Report	1,4-Dioxane Ground-Water Letter Report	November 13, 2006

7.0 PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA

7.1 PROJECT QUALITY OBJECTIVES

The project quality objective is to provide valid data of known and documented quality to determine if each sample can be compared to its associated screening level, which is the USEPA Region IX Preliminary Remediation Goal (PRG) of 6.1 µg/L.

7.2 MEASUREMENT PERFORMANCE CRITERIA

Analytical results will be needed from at least 95 percent of the planned ground-water sample locations. (Due to the limited number of samples collected in this sampling event if data usability problems are encountered, samples will be re-collected during the course of the upcoming Phase III RI.) For duplicate samples, the Relative Percent Difference (RPD) should be no more than 30 percent. If instances occur where the RPD of duplicate samples are greater than 30 percent the data will be estimated and the imprecision will be documented in the data validation narrative. The laboratory reporting limit for 1,4-dioxane in ground-water samples is 2 µg/L which is well below the established screening level of 6.1 µg/L. Acceptance criteria are provided in Table 13-1A and 13-1B for QC samples, i.e. laboratory control samples (LCS) and matrix spike (MS)/matrix spike duplicate samples (MSDs). Analytical precision and accuracy/bias detemineations are described in Chapter 20.

8.0 SAMPLING PROCESS DESIGN

TtNUS will conduct ground-water sampling during the 1,4-dioxane ground-water sampling investigation in order to assess the potential nature and extent of 1,4-dioxane both within the area(s) of with chlorinated volatile organic compounds (CVOCs) impacts and at representative downgradient locations across Site 16. This section of the QAPP Addendum describes how representative samples will be collected in an appropriate and consistent manner to meet the project objectives. Detailed sampling procedures are provided in Section 9, and the associated SOPs are attached in Appendix B. The QA/QC requirements are provided in Chapters 13 and 17. The site-specific HASP is provided in Appendix A.

8.1 GROUND-WATER SAMPLING FROM MONITORING WELLS

The 1,4-dioxane ground-water sampling investigation analytical program is provided in Table 8-1. The rationale for sample locations are provided in Table 8-2. Samples will be collected from 10 existing Site 16 monitoring wells in accordance with techniques detailed in Section 9 and analyzed by Method SW-846 8270C Selective Ion Monitoring (SIM). The 10 existing Site 16 monitoring wells to be sampled are: MW16-45I, MW16-04D, MW16-39I, MW16-37S, MW16-37I, MW16-10D, MW16-05I, MW16-05D, MW16-59I, and MW16-15D as seen on Figure 8-1. These wells were selected to assess ground-water near the source areas where elevated CVOC levels are observed as well as ground-water at downgradient locations (where CVOCs have migrated).

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TABLE 8-1

ANALYTICAL PROGRAM FOR 1,4-DIOXANE GROUND-WATER SAMPLING
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Analysis	Method	Environmental Samples	Field Duplicates	Equipment Rinsate Blanks	MS/MSD Samples	Source Blanks[1]
GROUNDWATER						
1,4-Dioxane	SW-846 8270C SIM	10	1	1	1	2

1 Source blanks will be generated at a rate of one per decontamination water source (e.g., deionized and potable water).

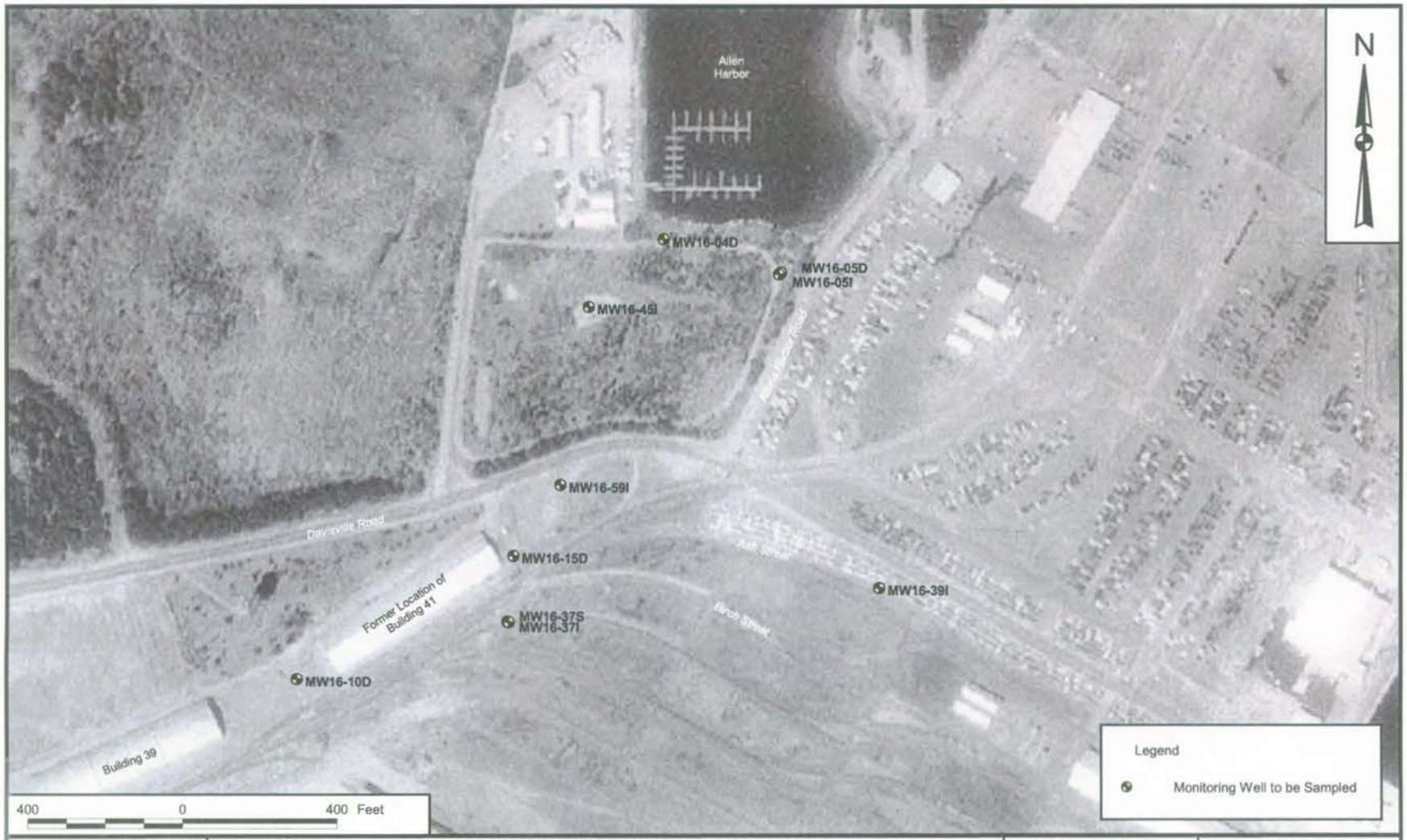
The field duplicate sample will be selected from a location where elevated CVOCs have been observed (MW 16-15D, MW 16-38I, MW 16-02D, or MW 16-05D).

An equipment rinsate blank will be generated from the section of Teflon-lined polyethylene tubing from the low-flow sampling equipment (section added between well head and flow-through cell).

TABLE 8-2

**RATIONALE FOR GROUND-WATER SAMPLE LOCATIONS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND**

Well Identifier	Rational for Inclusion into 1,4-Dioxane Sampling Program
MW16-37S	Most contaminated well in the shallow zone in the railroad spur area.
MW16-05I	Plume discharge area.
MW16-37I	Most contaminated well in the intermediate zone in the railroad spur area.
MW16-39I	Easterly downgradient well from source area at MW16-38I. Recommended by EPA.
MW16-45I	Elevated trichloroethene have been detected in both the intermediate and deep wells and this location is a source area (the former FFTA).
MW16-59I	Downgradient of former Building 41.
MW16-04D	Downgradient of MW16-45I source area.
MW16-05D	Plume discharge area.
MW16-10D	Upgradient location.
MW16-15D	Downgradient of former Building 41.



DRAWN BY C. SPEHAR DATE 4/24/06	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-0-0057	OWNER NUMBER —
CHECKED BY K. CARPER DATE 04/24/06	FIGURE 8 - 1 MONITORING WELLS TO BE SAMPLED 1,4-DIOXANE GROUNDWATER INVESTIGATION QAPP ADDENDUM NCBC DAVISVILLE NORTH KINGSTOWN, RHODE ISLAND	APPROVED BY Kelly M Carper DATE 4/27/06	
COST/SCHEDULE-AREA		APPROVED BY — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 8 - 1	REV 0

P:\GIS\DAVISVILLE_NCBC\MAPDOCS\APR\SITE16_QAPP.APR 04/06 MW 1,4-DIOXANE LAYOUT 04/24/06 CS

9.0 SAMPLING PROCEDURES AND REQUIREMENTS

Sampling, decontamination, equipment calibration, and maintenance procedures are provided in this section. SOPs for conducting the ground-water sampling are summarized in this section. Table 9-1 lists these SOPs, which are provided in Appendix B. Field documentation forms are also provided in Appendix B. Section 8.1 lists the ground-water monitoring wells to be sampled, and Figure 8-1 shows their locations at Site 16.

9.1 SAMPLING PROCEDURES

9.1.1 Ground-Water Sampling

Low-flow procedures will be used for purging and sampling the wells in accordance with TtNUS SOP DAV-1, Ground-Water Sample Acquisition and Onsite Water Quality Testing. Dedicated adjustable rate bladder pumps and discharge tubing are present in each of the monitoring wells to be sampled. A short length (a few feet) of new Teflon-lined polyethylene tubing will be used as necessary between the well cap and the flow-through cell. A flow-through cell and a water quality meter (Horiba model U-22 or equivalent) will be used during purging to measure pH, specific conductance, temperature, oxidation-reduction potential, dissolved oxygen, and salinity. A Lamotte 2020 (or equivalent) turbidity meter will be used to monitor turbidity throughout the well purging. Purged water will be containerized in drums, labeled, and handled in accordance with Section 9.2.

Ground-water sample logsheets will be prepared for each sample collected and will include sample-specific information that documents the well purging and sampling activities. Sample logsheets will be signed and dated, and the appropriate chain-of-custody procedures will be followed, as described in Section 10.2.

All ground-water samples will be analyzed for 1,4-dioxane by method SW-846 8270C SIM. Sampling and analysis methods, bottleware, preservation, and holding time requirements are provided in Table 9-1. The QA/QC samples to be collected are summarized in Table 8-1.

9.2 INVESTIGATION-DERIVED WASTE MANAGEMENT

This section addresses the procedures for handling, collection, and storage of investigation-derived waste (IDW) generated during well sampling activities. Three types of IDW will be generated during this investigation: monitoring well purge water, sampling equipment decontamination waste water, and discharge tubing/personal protective equipment (PPE) (solid wastes). Based on the historical site

activities and types of contaminants present, none of these IDW materials is expected to present a significant risk to human health or the environment if properly managed.

Purge and sampling decontamination waste water will be containerized in Department of Transportation (DOT)-approved, 17H, 55-gallon drums at the time of generation. The drums will be marked as IDW and labeled with the description of the drum contents, site name, date drum was filled, and contact information consisting of name, address, and phone number of the generator. The drummed IDW water will be staged at a location designated by the Navy pending its proper disposal.

Other wastes generated during sampling and decontamination activities, including discarded discharge tubing, PPE, aluminum foil, and other solid debris will be collected and disposed in on-site trash receptacles as directed by the Navy.

The analytical data collected during the field investigation will be provided to a transportation and disposal contractor will collect additional sample for further analysis as required by the disposal facility. It is presumed that liquid wastes will be non-RCRA and non-TSCA hazardous waste. It is presumed that the waste disposal subcontractor will conduct the characterization analyses. A letter will be prepared to describe the removal and disposal of IDW from the site.

9.3 DECONTAMINATION PROCEDURES

TtNUS will obtain precleaned sample containers for laboratory analyses. These containers will meet the requirements of the USEPA Specification and Guidance for Contaminant-Free Sample Containers [Office of Solid Waste and Emergency Response (OSWER) Directive No. 9240.0-05A].

Non-disposable equipment items that will come in contact with ground-water and requires decontamination include the following:

- Water level indicators (in contact with ground-water)
- Flow-through cell
- Turbidity meter

Equipment decontamination will include the following the procedures:

- Flush the equipment with potable water
- Wash/flush the equipment with non-phosphate detergent solution (e.g., Liquinox)
- Flush the equipment with tap water to remove all of the detergent solution

- Flush the equipment with distilled/deionized water
- Flush the equipment with isopropyl alcohol
- Flush the equipment with distilled/deionized water

It is recommended that the non-phosphate detergent and isopropyl alcohol be used sparingly in the above sequence. In addition, care should be taken to not get sensitive electronic components of the field equipment wet (see equipment owner's manuals for suggested cleaning procedures).

To ensure that sampling equipment has been decontaminated properly, equipment rinsate blanks will be collected and analyzed as described in Section 13.

9.4 FIELD EQUIPMENT MAINTENANCE, TESTING, CALIBRATION, AND INSPECTION

Equipment, instruments, gauges, and other items requiring preventive maintenance will be serviced, when appropriate, by the equipment supplier or the FOL (or designee) in accordance with the manufacturers' recommendations. Manufacturers' procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the FOL to adhere to this maintenance schedule and to arrange for any necessary and prompt service required. Service of the equipment, instruments, tools, gauges, etc. shall be performed to the extent possible by the FOL (or designee). If the service requires a more qualified person, the supplier or manufacturer will be contacted for assistance. Logs shall be established by the FOL (or designee) to record maintenance, service procedures, and schedules. Maintenance records will be documented and traceable to the specific equipment, instruments, and gauges.

The multi-probe water quality meters and turbidity meters will be tested and calibrated utilizing standard solutions supplied by the equipment manufacturer (or the rental company) at the beginning of each field day or more frequently if fluctuations in readings appear to be abnormal. The calibration will also be checked at the end of each field day or more frequently if fluctuations in readings appear to be abnormal. If a result of the calibration check exceeds 10 percent in any of the calibration standards, the meter will be recalibrated. Prior to use each day and after each use during a day, field analytical equipment will be decontaminated in accordance Section 9.3. When not in use, the instrument will be stored in an area shielded from weather conditions. Records of instrument calibration and calibration checks will be maintained on a field instrument calibration log sheet. The FOL or designee will maintain instrument manuals on site. If the meter does not maintain an acceptable level of calibration during a single day's use, the meter will be calibrated more frequently or it will be replaced.

It will be the responsibility of the FOL (or designee) to inspect all supplies to be used as part of the field program during mobilization and use. Supplies to be inspected include sampling equipment, field meters, and sample containers.

If the FOL encounters any problem with the supplies, he/she will inform the TtNUS PM and the laboratory supplying the containers. The TtNUS PM, in consultation with the Navy RPM and QA/QC Officer, will instruct the FOL on any corrective actions that should be implemented.

TABLE 9-1

GROUND-WATER SAMPLE HANDLING AND ANALYSIS INFORMATION
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Analysis	No. of Samples	Analytical Method	Bottleware	Preservation	Holding Time
GROUNDWATER SAMPLES					
1,4-Dioxane	10	SW-846 8270C SIM	1-Liter glass amber	Cool to 4° C	14 days to extract, 40 days to analyze

Notes:

1 Number of samples does not include QA/QC samples.

10.0 SAMPLE HANDLING, TRACKING, AND CUSTODY REQUIREMENTS

Sample labeling, handling, tracking, and custody requirements are provided in this Section, along with field note and documentation requirements.

10.1 SAMPLE DESIGNATION AND LABELING

All ground-water samples collected at Site 16 will be properly labeled with an indelible marker (or pre-printed labels), and the sample label will be affixed to the sample container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of an alphanumeric code that identifies the sample's associated site, sample type, location, and/or the sample round number.

The alphanumeric coding to be used in the Site 16 sample system is as follows:

AANN	NNA	AAA
Location Type and Site	Monitoring Well and Depth Qualifier	Sample Type

Character Type:

A = Alpha
N = Numeric

Location Type and Site:

MW16 = Ground-water sample from Site 16.

Monitoring Well and Depth Qualifier:

The ground-water monitoring well with depth qualifier, as presented in Section 8 and on Figure 8-1.

Sample Type:

NWG = Ground-water.

Example of Sample Nomenclature

A ground-water sample collected from MW 16-05D would be designated as MW16-05D-NWG. Field QA/QC samples will be designated using a different coding system. The QC code will consist of a two-segment alphanumeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN
QC Type	Date (MMDDYY)	Sequence Number (per day)

The QC types are identified as:

FD = Field duplicate
RB = Equipment rinsate blank (equipment blank)
SB = Source blank

The sampling time recorded on the chain-of-custody forms and labels for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

Example of Field QA/QC Nomenclature

The first duplicate of the day for a ground-water sample collected on April 15, 2006 would be designated as FD04150601.

10.2 HANDLING, CUSTODY, AND SHIPPING

Sample custody procedures are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. Field chain-of-custody procedures are described in TtNUS SOP SA-6.1, Non-Radiological Sample Handling provided in Appendix B. Laboratory chain-of-custody procedures are described in the laboratory SOPs.

Integrity of the samples collected during the site investigation will be the responsibility of identified persons from the time the samples are collected until they or their derived data are incorporated into the final report. Stringent chain-of-custody procedures will be followed to document sample possession.

10.2.1 Field Custody

The FOL (or designee) is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier.

Sample logs or other records will be signed and dated by the person(s) making the entries.

Chain-of-custody forms will be completed to the fullest extent possible before sample shipment. They will include the following information: project name, sample identification, date and time collected, analyses to be conducted, matrix, type of sample, grab or composite designation, preservative, and name of sampler. Sample depths will also be indicated on the chain-of-custody form. These forms will be filled out in a legible manner using waterproof ink and will be signed by the sampler. Similar information will be provided on the sample label, which will be securely attached to the sample bottle. The label will also include the analyses to be conducted. In addition, sampling forms will be used to document collection, filtration, and preparation procedures. Copies of all forms used during field activities are provided in the SOPs included in Appendix B.

10.2.2 Transfer of Custody

The following procedures will be used when transferring custody of samples:

- All sample coolers will be custody-sealed for security and accompanied by a chain-of-custody form. When transferring samples, the individual(s) relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the laboratory SOPs.

- Prior to shipment to the laboratory for analysis, samples will be properly packaged. Individual custody records will accompany each shipment. Shipping containers will then be sealed for shipment to the laboratory. The method(s) of shipment, courier name, and other pertinent information will be entered in the “remarks” section of the custody record.

- All shipments will be accompanied by the chain-of-custody form identifying the contents. The original record will accompany the shipment, and a copy will be retained by the field sampler.

- Proper documentation (i.e., airbills) will be maintained for shipments by common carrier.

10.2.3 Sample Shipment Procedures

The following procedures will be followed when shipping samples for laboratory analysis:

- Samples requiring cooling to 4 degrees Celsius (°C) will be promptly chilled with ice and will be packaged in an insulated cooler for transport to the laboratory. A temperature blank will be included in each cooler to be used as a temperature indicator. Each temperature blank will be clearly identified by the field sampling team. Ice will be sealed in containers to prevent leakage of water. Samples will not be frozen.

- Only shipping containers that meet all applicable state and federal standards for safe shipment will be used.

- The field chain-of-custody form will be placed inside the shipping container in a sealed, plastic envelope. Shipping containers will be sealed with nylon strapping tape, and custody seals will be signed, dated, and affixed in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to the laboratory.

- Samples to be delivered to the laboratory will be made by a public courier. After samples have been collected, they will be sent to the laboratory within 72 hours. Under no circumstances will sample holding times be exceeded.

10.2.4 Laboratory Sample Custody

To ensure the integrity of a sample from collection through analysis, it is necessary to have an accurate, written record that traces the possession and handling of the sample. This documentation is referred to as the chain-of-custody form.

A sample is under custody if:

- The sample is in the physical possession of an authorized person
- The sample is in view of an authorized person after being in his/her possession
- The sample is placed in a secure area by an authorized person after being in his/her possession
- The sample is in a secure area restricted to authorized personnel only

When samples are received, the chain-of-custody form is signed and dated to acknowledge sample receipt. The laboratory sample custodian must examine the shipping containers and verify that the correct number of containers was received. The shipping containers are then opened, and the enclosed

sample paperwork is removed. Samples are removed from the shipping containers, and the bottle condition and temperature of the temperature blank must be noted. The information on the chain-of-custody form, the airbill, the containers, and the laboratory request form is reviewed to note any discrepancies.

The laboratory will be required to fax the chain-of-custody forms and sample log-in information to the TtNUS PM after every shipment.

All samples received by the laboratory must be stored at 4°C until analysis. The laboratory sample holding times are specified by the contract and are presented in Table 9-1.

10.3 SAMPLE DOCUMENTATION

The documentation necessary for this investigation includes the following:

- Field logbook
- Chain-of-custody form(s)
- Field sampling form(s).

It will be the responsibility of the FOL to secure all documents produced in the field (e.g., sampling logs, calibration forms, field sampling forms, etc.) at the end of each work day. Copies of all forms used during field activities are included in the SOPs. Copies of all field logbooks will be sent to EFANE to the attention of Mr. Curt Frye (Navy RPM). Sample logs and chain-of-custody forms will be included as an appendix to the report that will be prepared based on results of this investigation.

At the completion of field activities, the FOL will send the TtNUS PM all field records, data, field notebooks, logbooks, chain-of-custody forms, sample log sheets, daily logs, etc. The TtNUS PM will ensure that these materials are entered into the TtNUS document control system in accordance with appropriate administrative guidelines.

10.3.1 Field Logbook

Documentation of field observations will be recorded in a field logbook and/or on field log sheets including sample collection logs (ground-water), water level logs, and well purging logs. Field logbooks used for this project will consist of bound, water-resistant logbooks. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink. Field logbooks will be maintained according to TtNUS SOP SA-6.3, Field Documentation (see Appendix B). Field sample log sheets will be used to document sample collection details, and other observations and activities will be recorded in the field logbook.

For sampling and field activities, the following types of information will be recorded as appropriate:

- Site name and location
- Location of sampling activity
- Description of sampling point(s)
- Date and time of sample collection
- Medium sampled
- Number and volume of sample(s) collected
- Analysis to be performed
- Additional sampling analysis observations
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made on site
- Visitor names, affiliations, arrival, and departure times
- Health and safety issues including PPE

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information, initialing and dating the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

Ground-water sample collection information will be recorded on TtNUS sampling log sheets. The field logbooks and sample log sheets will remain on site for the duration of the investigation. After the investigation is completed the field sampling log sheets will be placed in the project file. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project file after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be given titles based on dates and activities.

10.3.2 Chain-of-Custody Forms

A completed chain-of-custody form will accompany the samples shipped to the laboratory and will contain the following information:

- Project name and project and task numbers
- Name(s) of person(s) collecting samples
- Date and time samples were collected
- Type of sampling conducted (e.g., grab)
- Sample matrix (i.e., ground-water)
- Parameters and methods for analysis
- Locations of samples collected
- Field filtration and/or preservation methods
- Number and type of containers used
- Signature of field personal relinquishing sample
- Date and time of custody transfer to overnight courier
- Name of sample courier (e.g., Federal Express)

The chain-of-custody forms provided by the contracted laboratory with the sample containers/coolers may be used by the sampling team and included with the samples if the FOL deems that sufficient entries are provided to meet the above criteria. In lieu of the laboratory-provided chain-of-custody, a TtNUS-specific chain-of-custody form may be used, as described in TtNUS SOP SA-6.3, Field Documentation (see Appendix B).

10.3.3 Field Sampling Form

This form will be used by the person sampling to record the physical measurements of the sample information, and also as a reference. Details to be included on these forms was provided in Section 10.3.1. Example sampling forms are included in the SOPs in Appendix B.

11.0 FIELD ANALYTICAL METHOD REQUIREMENTS

This section of the QAPP describes the procedures that will be used in the field to obtain measurements of water quality parameters. A Horiba Model U-22 multi-probe water quality meter (or equivalent) will be used to measure these parameters in ground-water, in conjunction with a flow-through cell, as ground-water is pumped out of a well during low-flow well purging. Turbidity will be measured separately with a Lamotte 2020 (or equivalent) meter.

11.1 FIELD ANALYTICAL METHODS AND SOPS

Field measurements of pH, dissolved oxygen, specific conductance, salinity, temperature, turbidity, and ORP will be performed during low-flow purging for well sampling as described in Section 9.1.1. These measurements will be made using a Horiba Model U-22 or equivalent multi-probe water quality meter and Lamotte 2020 or equivalent turbidity meter. Each of these measurements will be performed using an electrode or sensor designed specifically for the parameter being measured. The calibration and use of the meters will be performed per Section 9.3.

11.2 FIELD ANALYTICAL METHOD/SOP MODIFICATIONS

No modifications of SOPs are anticipated.

12.0 FIXED-BASE LABORATORY ANALYTICAL METHOD REQUIREMENTS

Ground-water samples will be analyzed for 1,4-dioxane by Northeast Laboratory Services using Method SW-846 8270 SIM. The reporting limit for 1,4-dioxane in ground-water samples is 2 µg/L. Table 12-1 summarizes laboratory maintenance and calibration procedures. The laboratory SOP is provided as Appendix C.

