N60200.AR.005477
NAS CECIL FIELD, FL
5090.3a

FINAL SAMPLING AND ANALYSIS PLAN FOR TANKS 81 A, B AND C WITH TRANSMITTAL LETTER NAS CECIL FIELD FL
07/07/2010
TETRA TECH NUS

TETRA TECH

PITT-07-10-003

July 7, 2010

Project 112G02267

BRAC PMO SE
Attn: Mr. Art Sanford
4130 Faber Place Drive
North Charleston, South Carolina 29405

Reference: CLEAN Contract No. N62470-08-D-1001
Contract Task Order JM09

Subject: Final Sampling and Analysis Plan for Tanks 81 A, B, and C
Naval Air Station Cecil Field
Jacksonville, Florida

Dear Mr. Sanford:

Enclosed please find one copy of the subject deliverable. Copies have been sent to the members of the NAS Cecil Field Partnering Team as noted below. This document has been approved as identified by the signatures on this final document.

If you have any questions, please call me at 412-921-8163 or Megan Boerio at 412-921-7271.

Sincerely,

Robert F. Simcik, P.E.
Task Order Manager

RFS/clm

Enclosure

cc: G. Fraley, U.S. EPA (electronic copy)
D. Grabka, FDEP (1 copy)
M. Halil, J.A. Jones (electronic copy)
J. Trepanowski, Tetra Tech NUS
S. Currie/Tetra Tech NUS File JM09 (1 copy unbound)

Tetra Tech NUS, Inc.
661 Andersen Drive, Pittsburgh, PA 15220-2745
Tel 412.921.7090 Fax 412.921.4040 www.ttnus.com

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62470-08-D-1001

Sampling and Analysis Plan
for
Tanks 81 A, B, and C

Naval Air Station Cecil Field
Jacksonville, Florida

Contract Task Order JM09

JUNE 2010

BRAC Program Management Office Southeast
4130 Faber Place Drive, Suite 202
North Charleston, South Carolina 29405

TETRA TECH NUS, Inc.

SAP Worksheet #1 – Title and Approval Page
(UFP-QAPP Manual Section 2.1)

FINAL
SAMPLING AND ANALYSIS PLAN
JUNE 2010

TANKS 81 A, B, and C
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Prepared for:
Naval Facilities Engineering Command Southeast
NAS Jacksonville
Jacksonville, Florida 32212-00306

Prepared by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

Prepared under:
Contract N62470-08-D-1001
CONTRACT TASK ORDER JM09

Review Signatures:

T.F. Johnston 6-28-10
Tom Johnston, PhD/CLEAN Quality Assurance Manager/Date
Tetra Tech NUS

6/28/10
Rob Simcik/Project Manager/Date
Tetra Tech NUS

Approval Signatures:

Arthur Sanford 6/28/10
Art Sanford/RPM/Date
BRAC PMO SE

See attached
Government Chemist/Date
NAVFAC Quality Assurance Officer

see attached
David Grabka/Remedial Project Manager/Date
FDEP, Bureau of Waste Cleanup, Fed Section

SAP Worksheet #1 -- Title and Approval Page
(UFP-QAPP Manual Section 2.1)

FINAL
SAMPLING AND ANALYSIS PLAN
JUNE 2010

TANKS 81 A, B, and C
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Prepared for:
Naval Facilities Engineering Command Southeast
NAS Jacksonville
Jacksonville, Florida 32212-00306

Prepared by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

Prepared under:
Contract N62470-08-D-1001
CONTRACT TASK ORDER JM09

Review Signatures:

T. E. Johnston 6-28-10
Tom Johnston, PhD/CLEAN Quality Assurance Manager/Date
Tetra Tech NUS

6/28/10
Rob Simcik/Project Manager/Date
Tetra Tech NUS

Approval Signatures:

Art Sanford/RPM/Date
BRAC PMO SE

See attached
Government Chemist/Date
NAVFAC Quality Assurance Officer

7/2/10
David Grabka/Remedial Project Manager/Date
FDEP, Bureau of Waste Cleanup, Fed Section

SAP Worksheet #1 -- Title and Approval Page
(UFP-QAPP Manual Section 2.1)

DRAFT
SAMPLING AND ANALYSIS PLAN
APRIL 2010

TANKS 81 A, B, and C
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Prepared for:
Naval Facilities Engineering Command Southeast
NAS Jacksonville
Jacksonville, Florida 32212-00306

Prepared by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

Prepared under:
Contract N62470-08-D-1001
CONTRACT TASK ORDER JM09

Review Signatures:

T. Johnston 4-8-10
Tom Johnston, PhD/CLEAN Quality Assurance Manager/Date
Tetra Tech NUS

4/8/10
Rob Simcik/Project Manager/Date
Tetra Tech NUS

Approval Signatures:

Art Sanford/RPM/Date
BRAC PMO SE

TUCKER.JONATHAN.P.1239524180
Digitally signed by TUCKER.JONATHAN.P.1239524180
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=TUCKER.JONATHAN.P.1239524180
Date: 2010.04.14 14:25:16 -04'00'

Government Chemist/Date
NAVFAC Quality Assurance Officer

David Grabka/Remedial Project Manager/Date
FDEP, Bureau of Waste Cleanup, Fed Section

EXECUTIVE SUMMARY

The Site known as Building 81, Tanks 81 A, B, and C at the former Naval Air Station (NAS) Cecil Field, Jacksonville, Florida, was identified as having groundwater contamination in the form of isopropylbenzene (also referred to as cumene) in excess of the Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Level (GCTL). Monitoring was previously conducted at this site in accordance with the Natural Attenuation Monitoring Plan Approval Order (NAMPAO) issued by the FDEP on June 27, 2008. Subsequent to this Order, contamination was confirmed beyond the identified source area. A groundwater investigation was conducted in March 2009 using Direct Push Technology (DPT) to redefine the extent of the plume. This Monitoring Only Plan (MOP) (hereon referred to as the Sampling and Analysis Plan (SAP) for Tanks 81 A, B, and C) provides the basis and methods for completing and executing sampling and analysis.

Former Tanks 81 A, B, and C were three aboveground storage tanks (ASTs) located northwest of Building 81. Tanks 81 A, B, and C were contained in a secondary concrete containment pit that was approximately 2 feet deep. There is limited available information about the construction or possible contents of the three ASTs kept in this pit. No structures are currently located on the site.

Tetra Tech NUS, Inc. (Tetra Tech) prepared this SAP for the United States Department of Navy, Base Realignment and Closure Project Management Office (BRAC PMO) Southeast (SE) under the Comprehensive Long-term Environmental Action Navy Contract Number (CLEAN) N62470-08-D-1001, Contract Task Order (CTO) JM09. The information collected during this investigation, combined with information from previous investigations, is intended to support evaluation of the nature and extent of contamination.

Based on site operational history, previous investigations, the Conceptual Site Model (CSM), and problem statements presented in this SAP, it was determined that isopropylbenzene groundwater contamination needs to be monitored to ensure that the plume originating from the former location of Tanks 81 A, B, and C does not migrate outside of the boundaries of the former NAS Cecil Field.

After completion of each sampling event, a monitoring report presenting the results of the investigations will be prepared for Tanks 81 A, B, and C. This report will evaluate the results against the FDEP GCTL for isopropylbenzene and provide recommendations based on this evaluation. The proposed frequency of sampling is quarterly and will be adjusted in accordance with the revised NAMPAO to be issued by the FDEP upon acceptance of this SAP.

The SAP contained herein was generated for and complies with applicable Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP), FDEP, and United States Environmental Protection Agency (USEPA) Region 4 requirements, regulations, guidance, and technical standards as appropriate. This SAP outlines the organization, project management, objectives, planned activities, measurement, data acquisition, assessment, oversight, and data review procedures associated with the planned investigations at petroleum sites at former NAS Cecil Field. The scope of work includes information for the collection and analysis of groundwater at the site. The data will be used by the NAS Cecil Field Partnering Team to determine whether continued groundwater monitoring is appropriate or other actions must be taken to be protective of human health and the environment. Protocols for sample collection, handling, storage, chain of custody, laboratory and field analyses, data validation, and reporting are also addressed in this SAP.

Field activities conducted under this SAP shall meet the requirements of the former NAS Cecil Field Site-Specific Health and Safety Plan (HASP).