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TABLE 12-1

FIXED-LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Instrument	Activity	Maintenance, Testing, and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/ SOP Reference
GC/MS	SVOC Analysis	Cut column, change liner and replace septa (i.e., if soils were run in prior batch) or as needed. Manual tune if DFTPP not in criteria.	Initial – Instrument receipt, instrument change (new column, source cleaning, etc.), or when CCV is out of criteria.	Initial - %RSD must be less than or equal to 30%.	See method SOP Appendix C	Analyst/ Supervisor	Appendix C
			CCV – at the beginning of each 12-hour shift immediately after DFTPP tune.	CCV – %D for 1,4-dioxane must be less than or equal to 20%.	See method SOP Appendix C	Analyst/ Supervisor	Appendix C

GC/MS – Gas chromatography/mass spectroscopy.
SVOC – Semivolatile organic compounds.
CCV – Continuing Calibration Verification.
RSD – Relative Standard Deviation.
SOP - Standard Operating Procedure.
DFTPP – decafluorotriphenylphosphine.
%Ds – percent differences.

13.0 QUALITY CONTROL REQUIREMENTS

Northeast Laboratory Services will operate QC programs that assure data users of the reliability and validity of the analyses performed at the laboratory. The laboratory's QA plan describes the policies, organization, objectives, QC activities, and specific QA functions used by the laboratory. The analysis procedure is documented as an SOP. The analytical SOP specifies minimum QC requirements for the procedure. The analytical SOP is provided as Attachment C. In addition, the laboratory maintains SOPs regarding general laboratory QA operations.

Internal laboratory analytical QC requirements beyond those used for instrument calibration QC are highlighted in the remainder of this section. Additional QC requirements specific to the Navy's Installation Restoration Laboratory Quality Assurance/Quality Control Program (Lab QA/QC Program) are also specified, as applicable, for each of the QC checks. Target precision and accuracy values (control limits) are presented in Tables 13-1A and 13-1B. The analytical SOP should be consulted for calibration QC measures.

13.1 LABORATORY CONTROL SAMPLES

LCSs provide a means to monitor the overall performance of each step of the analysis, including the sample preparation in a clean sample matrix. These are blank spikes (water analyses) that contain concentrations of analytes that are known with a specified degree of certainty.

Based on the requirements of the Department of Defense Quality Systems Manual (2002), LCSs for organic analyses must contain all analytes of interest. If recovery of an LCS falls outside the control limits, the laboratory will reject the data for the analytical batch and take corrective action. The associated samples or extracts may be reanalyzed a single time, and if the LCS recoveries meet acceptance criteria, the data will be reported. If LCS analyte recovery is still outside the acceptance limits, the associated samples in the preparation batch will be reprocessed if sufficient sample is available and holding times have not lapsed. If repreparation or reanalysis is not possible, the data will be flagged, and the sample delivery group (SDG) narrative will include details of the failed LCS.

13.2 LABORATORY METHOD BLANKS

A laboratory method blank or preparation blank is an analyte-free matrix prepared and analyzed in accordance with the analytical method employed to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. Analyte-free matrix is used as a blank for analyses.

Acceptance criteria for laboratory method blanks and corrective actions for non-compliant results are described in the applicable analytical SOPs, which will be provided under separate cover. Under no circumstances should laboratory method blank contaminant values be subtracted from environmental sample analytical results.

13.3 MATRIX SPIKES/MATRIX SPIKE DUPLICATES

MSs are environmental samples to which known quantities of analytes are added prior to sample preparation (digestion or extraction). These samples provide information about the heterogeneity of the samples as well as the effect of the sample matrix on the sample digestion and measurement methodology.

To conform to Navy requirements, MSs will contain as many representative analytes as practicable. For many analyses, the spiking list will consist of most or all the target analytes.

If MS recovery is not within applicable control limits, the laboratory will assess the batch to determine whether the spike results are attributable to a matrix effect or are the result of other problems in the analytical process. Based on Navy requirements, if all the batch QC elements that are not affected by the sample matrix are in control (e.g., method blank, LCS, calibration checks) and if no evidence shows that spiking was not properly performed, the poor spike recovery may be attributed to matrix effects. In this case, the associated data will be flagged, but repreparation and reanalysis will not be required. If any of the batch QC elements that are not affected by the sample matrix are out of control, or if any evidence shows that spiking may have been improperly performed, the MS sample will be reprocessed through the entire analytical sequence. If insufficient sample is available or if holding times have passed, the laboratories will flag the associated data. Details of non-compliant and laboratory duplicate results will be included in the SDG narrative.

MSDs are duplicates of MSs and are used for estimating the precision of organic target analyte analyses. They are used in lieu of simple duplicate samples because native environmental samples frequently do not exhibit detectable levels of organic target analytes, which otherwise prevents the calculation of RPD values.

13.4 SYSTEM MONITORING COMPOUNDS (SURROGATES)

System Monitoring Compounds are organic compounds (typically brominated, fluorinated, or isotopically labeled) that are similar in nature to the compounds of concern and are not likely to be present in

environmental media. They are spiked into each sample, standard, and method blank before analysis and are used in organic chromatographic analytical procedures as a check of method effectiveness.

13.5 PERFORMANCE EVALUATION SAMPLES

Northeast Laboratory Services is the fixed-based laboratory conducting analysis of the 1,4-dioxane ground-water investigation samples. The selected laboratory has had a Naval Facilities Engineering Service Center (NFESC) audit (as per the Department of Defense Quality Systems Manual, 2002) within the last 18 months, which required evaluation of Performance Evaluation (PE) samples. The laboratory passed the audit; therefore, further testing of PE samples by the laboratory is not required. Results of the PE evaluation are available from the laboratory. The NFESC audit/review cycle is approximately 18 months.

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TABLE 13-1A

FIXED-BASE LABORATORY ANALYTICAL QC SAMPLE TABLE
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 1 OF 4

Medium/Matrix	Aqueous
Sampling SOP	See Section
Analytical Parameter	1,4-Dioxane
Concentration Level	Low (2 µg/L)
Analytical Method/SOP Reference	SW846 3510C/8270C-SIM
Laboratory Name	Northeast Laboratory Services
No. of Sample Locations	10

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1 per 20 samples or daily whenever samples are extracted by the same procedure	1,4-dioxane less than 2.0 ug/l	(1) Investigate source of contamination (2) Evaluate the samples and the associated QC, i.e., if the blank results are above the RL, report sample results which are <RL or >10X the blank concentration for that analyte. If sample >RL and <10X the blank concentration for that analyte, reprep if less than 2X hold-time	Analyst/ Supervisor	Accuracy/ bias-Contamination	1,4-dioxane ≤ 2.0 ug/l
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA

TABLE 13-1A

FIXED-BASE LABORATORY ANALYTICAL QC SAMPLE TABLE
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 2 OF 4

Medium/Matrix	Aqueous
Sampling SOP	See Section
Analytical Parameter	1,4-Dioxane
Concentration Level	Low (2 µg/L)
Analytical Method/SOP Reference	SW846 3510C/8270C-SIM
Laboratory Name	Northeast Laboratory Services
No. of Sample Locations	10

Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Laboratory Matrix Spike	1 for each group of 20 samples of a similar matrix or concentration	1,4-dioxane: 30-150%	See Section 13.3	Analyst/ Supervisor	Accuracy/bias	1,4-dioxane: 30-150%
Matrix Spike Duplicate	1 for each group of 20 samples of a similar matrix or concentration. In the event insufficient volume is available, the lab will perform LCS/LCSD analyses	1,4-dioxane: 30-150%	(1) In the event that the MS or MSD surrogates are outside criteria and the sample <25 ug/l the MS/MSD will be reextracted and reanalyzed if less than 2X hold-time. (2) No CA will be taken when both the MS and MSD	Analyst/ Supervisor	Accuracy/bias	1,4-Dioxane: 30-150%

TABLE 13-1A

FIXED-BASE LABORATORY ANALYTICAL QC SAMPLE TABLE
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
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Medium/Matrix	Aqueous
Sampling SOP	See Section
Analytical Parameter	1,4-Dioxane
Concentration Level	Low (2 µg/L)
Analytical Method/SOP Reference	SW846 3510C/8270C-SIM
Laboratory Name	Northeast Laboratory Services
No. of Sample Locations	10

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
			surrogates are in criteria.			
Laboratory Control Sample	Every 20 samples of a similar matrix or concentration or every batch of samples extracted	1,4-dioxane: 30-150%	(1) If an MS/MSD was performed and acceptable narrate. (2) If the surrogate recoveries in the LCS are also low but are acceptable in the blank and samples narrate. (3) If the LCS recovery is high but the sample results are <QL, narrate. Otherwise reextract affected sample batch if less than 2X Hold-time.	Analyst/ Supervisor	Accuracy/bias	1,4-dioxane: 30-150%
Surrogates	Every sample, blank, LCS, MS/MSD	All surrogates must meet the following acceptance limits:	(1) If the surrogates are outside high and sample is <QL, no CA taken.	Analyst/ Supervisor	Accuracy/bias	All surrogates must meet the following acceptance limits:

TABLE 13-1A

FIXED-BASE LABORATORY ANALYTICAL QC SAMPLE TABLE
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 4 OF 4

Medium/Matrix	Aqueous
Sampling SOP	See Section
Analytical Parameter	1,4-Dioxane
Concentration Level	Low (2 µg/L)
Analytical Method/SOP Reference	SW846 3510C/8270C-SIM
Laboratory Name	Northeast Laboratory Services
No. of Sample Locations	10

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
		2-methylnapthalene-d10: 20-150%	(2) If surrogates are low outside limits, the affected sample is reextracted and reanalyzed to confirm matrix interference.			2-methylnapthalene-d10:20-150%
Internal Standards (	Every sample, blank, laboratory control sample, matrix spike, matrix spike duplicate	Response must be within -50 % to +100 % of daily continuing calibration standard. Retention time must be within specified RT window	Re-analysis	Analyst/ Supervisor	Accuracy/bias	Response must be within -50 % to +100 % of daily continuing calibration standard. Retention time must be within specified RT window

RL - Reporting Limit
RT – Retention Time
LCS – Laboratory control sample
QL – Quantitation limit
NA – Not applicable

TABLE 13-1B

FIXED-BASE LABORATORY METHOD/SOP PRECISION AND ACCURACY TABLE 1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Analyte	Achievable Laboratory Sensitivity/ Quantitation Limit (µg/L)	Analytical Precision Relative Percent Difference	Analytical Accuracy/Bias %Recovery
1,4-Dioxane	2	≤20	30-150

14.0 DATA ACQUISITION REQUIREMENTS

The 1,4-dioxane ground-water investigation ground-water samples will be submitted to Northeast Analytical Laboratory for analysis. The analytical data will be validated in accordance with Tier 2 USEPA Region I Guidance by TtNUS chemists, and the validated data incorporated into the site database. Validated ground-water data will be compared to Region IX PRGs, and a data summary report will be prepared.

15.0 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

15.1 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

This section describes how all analytical information will be managed, organized, and maintained for efficient use by project personnel. The information management process is outlined from the point of data generation to ultimate storage.

15.1.1 Documentation and Records of the Analytical Program

A summary of records and documentation to be generated as a result of the 1,4-dioxane ground-water investigation and stored in the TtNUS project files is provided in Table 15-1. Information to be maintained in the laboratory files is outlined in Table 15-2 of this QAPP Addendum.

15.1.2 Field Analysis Data Package Deliverables

The only field measurements to be collected are monitoring well development, and purging which will be recorded on field log sheets as described in Section 9.0.

15.1.3 Fixed-Base Laboratory Data Package Deliverables

A turnaround time of 21 days will be required. Contract Laboratory Program (CLP)-like Portable Document Format (PDF) data package deliverables will be provided by Northeast Laboratory Services.

15.1.4 Data Reporting Formats

Field data will be recorded in field logbooks and on field forms. All logbook and log sheet entries must be made in indelible ink (black pen is preferred). No erasures or liquid paper or white out are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed, and dated. The field personnel will sign and date the logbook pages and field forms. Examples of the forms to be used in the field are presented in Appendix B of this QAPP Addendum.

The equivalent of CLP data reporting Forms 1 through 14 required in the Statement of Work (SOW) for organic analyses will be submitted by the laboratory for the sample results. Table 15-2 displays the laboratory data package requirements.

15.1.5 Data Handling and Management

The data-handling procedures to be followed by the laboratory will meet the requirements in the laboratory subcontracts. All analytical and field data will be maintained in the project files. The project files will contain hard copies of the chain-of-custody forms, sample log forms, and sample location maps and documentation of QA of data manipulation.

15.1.6 Data Tracking and Control

A “cradle-to-grave” sample tracking system will be used from the beginning to the end of the investigation. The sample identification system will consist of the format described in detail in Section 10.0. Before field mobilization, the FOL will coordinate with the SMC to initiate the sample tracking process. All sample numbers, requested laboratory analyses, and preservative information will be entered into a sample tracking database before each sampling event. The SMC will use the database to print sample jar labels, if necessary, before field sampling. The FOL and Lead Chemist will review the labels for completeness of information and adherence to QAPP Addendum requirements, as well as for accuracy. The SMC will also send an advance paper copy of labels and the sample tracking database to the laboratory.

When field sampling is underway, the FOL will forward the chain-of-custody forms to the SMC via facsimile at the end of each day. The Lead Chemist will compare the entries on the chain-of-custody forms with the sample tracking database and enter the sample date and other sample information as appropriate. The Lead Chemist will also confirm that the chain-of-custody forms provide the information required by the QAPP Addendum. This will allow for early detection of errors made in the field so that adjustments can be made while the crew is mobilized. After successful completion of all requested analyses, the laboratory will submit an electronic deliverable for every SDG. When all electronic deliverables have been received from the laboratory, queries will be run versus the pre-field effort database of sample labels and sample collection information to ensure that the laboratory performed all the requested analyses. The TtNUS PM will be notified of any discrepancies. Ideally, discrepancies will be noted early enough so that all samples can be analyzed within the prescribed holding times.

15.1.6.1 Sample Information

Data from field observations will be recorded directly in field notebooks or on sample logs. The reduction of laboratory data entails the manipulation of raw data instrument output into reportable results. Laboratory data will be verified by the group supervisor and then by the laboratories' QC/Documentation Department.

Before electronic files are received from the laboratory, all sample-specific information will be entered into the data management system. The sample information file will allow the analytical results to be grouped together properly for statistical purposes. The data will be managed in one data structure.

Electronic data arriving from the laboratory will pass through the SMC to the Data Validation Manager (DVM) for database compilation and validation. The DVM will compile all the formatted laboratory electronic deliverables into a working project database. Data that are to be validated will be printed as data packages that include the samples included in each SDG and the appropriate analytical fraction. The data packages will be distributed to the appropriate data validators. The data validators will enter all data qualifiers and qualifier codes into the database, print out a hard copy, of the validated results and return it to the DVM. The DVM will check the data qualifiers and qualifier codes in the project database and print the final validated data for incorporation into the data validation letter. When all samples and analyses have been accounted for and validated, the DVM will forward the project database to the Information Management Resource Group (IMRG), which will incorporate the analytical data into the relational database located on the Local Area Network (LAN) in the TtNUS Pittsburgh office.

15.1.6.2 Project Data Compilation

The analytical laboratory subcontractor will generate PDF files of the analytical data packages and the electronic data deliverables. The electronic database will be checked against hard-copy results from the PDF file provided by the laboratory and updated as required based on data qualifier flags applied during the data validation process. The data generated under this additional scrutiny program will be incorporated into the NCBC Davisville database and Geographical Information System (GIS). All data, such as units of measure and chemical nomenclature, will be manipulated to maintain consistency with the project database. The project database is a relational database that ensures data structure integrity and data quality for all NCBC Davisville data.

15.1.6.3 Geographical Information System

Data management systems consist of a relational database and GIS used to manage environmental information pertaining to NCBC Davisville. The relational database stores chemical, geological, hydrogeological, and other environmental data collected during environmental investigations. The GIS is built from the relational database and contains subsets of the larger data pool.

Upon compilation of sample, chemical, and positional data, the data will be incorporated into the NCBC Davisville GIS. The GIS can be used to generate various maps for NCBC Davisville data including site location maps, sample location maps, and contaminant tag maps, as needed. ESRI ArcView 3.x and ESRI ArcView 9.x are the GIS software packages that will be used. The sampling locations will be

assigned coordinates based on North American datum (NAD) 1927 State Plane Rhode Island U.S. Survey Feet coordinate system. The North American Vertical Datum (NAVD) 1988 will be used for elevation data.

TABLE 15-1

SAMPLING AND ANALYTICAL PROGRAM DOCUMENTATION AND RECORDS 1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Sample Collection Records	Fixed-Base Laboratory Records	Data Assessment Records	Other
Field Logbooks	Sample receipt, custody, and tracking records	Audit report and quality notices	All versions of Addendum QAPP
Sample Log Sheet-ground-water	Standards traceability logs	Data validation report	Health and Safety Plan
Chain-of-Custody Records	Equipment calibration logs		All versions of project reports
Telephone Logs	Sample prep logs		
Field Instrument Calibration Logs	Sample analysis logs		
	Sample disposal records		
	Telephone logs		

TABLE 15-2

**LABORATORY DATA PACKAGE ELEMENTS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 1 OF 2**

DATA PACKAGE ELEMENT	1,4-DIOXANE
Table of Contents	☑
Full Narrative	☑
EPA Shipping/Receiving Documents & Internal Laboratory COC Records	
External chains of custody	☑
Internal Chains of Custody	☑
Sample Data	
Report of Analysis (Form 1 or equiv)	☑
Reconstructed Total Ion Chromatogram (RIC) for each sample	☑
Raw spectra of target compound and background subtracted spectrum of target compound for each sample	☑
GC Integration report or data system printouts and calibration plots for each sample	☑
Sample preparation, extraction and/or digestion logbook pages	☑
Initial Calibration (Org Form 6)	☑
Continuing Calibration (Org Form 7)	☑
RICs and Quant Reports for all GC/MS Standards	☑
GC Chromatograms and Data System Printouts for all GC Standards	☑
Sample Preparation logs	☑

TABLE 15-2

**LABORATORY DATA PACKAGE ELEMENTS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 2 OF 2**

DATA PACKAGE ELEMENT	1,4-DIOXANE
QC Data	
Blank Results (Org Form 1)	☑
Surrogate Recoveries (Org Form 2 or equiv)	☑
Laboratory Control Sample Recovery (Org Form 3)	☑
Dup/MS/MSD if performed on client sample (Org Form 3)	☑
Blank Summary (Org Form 4 or equiv)	☑
Tune Summary (Org Form 5 or equiv)	☑
Internal Standard Area Summary (Org Form 8 or equiv)	☑
QC raw data (RICs, chromatograms, quant reports, integration reports, mass spectra)	☑
QC sample preparation logbook pages	☑

TABLE 15-3

DATA VALIDATION SUMMARY TABLE / MODIFICATION
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Medium/ Matrix	Analytical Parameter	Concentration Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level Used	Modified Tier Level Used	Data Validator (Name, Title, and Organizational Affiliation)	Responsibility for Data Validations
Ground-water/ Aqueous Field QC	1,4-Dioxane	Low	USEPA Region I Functional Guidelines for Evaluating Organic Analyses, (1996), as relevant; National Functional Guidelines for Organic Review, 1999, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual, (1999) as relevant.	N	Tier II	N	TBD[1]	Data Validation Coordinator

1 Data validator will be determined when the pdf data deliverables arrive from the laboratory.

NFESC Naval Facilities Engineering Service Center.
TBD To be determined.

16.0 ASSESSMENTS AND RESPONSE ACTIONS

Assessment activities ensure that the resultant data quality is adequate for its intended use and that appropriate corrective actions are implemented to address nonconformances and deviations from the QAPP Addendum.

16.1 PLANNED ASSESSMENTS

The assessments planned for this project are system audits and field audits, as identified in Table 16-1.

System audits will be performed as appropriate to ensure that work is being implemented in accordance with the approved project SOPs and in an overall satisfactory manner. These audits will be performed in the following manner:

- The FOL will supervise and check on a daily basis that field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is accurately and neatly documented. The FOL will update the TtNUS PM of field activities on a daily basis.

- System audits for the laboratory will be performed regularly, and in accordance with NFESC guidance, as provided in the Laboratory Quality Assurance Plan (LQAP).

- The data validator will review the chemical analytical data packages submitted by the laboratory. The data validator will check that the data were obtained through use of the approved methodology, that the appropriate level of QC effort and reporting was conducted, and whether or not the results are in conformance with QC criteria. On the basis of these factors, the data validator will generate a report describing data limitations, which will be reviewed internally by the DVM before submittal to the PM.

- The PM will maintain contact with the FOL and DVM to ensure that management of the acquired data proceeds in an organized and expeditious manner.

Additionally, an independent performance audit of field activities may be conducted at the discretion of and under the direction of the QA Officer. If a formal field audit is conducted, the QA Officer will check that sample collection, handling, and shipping protocols, as well as equipment decontamination and field documentation procedures, are being performed in accordance with the approved project planning documents and SOPs.

Performance audits of laboratories are coordinated through NFESC and are conducted periodically by NFESC's independent QA contractor.

16.2 ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

Assessment findings that require corrective action initiate a sequence of events that includes documentation of deficiencies, notification of findings, request for corrective action, implementation of corrective action, and follow-up assessment of corrective action effectiveness. Table 16-1 summarizes how QAPP Addendum deviations and project deficiencies, which are identified through the planned project assessments, will be handled.

Potential problems may involve nonconformance with the SOPs and/or analytical procedures established for the project or other unforeseen difficulties. Any person identifying a condition adverse to project quality will notify the TtNUS PM. The TtNUS PM, with the assistance of the QA Officer, will be responsible for developing and initiating appropriate corrective action through the FOL and for verifying that the corrective action has been effective. Corrective actions may include: resampling and/or reanalyzing a sample or amending or adjusting project procedures. If warranted by the severity of the problem (e.g., if a change in the approved plan is required), the Navy will be notified in writing and its approval will be obtained before implementing any change. The USEPA and RIDEM will be consulted about any scope changes that may occur while fieldwork is underway. Communications and correspondence to the BCT will be handled through inclusion on the distribution list or written correspondence and updates at BCT meetings. Minor changes will be documented for the main file by the TtNUS PM. Additional work that depends on a nonconforming activity will not be performed until the problem has been eliminated. The overall corrective action responsibility for system audits will reside with the TtNUS PM. The overall corrective action responsibility for field audits will reside with the TtNUS QA Officer.

For QA issues involving the analytical laboratory to be used for the project, the laboratory also maintains an internal closed-loop corrective action system that operates under the direction of the laboratory QA coordinator.

16.3 ADDITIONAL QAPP ADDENDUM NONCONFORMANCES

Deviations from the QAPP Addendum noted by project personnel outside of the formal assessment process will be documented and resolved using the procedures and personnel that were detailed for planned assessments in Sections 16.1 and 16.2.

TABLE 16-1

PROJECT ASSESSMENT
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person responsible for performing assessment, title and organizational affiliation	Person responsible for responding to assessment findings, title and organizational affiliation	Person responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person responsible for monitoring effectiveness of CA, title and organizational affiliation
System Audit	Continuously	Internal	TtNUS	TtNUS PM: L. Sinagoga	TtNUS FOL	TtNUS FOL	TtNUS Program Manager: J. Trepanowski
Field Audit	Conducted at the discretion of the QA Officer	Internal	TtNUS	TtNUS QA Officer: K. Carper (or designee)	TtNUS PM: L. Sinagoga	TtNUS FOL	TtNUS QA Officer: K. Carper

17.0 QUALITY ASSURANCE MANAGEMENT REPORTS

This section presents the activities that will be performed to keep management updated on the project status. Open communication pathways will benefit the project by allowing all appropriate personnel to be aware of activities and to have the ability to provide input in a timely manner. Input from these parties will be used to make necessary corrective actions so project quality objectives are met.

The information to be included in each of the QA Management Reports listed in Table 17-1 is summarized as follows.

17.1 VERBAL STATUS REPORTS

The Lead Chemist and FOL will give verbal status reports to the TtNUS PM on a daily basis during field activities or more frequently if needed. The status reports will include the field activities completed for the day, the personnel who completed each activity, the anticipated activities to be completed during the next day, and any issues or problems identified. A summary of most significant progress in project activities will be sent via electronic mail to the PM.

17.2 PROJECT STATUS REPORTS

No formal status reports are needed because of the short duration of the project. The field logbooks will serve as records of field activities.

17.3 FIELD AUDIT REPORT

Field audits may be performed at the discretion of the QA Officer. The audits will be performed by the QA Officer or designee during field investigations and will include checks on adherence to the QAPP Addendum and all applicable SOPs. The QA Officer will then prepare an audit report summarizing the findings. Nonconformance Quality Notices will be issued to document each observation, deficiency, or concern discovered during the audit. This report will be distributed to the Navy RPM, the TtNUS PM, and the project file. Any findings that require immediate corrective action will be communicated immediately to the TtNUS PM.

17.4 DATA VALIDATION REPORTS

Tier II data validation reports will be developed for this project. The data validation reports will be prepared and formatted as described in Section 19.0. The data validation reports will be included in the 1,4-Dioxane Ground-Water Investigation Letter Report.

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TABLE 17-1

QA MANAGEMENT REPORTS
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

Type of Report	Frequency	Project Delivery Date	Person Responsible for Report Preparation	Report Recipients
Verbal Status Report	Daily during field activities	At the end of every day of field activities or as needed	TtNUS FOL	TtNUS PM: L. Sinagoga
Field Audit Report	Conducted at the discretion of the QA Officer	10 days after audit	TtNUS QA Officier: K. Carper	TtNUS PM: L. Sinagoga

18.0 VERIFICATION AND VALIDATION REQUIREMENTS

Data verification is a process of evaluating the completeness, correctness, and contractual compliance of a data set against the method standard, SOP, or contract requirements documented in this QAPP Addendum. Data validation is an analyte- and sample-specific process that extends the qualification of data beyond data verification to determine the quality of a specific data set.

The internal data verification requirements for this project include the maintenance and periodic review of field documentation (site logbooks, instrument calibration logs, chain-of-custody forms, field summary reports, and field modification records) and laboratory analytical data packages.