SAP Worksheets **Page Number**

SAP Worksheet #1 -- Title and Approval Page 1
SAP Worksheet #2 -- SAP Identifying Information 9
SAP Worksheet #3 -- Distribution List 11
SAP Worksheet #5 -- Project Organizational Chart 15
SAP Worksheet #6 -- Communication Pathways 16
SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table 17
SAP Worksheet #8 -- Special Personnel Training Requirements Table 20
SAP Worksheet #9 -- Project Scoping Session Participants Sheet 21
SAP Worksheet #10 -- Conceptual Site Model 23
SAP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process Statements 27
SAP Worksheet #12 -- Measurement Performance Criteria Table 30
SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table 31
SAP Worksheet #14 -- Summary of Project Tasks 32
SAP Worksheet #15 -- Reference Limits for Groundwater 38
SAP Worksheet #16 -- Project Schedule/Timeline Table 39
SAP Worksheet #17 -- Sampling Design and Rationale 40
SAP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table 41
SAP Worksheet #19 -- Analytical SOP Requirements Table 42
SAP Worksheet #20 -- Field Quality Control Sample Summary Table 43
SAP Worksheet #21 -- Project Sampling SOP References Table 44
SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table 45
SAP Worksheet #23 -- Analytical SOP References Table 46
SAP Worksheet #24 -- Analytical Instrument Calibration Table 47
SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 48
SAP Worksheet #26 -- Sample Handling System 49
SAP Worksheet #27 – Sample Custody Requirements Table 50
SAP Worksheet #28 -- Laboratory QC Samples Table 52
SAP Worksheet #29 -- Project Documents and Records Table 54
SAP Worksheet #30 -- Analytical Services Table 55
SAP Worksheet #31 -- Planned Project Assessments Table 56
SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses 57
SAP Worksheet #33 -- QA Management Reports Table 58
SAP Worksheet #34 -- Verification (Step I) Process Table 59
SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table 61
SAP Worksheet #36 -- Validation Data Validation (Steps IIa and IIb) Summary Table 63
SAP Worksheet #37 -- Usability Assessment 64

List of Figures

Figure 1: General Location Map
Figure 2: Topographical Map
Figure 3: Land Use Map
Figure 4: Isopropylbenzene Contours (34’ bgs)
Figure 5: Isopropylbenzene Contours (40’ bgs)
Figure 6: Isopropylbenzene Contours (46’ and 52’ bgs)
Figure 7: Conceptual Site Model
Figure 8: Monitoring Well Location Map

List of Appendices

Appendix A Source Removal Documentation
Appendix B DQO Meeting Minutes
Appendix C Field Standard Operating Procedures
Appendix D Laboratory Standard Operating Procedures
Appendix E Laboratory Certification

ACRONYMS AND ABBREVIATIONS

BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
bgs	Below ground surface
bls	Below land surface
BRAC	Base Realignment and Closure
°C	Degree Celsius
CA	Corrective Action
CCC	Calibration Check Compound
CH2MHILL	CH2M Hill Constructors, Inc.
CG	Certified Geologist
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Contaminant of concern
CSM	Conceptual site model
CSR	Confirmatory Sampling Report
CTO	Contract Task Order
DoD	Department of Defense
DPT	Direct push technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
DVM	Data Validation Manager
EBS	Environmental Baseline Study
EGIS	Environmental Geographic Information System
F.A.C.	Federal Administrative Code
FDEP	Florida Department of Environmental Protection
FOL	Field Operations Leader
GC/MS	Gas Chromatograph/Mass Spectrometer
GCTL	Groundwater Cleanup Target Level
GWMR	Groundwater Monitoring Report
HASP	Health and Safety Plan
HSM	Health and Safety Manager
IDW	Investigation-derived waste
IRCDQM	Installation Restoration Chemical Data Quality Manual
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation

LUC	Land Use Control
µg/L	Micrograms per liter
MDL	Method Detection Limit
mL	Milliliter
MPC	Measurement Performance Criterion
MOP	Monitoring Only Plan
MS/MSD	Matrix spike/matrix spike duplicate
NAMP	Natural Attenuation Monitoring Plan
NAMPAO	Natural Attenuation Monitoring Plan Approval Order
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NFA	No Further Action
NTU	Nephelometric turbidity unit
OWS	Oil/water separator
PAL	Protection Action Level
PARCCS	Precision, accuracy, representativeness, comparability, completeness, and sensitivity
PM	Project Manager
PMO	Project Management Office
PQLG	Project Quantitation Limit Goal
PWMA	Public Works Maintenance Area
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RF	Response Factor
RMO	Risk Management Option
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative standard deviation
SAP	Sampling and Analysis Plan
SAR	Site Assessment Report
SDG	Sample Delivery Group
SE	Southeast
SOP	Standard operating procedure
SPCC	System performance check compound
SQL	Standard query language

SSAR	Supplemental Site Assessment Report
SSO	Site Safety Officer
TBD	To be determined
TFM	Transportation and Fuel Management
Tetra Tech	Tetra Tech NUS, Inc.
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Tanks 81 A, B, and C
Operation Unit: Not Applicable
Contractor Name: Tetra Tech NUS, Inc. (Tetra Tech)
Contract Number: N62470-08-D-1001
Contract Title: Comprehensive Long-term Environmental Action Navy (CLEAN)
Work Assignment Number: Contract Task Order (CTO) JM09

1. This Sampling and Analysis Plan (SAP) for Tanks 81 A, B, and C was prepared in accordance with the requirements of the United States Environmental Protection Agency's (USEPA) *Uniform Federal Policy (UFP) for Quality Assurance Project Plans (QAPPs)* and *Guidance for Quality Assurance Project Plans, EPA QA/G-5, Quality Assurance Management Staff*.

2. Identify regulatory program: Florida Department of Environmental Protection (FDEP) Petroleum Contamination Site Cleanup Criteria, Regulation Chapter 62-770, Florida Administrative Code. (F.A.C.)

3. This document is a project-specific SAP.

4. List dates of scoping sessions that were held:

Data Quality Objective (DQO)/SAP Meeting – Tetra Tech Internal	August 4, 2009
DQO Scoping Meeting with Base Realignment and Closure (BRAC) Cleanup Team (BCT)	August 13, 2009
SAP Meeting – Tetra Tech Internal	September 4, 2009

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
Site Assessment Report (SAR) for Tanks 81 A, B, and C	July 19, 2002
Groundwater Monitoring Report (GWMR) – Year 1 – 1st Quarter	November 17, 2003
Work Plan for Supplemental Site Assessment	November 10, 2006
SAR Addendum	May 4, 2007
GWMR 1st Quarter, 2nd Year (February 2007)	June 8, 2007
GWMR Letter, Year 2 – 2nd Quarter	September 27, 2007
Tanks 81 A, B, and C Natural Attenuation Monitoring Plan (NAMP)	November 21, 2007
GWMR Letter, Year 2 – 3rd Quarter	February 7, 2009
GWMR Letter, Year 2 – 4th Quarter	March 12, 2008
GWMR Letter Year 3 – 1st Quarter	July 1, 2008
GWMR Letter, Year 3, 2nd Quarter [Natural Attenuation Monitoring Plan Approval Order (NAMPAO) 3rd Quarter]	October 17, 2008
GWMR Letter, Year 3 – 3rd Quarter (NAMPAO 4th Quarter)	December 15, 2008
Direct Push Technology (DPT) Investigation Work Plan at Tanks 81 A, B, and C	March 4, 2009

6. List organizational partners (stakeholders) and connection with lead organization:
RAC Program Management Office (PMO) Southeast (SE) (property owner), USEPA Region 4 (regulatory), FDEP (regulatory)

7. Lead organization (see Worksheet #7 for detailed list of data users)
BRAC PMO SE (Property Owner)

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

Not Applicable

SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipients	Title	Organization	Telephone Number (Optional)	E-Mail Address
Mr. Art Sanford	Navy Remedial Project Manager (RPM)	BRAC Project Management Office (PMO) SE	(843) 743-2135	art.sanford@navy.mil
Mr. Gregory Fraley	USEPA RPM	USEPA Region 4	(404) 562-8544	fraley.gregory@epa.gov
Mr. David Grabka	FDEP RPM	FDEP	(850) 245-8997	david.grabka@dep.state.fl.us
Mr. Mark Davidson	BRAC Environmental Coordinator (BEC)	BRAC PMO SE	(843) 743-2124	mark.davidson@navy.mil
Mr. Robert Simcik	Tetra Tech Project Manager (PM) CLEAN Contractor	Tetra Tech	(412) 921-8163	robert.simcik@tetratech.com
Mr. Mike Halil	CH2M Hill PM Remedial Action Contactor (RAC)	CH2M Hill	(904) 777- 4812 ext. 233	michael.halil@CH2M.com

Name of SAP Recipients	Title	Organization	Telephone Number (Optional)	E-Mail Address
Mr. Matt Soltis	Tetra Tech Health and Safety Program Manager	Tetra Tech	(412) 921-8912	matt.soltis@tetratech.com
Ms. Bonnie Capito	Librarian and Records Manager	Naval Facilities Engineering Command (NAVFAC) Atlantic	(757) 322-4785	bonnie.capito@navy.mil
Dr. Ronald Kotun	Tetra Tech Project Risk Assessor and DQO Facilitator	Tetra Tech	(412) 921-8291	ronald.kotun@tetratech.com
Ms. Ralinda Miller	Tetra Tech Florida Certified Geologist (CG)	Tetra Tech	(412) 921-8995	ralinda.miller@tetratech.com
Dr. Tom Johnston	Tetra Tech Quality Assurance (QA) Manager (QAM)	Tetra Tech	(412) 921-8615	tom.johnston@tetratech.com
Ms. Megan Ritchie	Tetra Tech Project Chemist	Tetra Tech	(610) 382-1527	megan.ritchie@tetratech.com
Mr. Joe Samchuck	Data Validation Manager (DVM)	Tetra Tech	(412) 921-8510	joseph.samchuck@tetratech.com