Data validation is a systematic review of the analytical data package with respect to sample receipt and handling, compliance with required analytical methods, data reporting and deliverables, and document control. A qualified chemist will review the analytical data packages using USEPA procedures. One hundred percent of the total number of environmental samples will be validated.

After the data are validated, a list of nonconformities will be generated. Nonconformities require data qualifiers, which are used to alert the data user to inaccurate or imprecise data. For situations in which several QC criteria are out of specification with regard to the limits specified in the Navy Installation Restoration Chemical Data Quality Manual, (NFESC, 1999), the data validator may make professional judgments and/or comments on the validity of the overall data package. In situations where the validity of an entire data package is in question, it may be necessary for the sample(s) to be reanalyzed. The reviewer will then prepare a technical memorandum presenting changes in the data, if necessary, and the rationale for making such changes.

The net result is a data package that has been carefully reviewed for its adherence to prescribed requirements and is suitable for its intended use. Data validation thus plays a major role in determining the confidence with which key technical evaluations may be made.

The Tier II data validation reports for 1,4-dioxane will be generated according to the requirements described in Attachment B of the Region I EPA – New England Data Validation Functional Guidelines for Evaluating Environmental Analyses, (USEPA, 1996). The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region I worksheets (where appropriate), and documentation to support data qualification. All data will be flagged by an appropriate qualifying symbol.

The data and field records will also be reviewed by project personnel to ensure that the samples represent the intended sampling conditions and populations. Data qualified during validation will be reviewed to assess the impact of the qualifiers on the attainment of project objectives.

19.0 VERIFICATION AND VALIDATION PROCEDURES

This section describes the procedures that will be followed to meet the data verification and validation requirements discussed in Section 18.0.

19.1 VERIFICATION

Verification includes field data verification and laboratory data verification.

19.1.1 Field Measurement Data Verification

The data verification process for this project includes the maintenance and periodic review of field documentation, including the following:

- Field logbook(s)
- Chain-of-custody form(s)
- Field summary report(s)
- Field modification record(s)
- Field log sheet(s)

Field audits and laboratory internal data reviews are important elements of the data verification process. Each of these elements is discussed in detail in Table 19-1.

Field data will be generated as a result of real-time measurement through on-site water quality testing for general indicator parameters including pH, specific conductance, oxidation-reduction potential, salinity, and dissolved oxygen. Field data will not be generated using a field laboratory.

The field parameters will be recorded in the site logbook and on sample log sheets immediately after the measurements are taken and later encoded in the NCBC Davisville database for presentation in the report. If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed, and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data for inclusion in the report. Field data will be entered in the electronic database manually, and the entries will be verified by an independent reviewer to make sure that no transcription errors occurred. Field measurements will be recorded and reported in the following units:

- Hydronium ion concentration - standard pH units
- Temperature - °C
- Specific conductance - millimhos
- Turbidity - nephelometric turbidity units
- Dissolved oxygen – milligrams per liter (mg/L)
- Salinity – percent
- Oxidation-reduction potential - millivolts

Standard pH units as specified above are the negative logarithm (base 10) of the hydronium ion concentration in moles/liter.

19.1.2 Laboratory Data Verification

Laboratory data reduction of 1,4-dioxane results generated via Method SW-846 8270C SIM will be completed in accordance with the applicable analytical method.

Laboratory analytical data will be reported using standard concentration units to ensure comparability with regulatory standards/guidelines and previous analytical results. The reporting unit for ground-water samples is µg/L.

19.2 DATA VALIDATION

Validation of field measurements and laboratory analytical data are discussed in this section. Validation of field data will be limited to real-time "reality" checks, whereas laboratory analytical data will be validated in accordance with current USEPA guidance. Validation of field measurements is discussed in Section 19.2.1. Validation of laboratory analytical data is discussed in Section 19.2.2.

19.2.1 Field Measurement Data Validation

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via calibration as discussed in Section 9.0 of this QAPP. As described in Section 19.1.1, all field data entered into the electronic database will be independently reviewed for transcription errors.

19.2.2 Analytical Laboratory Data Validation

One hundred percent of the laboratory data from chemical analyses will be validated. Validation of analytical data will be completed by the TtNUS Chemistry Department located in TtNUS Pittsburgh,

Pennsylvania office. Final review and approval of validation deliverables will be completed by the department's DVM. All laboratory analytical data will be subjected to validation in accordance with the USEPA Region I guidelines. The components of laboratory data validation are provided in Table 15-3.

As part of the validation process, the validator will check that the laboratory has provided all of the documentation required to support the reported analytical results. If any documentation is missing from the data package, the data validator will contact the laboratory to request a resubmittal. If the laboratory fails to resubmit the requested information, the data validator will note this on the data validation cover letter. The usability of such data will then be determined by the PM and Navy, as discussed in Section 20.0.

Data validation will be completed to ensure that the data are of evidentiary quality. Particular emphasis will be placed on holding time compliance, equipment calibration, spike recoveries, and blank results, although all required elements of the validation process will be considered.

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TABLE 19-1

VERIFICATION TASKS AND PROCEDURES
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
PAGE 1 OF 2

Verification Task	Description	I - INTERNAL E - EXTERNAL	Responsible for Verification (Name, Organization)
Site Logbook	The site logbook is a hardbound, paginated, controlled-distribution record book. Entries are made for every day that onsite activities take place. Upon completion of the fieldwork, the site logbook becomes part of the project's central file. All logbook entries are made in indelible ink. No erasures are permitted. If an incorrect entry is made, the data is crossed out with a single strike mark, initialed, and dated. At the completion of entries by any individual, the logbook pages used are signed and dated. The FOL signs the site logbook at the end of each day.	I	FOL, TtNUS
Instrument Calibration Log	Field team members calibrate or check the calibration of monitoring instruments in accordance with the SOPs. The field team member completes a calibration logsheet, initials it, and dates it. Equipment that does not calibrate properly is taken out of service. The FOL collects and submits the calibration log sheets to the project file.	I	Field Team Members, TtNUS
Chain-of-Custody Form	The FOL designates one field team member as shipment coordinator. The shipment coordinator organizes the samples into SDG by matrix, analysis, and destination and fills out the chain-of-custody form and airbill for each SDG. The samplers sign the chain-of-custody form. The shipping coordinator assigns each SDG to a field team member for packing in coolers. The packer checks each cooler's contents against the chain-of-custody form before sealing it. The original chain-of-custody form is shipped with the samples. The FOL provides a copy of the chain-of-custody form to the Lead Chemist and submits a copy to the project file. The Lead Chemist uses the chain-of-custody form to track the progress of the shipment.	I	Field Team Members, TtNUS
Field Summary Report	The project is short in duration, and field summary reports will not be required.	I	FOL, TtNUS
Field Modification Record	Changes in field operating procedures may be necessary as a result of changed field conditions or unanticipated events. If a substantial change is required, the FOL or designee notifies the TtNUS PM of the need for the change. If necessary, the PM will discuss the change with pertinent individuals, e.g., the Navy RPM, and will provide verbal approval or denial to the FOL or assistant FOL for the proposed change. The FOL will document the change on a field modification record form and forward the form to the TtNUS PM at the earliest convenient time. The PM will sign the form and distribute copies to the QA Officer, FOL, Navy, and the project file. A copy of the completed field modification record form will also be attached to the field copy of the QAPP Addendum.	I	FOL, TtNUS

TABLE 19-1

VERIFICATION TASKS AND PROCEDURES
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM
NCBC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND
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Verification Task	Description	I - INTERNAL E - EXTERNAL	Responsible for Verification (Name, Organization)
Field Audit	The QA Officer or designated representative audits fieldwork according to audit checklists or audit guides. The QA Officer immediately informs the FOL and PM of any findings that require immediate corrective action. The audits verify adherence to the QAPP and all applicable SOPs. The QA Officer records each finding of nonconformance on a Quality Notice report and submits it to the PM. The QA Officer prepares an audit report summarizing the findings, which is distributed to the Navy RPM, the PM, the FOL, and the Program and Project QA/QC files.	I	QA Officer, TtNUS
Analytical Laboratory Internal Data Review	There are five categories of review performed in the laboratory: 1. Analytical review performed by the bench chemist. It includes a review of raw data, verification of all method- and project-specific QC requirements, the addition of data qualifier flags when needed, and documentation of any unusual circumstances. 2. Technical review performed by Team Leader or QA-approved peer. 3. QA review performed by a QA specialist emphasizing overall quality of the data. 4. Data report review by the Reporting Manager, Team Leader, or approved peer to ensure the accuracy of the final report. 5. Electronic deliverable review to ensure the accuracy of the final electronic report.	I	Laboratory Manager or designee
Field log sheets	The field log sheets include sampling logs, boring logs, and well construction logs. Entries are made on-site while activities are conducted. Upon completion of field work, the field log sheets are made part of the project's central file. All entries are made in indelible ink. No erasures are permitted. If an incorrect entry is made, the information is crossed out with a single strike mark, initialed, and dated.	I	FOL, PM, TtNUS

FOL – Field Operations Leader
SDG – Sample Delivery Group
PM – Project Manager
RPM – remedial Project Manager
SOPs – Standard Operating Procedures
QC – Quality Control
QA – Quality Assurance

20.0 DATA USABILITY/RECONCILIATION WITH PROJECT QUALITY GOALS

The PARCC parameters are precision, accuracy, representativeness, comparability, completeness. Each of these parameters along with sensitivity/quantitation limits is described below.

20.1 PRECISION

The precision goals described below will be evaluated. Field duplicate sample results, laboratory duplicate results, sampling procedures, sample transport problems (if any), sample matrix problems (if any), and sample heterogeneity will be considered, as appropriate, to evaluate the overall data precision. For example, field duplicate precision will be compared to laboratory precision. The RPD between a sample or MS (Sample 1) and its duplicate or MSD (Sample 2) will be calculated for chemical analyses using the following formula:

$$\text{RPD} = \frac{\left|\text{Amount in Sample 1} - \text{Amount in Sample 2}\right|}{0.5\,(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \text{ X } 100\,\%$$

20.2 ACCURACY

The data validator will evaluate the potential for adverse impacts to the accuracy of data by reviewing laboratory blanks, field blanks, LCSs, MSs, and QC check standards. Calculation of accuracy is described below.

Control charts are plotted by the laboratory for each target analyte and are kept on matrix- and analyte-specific bases. The percent recovery (%R) for a spiked sample will be calculated by using the following formula:

$$\%\text{R} = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \text{ X } 100\,\%$$

LCSs and surrogate spikes are also analyzed to assess accuracy. The %R calculation for LCSs and surrogate spikes is as follows:

$$\%\text{R} = \frac{\text{Experimental Concentration}}{\text{Certified or Known Concentration}} \text{ X } 100\,\%$$

During data validation, any data not meeting accuracy specifications will be identified to the data user through the use of data qualifiers. The field and laboratory blanks provide indications of the potential for having contaminated samples before or during analysis, respectively. Each type of blank will be evaluated for its impact on the sampling or the analytical processes, as appropriate. Laboratory control standards and check standards indicate whether analyte quantitation is accurate and whether the analytical system was capable of generating results within the project accuracy specifications. MS recoveries indicate and will be evaluated to assess the impact of specific sample matrices on the accuracy of project data.

20.3 SAMPLE REPRESENTATIVENESS

Sampling and analysis methods and procedures were selected during project planning to provide data representing environmental media at locations selected for sampling without bias, except when a bias was intended. To evaluate the representativeness of data, the actual samples collected will be compared to the specifications for samples that were intended to be collected. Furthermore, the data verifications and validations will be reviewed to ensure that data have met project specifications for precision and accuracy. The degree to which project specifications have been met will provide a qualitative assessment of the representativeness of the data.

20.4 COMPARABILITY

Compliance with the selected methods of sample collection and analyses will produce data of suitable comparability with past and future investigations, as well as within this investigation. Therefore, compliance with the selected methods will be evaluated by reviewing field notes and data validation reports generated during data verification and validation. Data from each matrix collected at the site will be compared with historical and expected data results.

20.5 COMPLETENESS

Completeness will be computed in accordance with the following equation:

$$\%\,\text{Completeness} = \frac{(\text{Number of Valid Measurements})}{(\text{Numer of Measurements Planned})} \text{ x } 100\%$$

Completeness is a measure of the amount of valid data obtained from the measurement program compared to the total amount collected. Valid data are defined as data that have not been rejected or considered unusable during validation or data review. Percent completeness is expressed as the ratio of the number of validated data points to the number of planned data points. For relatively clean,

homogeneous matrices, 95 percent completeness is expected. However, as matrix complexity and heterogeneity increase, completeness may decrease. Where analysis is precluded or where DQOs are compromised, the ability to achieve project objectives will be evaluated. Whether any particular sample is critical (i.e., absolutely necessary for the attainment of project objectives) to the investigation will be evaluated in terms of the sample location, the parameter in question, the intended data use, and the effects of an incomplete data set on the attainment of project objectives.

Critical data points may not be identified until all the analytical results are evaluated. If in the evaluation of results it becomes apparent that the data for a specific medium are of insufficient quality (i.e., less than 95 percent completeness), either with respect to the number of samples or an individual analysis, resampling to replace the deficient data points may be necessary. The Navy and TtNUS will determine whether resampling is necessary.

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APPENDIX A

HEALTH AND SAFETYPLAN

Health and Safety Plan
Ground-Water Sampling

at

IR Program Site 16

Former Naval Construction Battalion Center
Davisville
North Kingstown, Rhode Island

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62472-03-D-00057
Contract Task Order 049

December 2005

HEALTH AND SAFETY PLAN

FOR

GROUND-WATER SAMPLING

AT

IR PROGRAM SITE 16

FORMER NAVAL CONSTRUCTION BATTALION
DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

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

Submitted to:
Environmental Branch (Code EV2)
Engineering Field Activity Northeast
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop 82
Lester, Pennsylvania 19113-2090

Submitted by:
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Contract Number N62472-03-D-0057
Contract Task Order 0049

DECEMBER 2005

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide safe work practices and procedures for Tetra Tech NUS, Inc. (TtNUS) and subcontractor personnel conducting site activities in support of 1,4-dioxane ground-water sampling at Site 16 at the Former Naval Construction Battalion Center (NCBC) Davisville, North Kingstown, Rhode Island. This HASP is to be used in conjunction with the TtNUS Health and Safety Guidance Manual, which provides supporting information pertaining to procedures detailed in the HASP as well as TtNUS Standard Operating Procedures (SOPs). The HASP and the TtNUS Health and Safety Guidance Manual were developed to comply with the requirements established by the Occupational Safety and health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120.

This HASP was developed using historical site background information regarding known or suspected chemical contaminants, previous site visits, and potential physical hazards that may be associated with the proposed work at the site. This HASP will be modified, as necessary, if new information becomes available, and changes will be made with the approval of the TtNUS Site Safety Officer (SSO) and the Comprehensive Long-Term Environmental Action Navy (CLEAN) Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the SSO. The SSO will notify the HSM, who will then notify affected personnel of the changes.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibilities for site safety and health for TtNUS and subcontractor personnel engaged in on-site activities. These people will be the primary points of contact for questions regarding the safety and health procedures and the selected control procedures:

- The TtNUS Project Manager (PM) is responsible for the overall direction and implementation of health and safety for this project.

- The TtNUS HSM is responsible for ensuring this HASP is in accordance with applicable OSHA regulations. Specific responsibilities include:
  - Providing information regarding site contaminants and physical hazards associated with the site.
  - Establishing air monitoring and decontamination procedures.
  - Assigning personal protective equipment (PPE).
  - Determining emergency response procedures and emergency contacts.
  - Stipulating training requirements and reviewing appropriate training and medical surveillance certificates.

- Providing standard work practices to minimize potential injuries and exposures associated with hazardous work.
- Modifying this HASP, as it becomes necessary.

- The TtNUS Field Operations Leader (FOL) is responsible for the implementation of this HASP with the assistance of an appointed SSO. The FOL is responsible for field activities, executes elements of the Quality Assurance Project Plan (QAPP) Addendum, and enforces safety procedures, as applicable to this HASP and the QAPP Addendum.

- The Project Health and Safety Officer (PHSO) is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:
  - Providing information regarding site contaminants and physical hazards.
  - Establishing air monitoring and decontamination procedures.
  - Assigning PPE based on task and potential hazards.
  - Determining emergency response procedures and emergency contacts.
  - Stipulating training requirements and reviewing appropriate training and medical surveillance certificates.
  - Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste site work.
  - Modifying this HASP, as it becomes necessary.

- The SSO supports site activities by advising the FOL on the aspects of health and safety on site. These duties may include:
  - Coordinating health and safety activities with the FOL.
  - Selecting, applying, inspecting, and maintaining PPE.
  - Establishing work zones and control points.
  - Implementing air monitoring procedures for on-site activities.
  - Verifying the training and medical status of on-site personnel.
  - Implementing hazard communication, respiratory protection, and other associated safety and health programs.
  - Coordinating emergency services.
  - Providing site specific training to on-site personnel.
  - Investigating accidents and injuries (see Attachment I - Illness/Injury Reporting Procedure and Form).
  - Providing input to the HSM regarding the need to modify this HASP or applicable health and safety associated documents as per site-specific requirements.

- Compliance with the requirements established in this HASP is monitored by the SSO and coordinated through the TtNUS HSM.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: NCBC Davisville

Address: Davisville Road
North Kingstown, Rhode Island

Client Contact: David Barney - South Weymouth NAS **Phone Number:** 617-753-4656

Navy RPM: Fred Evans - Philadelphia **Phone Number:** 610-595-0567 x 150

Effective Date: Spring 2006

Purpose: Conduct groundwater sampling.

Project Team:

TtNUS Personnel	Discipline/Tasks Assigned	Phone Number
Lee Ann Sinagoga	Project Manager (PM)	(412) 921-8887
TBD	Field Operations Leader (FOL)	
James K. Laffey	Project Health and Safety Officer (PHSO)	(412) 921-8678
Matthew M. Soltis, CIH, CSP	Health and Safety Manager (HSM)	(412) 921-8912
TBD	Site Safety Officer (SSO)	
Tom Patton	Equipment Manager	(412) 859-4670

Non-TtNUS Personnel	Affiliation/Discipline/Tasks Assigned	Phone Number
Kelly Perkins	Northeast Laboratory	1-800-244-8378
TBD	IDW Transportation & Disposal	TBD

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation have been conducted by:
James K. Laffey

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. Site activities will be coordinated with the client and site contact, David Barney, as well as local fire protection and emergency services prior to commencement. In the event of an emergency that cannot be mitigated using on-site resources, site personnel will evacuate to a safe place of refuge and notify the appropriate emergency response agencies and the client/site contact. Because a majority of foreseeable emergency situations will require assistance from outside emergency responders, TtNUS and subcontractor personnel will provide emergency response support to the levels listed below. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, which ensures adequate emergency response time. This Emergency Action Plan, therefore, conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as designated in OSHA 29 CFR 1910.120(l)(1)(ii).

TtNUS and subcontractor personnel will, through necessary services, provide the following response measures:

- Incipient stage fire fighting support and prevention
- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Initial medical support for injuries or illnesses requiring first-aid level support only
- Site control and security measures, as necessary

2.2 EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, injuries resulting from exposure to physical hazards are the most probable emergencies that may be encountered during site activities.

To minimize and eliminate these potential emergency situations, emergency planning activities associated with this project include the following (and are the responsibility of the SSO and/or the FOL):

- Coordinating with local emergency response personnel to ensure that TtNUS emergency action activities are compatible with existing emergency response procedures.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:

  - List of phone numbers for local emergency services
  - Chemical inventory (used on site), with Material Safety Data Sheets (MSDSs)
  - On-site personnel medical records (Medical Data Sheets)
  - A logbook or sign-in log sheet identifying personnel on site
  - A hospital route map with directions in each support vehicle

The following emergency planning requirements are the responsibility of the TtNUS FOL:

- Identifying a chain of command for emergency action.

- Educating site workers as to the hazards and control measures associated with planned activities of the site and providing early recognition and prevention where possible.

- Periodically performing practice drills to ensure site workers are familiar with incidental response measures.

- Providing necessary equipment to safely accomplish identified tasks.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Foreseeable emergency situations will generally be recognized by visual observation. Visual observation is primarily relevant for physical hazards that may be associated with the proposed scope of work. Visual observation will also play a role in detecting some chemical hazards. To adequately recognize chemical exposures, site personnel will have a clear knowledge of signs and symptoms of exposure associated with site contaminants. This information is provided in Table 6-1 of this HASP. Tasks to be performed at the site, potential hazards associated with those tasks, and the recommended control methods are discussed in detail in Section 5.0 and 6.0. Additionally, early recognition of hazards will be supported by daily site surveys to eliminate any situation predisposed to an emergency. The FOL and the SSO will be responsible for performing these surveys. Site surveys will be conducted at work locations prior to the commitment of resources and personnel. This will be done for the purpose of removing or barricading identified physical hazards. Additionally, site surveys will be conducted at least once a week at resource/staging areas. Site surveys conducted during this effort will be documented in the field logbook.

2.3.2 Prevention

TtNUS and subcontractor personnel will minimize the potential for emergencies by following this HASP and the TtNUS Health and Safety Guidance Manual and by complying with applicable OSHA regulations. Daily site surveys of work areas and correction of any identified deficiencies by the FOL and SSO prior to the commencement of that day's activities will assist in the prevention of illness/injuries when hazards are recognized early and control measures initiated.

2.4 SAFE PLACES OF REFUGE

In the event that the site must be evacuated, personnel will immediately stop activities and report to the designated safe place of refuge. Safe places of refuge will be identified prior to the commencement of site activities and will be conveyed to personnel as part of the safety meeting conducted each morning. Maps should also be posted showing designated meeting areas. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the TtNUS FOL or SSO. The FOL or the SSO will perform a head count at this location to account for and to confirm the location of site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel.

2.5 EVACUATION ROUTES AND PROCEDURES

An evacuation will occur whenever the health, safety, or welfare of site workers is compromised. Some specific examples of conditions that may initiate an evacuation include: severe weather conditions; the occurrence of a fire or explosion; readings on monitoring instrumentation indicating levels of contamination greater than instituted action levels; or personnel showing signs or symptoms of overexposure to potential site contaminants. In the event of an evacuation, personnel will proceed immediately to the designated safe place of refuge unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS FOL. Evacuation procedures will be discussed before the initiation of any work at the site. Evacuation routes from the site and safe places of refuge are dependent on the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may affect evacuation routes. As a result, assembly points will be selected in an upwind direction from the site and away from water bodies and then communicated to workers relative to the site location where work is being performed.

2.6 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During an evacuation, decontamination procedures will be performed only if the welfare of site workers can be maintained. Decontamination will delayed if the incident warrants immediate evacuation. However, it is unlikely that an evacuation would occur that would require workers to evacuate the site without first performing decontamination procedures.

TtNUS personnel will perform removal of personnel from emergency situations and may provide initial medical support for injury/illnesses requiring only first-aid level support. Personnel identified within the field crew with bloodborne pathogen and first-aid training will be the only personnel permitted to offer first-aid assistance. Medical attention above that level will require assistance and support from the designated emergency response agencies. Any pertinent information regarding allergies to medications or other special conditions must be provided to medical service personnel. This information is listed on Medical Data Sheets kept on site (See Attachment II). If an exposure to hazardous materials has occurred, provide hazard information from Table 6-1 to medical service personnel. Contact David Barney, the client/site contact, in the event that any incident or accident requires medical attention. Attachment I provides the procedure to follow when reporting an injury/illness and the form to be used for this purpose. If the emergency involves personnel exposures to chemicals, follow the steps provided in Figure 2-1.

2.7 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

TtNUS and subcontractor personnel will be working in proximity to each other during planned site activities. Site personnel will initiate emergency notification to on-site personnel by hand signals, voice commands, or air horns to alert other personnel of an emergency. Two-way radios may also be used between site workers to communicate emergency situations and request assistance. If an emergency warranting evacuation occurs, the following steps are to be taken:

- Initiate an evacuation by hand signals, voice commands, air horn, or two-way radios. Report to the designated safe place of refuge.

- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and include as many details as possible. After personnel are evacuated, appropriate response procedures will be enacted to control the situation.

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL and SSO will enact emergency notification procedures to secure additional assistance in the following manner:

FIGURE 2-1

POTENTIAL EXPOSURE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations. In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e., ambulance for serious events).
- Obtain as much exposure history as possible (a Potential Exposure Protocol form is attached).
- If the injured person is a TtNUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing that may be appropriate. WorkCare physicians will monitor the care of the victim.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, or follow the voice prompt for after hours and weekend notification, and being prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved TtNUS employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
- Fax appropriate information to WorkCare at (714) 456-2154.
- Contact the TtNUS Corporate Health and Safety Department (Matt Soltis) and Human Resources Manager Marilyn Duffy at 1-800-245-2730.

As data are gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare. WorkCare will compile the results of data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-1 (continued)
POTENTIAL EXPOSURE PROTOCOL

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known): _____

_____

Characteristics (if the name is unknown)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? _____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was their skin contact? _____

Was the exposing agent inhaled? _____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

- Call the emergency contacts (Table 2-1) and report the emergency. Give the operator the location of the emergency, the type of emergency, the number of people injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.8 EMERGENCY EQUIPMENT

A first-aid kit, eye wash units or bottles of disposable eyewash solution, and fire extinguishers will be maintained on site in either the field office or site vehicle and shall be immediately available for use in the event of an emergency.

2.9 EMERGENCY CONTACTS

Prior to performing field activities, personnel will be thoroughly briefed on the emergency procedures that are to be followed in the event of an accident. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted where it is readily available to site personnel.