Name of SAP Recipients	Title	Organization	Telephone Number (Optional)	E-Mail Address
Ms. Kara Wimble	Tetra Tech Field Operations Leader (FOL) – Petroleum Sites	Tetra Tech	(904) 636-6125	kara.wimble@tetratech.com
Mr. Mark Jonnet	Tetra Tech Project Environmental Geographic Information System (EGIS) Specialist	Tetra Tech	(412) 921-8622	mark.jonnet@tetratech.com
Ms. Kim Kostzer	Laboratory PM	Empirical Laboratories	(615) 345-1115	kkostzer@empirlabs.com

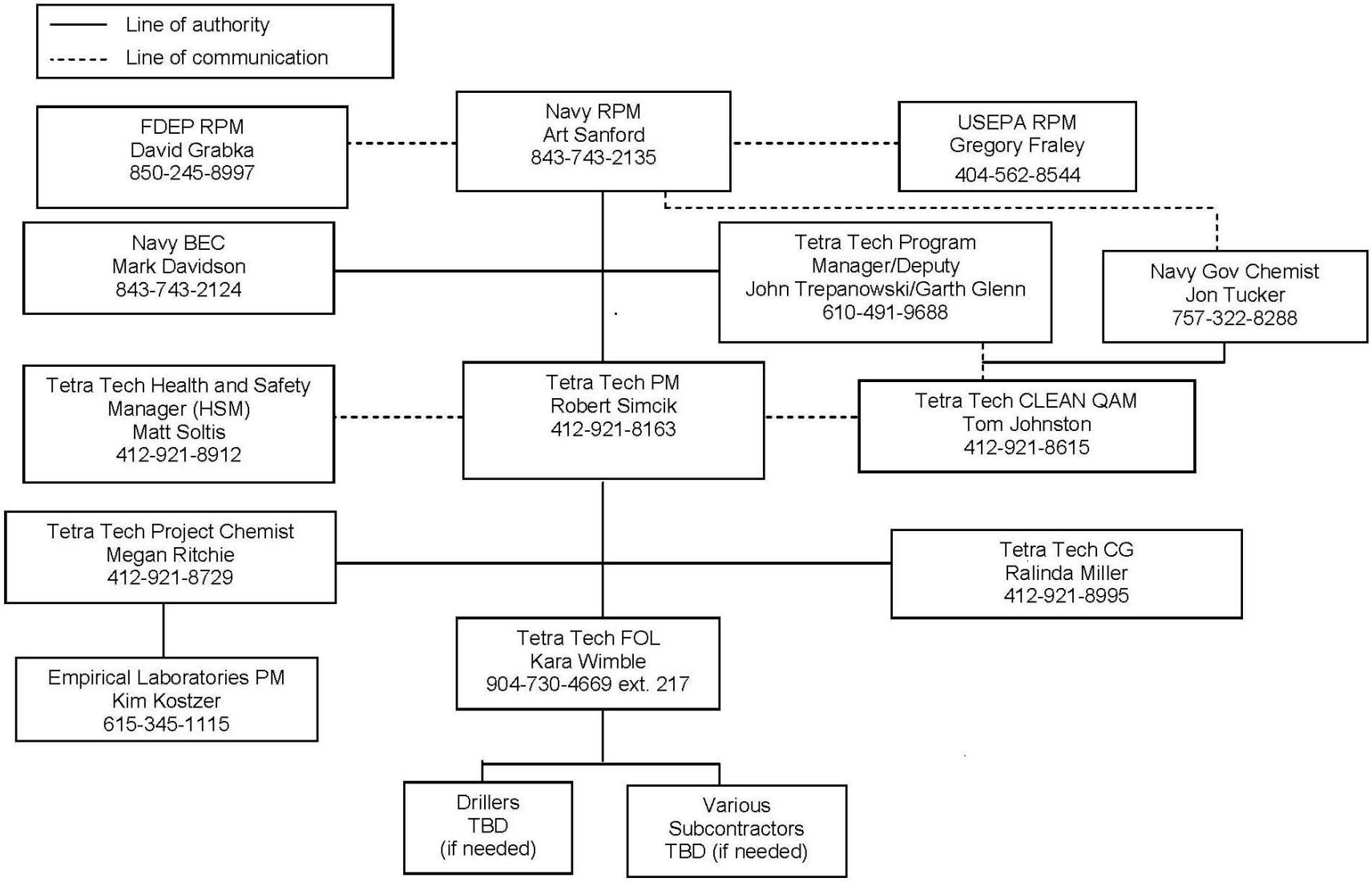
SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

(UFP-QAPP Manual Section 2.3.2)

Name	Organization/Title/Role	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Robert Simcik, PE	Tetra Tech/PM/Oversees planning and activities at former NAS Cecil Field by Tetra Tech	See Worksheet # 1 Tetra Tech Title and Approval Page	All	
Kara Wimble	Tetra Tech/FOL – Petroleum Sites/ Leads Tetra Tech field activities related to the Petroleum Program at former NAS Cecil Field		All	
Ralinda Miller, PG	Tetra Tech/CG/Verifies sampling methods		All	
Joseph Samchuck	Tetra Tech/DVM/ Verifies data collected during sampling events		Worksheets #12, #14, #15, #19, #20, #23-28, #30, #34-37	
Tom Johnston, PhD	Tetra Tech/CLEAN QA Manager/ Ensures that all quality standards are met	See Worksheet #1 Tetra Tech Title and Approval Page	All	
Kim Kostzer	Empirical/Laboratory PM/ Oversees laboratory analyses and communicates with other organizations involved		Worksheets #12, #14, #15A-D, #19, #20, #23-28, #30, #34-37	
Megan Ritchie	Tetra Tech/Project Chemist/ Determines necessary data analysis methods and statistics		Worksheet #s 12, 14, 15, 19, 23 through 28, 30, 34 through 37	
Ronald Kotun, PhD	Tetra Tech/DQO Facilitator and Human Health Risk Assessor		All	

SAP Worksheet #5 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)



SAP Worksheet #6 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Changes in schedule	Tetra Tech PM Navy RPM	Robert Simcik Art Sanford	412-921-8163 843-743-2135	Tetra Tech PM informs the Navy RPM via email within one week and Navy RPM informs via email Regulatory RPMs within one week.
Issues in the field that result in minor modifications of field methodology or sampling protocol	Tetra Tech FOL Tetra Tech PM	Kara Wimble – Petroleum Sites Robert Simcik	904-730-4669 ext: 214 412-921-8163	Tetra Tech FOL informs via email and phone call, if necessary, Tetra Tech PM within one business day, and Tetra Tech PM informs Navy RPM via and Tetra Tech CG within one week. Tetra Tech FOL documents in field log book, and Navy RPM informs Regulatory RPMs.
Field conditions that result in changes in scope of field work or major modifications in field methodology or sampling protocol	Tetra Tech FOL Tetra Tech PM	Kara Wimble – Petroleum Sites Robert Simcik	904-730-4669 ext: 217 412-921-8163	Tetra Tech FOL informs Tetra Tech PM via email within one business day, who informs the Navy RPM and Tetra Tech CG within the same business day. Tetra Tech FOL and PM prepare a field task modification request, and Navy RPM provides request via e-mall within one week o Regulatory RPMs.
Recommendation to stop work and initiate work upon CA	Tetra Tech FOL, SSO Tetra Tech PM Tetra Tech QAM Tetra Tech Health and Safety Manager (HSM) Navy RPM	Kara Wimble – Petroleum Sites Robert Simcik Tom Johnston Matt Soltis Art Sanford	904-730-4669 ext: 214 412-921-8163 412-921-8615 412-921-8912 843-743-2135	Responsible party immediately (within one hour) informs subcontractors, Navy, and Tetra Tech PM via email and phone call. Navy RPM informs Regulatory RPMs.
Analytical data quality issues	Analytical Laboratory Tetra Tech Project Chemist	Empirical Laboratories (Kim Kostzer) Megan Ritchie	615-345-1115 601- 382-1527	Laboratory PM notifies Tetra Tech Project Chemist within one business day via email, who notifies Tetra Tech PM within one day.

SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table

(UFP-QAPP Manual Section 2.4.3)

Name	Title/ Role	Organizational Affiliation	Responsibilities
Art Sanford	Navy RPM	BRAC PMO SE	Functions as primary Navy interface with the Tetra Tech PM and Regulatory RPMs. • Oversees Tetra Tech management of project. • Provides Navy input through participation in technical meetings, review of SAP and project documents, and regular discussion with Tetra Tech PM and Regulatory RPMs.
Mark Davidson	Navy BEC	BRAC PMO SE	Functions to support elevated issues as identified by the Navy RPM.
Gregory Fraley	Regulatory RPM	USEPA Region 4	Function as BCT member providing input when requested. • Provide input through participation in technical meetings and regular discussion with Navy RPM, but does not have direct regulatory input in the Petroleum Program.
David Grabka	Regulatory RPM	FDEP	Function as primary regulatory interface with the Navy RPM. • Provide regulatory input through participation in technical meetings, review of SAP and project documents, and regular discussion with Navy RPM. • Provide approval of documents in accordance with the requirements of the current Amended Site Management Plan (SMP) for former NAS Cecil Field.
Robert Simcik	PM	Tetra Tech	Oversees project, manages financial, schedule, and technical day-to-day activities of the project. • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Certifies reports. • Functions as the primary Tetra Tech interface with the Navy RPM, CG, Tetra Tech field and office personnel, and laboratory points of contact. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and offsite laboratories. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues Tetra Tech deliverables to the Navy and project team.