TABLE 2-1

EMERGENCY REFERENCE

SITE 16 NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

CONTACT	PHONE NUMBER
EMERGENCY	**911**
Fire and Rescue	**(401) 294-3344**
Police	**(401) 294-3311**
Kent Hospital	
General	(401) 373-7000
Emergency Department	(401) 736-4288
Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
Poison Control Center	(800) 222-1222
NCBC Davisville Contact: David Barney	(617) 753-4656
TtNUS PM: Lee Ann Sinagoga	(412) 921-8887
TtNUS PHSO: James K. Laffey	(412) 921-8678
TtNUS CLEAN HSM: Matt Soltis	(412) 921-8912

2.10 EMERGENCY ROUTE TO HOSPITAL

Directions to the Hospital:

Kent Hospital
455 Toll Gate Road
Warwick, RI 02886
Telephone: (401) 253-7000 (general number)
(401) 845-1120 (emergency)

Exit NCBC Davisville by traveling west on Davisville Road.

Proceed under Route 2 overpass onto Devil's Foot Road.

Continue approximately 2 miles on Devil's Foot Road.

Right onto Route 4 North to Route 95 North.

Take the first exit off Route 95 onto Route 117.

Left onto Route 117.

Proceed one block to a traffic light and turn right.

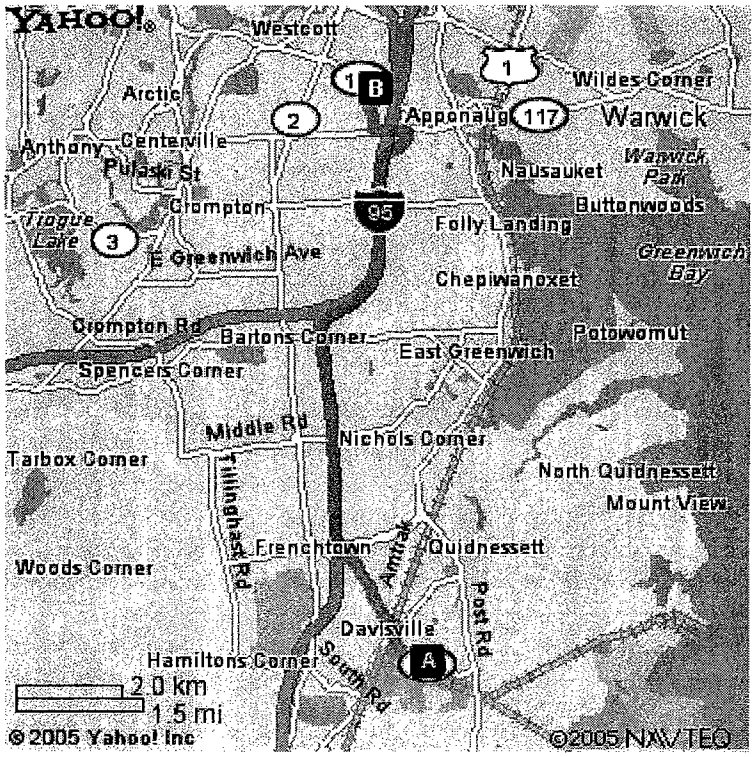
Follow road and bear right at first intersection.

Follow road to the end and take a left onto Toll Gate Road.

Hospital is on right.

Figure 2-2

Route to Kent Hospital



3.0 SITE BACKGROUND

3.1 SITE CONDITIONS

The former NCBC Davisville, located 18 miles south of Providence in North Kingstown, Rhode Island covers approximately 900 acres. Serving as a military installation since 1942, its primary mission was to provide mobilization support to Naval Construction Forces. Much of the NCBC Davisville site is contiguous with Narragansett Bay and consists of four areas including the Main Center, the West Davisville storage area, the Allen Harbor area, and the Pier Support area. Camp Fogarty, a training facility 4 miles west of the Main Center in the Town of East Greenwich, was transferred to the Army in 1993 is also part of the listing. Adjoining NCBC Davisville's southern boundary is the decommissioned Naval Air Station Quonset Point, which was sold to the Rhode Island Port Authority between 1978 and 1980. The Navy disposed of wastes in all areas.

NCBC Davisville's mission was to provide mobilization support to the active Naval Construction Force; to act as a mobilization base for the rapid assembly, outfitting, and readying of Reserve Construction Battalions; to store, preserve, and ship advanced base and mobilization stocks; and to procure, receive, pack, and ship collateral equipment for Atlantic, European, and Caribbean military construction projects. NCBC Davisville was comprised primarily of warehouse space and freight yards, most of which are currently demolished, redeveloped, or empty.

3.1.1 Site 16

The Site 16 investigation area covers approximately 70 acres. The north-central portion is primarily wooded with the exception of an asphalt-paved area in the center. This area is generally bounded by Westcott Road, Davisville Road, Allens Harbor Road, and the Allen Harbor southern shoreline. A unnamed asphalt-paved road circles the outer perimeter of this portion of the site and was formerly used by the Navy for the purpose of training construction equipment operators. In the past, this area was extensively bulldozed and disrupted during training exercises, but now has a vegetative cover of shrubs and grasses. The site topography slopes from an elevation of approximately 33 feet above mean sea level (msl) in the southwestern corner to msl along the Allen Harbor shoreline in the northeastern portion of the site. The area immediately around Building E-107 is also paved for parking. The area west of Building WE-107 (east of Westcott Road) is grass covered. The area west of Westcott Road is the eastern portion of a former NCBC gravel borrow pit and is densely overgrown. The area south of Davisville Road slopes gently toward the east and includes former railroad spurs located south and east of Former Building 41. The area east of Allens Harbor Road is an asphalt-paved lot where new cars are temporarily stored after delivery by ships.

4.0 SCOPE OF WORK

4.1 SUMMARY OF PROPOSED ACTIVITIES

The field activities scoped under this HASP include the following:

- Mobilization/demobilization
- Multimedia sampling
  - Groundwater
  - Investigation derived waste (IDW)
- Management of IDW

Refer to the QAPP Addendum for more detailed information regarding the sampling activities.

Any field modifications that will require work other than that described in this section will be brought to the attention of the HSM to determine what health and safety procedures will be required. The PM or designated representative will submit requested modifications to this document to the HSM.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES

Table 5-1 of this section summarizes the potential hazards, by task, and their associated control measures for the work addressed by this site-specific HASP. This table is intended to assist project personnel in the recognition of hazards and recommended procedures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to be used, as well as appropriate air monitoring techniques and other requirements/restrictions. The evaluation of each task provides detailed information including anticipated hazards, recommended control measures, air monitoring recommendations, required PPE, and decontamination measures. This table will be updated if the scope of work, contaminants of concern, or pertinent conditions change.

This HASP, including Table 5-1, is meant to be used in conjunction with the TtNUS Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site-specific operations as required by 29 CFR 1910.120. The Guidance Manual should be referenced for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of TtNUS's SOPs are also provided in the Guidance Manual.

Safe Work Permits will be issued (See Section 10.9 and Attachment III). The FOL and/or SSO will use the elements defined in Table 5-1 as the primary reference for completing the permits. The Safe Work Permit is used to add additional site-specific information. In situations where the Safe Work Permit is more conservative than the direction provided in Table 5-1 due to the incorporation of site-specific elements, the Safe Work Permit will be followed.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices identified on Table 5-1, the following safe work practices establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations when conducting work involving known and unknown site hazards:

- Eating, drinking, chewing gum or tobacco, or taking medication, is permitted in the support zone only.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.

- Avoid contact with potentially contaminated substances by walking around puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment.

- Avoid placing monitoring equipment on potentially contaminated surfaces.

- Be familiar with and adhere to the instructions in this site-specific HASP.

- Be aware of the location of the nearest telephone and emergency telephone numbers.

- Attend briefings on anticipated hazards, equipment requirements, Safe Work Permits, emergency procedures, and communication methods before going on site.

- Rehearse unfamiliar operations prior to implementation.

- Maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.

- Establish appropriate safety zones including support, contamination reduction, and exclusion zones.

- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Non-essential vehicles and equipment should remain within the support zone.

- Establish appropriate decontamination procedures for leaving the site.

- Immediately report injuries, illnesses, and unsafe conditions, practices, and equipment to the SSO.

- Observe co-workers for signs of toxic exposure and heat or cold stress.

- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

TABLE 5-1

**TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND
PAGE 1 OF 2**

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO require.)*	Decontamination Procedures
Mobilization/ Demobilization	***Physical hazards:*** 1) Lifting (strain/muscle pulls) 2) Pinches and compressions 3) Slips, trips, and falls 4) Vehicular and foot traffic 5) Ambient temperature extremes (cold/heat stress) ***Natural hazards:*** 6) Insect/animal bites and stings, poisonous plants, etc. 7) Inclement weather	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Keep any machine guarding in place. Avoid moving parts. Use tools or equipment where necessary to avoid contacting pinch points. 3) Preview work locations for unstable/uneven terrain. 4) Traffic and equipment considerations are to include the following: - Establish safe zones of approach. - Secure all loose articles. - All activities are to be conducted consistent with the site requirements. 5) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 6) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual. 7) Suspend or terminate operations until directed otherwise by SSO.	Not required	Level D - (Minimum Requirements): - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.*	Not required
Decontamination of Sampling Equipment	***Chemical hazards:*** 1) The contaminants of concern that have been identified in site ground-water are VOCs including 1,1-dichloroethene. Refer to Table 6-1 for additional information on site contaminants of concern. 2) Decontamination fluids - Liquinox (detergent), acetone or isopropanol ***Physical hazards:*** 3) Ambient temperature extremes (heat/cold stress) 4) Slips, trips, and falls ***Natural hazards:*** 5) Inclement weather	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Obtain manufacturers' MSDSs for any decontamination fluids used on-site. These must be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDSs. Chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication section of the Health and Safety Guidance Manual (Section 5). 3) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress concerns is provided in the Health and Safety Guidance Manual. 4) Preview work locations for unstable/uneven terrain. 5) Suspend or terminate operations until directed otherwise by SSO.	Use visual observation, and real-time monitoring instrumentation to ensure equipment has been properly cleaned of contamination and dried. After decontamination is completed, screen equipment with a PID or FID. If any elevated readings (i.e., greater than background) are observed, perform decontamination again and re-screen. Repeat until no elevated PID/FID readings are noted.	For sampling equipment (trowels, MacroCore samplers, bailers, etc.), the following PPE is required: Note: Consult MSDSs for PPE guidance. Otherwise, observe the following. Level D Minimum requirements - - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes or boots - Nitrile outer gloves - Safety glasses	**Personnel Decontamination** This will consist of a soap/water wash and rinse for reusable outer protective equipment if applicable. The decon function will take place at an area adjacent to the site activities. This procedure will consist of the following: - Equipment drop - Soap/water wash and rinse of outer boots and gloves, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Disposable PPE will be removed and bagged. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the QAPP Addendum. MSDSs for any decon solutions (Alconox, isopropanol, etc.) will be obtained and used to determine proper handling / disposal methods and protective measures (PPE, first-aid, etc.). Equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO require.)*	Decontamination Procedures
Groundwater sampling	***Chemical hazards:*** 1) The contaminants of concern that have been identified in site ground-water are VOCs including 1,1-dichloroethene. Refer to Table 6-1 for additional information on site contaminants of concern. 2) Transfer of contamination into clean areas. ***Physical hazards:*** 3) Lifting (strain/muscle pulls) 4) Slips, trips, and falls 5) Ambient temperature extremes (cold/heat stress) 6) Vehicular and foot traffic ***Natural hazards:*** 7) Insect/animal bites and stings, poisonous plants, etc. 8) Inclement weather	1) Avoid contact with potentially contaminated media (ground-water). The use of safe work practices and protective equipment (PPE) will be adequate to prevent potential exposures via contact and incidental ingestion. Real-time monitoring instrumentation (PID or FID) will be used to detect the presence of airborne contaminants that would indicate an unanticipated condition. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. 3) Use multiple personnel for heavy lifts. Use proper lifting techniques when handling heavy objects (sample coolers, instrument cases, sampling equipment, etc). 4) Preview work locations for unstable/uneven terrain. 5) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress is provided in Section 4 of the Health and Safety Guidance Manual. 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach. See Section 9 of the HASP for specific safety zones based on media being sampled. - All activities are to be conducted consistent with the site requirements. 7) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual. 8) Suspend or terminate operations until directed otherwise by the SSO.	A direct reading Photoionization Detector (PID) with a 10.6 eV lamp or higher, or a Flame Ionization Detector (FID), will be used to screen samples and to detect the presence of any potential VOCs. The following procedures will be followed when air monitoring: - Screen source areas (monitoring wells and sample media) to evaluate the presence of VOCs. Monitor the breathing zone of at-risk and downwind employees. Any sustained readings (greater than 1 minute in duration) greater than 5 ppm above established background levels in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. Work may only resume if airborne readings in the worker breathing zone return to background levels. If elevated readings in worker breathing zone are present or frequently noted, contact the PHSO for additional guidance.	Level D protection will be utilized for the initiation of all sampling activities. Level D - (Minimum Requirements): - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes or boots - Surgical style gloves *(double-layered if necessary)* - *Reflective vest for high traffic areas* **Note:** The Safe Work Permit(s) for this task (see Attachment III) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** This will consist of removal and disposal of non-reusable PPE (gloves, coveralls, etc., as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of the following: - Equipment drop - Outer glove removal (as applicable) - Removal, segregation, and disposal of non-reusable PPE in bags/containers provided - Soap/water wash and rinse of reusable PPE (e.g., hardhat) if potentially contaminated - Wash hands and face or use hand wipes, leave contamination reduction zone.
IDW Management	***Chemical hazards:*** Site contaminants present in ground-water are expected to be at concentrations that are unlikely to be present in air. Avoid contact with potentially contaminated ground-water through the use of safe work practices and PPE. The primary hazard associated with IDW management is handling heavy drums and the potential for a spill. ***Physical hazards:*** 1) Lifting hazards/back injuries 2) Loading bulk transport containers ***Natural hazards:*** 3) Inclement weather 4) Insect/animal bites or stings, poisonous plants, etc.	1) Strains and sprains (lifting hazards)/back injuries - Use multiple personnel for heavy lifts. - Use proper lifting techniques. - Lift with your legs, not your back, bend your knees and move as close to the load as possible, and ensure good hand holds are available. - Minimize the horizontal distance from the center of the lift to your center of gravity. - Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time. - Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive. - Plan lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves. - Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury. 2) Material-handling devices shall be used for moving drums. This includes drum dollies with pneumatic tires, drum grapplers, etc. These pieces of equipment are engineered to allow placement of these containers while removing hands from the point of operation. 3) Suspend or terminate operations until directed otherwise by SSO. 4) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual.	None required, unless spill containment provisions are invoked. Then monitoring will proceed as described in the activity associated with the task when the materials were generated such as soil boring or well installation.	Level D - (Minimum Requirements): - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes or boots - Leather or cotton work gloves - *Safety glasses (when utilizing cables or slings to move containers)* - *Hardhat (when overhead hazards exists or when identified as a operation requirement)* PPE changes may be made with the implementation of the Spill Containment Program. This represents the only anticipated modification to this level of protection.	Not required, unless the implementation of the Spill Containment Program is required due to a spill and/or release. At that point, the decontamination procedures for those activities such as soil borings and/or well installation should be used. The reference reflects the tasks conducted when the materials were generated.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and physical hazards associated with the 1,4-dioxane ground-water sampling and the activities to be conducted as part of the scope of work. Table 6-1 provides information on the most common and significant substances likely to be present at the site, based on review of available data. Specifically, toxicological information, exposure limits, symptoms of exposure, and physical properties are discussed in the table. Section 6.1 provides a general list of contaminants that may be present at the site. Section 6.2 lists the physical hazards that may be present at the site or associated with site activities.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with the field activities to be conducted include inhalation, ingestion, and dermal contact of various contaminants that are known to be or may be potentially present on site. Analytical data from previous ground-water sampling indicate that the primary contaminants of concern include VOCs and, in particular, 1,1-dichloroethene.

It is anticipated that the greatest potential for exposure to site contaminants is during ground-water sampling activities. Exposure to these compounds is most likely to occur through ingestion and inhalation of contaminated soil or hand-to-mouth contact. PPE and basic hygiene practices (e.g., washing face and hands before leaving site) will be extremely important. Inhalation exposure will be avoided by using appropriate PPE and engineering controls where necessary.

6.2 PHYSICAL HAZARDS

The physical hazards that may be present during the performance of site activities are as follows:

- Working around heavy equipment
- Uneven or unstable terrain (slip, trip, and fall hazards)
- Ambient temperature extremes (heat or cold stress)

These physical hazards are discussed in Table 5-1 as applicable to each site task. Furthermore, many of these hazards are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. A specific discussion of ambient temperature extremes is presented below.

TABLE 6-1

CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
SITE 16 - NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

Substance	CAS No.	Air Monitoring	Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
1,1-Dichloroethene See also vinylidene chloride	75-34-4	PID: I.P. 10.00 eV, relative response ratio is 80%. FID: Relative response ratio for detection with the FID is 40%.	ACGIH: 5 ppm NIOSH & OSHA have not established exposure limits.	Odor threshold - 190 ppm. An air purifying respirator equipped with an organic vapor filter is acceptable for escape purposes only. For exposure greater than the exposure limits, use supplied air respirators. **Recommended glove:** Butyl, nitrile, or neoprene.	**Boiling Pt:** 89°F (32°C) **Melting Pt:** -188°F (-122°C) **Solubility:** Slight (0.04%) **Flash Pt:** -2°F (-19°C) **LEL/LFL:** 6.5% **UEL/UFL:** 15.5% **Vapor Density:** 3.25 **Vapor Pressure:** 500 mmHg @ 68°F (20°C) **Specific Gravity:** 1.21 @ 20°F (4°C) **Incompatibilities:** Aluminum, air, copper, and heat. Polymerization may occur if exposed to oxidizers. **Appearance and Odor:** Colorless liquid with a slight sweet chloroform odor.	Overexposure to this substance may result in irritation to the eyes, nose, throat, and respiratory system. Dermal contact with concentrated solutions may cause slight irritation, redness and inflammation. Systemically, headaches, dizziness, nausea, and difficulty in breathing. Chronic effects may include kidney and liver dysfunction and pneumonitis. This material has expressed cancer-causing potential in laboratory animals including liver and kidney tumors.

6.2.1 Ambient Temperature Extremes

Ambient temperature extremes (heat or cold stress) may exist during performance of this work depending on the project schedule. Work performed when temperatures are below 50 degrees Fahrenheit (°F) may result in varying levels of cold stress (frost nip, frost bite, etc.) depending on factors such as temperature, wind speed, and humidity; psychological factors such as metabolic rate and moisture content of the skin; and other factors such as the protective clothing being worn. Work performed when ambient temperatures exceed 70°F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on factors similar to those presented for cold stress.

For more information concerning the effect of and controls for cold and heat stress, see Section 4.0 of the TtNUS Health and Safety Guidance Manual.

6.3 NATURAL HAZARDS

6.3.1 Insect/Animal Bites and Stings/Poisonous Plants

Because proposed work will be conducted outdoors and sometimes in brush, marsh, and other natural areas, various animals, insects, or poisonous plants indigenous to the area may be encountered. During warm months (spring through early fall), tick-borne Lyme Disease may be a potential health hazard in the region. Specific information on Lyme Disease is included in Section 4.0 of the Health and Safety Guidance Manual. In general, avoidance of areas of known insect infestation or poisonous plant growth will be the preferred exposure control. Wearing long sleeve shirts and long pants may decrease the ability of insects (specifically ticks) and poisonous plants of coming into contact with skin. Body checks for ticks during and after potential exposure may reduce the number of ticks becoming attached for the long term. If a tick is attached to the skin, procedures to remove the tick are presented Section 4.0 of the Guidance Manual. In addition, individuals with known allergic reactions to insect bites and poisonous plants should notify the FOL and SSO prior to engaging in activities where these hazards may be encountered. Information regarding any medical condition or allergy must be listed on the Medical Data Sheet (see Attachment II).

Mosquito-Borne Illnesses

Mosquitoes may carry diseases including St. Louis Encephalitis, Eastern Equine Encephalitis, La Crosse Encephalitis, and West Nile Virus. Mosquitoes become infected after biting infected birds. The symptoms of mosquito-borne illnesses may include headache, moderate to high fever, stiff neck, and confusion. In serious cases, coma, seizures, or paralysis can result. Symptoms usually appear between 5 to 15 days after exposure to infected mosquitoes. Mosquito-borne illnesses may be mild or serious and can lead to death.

Precautions include the following:

- Limit outdoor activities during peak mosquito times – at dusk and dawn.
- Avoid standing water.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Apply insect repellent according to manufacturer's instruction to exposed skin. An effective repellent will contain 20 to 30 percent DEET (N,N-diethyl-meta-toluamide). Avoid products containing more than 30 percent DEET.
- Spray clothing with repellents containing permethrin or DEET; mosquitoes may bite through thin clothing.

6.3.2 Inclement Weather

The project tasks in this scope of work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather (electrical storms, hurricanes, etc.) conditions arise, the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 AIR MONITORING

Direct read instruments (DRIs) will be used to screen samples and source areas (sample locations, monitoring wells, etc.) as well as worker breathing zones for VOCs. However, other potential contaminants of concern, metals and semivolatile organic compounds (SVOCs), are not readily detected with traditional field instrumentation. The presence of elevated instrument readings, particularly in worker breathing zones, will indicate the presence of airborne concentrations of VOCs that may pose an exposure concern. This will alert workers of an unanticipated condition that will require site activities to be suspended until readings return to background levels.

Exposure to metals is most likely to occur as a result of inhalation of airborne dusts containing these contaminants or incidental ingestion as a result of hand to mouth activities. Observations of airborne dust will require that area wetting methods be used to control the material. The use of PPE and the observance of the other control requirements presented in this HASP will minimize the potential for exposure to metals and SVOCs.

7.1 INSTRUMENTS AND USE

Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location.

7.1.1 Photoionization or Flame Ionization Detector

A photoionization (PID) with a 10.6 electron volt (eV) source or a flame ionization detector (FID) will be used to screen source areas (sampling locations, monitoring wells, etc.) to detect the presence of VOCs. This instrument will also be used to monitor the breathing zones of employees during site activities in the event that elevated readings are present at a source area. The PID/FID has been selected because it is capable of detecting a large array of VOCs.

Prior to the commencement of any field activities, background levels of VOCs and the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity), and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

7.1.2 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring will be performed as well as the action levels that will initiate the use of elevated levels of protection. The SSO may decide to increases these frequencies based on instrument responses and site observations. The frequency at which monitoring is performed will not be reduced without the prior consent of the PHSO or HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Operational checks and field calibration will be performed on each instrument every day prior to use. Field calibration will be performed on instruments according to manufacturers' recommendations (for example, the PID/FID must be field calibrated daily, and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employee's health and safety training, the manufacturer's recommendations, and with the applicable manufacturer SOP. Calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field operations logbook, provided that the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot number, source concentration, supplier)
- Any relevant comments or remarks

7.3 DOCUMENTING INSTRUMENT READINGS

The SHSO is responsible for ensuring that air monitoring instruments are used in accordance with the specifications of this HASP and with manufacturers' specifications/recommendations. In addition, the SHSO is also responsible for ensuring that instrument use is documented. This requirement can be satisfied either by recording instrument readings on pre-printed sampling log sheets or in a field logbook. This includes the requirement for documenting instrument readings that indicate no elevated readings greater than noted daily background levels (i.e., no-exposure readings). At a minimum, the SHSO must document the following information for each use of an air monitoring device:

- Date, time, and duration of the reading.
- Site location where the reading was obtained.

- Instrument used [e.g., PID, FID, lower explosive limit/oxygen (LEL/0_2) meter, etc.].
- Personnel present at the area where the reading was noted.
- Other conditions that are considered relevant by the SHSO (e.g., weather conditions, possible instrument interferences, etc.).

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ PROJECT NO.:_____

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for both TtNUS and subcontractor personnel participating in site activities.

8.1.1 Requirements for TtNUS Personnel

TtNUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the site. Additionally, TtNUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before they can be cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory, and refresher training, as well as site-specific training, will be maintained at the TtNUS field office location. Copies of certificates or other official documentation will be used to fulfill this requirement. TtNUS personnel must verify that in addition to their own training documentation, the subcontract personnel have provided legible copies of their current training and medical surveillance documentation.

TtNUS will also conduct a brief meeting daily to discuss operations planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered.

8.1.2 Requirements for Subcontractors

TtNUS subcontractor personnel must have completed the 40-hour introductory hazardous waste site training or have equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e). Additionally, personnel who have had the introductory training more than 12 months ago are required to have 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at the site. TtNUS subcontractors must certify that each employee has had such training by sending TtNUS a letter, on company letterhead, containing the information in the example letter shown in Figure 8-1 and by providing copies of certificates for subcontractor personnel participating in site activities. Subcontractor personnel shall provide a legible copy of their complete training documentation to the TtNUS site representative upon arrival at the job site.

FIGURE 8-1

TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
COMPANY NAME
Street/Mailing Address
Town, State Zip code

Month, day, year

Ms. Lee Ann Sinagoga
Project Manager
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220-2745

Subject: HAZWOPER Training

Dear Ms. Sinagoga:

As an officer of XYZ Corporation, I hereby state that I am aware of the potentially hazardous nature of the subject project. I also understand that it is our responsibility to comply with the applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as applicable and as required by 29 CFR 1910.120(e)(8). I further state that site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

8.2 SITE-SPECIFIC TRAINING

TtNUS personnel will provide site-specific health and safety training to TtNUS employees and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to personnel [United States Environmental Protection Agency (EPA), Navy, Rhode Island Department of Environmental Management (RIDEM), etc.] who may enter the site to perform functions that may be directly related to site operations. Site-specific training will last approximately 1 hour and include an overview of the following:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of PPE
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the HASP
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Contents of relevant Material Safety Data Sheets (MSDSs)
- Review of the use of Safe Work Permits

Site-specific documentation will be verified through the use of Figure 8-2. Site personnel and visitors must sign this document upon receiving site-specific training.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for TtNUS Team Personnel

TtNUS personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS' medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the TtNUS Pittsburgh, Pennsylvania office and made available as necessary.