Name	Title/ Role	Organizational Affiliation	Responsibilities
Kara Wimble	FOL	Tetra Tech	Supervises, coordinates, and performs field sampling activities. Specific responsibilities include: • Functions as the on-site communications link between field staff members, subcontractors, and Tetra Tech PM and keeps the schedules provided by the PM. • Ensures the proper maintenance of site logbooks, field logbooks, and field record keeping. • Initiates field change orders when necessary. • Identifies and resolves problems in the field, implements and documents CA procedures. • Alerts off-site analytical laboratories of any special health and safety hazards associated with environmental samples. • Ensures that all health and safety requirements for the investigation are implemented. • Initiates and conducts equipment inventories to ensure equipment is available, purchases equipment as required, staging equipment for efficient loading and transport from the Tetra Tech office to the site, and, after field activities are completed, demobilizing the equipment.
Kara Wimble	SSO	Tetra Tech	The SSO will be responsible for training and monitoring site conditions. Details of these responsibilities are presented in the HASP and include: • Controlling specific health and safety-related field operations such as personnel decontamination, monitoring of worker heat or cold stress, and distribution of safety equipment. • Conducting and documenting a daily health and safety briefing each day while on site. • Assuring that field personnel comply with all procedures established in the HASP. • Identifying SSOs in their absence. • Terminating work in an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered. • Assuring the availability and the condition of health and safety monitoring equipment. • Coordinating with the FOL and Tetra Tech PM to institute and document any necessary HASP modifications. • Ensuring that facility personnel and subcontractors are adequately advised and kept clear of potentially contaminated materials.
Tom Johnston, PhD	QAM	Tetra Tech	Reviews the SAP, oversees preparation of lab scope, and data quality review. Ensures quality aspects of the CLEAN program are implemented. Specific responsibilities include: • Develops, maintains, and monitors QA policies and procedures. • Provides training to Tetra Tech staff in QA/quality control (QC) policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, SAP requirements, and corporate policies and procedures. • Monitors subcontractor quality controls and records. • Assists in the development of CA plans and ensuring correction of non-conformances reported in internal or external audits. • Ensures that this SAP meets Tetra Tech, DON, and U.S. EPA QA requirements. • Prepares QA reports for management.

Name	Title/ Role	Organizational Affiliation	Responsibilities
Megan Ritchie	Project Chemist	Tetra Tech	Provide support to the project including: • Assists in preparation of SAP and provides advice to the Tetra Tech team on matters of project chemistry. • Prepares laboratory scopes of work, coordinates analyses with laboratory chemists, ensures that the laboratory scope of work is followed, and communicates with Tetra Tech/Tetra Tech staff. • Reviews laboratory data and evaluates data usability • Functions as the primary interface between the subcontracted laboratory and Tetra Tech staff.
Ralinda Miller	CG	Tetra Tech	Oversees planning, collection, reporting, and interpretation of geologic and hydrogeologic data. • Provides oversight of the project geologist and any field activities, field decisions, and modifications based on field conditions. • Reviews the SAP.
Ronald Kotun, Ph.D.	Human Health Risk Assessor and DQO Facilitator	Tetra Tech	Performs human health risk assessment and oversees preparation of human health risk assessment and risk management decisions as well as coordination of the DQO process.
Joseph Samchuck	DVM	Tetra Tech	Manages data validation activities within Tetra Tech, including: • Ensure quality assurance of data validation deliverables and provide technical advice on usability. • Coordinate and maintain data validation review schedule.
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program. • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the HASP and prepares health and safety reports. • Conducts health and safety audits.
Kim Kostzer	Laboratory PM	TBD	The subcontracted laboratory is responsible for analyzing all samples in accordance with the analytical methods and additional requirements specified in this SAP. It will also be the analytical laboratory's responsibility to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined below. Interfaces directly with the Tetra Tech Project Chemist, Tetra Tech PM, and Tetra Tech QAM. • Ensures that methods and project-specific analytical and QA requirements are properly communicated, understood, and complied with by laboratory personnel. • Informs the Tetra Tech PM of project status and any sample receipt or analytical problems. • Oversees the preparation of, reviews, and approves final analytical reports and data packages before they are submitted to Tetra Tech.