FIGURE 8-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potentially hazardous nature of performing site activities at Site 16, NCBC Davisville, Rhode Island and that I have received site-specific training that included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

My signature below indicates that I have been given the opportunity to ask questions, that my questions have been answered to my satisfaction, and that the dates of my training and medical surveillance indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3.2 Medical Surveillance Requirements for Subcontractors

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The Subcontractor Medical Approval Form provided in Figure 8-3 shall be used to satisfy this requirement, provided it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute the Subcontractor Medical Approval Form with a letter, on company letterhead, containing the information in the example letter presented in Figure 8-4 of this HASP. Completed copies of these forms will be provided to TtNUS personnel at the start of the job.

8.3.3 Medical Data Sheets

Each field team member (including subcontractors and visitors) entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet presented in Attachment II of this HASP. This shall be provided to the SSO prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

Subcontractors who will not enter the exclusion zone during intrusive operations and whose activities involve no potential for exposure to site contaminants will not be required to meet the requirements for training/medical surveillance other than site-specific training as stipulated in Section 8.2.

FIGURE 8-3

SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____

Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the site
   ( ) not qualified to perform work at the site and

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer:

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.

( ) A description of the employee's duties as they relate to the employee's exposures.

( ) A list of known/suspected contaminants and their concentrations (if known).

( ) A description of any personal protective equipment used or to be used.

( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3

SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

_____
_____
_____

2. Any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health:

_____
_____
_____

3. Recommended limitations on the employee's assigned work:

_____
_____
_____

I have informed this participant of the results of this medical examination and any medical conditions that require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

_____

_____
Address

FIGURE 8-4

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
COMPANY NAME
Street/Mailing Address
Town, State Zip code

Month, day, year

Ms. Lee Ann Sinagoga
Project Manager
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220 - 2745

Subject: Medical Surveillance

Dear Ms. Sinagoga:

As an officer of XYZ Corporation, I hereby state that the persons listed below have participated in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative-pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the NCBC Davisville Site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

9.0 SPILL CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

It is not anticipated that quantities of bulk potentially hazardous materials (greater than 55 gallons) will be handled during the site activities conducted as part of the scope of work. Small quantities of IDW including purge water and decontamination fluids may be generated as part of site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Furthermore, it is possible that as the job progresses, disposable PPE and other non-reusable items may be generated. IDW will be containerized in 55-gallon drums. If needed, samples will be collected and analyzed to characterize the material and to determine appropriate disposal measures. Once characterized, the waste can be removed from the staging area and disposed of in accordance with federal, State and local regulations.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. The areas vulnerable to this hazard include the central staging area, the waste transfer area, if there is one, and decontamination area.

9.2.1 Site Drums/Containers

Containers used for IDW liquids will be sealed, labeled, and staged in a centralized area in a secure storage box awaiting disposal.

9.3 LEAK AND SPILL DETECTION

For early detection of potential spills or leaks, a periodic walk-around by the SSO will be conducted during working hours to visually determine containers are not leaking. If a leak is detected, the first approach will be to transfer the container contents into a new container by using a sump pump or other device. In most instances, leaks will be collected and contained using absorbents such as spill pads, oil-dry, vermiculite, or sand, which will be stored at the staging area in a conspicuously marked drum. This used material will also be containerized for disposal pending analyses. Inspections will be documented in the project logbook.

9.4 PERSONNEL TRAINING AND SPILL PREVENTION

Personnel will be instructed on the procedures for spill prevention and containment and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

9.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging area for the purpose of supporting this Spill Prevention/Containment Program:

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- 55-gallon drums with sealing lids [Department of Transportation (DOT) 17-E or 17-H]
- Shovels, rakes, and brooms
- Hand-operated drum pump with hose
- Labels

9.6 SPILL CONTROL PLAN

The following describes the procedures that TtNUS field crew members will employ upon the detection of a spill or leak:

1) Notify the SSO or FOL immediately upon the detection of a leak or spill.

2) Employ PPE stored at the staging area including gloves (appropriate for the spill medium), tyvek, steel toe boots with covers, etc. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point on the container. Spread absorbent material in the area of the spill so that the area is covered completely.

3) Transfer the material to a new container and collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.

4) Re-containerize spills, including 2 inches of top cover impacted by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of appropriate emergency response agencies will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which TtNUS and subcontractor personnel will delineate work zones and use these work zones in conjunction with decontamination procedures in order to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three-zone approach includes an exclusion zone, a contamination reduction zone (CRZ), and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

10.1 EXCLUSION ZONE

The exclusion zone will be considered those areas of the site which known or suspected contamination. It is not anticipated that significant amounts of surface contamination are in the proposed work areas of this site. The exclusion zones for this project will be limited to those areas of the site where active work is being performed plus an established safety zone depending on the task, as follows:

- Ground-water sampling – 5 feet surrounding the sample collection point

10.2 CONTAMINATION REDUCTION ZONE

The CRZ will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. Personnel and equipment decontamination will take place in this area at a central location to facilitate and support field activities. When necessary, the CRZ will be delineated using barrier tape and/or cones to inform and direct personnel.

10.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and food and drink containers will be maintained. The support zone will be established at an area of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

10.4 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS
- Regulatory personnel (EPA, RIDEM, OSHA, etc.)
- Naval personnel

People requiring site access into active work areas will be required to obtain permission from the FOL or designee. Upon gaining access to the site, site visitors who contact the field team and are interested in observing operations in progress will be escorted by a TtNUS representative (arranged for by the FOL) and shall be required to meet the following minimum requirements:

- Site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity that they represent, and the purpose of the visit.

- Site visitors will be required to produce the necessary information supporting clearance onto the site. This includes information attesting to applicable training [40 hours of Hazardous Waste Operations (HAZWOPER) training for Navy personnel] and medical surveillance, as stipulated in Section 8 of this document. To enter the site's operational zones during planned activities, visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this document. Site visitors not associated with the sampling team will be required to maintain a safe distance from the active sampling location as determined by the SSO.

After the site visitors have completed the above items, they will be permitted to enter the operational zone. Visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit.

Visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of on-site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the NCBC Davisville client/site contact, if necessary.

10.5 SITE SECURITY

Security at each active sampling location will be the responsibility of TtNUS personnel and their subcontractors, as necessary. TtNUS personnel will retain control over active sample locations. The first line of security consists of visual barriers (e.g., safety cones, barrier tape) that restrict the general public

and Naval personnel. The second line of security will take place at the work site referring interested parties to the FOL. In addition, the FOL will serve as a focal point for non-project interested parties and will serve as the final line of security and the primary enforcement contact.

10.6 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of the personnel involved in this operation.

10.7 MATERIAL SAFETY DATA SHEET REQUIREMENTS

TtNUS and/or subcontractor personnel will provide MSDSs for the chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of the chemicals used on site will be developed using Figure 1 (Section 5.0) of the Health and Safety Guidance Manual. The MSDSs will then be maintained at the field office and will be available for anyone to review upon request.

10.8 COMMUNICATION

If personnel are not working in proximity to one another during field activities, a supported means of communication between field crews may be necessary. As a result, two-way radio communication devices may be used by field personnel while at the site.

External communication will be accomplished by using provided cellular telephones.

10.9 SAFE WORK PERMITS

Exclusion zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task-by-task basis. An example of the Safe Work Permit to be used is illustrated in Figure 10-1. The daily meetings conducted at the site will further support these Work Permits. This effort will ensure that site-specific considerations and changing conditions are incorporated into the planning effort.

Use of these permits will provide the communication line for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The Safe Work Permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

The FOL and/or the SSO will be responsible for completing the Safe Work Permits and issuing them to the appropriate parties. At the end of each day's activity, site personnel will turn in the permit(s) used for that day to the SSO. Permits will be maintained as part of the permanent project files attesting to safety and health measures employed for a given task at a given time and place. Any problems encountered with the protective measures required should be documented on the permit and brought to the attention of the SSO. Partially completed Safe Work Permits are included in Attachment III.

FIGURE 10-1
SAFE WORK PERMIT

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

I. Work limited to the following (description, area, equipment used): _____

II. Primary Hazards: Potential hazards associated with this task: _____

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☐ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☐

Modifications/Exceptions: _____

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

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Work)	☐ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☐ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that permit-required confined space activities will be conducted. Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces. A confined space is defined as an area that has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A permit-required confined space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.
- Contains any other recognized and serious safety or health hazard.

For further information on confined space, consult the PHSO or HSM. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS FOL shall ensure the following materials/documents are taken to the project site and used when required:

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports forms (blank)
- Medical Data Sheets
- MSDSs for chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (to be posted in the site trailers)
- Training/Medical Surveillance Documentation Form (blank)
- Emergency reference information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as at sites with no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents chemicals brought on site, including decontamination solutions, sample preservations, fuel, etc. This list should be posted in a central area.

MSDSs (maintained) - The MSDSs should also be in a central area accessible to site personnel. These documents should match the listings on the chemical inventory list for substances used on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster (posted) - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (see Figure 8-2) and identifies site personnel, dates of training (including site-specific training), and medical surveillance. The list indicates clearance and status. Personnel must meet these requirements to enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) (posted) - This list of numbers and directions will be maintained at the phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by on-site personnel and filed in a central location. For any injury or illness requiring medical attention, the site worker's Medical Data Sheet will accompany him/her to the medical facility. A copy of this sheet or a wallet card will be given to personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - This standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - The results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using DOT placards and acceptable [Hazard Communication 29 CFR 1910.1200(f)] labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objective is accomplished.

13.0 ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
CFR	Code of Federal Regulations
CLEAN	
CRZ	Contamination reduction zone
DRI	Direct read instruments
DOT	Department of Transportation
EPA	United States Environmental Protection Agency
eV	Electron volts
FID	Flame ionization detector
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IDW	Investigative-Derived Wastes
LEL	Lower explosive limit
LFL	Lower flammable limit
MSDS	Material Safety Data Sheets
MSL	Mean sea level
N/A	Not Available
NCBC	Naval Construction Battalion Center
NIOSH	National Institute for Occupational Safety and Health
O_2	Oxygen
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PHSO	Project Health and Safety Officer
PID	Photoionization detector
PM	Project Manager
PPE	Personal protective equipment
QAPP	Quality Assurance Project Plan
RIDEM	Rhode Island Department of Environmental Management
SOP	Standard Operating Procedure
SSO	Site Safety Officer

SVOC	Semivolatile organic compound
TtNUS	Tetra Tech NUS, Inc.
UEL/UFL	Upper Explosive Limit/Upper Flammable Limit
VOC	Volatile organic compound

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- Stop work as needed to ensure no further harm is done.
- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room. Check with your office location or project health and safety plan for specific instructions.
- If incident involves an injury, illness, or chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Duffy at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours of the injury. You will be required to complete an Injury/Illness Report. You may also be required to participate in a more detailed investigation with the Health Sciences Department.
- In the event of a serious near-miss incident, a "Serious Near Miss Report" (Form AR-2, available online at https://go2.tetratech.com under "Departments", "Health and Safety", "Accident Reporting Procedures", hyperlink for "Serious Near Miss Report") must be completed and faxed to the Corporate Health and Safety Manager within 48 hours.
- If further medical treatment is needed, our insurance carrier, ACE, will provide information on the authorized providers customized to the location of the injured employee. You can find this information by accessing the website of ACE's claims handler, ESIS, at : **www.esis.com**. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local Human Resources representative (Marilyn Duffy), Corporate Health and Safety Manager (Matt Soltis), or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries pay premiums on behalf of their employees. This program is based on a no-fault system, and benefits are provided for covered events as an exclusive remedy to the injured employee regardless of fault. The types of injuries or illnesses covered and the amount of

benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits from the first day of work. All employees must follow the above injury/illness reporting procedures. If you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

Consultants, independent contractors, and employees of subcontractors and employees from temporary employment agencies are not covered by Tetra Tech's Worker's Compensation plan.

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: _____
Subsidiary Health and Safety Representative

cc: _____
Workers Compensation Administrator

Project name: _____

Project number: _____

Prepared by: _____

Position: _____

Office: _____

Telephone number: _____

Fax number: _____

Information Regarding Injured or Ill Employee

Name: _____

Home address: _____

_____

Home telephone number: _____

Occupation (regular job title): _____

Department: _____

Office: _____

Gender: M ☐ F ☐ No. of dependents: _____

Marital status: _____

Date of birth: _____

Social security number: _____

Date of Accident: _____

Time Employee Began Work: _____

Time of Accident: _____ a.m. ☐ p.m. ☐

☐ Check if time cannot be determined

Location of Incident

Street address: _____

City, state, and zip code: _____

County: _____

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Incident

What was the employee doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the employee was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time"

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Incident (Continued)

What was the injury or illness? Describe the part(s) of the body affected and how it was affected. Be more specific than "hurt," "pain," or "sore." Examples "Strained back"; "Chemical burn, right hand"; "Carpal tunnel syndrome, left wrist"

Describe the Object or Substance that Directly Harmed the Employee: Examples: "Concrete floor"; "Chlorine"; "Radial arm saw." If this question does not apply to the incident, write "Not applicable."

Did the employee die? Yes ☐ No ☐ Date of death: _____

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this report.

Witness (Attach additional sheets for other witnesses.)

Name: _____

Company: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Medical Treatment Required? ☐ Yes ☐ No ☐ First aid only

Name of physician or health care professional: _____

If treatment was provided away from the work site, provide the information below.

Facility name: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized over night as an in-patient? ☐ Yes ☐ No

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ **Time of Report:** _____

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

_____ _____

Printed Name of Injured Employee Telephone Number

_____ _____

Signature of Injured Employee Date

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Office Manager				
Project Manager				
Site Safety Coordinator or Office Health and Safety Representative				

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To Be Completed by the Subsidiary Health and Safety Representative

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First aid only

☐ Days away from work

☐ Remained at work but incident resulted in job transfer or work restriction

☐ Incident involved days away and job transfer or work restriction

☐ Medical treatment only

No. of days away from work _____

Date employee left work _____

Date employee returned to work _____

No. of days placed on restriction or job transfer: _____

OSHA Recordable Case Number _____

To Be Completed by Human Resources

Social security number: _____

Date of hire: _____ Hire date for current job: _____

Wage information: $ _____ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: _____

Current position: _____ Shift hours: _____

State in which employee was hired: _____

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date: _____

To Be Completed during Report to Workers Compensation Carrier

Date reported: _____ Reported by: _____

Confirmation number: _____

Name of contact: _____

Field office of claims adjuster: _____

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

ATTACHMENT II

MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by on-site personnel and kept in a central location during the execution of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next Kin _____

Drug or other Allergies _____

_____

Particular Sensitivities _____

_____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals _____

_____

_____

_____

What medications are you presently using? _____

_____

_____

_____

Do you have any medical restrictions? _____

_____

_____

_____

Name, Address, and Phone Number of personal physician: _____

_____

_____

I am the individual described above. I have read and understand this HASP.

_____ _____

Signature Date

ATTACHMENT III

SAFE WORK PERMITS

SAFE WORK PERMIT
MOBILIZATION/DEMOBILIZATION ACTIVITIES
NAVAL CONSTRUCTION BATTALION DAVISVILLE
NORTH KINGSTON, RHODE ISLAND

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

I. **Work limited to the following (description, area, equipment used):** Mobilization and demobilization activities not associated with typical hazardous waste site activities.

II. **Primary Hazards:** Lifting; pinches and compressions; vehicular and foot traffic; slips/trips/falls, and ambient temperature extremes.

III. **Field Crew:** _____

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

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
None anticipated			

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – leather/cotton)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☒ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☒ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: PPE selection is dependent upon tasks being performed. In general, site activities require the use of basic safety equipment (field clothing and steel-toe footwear). Work gloves (cotton or leather) will be used when necessary to protect against cut or abrasions.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Site contaminants are unlikely to be encountered during this site activity. Material Safety Data Sheets (MSDS) will be provided for all chemicals used on site (sample preservatives, decon solutions, fuels, etc.). Refer to MSDS for additional guidance including use of PPE and safe handling procedures. Obtain assistance when handling heavy equipment (sample coolers, instrument cases, sampling equipment, etc.).

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
GROUNDWATER SAMPLING
NAVAL CONSTRUCTION BATTALION DAVISVILLE
NORTH KINGSTON, RHODE ISLAND

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

I. **Work limited to the following (description, area, equipment used):** Groundwater sampling

II. **Primary Hazards:** contact with contaminants; transfer of contamination; lifting; slip/trips/falls; ambient temperature extremes; vehicular and foot traffic; insect/animal bites and stings, poisonous plants and inclement weather.

III. **Field Crew:** _____

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

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Modifications/Exceptions: _____

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
1,1-dichlorethene	PID or FID	any sustained reading above 5 ppm in breathing zone	evacuate area and resume when levels return to normal

Primary Route(s) of Exposure/Hazard: Contact with contaminated media, incidental ingestion. Airborne concentrations of site contaminants are unlikely to be present.

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☒ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type -- Nitrile)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☒ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☒ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Other PPE as identified in Table 5-1 may be necessary based on observed hazards (safety glasses, high visibility reflective vests, etc.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Significant airborne concentrations of potential site contaminants are unlikely to be encountered during this site activity. Use of safe working practices and PPE will prevent potential contact/exposure to site contaminants. Obtain assistance when handling heavy equipment (sample coolers, instrument cases, sampling equipment, etc.).

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PRACTICES
DECONTAMINATION ACTIVITIES
NAVAL CONSTRUCTION BATTALION DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND

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

I. **Work limited to the following (description, area, equipment used):** Decontamination of sampling equipment used during groundwater sampling tasks.

II. **Primary Hazards:** decontamination fluids; vehicular and foot traffic, ambient temperature extremes, slips, trips and falls; inclement weather

III. **Field Crew:** _____

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

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
1,1-dichlorethene	PID or FID	any reading	decontaminate equipment again and re-screen

Primary Route(s) of Exposure/Hazard: Contact with contaminated media, incidental ingestion. Airborne concentrations of site contaminants are unlikely to be present.

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Nitrile)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☒ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Other PPE as identified in Table 5-1 may be necessary based on observed hazards (safety glasses, high visibility reflective vests, etc.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Significant concentrations of potential site contaminants are unlikely to be encountered during this site activity. Use of safe working practices and PPE will prevent potential contact/exposure to site contaminants.

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT
IDW MANAGEMENT ACTIVITIES
NAVAL CONSTRUCTION BATTALION CENTER
NORTH KINGSTOWN, RHODE ISLAND

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

I. **Work limited to the following (description, area, equipment used):** IDW management activities.

II. **Primary Hazards:** Site contaminants; lifting, compression injuries; loading bulk transport containers; inclement weather and insect/animal bites or stings, poisonous plants, etc.

III. **Field Crew:** _____

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

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
1,1-dichlorethene	None required unless spill provisions are involved.	5 ppm	If concentrations are suspected contact the PHSO.

Primary Route(s) of Exposure/Hazard: Contact with contaminated media, incidental ingestion. Airborne concentrations of site contaminants are unlikely to be present.

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☒ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – leather or cotton)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☒ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☒ No
Safety Shower/Eyewash	☒ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Other PPE as identified in Table 5-1 may be necessary based on observed hazards (safety glasses, chemical resistant coveralls, etc).

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Significant concentrations of potential site contaminants are unlikely to be encountered during this site activity. Use of safe working practices and PPE will prevent potential contact/exposure to site contaminants. Obtain assistance or use material handling when handling heavy equipment (sample coolers, instrument cases, sampling equipment, etc.).

Permit Issued by: _____ Permit Accepted by: _____

APPENDIX B

TtNUS SOPs

TETRA TECH NUS, INC.	STANDARD OPERATING PROCEDURES	Number DAV-1	Page 1 of 25
		Effective Date 04/06	Revision 0
		Applicability Tetra Tech NUS, Inc.	
		Prepared Earth Sciences Department	
Subject GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING		Approved D. Senovich	

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C LOW FLOW PURGE DATA SHEET 25

1.0 PURPOSE

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

2.0 SCOPE

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

3.0 GLOSSARY

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

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

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

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

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

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

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

4.0 RESPONSIBILITIES

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

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

5.0 PROCEDURES

5.1 General

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

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

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

2. For wells that can be purged dry, the well shall be evacuated and allowed to recover to 75% full capacity prior to sample acquisition. If the recovery rate is fairly rapid, evacuation of more than one volume of water is required.

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

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

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

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

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

5.2 Sampling, Monitoring, and Evacuation Equipment

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

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

- Sample packaging and shipping equipment - Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler, ice, labels and chain-of-custody documents.
- Field tools and instrumentation - Multi-parameters water quality meter capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity and salinity or individual meters (as applicable), pH paper, camera and film (if appropriate), appropriate keys (for locked wells), water level indicator.
- Pumps
  - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable.
  - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.
- Other sampling equipment - Bailers and inert line with tripod-pulley assembly (if necessary).
- Pails - Plastic, graduated.
- Decontamination solutions - Deionized water, potable water, laboratory detergents, 10% nitric acid solution (as required), and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

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

5.3 Calculations of Well Volume

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

- Obtain all available information on well construction (location, casing, screens, etc.).
- Determine well or inner casing diameter.
- Measure and record static water level (depth below ground level or top of casing reference point).
- Determine depth of well by sounding using a clean, decontaminated, weighted tape measure.

- Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).

- Calculate one static well volume in gallons $V = (0.163)(T)(r^2)1$

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

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

5.4 Evacuation of Static Water (Purging)

5.4.1 General

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

5.4.2 Evacuation Devices

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

Bailers

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

Advantages of bailers include:

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

Limitations on the use of bailers include the following:

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

Suction Pumps

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

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

Air-Lift Samplers

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

Submersible Pumps

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

Limitations of this class of pumps include:

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

5.5 Onsite Water Quality Testing

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

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen (DO)
- Oxidation-Reduction Potential (ORP)

- Turbidity
- Salinity

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

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Since instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use. Most meters used to measure field parameters require calibration on a daily basis. Refer to SOP 6.3 for example equipment calibration log.

5.5.1 Measurement of pH

5.5.1.1 General

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

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

5.5.1.2 Principles of Equipment Operation

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

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

5.5.1.3 Equipment

The following equipment is needed for taking pH measurements:

- Stand-alone portable pH meter, or combination meter (e.g., Horiba U-10), or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).

- Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs).
- Buffer solutions, as specified by the manufacturer.
- pH indicator paper, to cover the pH range 2 through 12.
- Manufacturer's operation manual.

5.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

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

- Inspect the instrument and batteries prior to initiation of the field effort.
- Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
- If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- Calibrate on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on an equipment calibration log sheet.
- Immerse the electrode(s) in the sample. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.
- Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH unit. Also record the sample temperature.
- Rinse the electrode(s) with deionized water.
- Store the electrode(s) in an appropriate manner when not in use.

Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is adequately determined.

5.5.2 Measurement of Specific Conductance

5.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance. Most conductivity meters in use today display specific conductance (SC); units of milliSiemens per centimeter, which is the conductivity normalized to temperature @ 25°C. This format (SC) is the required units recorded on the groundwater sample log field form (Attachment B).

5.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.5.2.3 Equipment

The following equipment is needed for taking specific conductance (SC) measurements:

- Stand alone portable conductivity meter, or combination meter (e.g., Horiba U-10), or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available which may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirement of the sampling program.

5.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet. Potassium chloride solutions with a SC closest to the values expected in the field shall be used for calibration.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the electrode in the sample and measure the conductivity.
- Read and record the results in a field logbook or sample log sheet.
- Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for details.

5.5.3 Measurement of Temperature

5.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury filled, dial-type thermometers or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).. In addition, various meters such as specific conductance or dissolved oxygen meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

5.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample:

- Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.
- Record values in a field logbook or sample log sheet.

If a temperature meter or probe is used, the instrument shall be calibrated according to manufacturer's recommendations.

5.5.4 Measurement of Dissolved Oxygen

5.5.4.1 General

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms as well as the rate of corrosivity, are dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of dissolved oxygen meters only. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible, and is not susceptible to interference caused by color, turbidity, colloidal material or suspended matter.

5.5.4.2 Principles of Equipment Operation

Dissolved oxygen probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, while leaving the surface of the solution undisturbed.

Dissolved oxygen probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide, which are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field log book and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer.

5.5.4.3 Equipment

The following equipment is needed to measure dissolved oxygen concentration:

- Stand alone portable dissolved oxygen meter, or combination meter (e.g., Horiba U-10), or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

5.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure the dissolved oxygen concentration:

- The equipment shall be calibrated and have its batteries checked before going to the field.
- The probe shall be conditioned in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
- The instrument shall be calibrated in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature.
- Record all pertinent information on an equipment calibration sheet.
- Rinse the probe with deionized water.
- Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells can be moved up and down.
- Record the dissolved oxygen content and temperature of the sample in a field logbook or sample log sheet.
- Rinse the probe with deionized water.
- Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This however, may not always be practical.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen solubilization and positive test interferences.

5.5.5 Measurement of Oxidation-Reduction Potential

5.5.5.1 General

The oxidation-reduction potential (ORP) provides a measure of the tendency of organic or inorganic compounds to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of oxidized to reduced species in the sample.

5.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental

measurements, such as dissolved oxygen, may be correlated with ORP to provide a knowledge of the quality of the solution, water, or wastewater.

5.5.5.3 Equipment

The following equipment is needed for measuring the oxidation-reduction potential of a solution:

- Combination meters with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring oxidation-reduction potential:

- The equipment shall be checked using the manufacturer's recommended reference solution and have its batteries checked before going to the field.

- Thoroughly rinse the electrode with deionized water.

- If the probe does not respond properly to the recommended reference solution, then verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of a test solution is altered. The ORP will increase when the pH of a test solution decreases, and the ORP will decrease if the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note the ORP drops sharply when the caustic is added (i.e., pH is raised) thus indicating the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions or the probe should be replaced.

- Record all pertinent information on an equipment calibration log sheet.

5.5.6 Measurement of Turbidity

5.5.6.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and microscopic organisms, including plankton.

It is important to obtain a turbidity reading immediately after taking a sample, since irreversible changes in turbidity may occur if the sample is stored too long.

5.5.6.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid

natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidmeter. Therefore, nephelometric turbidity units (NTU) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

5.5.6.3 Equipment

The following equipment is needed for turbidity measurement:

- Light meter (e.g., LaMotte 2020) which calibrates easily using test cells with standards of 0.0 NTUs, and 10 NTUs, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.6.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements utilizing an electrode (e) or light meter (l) are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the electrode with one or more portions of the sample to be tested or with deionized water (applies to "e").
- Fill the light meters glass test cell with ~5 ml of sample, screw on cap, wipe off glass, place test cell in light meter and close the lid (applies to "l").
- Immerse the electrode in the sample and measure the turbidity (applies to "e").
- The reading must be taken immediately as suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
- Read and record the results in a field logbook or sample log sheet. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
- Rinse the electrode or test cell with deionized water.

5.5.7 Measurement of Salinity

5.5.7.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Note: Most field meters determined salinity automatically from conductivity and

temperature. The displayed value will be displayed in either parts per thousand (ppt) or % (e.g., 35 ppt will equal 3.5%).

5.5.7.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (found in *Standard methods for the Examination of Water and Wastewater*). Depending on the meter, the results are displayed in either ppt or %. The salinity measurements are carried out in reference to the conductivity of standard seawater (*corrected to S = 35*).

5.5.7.3 Equipment

The following equipment is needed for Salinity measurements:

- Multi-parameter water quality meter capable of measuring conductive, temperature and converting them to salinity (e.g., Horiba U-10 or YSI 600 series).
- Calibration Solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.7.4 Measurement Techniques for Salinity

The steps involved in taking Salinity measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the cell with the sample to be tested.
- Immerse the multi-probe in the sample and measure the salinity. Read and record the results in a field logbook or sample log sheet.
- Rinse the probes with deionized water.

5.6 Sampling

5.6.1 Sampling Plan

The sampling approach consisting of the following, shall be developed as part of the project plan documents which are approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).

- Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.

- Sample preservation requirements.

- Work schedule.

- List of team members.

- List of observers and contacts.

- Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.6.2 Sampling Methods

The collection of a groundwater sample consists of the following steps:

1. The site Health & Safety Officer (or designee) will first open the well cap and use volatile organic detection equipment (PID or FID) on the escaping gases at the well head to determine the need for respiratory protection.

2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet (see Attachment B); then calculate the fluid volume in the well pipe (as previously described in this SOP).

3. Calculate well volume to be removed as stated in Section 5.3.

4. Select the appropriate purging equipment (see Attachment A). If an electric submersible pump with packer is chosen, go to Step 10.

5. Lower the purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner (as applicable). Lower the purging device, as required, to maintain submergence.

6. Measure the rate of discharge frequently. A graduated bucket or cylinder and stopwatch are most commonly used.

7. Observe the peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.

8. Purge a minimum of three to five casing volumes before sampling. In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Purged water shall be collected in a designated container and disposed in an acceptable manner.

9. If sampling using a pump, lower the pump intake to midscreen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.

10. (For pump and packer assembly only). Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.

11. In the event that recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this occurrence in the site logbook.

12. Fill sample containers (preserve and label as described in SOP SA-6.1).

13. Replace the well cap and lock as appropriate. Make sure the well is readily identifiable as the source of the samples.

14. Process sample containers as described in SOP SA-6.1.

15. Decontaminate equipment as described in SOP SA-7.1.

5.7 Low Flow Purging and Sampling

5.7.1 Scope & Application

Low flow purging and sampling techniques are sometimes required for groundwater sampling activities. The purpose of low flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at or near natural flow conditions. The minimum stress procedure emphasizes negligible water level drawdown and low pumping rates in order to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 1 inch or more and a saturated screen, or open interval, length of ten feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This procedure is not designed to collect non-aqueous phase liquids samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs), using the low flow pumps.

The procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 10 NTU and to achieve a water level drawdown of less than 0.3 feet during purging and sampling. If these goals cannot be achieved, sample collection can take place provided the remaining criteria in this procedure are met.

5.7.2 Equipment

The following equipment is required (as applicable) for low flow purging and sampling:

- Adjustable rate, submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom filling bailers may be used to check for and obtain samples of LNAPLs or DNAPLs.

- Tubing - Teflon, Teflon-lined polyethylene, polyethylene, PVC, Tygon, or stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device, 0.01 foot accuracy, (electronic devices are preferred for tracking water level drawdown during all pumping operations).
- Interface probe, if needed.
- Flow measurement supplies.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments - pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional Indicators - ORP, salinity, and dissolved oxygen, flow-through cell is required. Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s), and other forms (see Attachments B and C).
- Sample Bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event (if available).
- Field Sampling Plan.
- PID or FID instrument for measuring VOCs (volatile organic compounds).

5.7.3 Purging and Sampling Procedure

Open monitoring well, measure head space gases using PID/FID. If there is an indication of off gassing when opening the well, wait 3-5 minutes to permit water level an opportunity to reach equilibrium.

Measure and record the water level immediately prior to placing the pump in the well.

Lower pump or tubing slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is three feet or less of standing water in the well.

Start with the initial pump rate set at approximately 0.1 liters/minute. Use a graduated cylinder and stopwatch to measure the pumping rate. Adjust pumping rates as necessary to prevent drawdown from exceeding 0.3 feet during purging. If no drawdown is noted, the pump rate may be increased (to a max of 0.4 liters/minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. If groundwater is drawn down below

the top of the well screen, purging will cease or the well will be pumped to dryness and the well will be allowed to recover before purging continues. Slow recovering wells will be identified and purged at the beginning of the workday. If possible, samples will be colleted from these wells within the same workday and no later than 24 hours after the start of purging.

Measure the well water level using the water level meter every 5 to 10 minutes. Record the well water level on the Low-Flow Purge Data Form (Attachment C).

Record on the Low-Flow Purge Data Form every 5 to 10 minutes the water quality parameters (pH, specific conductance, temperature, turbidity, oxidation-reduction potential, dissolved oxygen and salinity or as specified by the approved site specific work plan) measured by the water quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled/deionized water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form.

Measure the flow rate using a graduated cylinder. Remeasure the flow rate any time the pump rate is adjusted.

During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections.

After stabilization is achieved, sampling can begin when a minimum of two saturated screen volumes have been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits:

- pH ±0.1 standard units
- Specific conductance ±3%
- Temperature ±3°C
- Turbidity ±10% for values greater than 1 NTU and less than 10 NTU
- Dissolved oxygen ±10%
- ORP/Eh ±10 mV

If the above conditions have still not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. Record the final well stabilization parameters from the Low-Flow Purge Data Form onto the Groundwater Sample Log Form.

VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples: (1) Collect the non-VOCs samples first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample and record the new flow rate; (2) reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel), or clamp which should reduce the flow rate by constricting the end of the tubing; (3) insert a narrow diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, collect sample from the narrow diameter tubing.

Prepare samples for shipping as per SOP SA-6.1.

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U.S. Geological Survey, 1984. National Handbook of Recommended Methods for Water Data Acquisition, Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

ATTACHMENT A

PURGING EQUIPMENT SELECTION

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet	X	X	X	X	X			
	Water Level >25 feet	X			X				
2-Inch	Water level <25 feet	X	X	X	X	X	X		
	Water Level >25 feet	X			X		X		
4-Inch	Water level <25 feet	X	X	X	X	X	X	X	X
	Water Level >25 feet	X			X		X	X	X
6-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X
8-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 2

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, Inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump	Portable; peristaltic (suction)	<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	670 mL/min with 7015-20 pump head	$500-600	AC/DC; variable speed control available; other models may have different flow rates.
ECO Pump Corp.	SAMPLifier	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift	$400-700	AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	$185	Acts as piezometer; requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	$1,500-3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflon®, PP, PE, Detrin®, acetal	0-150	0-7,500 mL/min	$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teflon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#0500)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	$1,400-1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	$300-400	Requires compressed gas; piezometric level indicator; other materials available.

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 3

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; peristaltic (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	$1,200-1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Bennett Co.	Model 180	Portable; piston (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	$2,600-2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Canada Ltd.	5W Water Sampler	Portable; grab (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	$1,300-1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; grab (positive displacement)	1.66/Custom	PVC, PP	No limit	250 mL/ft of bailer	$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon®, Teflon®	0-150	350 mL/flushing cycle	$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; bladder (positive displacement)	1.38/48	SS, silicone, Delrin®, Tygon®	0-125	0-4,000 mL/min	$800-1,000	Compressed gas required; DC control module; custom built.

Construction Material Abbreviations:

- PE Polyethylene
- PP Polypropylene
- PVC Polyvinyl chloride
- SS Stainless steel
- PC Polycarbonate
- EPDM Ethylene-propylene diene (synthetic rubber)

Other Abbreviations:

- NA Not applicable
- AC Alternating current
- DC Direct current

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.

ATTACHMENT B
GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type: _____
[ ] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method:								
Monitor Reading (ppm):			SEE LOW FLOW PURGE DATA SHEET					
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

ATTACHMENT C
LOW FLOW PURGE DATA SHEET

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: _____ WELL ID.: _____
PROJECT NUMBER: _____ DATE: _____

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments

SIGNATURE(S): _____ PAGE___OF___

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO_3, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.

- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).

- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

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ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration		Container[1]	Sample Size	Preservation[2]	Holding Time[2]
WATER					
Organics (GC&GC/MS)	VOC Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days[9]
	Extractables (Low SVOCs and pesticide/PCBs)	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables (Medium SVOCs and pesticide/PCBs)	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals Low	High-density polyethylene	1 L	HNO_3 to pH ≤2	6 months (Hg-28 days)
	Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	14 days
SOIL					
Organics (GC&GC/MS)	VOC	EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables (Low SVOCs and pesticides/PCBs)	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables (Medium SVOCs and pesticides/PCBs)	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium	Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All	Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All	Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR					
Volatile Organics	Low/Medium	Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

1 All glass containers should have Teflon cap liners or septa.
2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid[5]	14 days[6]
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH 2; H_2SO_4 to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H_2SO_4 to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE TWO

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS (Cont'd):			
Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours
METALS:[7]			
Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO_3 to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO_3 to pH 2	6 months
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] HCl to pH 2 [9]	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] adjust pH to 4-5 [10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Benzidines[11],[12]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate esters[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines[11],[14]	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
PCBs[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)[11],[14]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF)[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
(5) Should only be used in the presence of residual chlorine.
(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
(14) For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded or referenced (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Time and date of H&S training
- Arrival/departure of equipment
- Time and date of equipment calibration
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day

that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of camera (digital or film), and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives and/or digitally saved images to compact disks must be docketed into the project's central file.

5.2 Field Notebooks

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 Field Forms

All Tetra Tech NUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (http://intranet.ttnus.com) under Field Log Sheets. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager (or designee), while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing vials for VOC analysis or the cooler with the air bill attached. The air bill should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment C. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment D is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the sampler(s) and affixed across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Field Analytical Log Sheets are used to record geochemical and/or natural attenuation field test results.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A Groundwater Level Measurement Sheet must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The Pumping Test Data Sheet facilitates this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A Packer Test Report Form must be completed for each well upon which a packer test is conducted.

5.3.2.4 Boring Log

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these readings must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Monitoring Well Materials Certificate of Conformance should be used as the project directs to document all materials utilized during each monitoring well installation.

The Monitoring Well Development Record should be used as the project directs to document all well development activities.

5.3.2.8 Miscellaneous Field Forms - QA and Checklists

Container Sample and Inspection Sheet should be used as the project directs each time a container (drum, tank, etc.) is sampled and/or inspected.

QA Sample Log Sheet should be used at the project directs each time a QA sample is colleted, such as Rinsate Blank, Source Blank, etc.

Field Task Modification Request (FTMR) will be prepared for all deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Copies of all FTMRs will be maintained with the onsite planning documents and originals will be placed in the final evidence file.

The Field Project Daily Activities Check List and Field Project Pre-Mobilization Checklist should be used during both the planning and field effort to assure that all necessary tasks are planned for and completed. These two forms are not a requirement but a useful tool for most field work.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used or in accordance with the manufacturer's recommendations.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Daily Activities Report

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

It should be noted that in addition to summaries described herein, other summary reports may also be contractually required.

All Tetra Tech NUS field forms can be found on the company's intranet site at http://intranet.ttnus.com under Field Log Sheets.

6.0 LISTING OF TETRA TECH NUS FIELD FORMS FOUND ON THE TTNUS INTRANET SITE. HTTP://INTRANET.TTNUS.COM CLICK ON FIELD LOG SHEETS

Groundwater Sample Log Sheet
Surface Water Sample Log Sheet
Soil/Sediment Sample Log Sheet
Container Sample and Inspection Sheet
Geochemical Parameters (Natural Attenuation)
Groundwater Level Measurement Sheet
Pumping Test Data Sheet
Packer Test Report Form
Boring Log
Monitoring Well Construction Bedrock Flush Mount
Monitoring Well Construction Bedrock Open Hole
Monitoring Well Construction Bedrock Stick Up
Monitoring Well Construction Confining Layer
Monitoring Well Construction Overburden Flush Mount
Monitoring Well Construction Overburden Stick Up
Test Pit Log
Monitoring Well Materials Certificate of Conformance
Monitoring Well Development Record

Daily Activities Record
Field Task Modification Request
Hydraulic Conductivity Test Data Sheet
Low Flow Purge Data Sheet
QA Sample Log Sheet
Equipment Calibration Log
Field Project Daily Activities Checklist
Field Project Pre-Mobilization Checklist

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: _____ DATE: _____

SITE LEADER: _____
PERSONNEL:

TtNUS	DRILLER	SITE VISITORS
_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

_____

Field Operations Leader

ATTACHMENT B

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Site:** **Location:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory:**	

ATTACHMENT C

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 3413 | PAGE ___ OF ___

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAP (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G) / PRESERVATIVE USED / TYPE OF ANALYSIS								COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME
COMMENTS					

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

ATTACHMENT D

CHAIN-OF-CUSTODY SEAL

CUSTODY SEAL	**CUSTODY SEAL**
Date	**Date**
Signature	**Signature**

APPENDIX C

LABORATORY SOPs

COPY

UNCONTROLLED

REV:	-
PAGE:	1 OF 21

DOCUMENT HISTORY AND APPROVAL PAGE

TITLE:	1,4-DIOXANE ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)-MODIFIED FOR SELECTED ION MONITORING (SIM) EPA METHOD 8270C
DEPARTMENTS AFFECTED:	Organics

ISSUE DATE:	REVISION CODE:	SOP #:	REVISION CHANGES:
10/20/05	-	SOP 3.3.49	Create an SOP in NELAC format
01/04/06	A	SOP 3.3.49	Change of ISTD at request of client

DOCUMENT APPROVAL		
Originator: James F. Galasyn, Ph.D.	Signature/Date: J Galasyn	Title Organics Supervisor 010406
Approved by:	Kelly Alertus 1/4/06	Lab Manager
Reviewed by:	Pamela M. Dougherty 1/4/06	Total Quality Manager

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NEL	STANDARD OPERATING PROCEDURE		
TITLE	1,4-DIOXANE ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)-MODIFIED FOR SELECTED ION MONITORING (SIM) EPA METHOD 8270C		
SOP# 3.3.49	REV# -	EFFECTIVE 10/20/05	PAGE 2 OF 21
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1.0 Test Method:

This standard operating procedure is for EPA Method 8270, current revision, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) Capillary Column Technique. This SOP addresses the modification used by NEL (selected ion monitoring) to achieve lower detection levels than can be routinely achieved using method 8270 with the GC/MS in the scan mode.

2.0 Applicable Matrix or Matrices

This standard operating procedure is suitable for the determination of semivolatile organic compounds in ground and surface waters as well as solid matrices.

3.0 Detection Limits

The SVOC addressed in this SOP, together with their corresponding Practical Quantitation Limits (PQLs) are as follows:

TABLE 1: PRACTICAL QUANTITATION LIMITS

ANALYTE	WATER UG/L	SOIL UG/KG
1,4-Dioxane	2.00	67

Other analytes may be added to this table at the request of the client and with sufficient lead-time to determine method detection levels prior to receipt of samples.

4.0 Scope and Application

This method is designed to meet the survey and monitoring requirements of the US EPA. The QA/QC requirements are routinely applied to water, ground water, soil and sediment analyzed for semi-volatile compounds (SVOC's) using Gas Chromatography /Mass Spectrometry (GC/MS). This method has been modified to utilize the selected-ion monitoring capabilities of the GC/MS to achieve lower detection limits than what is routinely found in typical method 8270C analyses. Note that this method is not

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applicable to determining any unknown constituents of a sample since only a limited and defined mass range is scanned. Also, the detection limits will increase as the number of analytes being analyzed for increases.

5.0 Summary of Method

5.1 The samples are prepared for analysis by gas chromatography/mass spectrometry (GC/MS) using the appropriate sample preparation (refer to Method 3500) and, if necessary, sample cleanup procedures (refer to Method 3600). NEL routinely utilizes method 3510 for aqueous matrices and method 3550 for soil/sediment matrices.

5.2 The semivolatile compounds are introduced into the GC/MS by injecting the sample extract into a gas chromatograph (GC) with a narrow-bore fused silica capillary column. The GC column is temperature-programmed to separate the analytes, which are then detected by a mass spectrometer (MS) connected to the gas chromatograph. Better sensitivity is achieved by only scanning for those ions that are relevant to the compound list, as follows:

Analyte	Primary Ion	Secondary Ion(s)
1,4-dioxane	88	58
2-methylnaphthalene-d10 (surr)	152	125
1,4-dioxane-d8 (istd)	96	64

Primary ions must not be changed except in instances where interference occurs with a co-eluting non-target analyte. If a secondary ion is used for quantitation, the corresponding standards (initial calibration curve, continuing calibration) and the applicable QC (method blank, LCS/LCSD, MS/MSD) must be quantitated using this same secondary ion.

It is NEL policy that a minimum of two ions be used for all SIM analyses.

5.3 Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct interface. Identification of target analytes is accomplished by comparing their mass spectra with the SIM spectra of standards, which has been obtained on the same instrument used for analysis. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a multi-point calibration curve.

5.4 The method includes specific calibration and quality control steps that meet the general requirements provided in Method 8000.

6.0 Definitions

6.1 INTERNAL STANDARD (IS) - Non-target analyte compounds that are similar to the target analytes but are not expected to be found in environmental media (generally isotopically labeled target analytes are used for this purpose) and are

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added to every standard, quality control sample, and field sample at a known concentration prior to analysis. IS responses are used as the basis for quantitation of target analytes.

6.2 SURROGATE ANALYTE (SS) - Non-target analytes compounds that are similar in composition and behavior to the target analytes but are not expected to be found in environmental media (often, isotopically labeled target analytes are used for this purpose) and are added to every standard, quality control sample, and field sample at a known concentration prior to preparation and/or analysis. Surrogate responses are used to evaluate the accuracy of the laboratory's performance of the analytical method in a specific sample matrix.

6.3 STOCK STANDARD SOLUTION - A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a commercial source.

6.4 PRIMARY DILUTION STANDARD SOLUTION - A solution of several analytes prepared in the laboratory from stock standard solutions and diluted as needed to prepare calibration solutions and other needed analyte solutions.

6.5 CALIBRATION STANDARD (CAL) - A solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and surrogate analytes. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

6.6 ANALYTICAL BATCH- 20 or fewer samples which are extracted and analyzed together .

6.7 CONTINUING CALIBRATION CHECK STANDARD (CCV) - An analytical standard containing all target analytes, surrogate and internal standard compounds that is used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

6.8 METHOD BLANK (BLK) - An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The BLK is used to determine if method analytes or other interferences are present in the laboratory environmental, the reagents, or the apparatus.

6.9 LABORATORY CONTROL SAMPLES (LCS) - The LCS consists of an aliquot of a clean (control) matrix similar to the sample matrix and of the same weight or volume that is spiked with a set of analytes at a known concentration. Its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements. When the results of the matrix spike analysis indicates a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix.

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6.10 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) - Aliquots of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS/MSD is analyzed exactly like a sample. Its purpose is used to evaluate the accuracy and precision of the laboratory performance of the analytical method in a specific sample matrix.

7.0 Interferences

7.1 Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interference. Determine if the source of interference is in the preparation and/or cleanup of the samples and take corrective action to eliminate the problem.

7.2 All materials used in the procedure shall be demonstrated to be free from interference under the conditions of analysis by running a method blank initially and with each set of samples (a set is defined as a maximum of 16 samples in a 12-hour period).

7.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed with solvent between injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

7.4 To further deter column contamination and carryover, the GC septum and liner should be replaced after a full set of samples has run, or after particularly concentrated or dirty samples have run.

8.0 Safety

8.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined, however each reagent should be treated as a potential health hazard. Exposure to these substances should be reduced to the lowest possible levels. The MSDS sheets for the chemicals used in this procedure must be kept on file in the main chemistry laboratory and read by the analyst before the method is performed.

8.2 Analysts will be provided with a copy of the Chemistry Safety Handbook and are expected to adhere to the pertinent guidelines including but not limited to the use of chemicals in fume hoods, safety goggles, chemical protective lab aprons and proper gloves to handle specific chemicals. Other safety items include no eating in the lab, no mouth pipetting, not wearing protective laboratory equipment in any break areas, and washing hands after handling samples.

8.3 A daily check of fume hood velocity is to be performed and the acceptable range is 80 fpm-120 fpm for the three major hoods located at the rear of the chemistry laboratory. The smaller portable hood located in the SVOA room must also be checked daily with the acceptable range 55-80 fpm.

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8.4 Analysts will know where all sinks, eyewashes and emergency showers and spill kits are located in the laboratory and whom the appropriate safety personnel are to contact in an emergency.

8.5 Radioactive analyses:

8.5.1 Radiation badges are worn by all chemistry staff, attached to the chest area, at all times and should never leave the building. This ensures that any dose recorded is from the lab and not any outside source and that the lab is within legal limits for exposure to employees. It is the responsibility of each analyst to wear the badge that is assigned to them and they will be responsible for it during the entire wear period. Upon the start of a new wear period, old badges will be collected and new ones will be assigned by the Radiation Safety Officer (RSO).

8.5.2 There are three levels at which the badges detect energies:

DDE--Deep dose equivalent, whole body (head and trunk), active blood forming organs, gonads. Applies to external whole body exposure and the annual occupational regulatory limits for dose equivalent at a tissue depth of 1 cm is 5000 mrem.

LDE--Eye dose equivalent. Applies to the external exposure to the lens of the eye and the annual occupational regulatory limits for dose equivalent at a tissue depth of 0.3 cm is 15000 mrem.

SDE--Shallow dose equivalent. Applies to the external exposure of the skin or an extremity and the annual occupational regulatory limits for dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm2 is 50000 mrem.

8.5.3 All radiation exposure records are stored on file and can be viewed by employees at any time.

8.5.4 Arms and extremities need to be covered at all times that radioactive material is being used. Proper Protective Equipment (PPE) should include wearing gloves, lab coats with long sleeves and goggles. Any open wounds should be covered. Personnel exposure should be kept As Low As Reasonably Achievable (ALARA).

8.5.5 Other methods of radiation monitoring include surveys and wipe analysis. Surveys are conducted after the use of any radioactive material and wipes are done on a weekly basis. The RSO will perform these and any clean up actions will be taken to ensure that there is no contamination within the laboratory.

8.5.6 All radioactive samples are listed on the radiation cooler door and are to be stored there at all times unless procedure requires otherwise and it has been checked with the R.S.O.

8.5.7 All radioactive materials must be carried in secondary containment and no trays with holes in the bottom should be used. Upon removal from the

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cooler, the sign out sheet must be filled out with the following information: 1) Date, 2) Analyst, 3) Material description, 4) Time removed from cooler, 5) Time work is finished.

8.5.8 Upon completion of work a usage log needs to be filled out to contain the following information: 1) Date, 2) Analyst, 3) Analysis, 4) Amount used. This is just for the original sample. All work areas must be surveyed by RSO before another task can be started in the same area.

8.5.9 All refuse created must be collected and returned to the storage area, including: extracted samples, gloves, disposable glassware, plastic ware, towels used for clean up, all vials containing any form of the radioactive material and any waste that is washed through the instrument during analysis. These materials need to be collected in bags and separated by client. They should be labeled as **residue or processing material** and not as waste. These bags will be given out by the RSO.

8.5.10 Any time radioactive samples are being analyzed for an extended period of time, overnight for example, a sign must be posted to warn employees of the presence of radiation.

8.5.11 For further radiation safety, emergency response and regulations refer to Radiation SOP 3.6.2.

9.0 Equipment and Supplies

9.1 All volumetric glassware will be of Type A quality and cleaned to meet EPA requirements.

9.2 Sample containers:

Soils - 4 or 8 oz. Jars equipped with PTFE-lined screw-cap lids and pre-rinsed with Methylene Chloride (MeCl2) prior to use.

Waters - 1-liter amber bottles equipped with PTFE-lined screw-cap lids and pre-rinsed with MeCl2 prior to use.

9.3 Micro vials, 1.5 ml, glass with screw-cap lids and Teflon-lined butyl rubber septa are used for preparing and storing working standards and dilutions.

9.4 Micro vials, 1.5 ml, amber glass with screw-cap lids and Teflon-lined butyl rubber septa or crimp tops are used for storing and running samples.

9.5 The GC/MS system is a temperature programmable, GC connected to a MS via a capillary interface. An automatic injector is attached to the rear injector port. The rear injector port is equipped with a split/ splitless injector interfaced to a 30 meter, 0.25mm ID x 0.25 um, Rtx-5MS capillary column or equivalent. The SVOA GC/MS in use at the time of this SOP is a Agilent model 5970.

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The GC/MS is equipped with a multi position liquid autosampler (HP 7673A).

9.6 The data handling system is a computer system interfaced to the mass spectrometer and allows continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer has software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundance versus time or scan number. Software is also available that allows integrating the abundance between specified time or scan-number limits. The most recent version of the EPA/NIST Mass Spectral Library is also available. Information is archived by transfer to a server and is backed up by computer personnel.

10.0 Reagents and Standards

10.1 All reagents are pesticide grade or better and are obtained from reputable suppliers.

10.2 Reagent grade water is obtained from a Reverse Osmosis/Ion Exchange system that meets ASTM D1193077 Type II requirements for conductivity.

10.3 Standard preparation follows the procedure outlined in EPA Method 8270C, Section 5.0, and EPA Method 3500B, SW-846, Third Ed., Revision 3,1996, Sections 5.3 and 5.4 with the following exceptions and additions:

Standard stock solutions are obtained from certified chromatography suppliers and dated upon receipt. Second source standards are also obtained from certified suppliers and are used to verify the accuracy of the primary standards.

10.4 All stock standards will be kept at 4 degrees C or as recommended by the standard manufacturer in the original sealed vials until ready to use. Transferred stocks become primary standards and will be replaced every six months or sooner if the stock integrity shows signs of degradation.

10.5 Internal standard solution - The internal standard used is 1,4-dioxane-d8.

10.6 Surrogate standards - The surrogate standard used is 2-methylnaphthene-d10. It is spiked into aqueous samples at a concentration of 2.0 ug/l and in soil matrices at a concentration of 66.7 ug/kg.

10.7 Matrix spike and laboratory control standards - See the standards preparation section of this SOP for instructions concerning the preparation of this standard. The same standard is used as the laboratory control standard.

10.8 Acetone, hexane, Methylene chloride, isooctane, carbon disulfide, toluene and other appropriate solvents - All solvents are reagent grade or equivalent.

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10.9 All standards and dilutions are entered into the Semi-volatile Standards preparation logbook. The following information is entered for each standard transferred or diluted.

Date prepared
Analyst
Lot #
Supplier
Standard name/concentration(s)
Comments/dilutions
Usage
Unique identification code

All surrogates, matrix spikes and QC checks are entered into the Semi-volatile Extraction Standard Logbook. The following information is entered for each standard transferred or diluted:

Date prepared
Analyst
Lot #
Supplier
Standard name/concentration(s)
Comments/dilutions
Usage
Unique identification code

11.0 Sample Collection, Preservation, Shipment and Storage

11.1 Sample collection follows the procedure outlined in, Organic Analytes, Sec.4.1 of SW-846, Third Ed., Revision 3, 1996, with the following exception: 4-oz glass jars may be substituted for the 8-oz glass jars.

11.2 All samples shall be labeled with the sample identifier, such as site identification or sample number, and date and time sampled. Other pertinent information can be found on the chain of custody. At a minimum, the sample will be labeled with the NEL sample number.

11.3 All samples are kept at 4 degrees C from the time they are sampled until they are analyzed. Samples should be shipped to the lab on ice or with other cooling devices to maintain this required temperature. The client is notified for instructions should any temperature excursions occur outside of the two degrees C to six degrees C temperature window.

11.4 Extraction holding time:

Waters – 7 days from sample collection
Soils – 14 days from sample collection

11.5 Sample extracts are stored in a dedicated refrigerator and analyzed within

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forty days from the extraction date.

11.6 Samples, extracts, and semi-volatile standards are stored in separate refrigerators.

11.7 All samples remaining after analysis are to be either returned to the client or are to be disposed of according to Federal regulations.

12.0 Quality Assurance/Quality Control

12.1 The analyst should demonstrate an initial ability to perform this analysis as outlined in EPA Method 8081, Section 7, and performance should be documented in the appropriate NEL training form.

12.2 Method blanks, must be analyzed with each analytical batch to demonstrate that all analytical systems, reagents and glassware interference are under control.

12.3 The analyst is permitted to modify GC columns, conditions, or detectors to improve separations, turn-around time, or to lower costs, as long as the analyst can prove equivalency utilizing the QC parameters outlined in EPA Method 8000A.

12.4 The laboratory will demonstrate through the analysis of proficiency samples that the system is in control. The frequency of these QC checks will be at least semi-annually.

12.5 A LCS (laboratory control sample) must be performed for each analytical batch (up to a maximum of 20 samples) analyzed. A matrix spike/matrix spike duplicate must also be extracted at this same frequency. Id insufficient sample is provided for a MS/MSD, a LCSD should be extracted so that precision of the batch may be evaluated.

12.6 When sufficient samples have been analyzed, statistical surrogate and LCS limits must be calculated. Calculate the mean surrogate recovery and standard deviation for 25-30 samples for each matrix. The upper and lower control limits are defined as the mean +3 standard deviations. If the values fall outside of this range, then the system must be checked for the source of these errors. Possible problems are: matrix interference, calculation errors, degradation of standards, contamination, or instrument performance. A second extraction must be performed to confirm matrix interference.

12.7 The analyst may adopt additional QC measures to further ensure data quality.

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13.0 Calibration and Standardization

13.1 Calibration standards - Six calibration standards are prepared in the following concentrations: 0.125 PPM, 0.625 PPM, 1.25 PPM, 2.00 PPM, 2.50 PPM, and 3.00 PPM. At least one of the calibration standards should correspond to sample concentration at or below that necessary to meet the data quality objectives of the project. The remaining standards should correspond to the range of concentrations found in actual samples but not exceed the working range of the GC/MS system. Each standard should contain each analyte for detection by this method.

13.2 Daily Calibration

13.2.1 GC/MS tuning standard - A Methylene chloride solution containing 50 PPM of decafluorotriphenylphosphine (DFTPP) should be used and should also contain 50 PPM each of 4,4-DDT, pentachlorophenol, and benzidine to verify injection port inertness and GC column performance. For runs on the GC/MS an acceptable DFTPP tune shall be generated every 12 hours. The acceptable criteria for a DFTPP tune are listed in Table 2.

TABLE 2: ACCEPTABLE DFTPP CRITERIA

MASS	ION ABUNDANCE CRITERIA
51	30.0 to 60.0 % of mass 198
68	Less than 2.0% of mass 69
69	present
70	Less than 2.0% of mass 69
127	40.0% to 60.0% of mass 198
197	Less than 1% of mass 198
198	Base Peak, 100% Relative Abundance
199	5.0 to 9.0% of mass 198
275	10.0 to 30.0% of mass 198
365	Greater than 1.00% of mass 198
441	Present, but less than mass 443
442	Greater than 40% of mass 198
443	17.0 to 23.0% percent of mass 442

13.2.2 All subsequent standards, samples, MS/MSD's and blanks associated with a DFTPP analysis must use the identical mass spectrometer instrument conditions.

13.2.3 The GC/MS tuning standard solution should also be used to assess GC column performance and injection port inertness.

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13.3 Calibration: either a six point initial calibration or a continuing calibration (the 1.25 ug/ml standard) must be analyzed each twelve-hour tuning window.

13.3.1 Initial calibration

For the initial calibration, calculate the mean response factor and the relative standard deviation (RSD) of the response factor for 1,4-dioxane. The % RSD must be less than or equal to 30% for analysis to proceed.

13.3.2 The percent difference for each analyte in a daily calibration check must be less than or equal to 20% to be valid. If the criterion is not met, corrective action must be taken.

13.4 Standards Preparation

This section of the SOP addresses preparation of all standards used in conjunction with this method, including standards used in tuning, initial and continuing calibration, and sample analysis.

13.4.1 Instrument Performance check- Decafluorotriphenylphosphine (DFTPP) Tuning mixture

The tuning criteria are examined by injecting 2 ul of DFTPP tuning mix into the GC/MS. The preparation is as follows:

Supplier	Standard	Initial Conc (ug/ml)	Volume added (ul)	Final Conc (ug/ml)
Accustandard	DFTPP	1000	40	25
Baker	MECL2	-	1560	-

Final Volume = 1.6 ml

13.4.2 In order to accurately prepare the initial and continuing calibration standards, a 5 ug/ml stock solution must first be prepared, as follows:

Supplier	Standard	Initial Conc (ug/ml)	Volume added (ul)	Final Conc (ug/ml)
Ultra Scientific	1,-4 dioxane Cat # NV-150-1	200	25	5.0
Baker	MECL2	-	975	-

Final concentration: 5.0 ug/ml 1,4-dioxane

13.4.3 The 5 ug/ml 1,4-dioxane stock solution is then diluted to create the initial calibration curve with concentrations of 0.125, 0.625, 1.25, 2.0, 2.5, and 3.0 ug/ml. A 80 ug/ml internal standard solution is added to these standards for a final internal standard concentration of 0.8 ug/ml.

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INTERNAL STANDARD SOLUTION

Supplier	Standard	Initial Conc (ug/ml)	Volume added (ul)	Final Conc (ug/ml)
CIL	1,4-dioxane-d8	100	1200	80
Baker	MECL2	-	300	-

Final concentration: 80 ug/ml, final volume = 1.5 ml

SURROGATE SOLUTION

Supplier	Standard	Initial Conc (ug/ml)	Volume Added (ul)	Final Conc (ug/ml)
CIL	2-methylnaphthalene-d10	200	62.5	12.5
Baker	MECL2	-	937.5	-

Final concentration: 12.5 ug/ml, final volume 1.0 ml

INITIAL CALIBRATION PREPARATION

Final Conc (ug/ml)	5.0 ug/ml SVOA Stock Solution Added (ul)	12.5 ug/ml SIM Surrogate Solution added (ul)	80 ug/ml ISTD Solution added (ul)	MECL2 Added (ul)	Final Volume (ul)
0.125	2.5	1.0	1.0	96.5	101
0.625	12.5	5.0	1.0	82.5	101
1.250	25	10	1.0	65	101
2.00	40	16	1.0	44	101
2.50	50	20	1.0	30	101
3.00	60	24	1.0	16	101

Standards Storage: All standards must be stored at –10 degrees C when not in use except for the CCV standard (1.250 ug/ml) which should be stored at 4 degrees C.

Standards Expiration: Stock solutions purchased from vendors in ampule form must be replaced after one year from date of receipt or sooner if other QC check samples indicate a problem. If the manufacturer's expiration date is before this one year date, it must be adhered to.

All standard preparations (tuning, calibration points, surrogates, LCS, MS/MSD, etc.) expire six months from the date of standards preparation or sooner if any of the individual components expire sooner. Standards prepared from various stock solutions must always use the first expiration date of any of the solutions used for preparation.

14.0 Procedure

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14.1 Samples are extracted according to the procedure in EPA Method 8270C, Section 7, with the following exceptions and additions:

14.1.1 Separatory funnel liquid/liquid extraction method 3510C is used for the extraction of water samples. An alternative may be by continuous liquid/liquid extraction method 3520 if requested by the client.

14.1.2 Ultrasonic extraction (EPA Method 3550B) is used for solid samples. An alternate if specified by the client is method 3540C. The solvent used is Methylene chloride. Sodium sulfate is added to the sample until it is free flowing.

14.2 The addition of 1 ml of a 2.0 ug/ml solution of surrogate standards to one liter of sample results in a surrogate concentration of 2.0 ug/liter. The B/N surrogate used is 2-methylnaphthalene-d10.

14.3 For this method, 1,4-dioxane is used as the LCS and MS/MSD mix. This analyte is spiked at a final concentration of 2.0 ug/l. Standards are procured from a separate vendor than are used for calibration standards.

14.4 Appropriate volumes of 80 ug/ml Internal Standard are added to the sample extract to give a 0.80 ug/L final concentration for analysis.

14.5 INSTRUMENT SETUP

14.5.1 GC/MS operating conditions.

Gas Chromatograph

Parameters	Method 8270	Method DFTPP
Initial temperature	35 °C	150 °C
Holding time	3 minutes	3 minutes
Ramp 1	25 °C/minute	20 °C/minute
Final temperature	245 °C	300 °C
Final time	0 minutes	0.0 minute
Ramp 2	6 °C/minute	
Final temperature	330 °C	
Final time	5.00 minutes	
Injector temperature	250 °C	250 °C
Carrier gas flow	1-2 ml/minute	1-2 ml/minute
Column Head pressure	10 psi	10 psi

Mass Spectrometer

Parameters	Method 8270
Mass range	SIM
Seconds/scan	SIM
Filament/multiplier delay	180 seconds
Peak threshold	2500 counts

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Mass defect	35
Ionization mode	EI

Autosampler

Parameters	Method 8270
Syringe solvent wash	3X
Syringe sample wash	1X
Sample pumps	3X
Amount injected	1 ul
Air plug after sample	1 ul
Hold time in injector (prior to injection)	2.0 seconds
Hold time in injector (after injection)	1.5 seconds

15.0 Data Analysis and Calculations

15.1 Concentrations of Calibrated Compounds:

$$C(x) = \frac{A(s) * C(is)}{A(s) * RRF} * DF$$

Where:
C(s) = Concentration of compound (ug/L)
C(is) = Concentration of associated internal standard (ug/L)
DF = Dilution Factor.
A(is) = Area of quantitation ion for associated internal standard
A(s) = Area of quantitation ion for compound
RRF = Average Relative Response Factor from five-point initial calibration

The concentration of the sample is then corrected for extraction. The raw concentration (in ug) is multiplied by the final extract volume (ml), and then it is divided by the volume of water extracted (in L) or the weight of soil extracted (in kg). The resulting concentration is given in ug/L for waters and ug/kg for soils.

$$C(f) = \frac{(\text{final extract volume(ml)}) \times C(s)}{(\text{Initial volume (L) or Initial weight (Kg)})}$$

15.2 Relative percent difference (RPD)- percent difference between a MS/MSD or LCS/LCSD

$$RPD = \frac{100(BNA1 - BNA\ 2)}{(BNA1 + BNA2)/2}$$

16.0 Method Performance

The specifications contained in this SOP are based on the requirements in US EPA Method 8270C, sec. 9.0.

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17.0 Pollution Prevention

Care is used to minimize the amount of solvents used. All solvents, standards and samples are properly labeled and placed in a labeled hazardous waste container and disposed of according to regulations.

18.0 Data Assessment and Acceptance Criteria for Quality Control Measures and Corrective Action

18.1 The initial data review is accomplished by the analyst who ran the samples and is a review of sufficient quality and detail to provide a list of samples that need to be reanalyzed, reextracted, or diluted. The initial data review is performed on the detailed quantitation reports of the analyzed sample. This data review examines criteria that directly impact whether or not the sample needs to be reanalyzed. Items evaluated include:

Surrogate recoveries
Internal standard area stability
Method blank acceptance
Chromatography
Target compound detection/quantitation/ false positive review
LCS/LCSD recoveries
MS/MSD recoveries

The analyst must evaluate all data using the QC|A acceptance criteria table at the conclusion of this SOP. This table gives acceptance criteria and corrective action for criteria that are not met. During this review, the analyst also must check the integration of each individual peak. The hardcopy has false positives crossed out so that they can be reviewed by the organics supervisor.

18.2 Method Blank criteria

A method blank is defined as a volume of a clean reference material (organic-free water or organic-free sand) that is carried throughout the entire analytical procedure. One method blank must be extracted with each group of samples of a similar matrix and must be analyzed on the same GC/MS system that was used to analyze samples.
A method blank must be extracted for every 20 samples and on a daily basis (one per extraction batch).
An acceptable method blank must contain less than or equal to the reporting level of 1,4-dioxane (2.0 ug/l). If the blank exceeds these contamination levels, the process is considered out of control and corrective action must be taken. Reanalysis of the blank is the first step of the corrective action process; if that does not solve the problem, a NEL discrepancy report must be initiated. Corrective action, most likely reextraction of the entire batch, will be specified after consultation including the supervisor, lab manager, and QA manager. If the

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field samples need to be reextracted outside of holding time, the client must be notified.

18.3 Surrogate recoveries

One surrogate is used for this method. Recovery limits are nominal; internal statistical limits will be put into effect as soon as sufficient data points are available for calculation.

Surrogate	Aqueous acceptance range	Soil acceptance range
2-methylnaphthalene (D10)	20%- 150%	20%- 150%

If these ranges are not met, the sample or blank should be reanalyzed. If criteria is met in the reanalysis, this only should be used for the report. If the range is still not met, discrepancy report must be initiated, with directives coming from the QA group.

18.4 Stability of Internal Standard Response

Internal standard responses and retention times must be evaluated in all samples and blanks. The method files have been set up to only detect compounds that fall within a set RT window (+/- 0.5 minutes).
If the extracted current ion profile (EICP) for the internal standard specific to 1,4-dioxane (1,4-dioxane-d8) changes by more than a factor of two (-50% to +100%) as compared to the daily CCV, reanalysis must occur. If this reanalysis meets criteria, only this analysis should be reported. If the reanalysis is still out of criteria, the better analysis should be reported with a matrix interference footnote.

18.5 Chromatography

Whether or not the chromatography is acceptable is a judgement call on the part of the analyst and should be used in conjunction with other monitored QC to determine the necessity of reanalysis.

Manual integrations are to be performed when chromatographic conditions preclude the computer algorithm from correctly integrating the peak of concern. In no instance shall a manual integration be performed solely to bring a peak within criteria.

Each peak of concern is evaluated by the primary analyst to ensure that the peak was integrated properly by the computer algorithm. Should a manual integration be necessary (due to a split peak, peak tailing/fronting, or incomplete resolution of isomeric pairs, etc.) the peak before the manual integration must be printed, followed by a copy of the peak after manual integration. The analyst must date and initial both pages. A "M" qualifier will automatically be printed on the quantitation report summary. The analyst must also date and initial in the space next to this qualifier.

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18.6 Target Compound Detection/Quantitation

The semivolatile method files have been set up to err on the side of false positives; that is to identify and quantitate peaks as target compounds that may not necessarily be valid hits. It is the responsibility of the GC/MS analyst to use his/her technical expertise to determine if the identification of a target compound is correct or not.

The analyst will review the quant report and mass spectra and cross-out any non-valid hits. All concentrations must fall within the upper range of the calibration curve, defined as follows:

Upper limit = 3.0 ug (highest curve point) times the dilution factor

If any target analyte concentration exceeds the upper limit, a dilution must be analyzed.

18.7 LCS/LCSD and MS/MSD recoveries

A LCS must be prepared for each extraction batch. If a matrix spike/matrix spike duplicate pair is not a part of the batch, a LCSD should be extracted so that precision of the batch can be evaluated.

Acceptance criteria for the LCS/LCSD QC samples are as follows:

Analyte	LCS Recovery Range-AQ	LCS Recovery Range-SL
1,4-dioxane	30%-150%	30%-150%

These are nominal limits. Statistical limits will be compiled as soon as a sufficient number of data points (twenty or more) are obtained.

The QC requirements table at the end of this SOP outlines the steps that should be taken if a LCS fails criteria.

These same limits are used for MS and MSD QC samples, but are advisory only because of the varying matrices involved.

19.0 Waste Management

Please refer to the NEL Chemical Hygiene Plan and Spill Prevention Control and Prevention Plan for information regarding waste management.

20.0 References

"Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods," SW-846, third edition, Final Update III, December 1996, Method 8270C

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"USEPA Contract Laboratory Program Statement of Work for Organics Analysis," Rev. OLM04.2
Code of Federal Regulations (40 CFR), Part 136, Appendix A, Rev. June, 1988
2003 NELAC Quality Systems Standard, January 14, 2004

21.0 Tables, Diagrams, Flowcharts and Validation Data

See Attached

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Table I. QC Requirements

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
DFTPP Tune	Prior to initial calibration and calibration verification; once per twelve hours of analysis	Refer to the criteria listed n Table 2, page 13 of this SOP	Retune instrument to meet criteria; calibration and sample analysis must not proceed until a valid tune is acquired
Six point initial calibration	Prior to sample analysis	%RSD must be ≤30% for 1,4-dioxane	Repeat calibration after corrective action (instrument maintenance) if curve criteria is not met
Continuing calibration verification	Once per each twelve hours, prior to sample analysis	1,4-dioxane≤ 20%D for analysis to proceed	Repeat initial calibration
ISTD Response	Checked for each QC sample and field sample	Compared to last CCV standard: retention time ± 30 seconds; extended ion current profile area for 1,4-dioxane-d8 within –50% to +100%	Reanalyze sample for confirmation of matrix interference
Initial P+A Study	Annually for extraction Analyst/SVOA chemist	All recoveries within Method acceptance limits for 4 replicates at 2.0 ug/ml spike	Locate and fix problem; repeat
Method Blank	One per preparation batch	No analytes greater than 2.0 ppb	Investigate source of contamination evaluate the associated samples and QC. If the blank results are above the limit, report samples that are less than the reporting level or greater than ten times the blank result. If neither of these cases hold, the affected samples must be reextracted and the issue noted in the narrative.
LCS for all analytes	One LCS per extraction batch (defined as less than twenty samples extracted in a single day)	Nominal limits 30%-150% for 1,4-dioxane until statistical limits are available	Evaluate the associated samples and QC. if LCS recovery high and there were no positive detects in any sample, narrate. If LCS recovery high and there were positive detects, report affected results with a "J" qualifier if sample can not be reextracted within extraction holding times; if it is within HT, reextract. (1) If LCS recovery low, reextract if within HT;

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
			(2) otherwise, report positive results with a J qualifier. If a MS/MSD or LCSD was extracted in the same batch and is (are) acceptable, accept results
Surrogate spike	Every sample, QC sample, standard	Nominal limits 20-150% until statiistical limts have been calculated	Reextract if any surrogates below 10%; otherwise narrate until statistical limit s calculated
MS/MSD	One set per 20 samples if sufficient sample provided; if not, a LCS/LCSD pair per twenty samples	Nominal limits 30%-150%	Advisory limits only due to varying matrices
MDL Study	Annually	Spike 7 replicates at the reporting level; detection limits must be less than the reporting level	Repeat MDL Study

Table 2- Procedure Condensation

Tuning Clock

Samples can be analyzed twelve hours from successful injection of 50 ng DFTPP

Initial Calibration Curve Criteria

1,4-dioxane must have a %RSD values less than 30%.

Continuing Calibration Verification Criteria

1,4-dioxane must have a %D value less than or equal to 20% for analysis to proceed.

Additional QC

Method blank and LCS every extraction batch

MS/MSD (or LCSD) every twenty samples

APPENDIX D

RESPONSE TO COMMENTS

0234-3.2-48

TETRA TECH NUS, INC.
661 Andersen Drive • Pittsburgh, PA 15220
Tel 412.921.7090 • Fax 412.921.4040 • www.tetratech.com

PITT-03-6-016

March 7, 2006

Project No. 00234

Ms. Christine Williams
U.S. Environmental Protection Agency, Region I
1 Congress Street Suite 1100 (HBT)
Boston, MA 02114-2023

Mr. Louis Maccarone
Office of Waste Management
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767

Reference: Contract No. N62472-03-D-0057
Contract Task Order (CTO) Number 049

Subject: Responses to Comments for Draft Quality Assurance Project Plan for 1,4-Dioxane Ground-Water Investigation at IR Program Site 16 Former Naval Construction Battalion Center, Davisville

Dear Ms. Williams/Mr. Maccarone:

On behalf of the Navy, enclosed are responses to comments submitted by the U.S. Environmental Protection Agency (EPA), Region I and the State of Rhode Island Department of Environmental Management (RIDEM) in correspondence dated January 25, 2006 and February 16, 2006, respectively. The comments were submitted based on the EPA and RIDEM review of the Draft Quality Assurance Project Plan (QAPP) for the 1,4-dioxane sampling event scheduled for the Spring of 2006 at the Former Naval Construction Battalion Center (NCBC), Davisville, Site 16.

Please note that the Navy has tentatively scheduled the 1,4-dioxane sampling event to occur in April of 2006. Consequently, the Navy is requesting a teleconference with the EPA and the RIDEM in March to discuss the enclosed responses to comments. Please advise Mr. Fred Evans (601-595-0567) of teleconference dates and times that would be convenient to you during March. Thank you in advance for your assistance in this matter.

Please call me at 412-921-8887 if you have any questions regarding the enclosed document.

Sincerely,

Lee Ann Sinagoga
Contract Task Order (CTO) Manager

Enclosures (1)

TETRA TECH NUS, INC.

cc: Mr. Fred Evans (1 copy)
Mr. David Barney, Navy Caretaker Site (CSO) (1 copy)
Dr. Ken Finkelstein, NOAA (1 copy)
Ms. Kathleen Campbell, CDW (1 copy)
Mr. Andrew Major, U.S. Fish and Wildlife Service (1 copy)
Mr. Steven King, Quonset Development Corporation (1 copy)
Ms. Marilyn Cohen, Town of North Kingston (1 copy)
Mr. Roger Boucher, Navy PMO (1 copy)
Mr. John Trepanowski, TtNUS PMO (1 copy)
Mr. Steve Vetere, TtNUS Boston (1 copy)
Ms. Kelly Carper, TtNUS Project Chemist (1 copy)
Ms. Lee Ann Sinagoga, TtNUS Project Manager (1 copy)
TtNUS Project Files, Sharon Currie (1 copy)

RESPONSES TO EPA COMMENTS DATED JANUARY 25, 2006
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM AT
IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE, NORTH KINGSTOWN, RI

GENERAL COMMENTS

1. **Comment:** The comments provided in this review are based upon knowledge of hydro-geological information available. Specifically, a complete, all encompassing depiction of groundwater flow patterns following the installation of additional groundwater monitoring wells related to the HRC® injection pilot study was not available. Also previous synoptic groundwater elevation measurements had omitted several key monitoring point locations, primarily several shallow monitoring wells where groundwater was noted to be below the intake of the pump, and was therefore not measured. As such, there is an incomplete picture of groundwater flow patterns at Site 16, especially in the shallower portions of the aquifer.

   Additionally, this review did not have available any recent groundwater quality data relative to chlorinated volatile organic compounds (CVOC) from additional monitoring wells installed. Although the release of 1, 4-Dioxane may be unrelated to releases of CVOC, an updated distribution of CVOC concentrations following installation of the additional monitoring wells would be useful in assessing overall likely contaminant release locations.

   A major concern is the focus of groundwater quality assessment for 1, 4-Dioxane primarily in the deep portions of the aquifer (7 out of 10 locations); with limited monitoring in the intermediate segment of the aquifer (3 out of 10 locations); and no samples being collected from the shallow portions of the Site 16 aquifer. Although 1, 4-Dioxane can be associated with CVOC it has different physical and chemical characteristics. It is also found as a separate component of paint and varnish strippers. The density of 1, 4-Dioxane is reported to be 1.028 gram per cubic centimeter (g/cm^3) or, essentially the same density of water. By way of comparison, the density of trichloroethylene (TCE) is 1.468 g/cm^3. The density of cis 1, 2-dichloroethylene (cis 1, 2- DCE) is 1.274 g/cm^3. Therefore, while the proposed groundwater sampling intervals might be suitable for CVOC constituents, they do not appear to be appropriate for monitoring of 1, 4-Dioxane. Releases of 1, 4-Dioxane that would have migrated to the groundwater table from one or more potential source areas would more likely be expected to be found in the shallow portions of the aquifer rather than the deep and intermediate intervals. This is especially true unless there were strong downward vertical hydraulic gradients. As such, primacy of groundwater monitoring locations should be on shallow and intermediate intervals of the aquifer for the monitoring of 1, 4-Dioxane. However, since there are relatively few available shallow intervals from which to sample, EPA will recommend a mixed group of sampling intervals.

   A second concern relates to the solubility and partitioning coefficient of 1, 4-Dioxane. This chemical is completely soluble in water. The solubility is given as 43,100 milligrams per liter (mg/L). For comparison purposes, the solubility of trichloroethylene (TCE) is 1,100 mg/L and that of cis 1, 2-DCE is 3,500 mg/L. The partitioning coefficient of 1, 4-Dioxane also indicates that it is little retarded in the aquifer. For instance, the organic carbon partitioning coefficient (K_{oc}) is given as 3.5 milliliters per gram (ml/g). For TCE and cis 1, 2-DCE, the partitioning coefficients are given as 126 and 49 ml/g, respectively. These properties indicate that if 1, 4-Dioxane has been released at one or more of the site source areas it is likely to have migrated at a much faster velocity than the CVOC constituents. Therefore, while conducting some

sampling in the "source" areas (assuming that they have been identified) can be a useful component of the sampling design, it is important to weight the sampling effort to the forward edges of the "plumes" or beyond. That is, 1, 4-Dioxane would be expected to migrate in groundwater much faster than any of the CVOC constituents or degradation products.

While less critical, a third concern is that in Section 8.0, Sampling Process Design, there is reference to "within the plume" and "down gradient from the source." The use of this language and/or designation for sample locations has the potential to be somewhat misleading. It appears that there is more than one "plume" at Site 16, and not one with a universal source as implied by the designations made. There appear to be multiple sources and the plumes emanating from those sources commingle into a site-wide area of CVOC contamination. As an example, the area of the former fire training area and landfill (central portion of Site 16 adjacent to Allen Harbor) is a known, documented source area. However, Table 8-2 calls, for instance, MW16-45D, "within the plume." This location is clearly within a documented source area.

On the other hand, location MW16-39I is called "down gradient from source area MW16-38I." It has not been established that the area of MW16-38I is a source area. Rather, to date, it appears to be an area contaminated by one or more source areas, including from the landfill/fire training area, former Building 41 area, as well as possibly from the railroad spur area in which it is located. Three other proposed sample locations also potentially provide misleading information when they are denoted as being "within CVOC plume." These include MW16-02D, MW16-05D, and MW16-15D. In fact, it has been postulated by the Navy that MW16-15D is actually within a source area (although it is not clear that this has been demonstrated). Contamination at MW16-02D may be from the landfill/fire training area (radial flow, dipping low permeability layers), or from the Building 41 area, railroad spur area, or further up gradient. Nonetheless, the contamination at the three locations noted, do not appear to be from the same, single source.

The sampling locations for 1, 4-Dioxane should be revised to reflect its physical and chemical characteristics, likely pattern of migration in groundwater, and likely points of origin. The first two parameters suggest that monitoring points should be located in the shallow and intermediate intervals of the aquifer and at points some distance down gradient of suspected source areas. While 1, 4-Dioxane may be associated with CVOC it is also a constituent of paint and varnish strippers. Therefore, one location might be assumed to be former maintenance and storage facilities (Building 41 and 42?). Material might also have been disposed within the landfill/fire training area, and also released in the railroad spur area (area suspected of being points of origin for CVOC). A current assessment of groundwater flow patterns, primarily shallow and intermediate groundwater, should be made using updated, current information. EPA is looking forward to the Revised Phase II hydrological data package currently due March 31, 2006.

Therefore, while not all inclusive, monitoring points should include shallow and, if possible, intermediate wells at the three known or suspected source areas: (1) landfill/fire training area, (2) just east of the former Building 41 footprint; and (3.) railroad spur area. If samples are limited, priority should be given to sampling from the shallow aquifer. The locations of MW16-45D, MW16-15D are appropriate for the first two locations, except that samples should be collected from the shallow and the intermediate aquifer intervals, not deep as is planned. A third monitoring point should be located in the railroad spur area south of MW16-38I also with sample collection from the shallow and intermediate intervals of the aquifer. Locations designated as MW16-39I, MW16-56I, and MW16-05D may also be used; however, the sampling interval should be at the shallow segment of the aquifer in addition to the intermediate

interval. The sample locations MW16-50D and MW16-52D are also acceptable, although samples should be collected from the shallow and intermediate zones of the aquifer.

Of the remaining locations, MW16-10D may be a suitable "up gradient" location although sampling should be conducted from the shallow and intermediate portions of the aquifer. Sampling from the locations of MW16-02D and MW16-38I may be useful, but probably will not provide significant additional information relative to migration of 1, 4-Dioxane and may be eliminated. However, given the potential mobility of 1, 4-Dioxane and the groundwater flow patterns that are understood, to date, two areas are not covered in the monitoring program. The first is to the east of MW16-39I. Because of the solubility and low retardation characteristics of 1, 4-Dioxane, monitoring 500 feet further to the east is warranted. The second area is that of Allen Harbor, itself. The current monitoring is truncated to the north of the landfill/fire training area. A monitoring location should be established west of MW16-52D and north-northeast of MW16-20D along the shoreline of Allen Harbor.

2. EPA understands that this screening level 1,4-Dioxane investigation was to be accomplished using the existing monitoring well network and therefore has revised the list of wells to be sampled keeping the same number of locations. See table below:

Well Number	Justification
MW45I	Fire fighting training area source area with higher hits than shallow well
MW04S	Groundwater discharge area near firefighting training area
MW04I	Groundwater discharge area near firefighting training area – Intermediate level
MW37S	RR spur source area
MW25S	Downgradient of rr spur source area
MW12S	Upgradient shallow well
MW05S	Downgradient plume discharge area
MW05I	Intermediate level plume discharge area
MW23S	Within plume well downgradient of bldg 41 source area
MW59 I	Within plume well to give more geographic coverage than if MW23I were sampled

Response to EPA General Comment Nos. 1 and 2: As discussed between Ms. Christine Williams, USEPA, and Mr. Fred Evans, US Navy, the Navy is willing to discuss possible changes to the monitoring well list presented in the Quality Assurance Project Plan (QAPP) Addendum for the 1,4-Dioxane Groundwater Investigation at IR Program Site 16 (the 1,4-Dioxane QAPP) provided it is not used as a reason for requiring additional rounds of sampling to determine presence/non-presence of 1,4-Dioxane. The monitoring well list presented in the 1,4-Dioxane QAPP was developed in consultation with both U.S EPA Region I and the State of Rhode Island in the fall of 2004. Also, the Navy agreed to sample for 1,4-dioxane in March 2004, based on the assumption that the solvent may have been used as a solvent stabilizer for TCE at Site 16. In fact, two wells (MW16-39I and MW16-50D) were specifically added to the list of wells to be monitored at the request of the EPA. The well list was comprised primarily of monitoring wells screened in the deep overburden because the bulk of the volatile organic contamination at Site 16 is present in deep overburden zone. The wells listed in the 1,4-dioxane QAPP were sampled in the Fall of 2004; analytical results will be presented in the Supplemental Phase II Remedial Investigation Data Package for IR Site 16 currently scheduled to be published March 31, 2006.

The 1,4-Dioxane QAPP was prepared assuming that both EPA Region I and the State of Rhode Island concurred with the Fall 2004 monitoring well list. Altering the well list at this time

would mean that there will be only one set of data for most of the wells selected for 1,4-dioxane monitoring; the original plan was to have two sets of 1,4-dioxane data for each well (i.e., fall and spring sampling events). The Navy does not object to altering the monitoring well list for the spring event; however, the Navy requests a teleconference with the EPA Region I and the State of Rhode Island to resolve this issue because the recommendations presented in General EPA Comment Nos. 1 and 2 differ from recommendations provided and agreement reached in 2004. Also, the Navy does not believe that 1,4-dioxane would be more likely detected in the shallow zone because of its specific gravity. The Navy does believe that the solubility of 1,4-dioxane is an important physical factor. The specific gravity of 1,4-dioxane indicates that it is slightly denser than water. However, because of its relatively high solubility and low retardation factors, 1,4-dioxane is expected to migrate very quickly with the groundwater flow and more readily than trichloroethene. The groundwater flow patterns at Site 16 indicate that the groundwater (and any associated contamination) are moving (or have moved) from shallower zones to deeper zones. Thus, given the anticipated age of the contaminant releases at Site 16, the intermediate and deep overburden zones are the more critical in terms of environmental monitoring than the shallow overburden. With regard to the recommended monitoring well list provided by the EPA (above), the following should be considered:

- MW16-45I – The Navy agrees with this recommendation. Elevated TCE levels have been noted in both the intermediate and deep overburden wells and this location is a source area (the former FFTA).

- MW16-04S and MW16-04I – Only minor volatile organic contamination only been detected in these wells which are downgradient of MW16-45I (former FFTA). Consequently, monitoring of MW16-04D is recommended by the Navy because it is also downgradient of MW16-45I and displays higher concentrations of trichloroethene (340 ug/L in 2004 sampling).

- MW16-37S and MW16-25S – These wells are located in the general vicinity of the railroad spur area. The Navy originally selected MW16-38I to monitor this area; trichloroethene (TCE) concentrations in this well exceed those reported for both MW16-37S and MW16-25S. Given the EPA's concern for contamination in the shallow zone, the Navy recommends MW16-37S and MW16-37I because these are the most contaminated wells in the shallow and intermediate zone in the railroad spur area.

- MW16-12S – This well is located in the immediate vicinity of the former Building 41 area which is an area warranting additional investigation. Additionally, low-level TCE contamination was detected in this well in the 2004 groundwater sampling event. Consequently, the Navy does not believe this is a true upgradient monitoring well. The Navy recommends MW16-10D or MW16-55D as the upgradient location.

- MW16-05S and MW16-05I – The TCE concentration in the deep well (1,100 ug/L in 2004) at this location exceeds concentrations detected in either the shallow (non-detect in 2004) or intermediate depth wells (470 ug/L in 2004 sampling). Navy recommends monitoring the intermediate and deep wells in this plume discharge area (MW16-05I and MW16-05D).

- MWW16-23S and MW16-59I – These wells are located downgradient of the former Building 41 source area. The Navy originally selected MW16-15D for monitoring which is located in the immediate downgradient area and demonstrated higher TCE contamination than either MW16-23S or MW16-59I. The Navy recommends monitoring MW16-15D and MW-16-59I. Both wells are located downgradient of the former Building 41 area and both demonstrate TCE concentrations exceeding most other monitoring wells screened in either the intermediate or deep zone in this area of Site 16.

The Navy also continues to recommend monitoring of MW16-39I which is located at the eastern boundary of the Site 16 Phase II RI boundary. This well was originally recommended by EPA because of the TCE contamination being detected at the eastern (overall downgradient) boundary of Site 16 (i.e., in MW16-39I and MW16-57I).

SPECIFIC COMMENTS

3. **Comment:** Page 2-6, Section 2.2, Bullet Comment: The objective of this monitoring program is not clear from the number, locations, and aquifer intervals of the wells provided. A summary of the rational for the "pre-selection" of the ten locations should be provided (Table 8-2 is inadequate). As noted in the General Comments above, the physical and chemical characteristics of 1, 4-Dioxane, do not support the development of a groundwater monitoring program focused primarily on the deep aquifer interval. Also, since 1, 4-Dioxane releases, if any, could be different from that of CVOC contaminants, some discussion of their potential origin should be provided to support the monitoring network. Also, this bullet notes that monitoring occurred during the fall of 2004. The results of this first monitoring period should be provided in this document.

   Response: Please see response to General EPA Comment No. 1. Also, the discussion and rationale for the recommended monitoring wells presented above will be incorporated in Table 8-2 after the proposed teleconference with EPA and the State of Rhode Island.

4. **Comment:** Page 2-7, Section 2.3.4: The documents that are referred to in this section do not provide an updated description of the site hydro-geology. The conceptual site model and information contained in these documents have been commented on by USEPA in various ways. In particular, the nature of the contaminant "plume" versus "plumes" and "source" versus "sources" is a key change. Further, those documents also lack groundwater elevation data, primarily for the shallow aquifer, but also for other intervals to the east of the former Building 41. These issues were to be addressed in follow on hydro-geological work pursuant to preparation of the HRC ® pilot study program. That is, a more complete assessment of CVOC distribution and groundwater flow patterns was to be developed incorporating USEPA concerns. This information was to be submitted subsequent to the 2002 and 2003 Phase II Investigation reports. EPA understands that the Supplemental Phase II RI Data Package due date was recently extended under the FFA from January 16, 2005 to March 31, 2006. The EPA proposal for new sampling locations may change based on review of the information contained in the March 2006 submittal.

   Response: As indicated by the reviewer, an updated description of the site hydro-geology and site conceptual model will be presented in Supplemental Phase II RI Data Package currently scheduled to be published March 31, 2006. Page 2.3.4 will be amended accordingly.

5. **Comment:** Page 6-1, Section 6.1: This objective for this investigation is in Section 2.2. Please revise the text accordingly.

   Response: Agreed. The text will be amended per the reviewer's comment.

6. **Comment:** Page 7-1, Section 7.2: Although this review did not focus on sampling protocol, etc. it is noted that this section implies that at least 95% of the planned samples to be collected

must be valid. This would imply that all 10 would have to be valid. The limited number of samples leaves no room for less than perfect execution of the sampling program. Provision should be made for additional sample collection.

Response: Please note that additional soil and groundwater monitoring will be recommended as part of the Phase III QAPP currently being prepared for Site 16. If a recommended well can not be sampled for 1,4-dioxane during the planned 2006 sampling event, the sampling/analysis will take place as part of the Phase III investigation or other monitoring conducted for Site 16.

7. **Comment:** Page 8-1, Section 8.1, 1st Paragraph: This section states that "representative samples" will be collected. However, as noted in the General Comments, the sampling design does not adequately address the most likely segments of the aquifer to be affected by a release (if any) of 1, 4-Dioxane. The physical and chemical nature of 1, 4-Dioxane indicates that the fate and transport of this constituent in groundwater will be significantly different from that of CVOC such that simply sampling in the "area impacted by CVOC" is not satisfactory unless sampling occurs in the upper portions of the aquifer. Also, the down gradient areas have not been adequately addressed, especially to the east (of MW16-39I) and north-northeast (of MW16-02D) of the several suspected or documented release areas. Therefore, the Sampling Process Design outlined will not collect "representative samples" and does not adequately meet the stated objectives of the program. EPA has proposed a different sampling scheme in this comment letter.

   Response: Please see Navy response to EPA General Comments No. 1 and 2.

8. **Comment:** Page 8-1, 2nd Paragraph: The groundwater monitoring locations and intervals outlined in this paragraph are inadequate to address the potential release and distribution of 1, 4-Dioxane in the Site 16 area. As noted in the General Comments, simple assessment in the areas and locations where elevated CVOC were detected is insufficient to evaluate the potential presence, nature and extent of 1, 4-Dioxane. While some 1, 4-Dioxane (if released) may be detected at these locations, the fate and transport of 1, 4-Dioxane is likely to be significantly different than CVOC found at Site 16 (TCE and cis 1, 2-DCE) in that it readily dissolves in water, has a density similar to water (much less than the CVOC constituents present), and has minimal retardation potential, and is not likely to break down in groundwater. Further, the sample locations are not adequately supported relative to groundwater flow patterns and specific documented or suspected source areas. Also, as noted in Specific Comments, the Phase II Investigation reports are incomplete in regard to delineating groundwater flow patterns, especially in the shallow aquifer. The information collected subsequent to those reports should be evaluated prior to finalizing 1, 4-Dioxane sampling locations. EPA may change the proposed new sampling scheme after review of the Navy's planned March 2006 submittal.

   Response: Please see Navy response to EPA General Comments No. 1 and 2.

9. **Comment:** Page 8-4, Table 8-2: The rational provided in the table are inadequate. First, as noted in previous comments above, the fate and transport characteristics of 1, 4-Dioxane suggest that it would most likely be detected (if present) in the upper portions of the aquifer, particularly the shallow, water table segment. Collection of samples at depth along where elevated CVOC has been detected is not sufficient justification for sampling at those depths. While sampling may certainly occur at those intervals, it is more important to sample at the

shallow and intermediate intervals. There are no shallow groundwater samples in the program and only three intermediate samples.

A further concern is the apparently indiscriminate use of CVOC "plume" and "source" when past investigations have clearly shown multiple likely source areas and more than one plume which may blend into an area of CVOC contamination. Adherence to the single plume and source terminology may inadvertently imply that there is only one source near the former Building 41 footprint and one plume migrating away from that location. This has not been shown to be the case. This problem appears to be related to lack of incorporation of post Phase II (2003) hydro-geological data and conceptual model formulation.

Response: Please see Navy response to EPA General Comments No. 1 and 2 and EPA Specific Comment No. 4. Also, the Supplemental Phase II Data Package (currently in preparation) will state that there is more than one source area at Site 16. The last sentence of Section 8.1 also acknowledges that there are source areas (not just a single source area) at Site 16.

10. **Comment:** Tetra Tech SOP "Groundwater Sample Acquisition and Onsite Water Quality Testing" page 19 of 25 - The criteria for turbidity, specific conductance, ORP, temperature, and pH are different that the criteria in the Region 1 Low Stress (low flow) SOP. Please verify that these criteria have been accepted by EPA and RIDEM. Please clarify in the text, the justification for deviating from the R1 low flow SOP. This QAPP is for 1,4-Dioxane analysis only. If Navy plans on sampling dissolved metals at the NCBC Site at another time, the R1 low flow SOP must be followed with no deviation.

    Response: The reviewer is correct. The limits for turbidity, specific conductance, ORP, temperature, and pH presented in the USEPA Region I SOP for Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (July 30, 1996; Revision 2) will be followed. The current version of the SOP presented in the Draft QAPP will be corrected.

RESPONSES TO RIDEM COMMENTS DATED FEBRUARY 16, 2006
1,4-DIOXANE GROUND-WATER INVESTIGATION QAPP ADDENDUM AT
IR PROGRAM SITE 16
FORMER NCBC DAVISVILLE, NORTH KINGSTOWN, RI

1. **Comment:** It is felt that the objective of the sampling plan and the rationale for given sampling locations were not properly detailed. Please expound upon the objective in section two and the reasoning in Section 8.

   Response: Please see the Navy's response to USEPA Comment No. 9.

APPENDIX E

CORRESPONDENCE

Sinagoga, Leeann

From: Louis Maccarone [louis.maccarone@DEM.RI.GOV]
Sent: Thursday, April 20, 2006 11:30 AM
To: Sinagoga, Leeann
Subject: RE: 1,4-dioxane Sampling QAPP

LeeAnn,

*I have no commnets on the RTCs.

THanks
Lou

-----Original Message-----
From: Sinagoga, Leeann [mailto:SinagogaL@ttnus.com]
Sent: Friday, April 07, 2006 12:08 PM
To: Louis Maccarone
Subject: RE: 1,4-dioxane Sampling QAPP

Thank you for your response.

Lee Ann

Lee Ann Sinagoga
Human Health Risk Assessment Specialist
TETRA TECH NUS, Inc.
Foster Plaza No. 7
661 Andersen Drive
Pittsburgh, PA 15220-2745
Telephone: (412)-921-8887
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-----Original Message-----
From: Louis Maccarone [mailto:louis.maccarone@DEM.RI.GOV]
Sent: Friday, April 07, 2006 12:07 PM
To: Sinagoga, Leeann; williams.christine@epamail.epa.gov
Cc: Barney, Dave A (EFANE); Frye, Curtis A (EFANE)(NMCI); Vetere, Stephen
Subject: RE: 1,4-dioxane Sampling QAPP

Leeann,

I'm sorry, but I have not yet reviewed it. I will forward comments by early next week.

Thanks
Lou

-----Original Message-----

From: Sinagoga, Leeann [mailto:SinagogaL@ttnus.com]
Sent: Friday, April 07, 2006 11:57 AM
To: williams.christine@epamail.epa.gov; Louis Maccarone
Cc: Barney, Dave A (EFANE); Frye, Curtis A (EFANE)(NMCI); Vetere, Stephen
Subject: 1,4-dioxane Sampling QAPP

Good Afternoon Christine,

Thanks for your prompt response on the 1,4-Dioxane QAPP.

Mr. Maccarone --- Does the state have any comments on the RTCs??

If not, Navy will move forward and execute that sampling plan with the revised monitoring well list recommended in the responses to comments.

Please advise.

Thank you for your time and support.

Lee Ann

-----Original Message-----
From: williams.christine@epamail.epa.gov
[mailto:williams.christine@epamail.epa.gov]
Sent: Thursday, April 06, 2006 8:20 AM
To: Sinagoga, Leeann; Brandon.Bill@epamail.epa.gov; kcampbell@cdwconsultants.com; Sugatt.Rick@epamail.epa.gov; DiMattei.Steve@epamail.epa.gov
Cc: curtis.frye@navy.mil; louis.maccarone@dem.ri.gov; conifer@tiac.net
Subject: RE: Upcoming Telecons/Meetings for Davisville Site 16

LeeAnn-

I have no issues with the RTC for the 1,4Dioxane, so I have no need for a telecon.

I will have to check with my reviewers as to when would be convenient during the last 2 weeks of May (keeping in mind that the 31st is Memorial Day and that I can't make the 25th) to discuss the data gaps and the potential resolution of the data gaps for Site 16 as presented in the recent report.
Bill? Conrad? Rick? Steve?

Christine A.P. Williams
Federal Facility Superfund Section
US EPA New England
Suite 1100 (HBT)
1 Congress Street
Boston, MA 02114-2023

phone - (617) 918-1384
fax - (617) 918- 0384
e-mail - williams.christine@epa.gov

"Sinagoga, Leeann" <SinagogaL@ttnus.com> 04/05/2006 05:44 PM		To
	Christine Williams/R1/USEPA/US@EPA, "Sinagoga, Leeann" <SinagogaL@ttnus.com>, curtis.frye@navy.mil, lmaccaro@dem.state.ri.us	
		cc

Subject
RE: Upcoming Telecons/Meetings
for Davisville Site 16

Good Afternoon Christine,

Yes. The RTCs for the 1,4-dioxane QAPP were mailed on March 7, 2006. In fact, Mr. Evans received an E-mail from you on 3-13-06 requesting additional copies of these type of letters in the future. I do have a Fed-X tracking number if that would help you.

I will check with Navy regarding available dates for proposed technical meeting. Are there any particular dates in that time frame that would be convenient for the EPA/State?? I will try to match EPA/State availability with the Navy's availability.

Thanks for your time and support.

Lee Ann
X8887

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From: williams.christine@epamail.epa.gov
[mailto:williams.christine@epamail.epa.gov]
Sent: Wednesday, April 05, 2006 5:21 PM
To: Sinagoga, Leeann; curtis.frye@navy.mil; lmaccaro@dem.state.ri.us
Subject: Re: Upcoming Telecons/Meetings for Davisville Site 16

LeeAnn: did you already send me the RTCs for the QAPP?

May 16th is out for a BCT meeting as I will be in Maine the 16th and 17th.
Please suggest another date.

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e-mail - williams.christine@epa.gov

Sinagoga, Leeann

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To: Sinagoga, Leeann; Brandon.Bill@epamail.epa.gov; kcampbell@cdwconsultants.com; Sugatt.Rick@epamail.epa.gov; DiMattei.Steve@epamail.epa.gov
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"Sinagoga, Leeann" <SinagogaL@ttnus.com>

04/05/2006 05:44 PM

To: Christine Williams/R1/USEPA/US@EPA, "Sinagoga, Leeann" <SinagogaL@ttnus.com>, curtis.frye@navy.mil, lmaccaro@dem.state.ri.us

cc:

Subject: RE: Upcoming Telecons/Meetings for Davisville Site 16

Good Afternoon Christine,

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