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker performing sampling of hazardous materials will be required to have completed a 40-hour course (and annual 8-hour refresher) in Health and Safety Training as described under Occupational Safety and Health Administration 29 Code of Federal Regulations 1910.120(b)(4).

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Former Naval Air Station (NAS) Cecil Field PM: Rob Simcik	Site Name: Tanks 81 A, B, and C Site Location: Jacksonville, Florida

Date of Session: August 4, 2009
Scoping Session Purpose: Tetra Tech internal discussion to prepare the presentations of the DQOs for the August 13, 2009, DQO meeting for the BCT.

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Ronald Kotun, Ph.D.	Senior Toxicologist	Tetra Tech	(412) 921-8291	ronald.kotun@tetratech.com	DQO Facilitator and Risk Assessor
Robert Simcik, P.E.	PM	Tetra Tech	(412) 921-8361	rob.simcik@tetratech.com	PM
Megan Ritchie	Project Chemist	Tetra Tech	(610) 491-9688	megan.ritchie@tetratech.com	Project Chemist
Kara Wimble	Geologist	Tetra Tech	(904) 730-4669 ext. 217	kara.wimble@tetratech.com	FOL for Petroleum Sites

Comments/Decisions:

Draft Worksheets #10 and #11 were prepared as a departure point for discussion at the August 13th meeting. It was decided that all of the sites to be investigated under the Petroleum Program would be included in one SAP, expect for the Tanks 81 A/B/C SAP.

Action Items:

Ron requested that Kara and Megan make Power Point slides of DQO Problem Statements, Decision Statements, Inputs, and Decision Rules for each Site at former NAS Cecil Field included in the UFP-SAP.

Consensus Decisions:

The slides would serve as a straw man for the DQO Facilitation meeting on August 13, 2009.

Project Name: Former NAS Cecil Field PM: Rob Simcik	Site Name: Petroleum Sites: North-South Apron; Building 82, Tank G82; BP Wells; 815 Wash Rack Site Location: Jacksonville, Florida
Date of Session: August 13, 2009 **Scoping Session Purpose:** DQO meeting with Tetra Tech, Navy, and Regulatory Team.	

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
David Grabka	RPM	FDEP	(850) 245-8997	david.grabka@dep.state.fl.us	RPM
Art Sanford	RPM	Navy	(843) 743-2135	art.sanford@navy.mil	RPM
Ronald Kotun, Ph.D.	Senior Toxicologist	Tetra Tech	(412) 921-8291	ronald.kotun@tetratech.com	DQO Facilitator and Risk Assessor
Doyle Brittain	RPM	USEPA	(404) 562-8518	brittain.doyle@epa.gov	RPM
Rob Simcik	PM	Tetra Tech	(412) 921-8163	robert.simcik@tetratech.com	Engineer
Mark Jonnet	EGIS/ Engineer	Tetra Tech	(412) 921-8622	mark.jonnet@tetratech.com	EGIS/ Engineer
Mike Halil	RAC PM	CH2M Hill	(904) 777-4812 ext. 233	michael.halil@CH2M.com	RAC PM
Kara Wimble	Geologist	Tetra Tech	(904) 730-4669 ext. 217	kara.wimble@tetratech.com	Petroleum PM

Comments/Decisions:

Draft SAP Worksheets #10 and #11 were provided to the meeting participants on August 13, 2009. Revisions to Worksheets #10 and #11 and figures were made based on the meeting discussion. The meeting minutes are included in Appendix B.

Action Items:

Complete UFP-SAP for Petroleum Sites and Tanks 81 A, B, and C based on BCT agreement of the DQOs.

Consensus Decisions:

BCT decisions regarding DQOs are included in meeting minutes in Appendix B.

SAP Worksheet #10 -- Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)

10.1 SITE DESCRIPTION AND HISTORY

The site known as Building 81, Tanks 81 A, B, and C at the former naval base NAS Cecil Field, Jacksonville, Florida, was identified as the area around the former tanks that has groundwater contamination in the form of isopropylbenzene in excess of the FDEP Groundwater Cleanup Target Level (GCTL).

The majority of former NAS Cecil Field is located in southwestern Duval County, Florida, and the southernmost portion of former NAS Cecil Field is located in Clay County, as shown on Figure 1. Former NAS Cecil Field is located 14 miles southwest of Jacksonville, Florida, occupied approximately 31,000 acres when operational, and currently occupies approximately 17,200 acres. The base was operated by the Navy from approximately 1943 to 1999. This SAP governs work to be conducted at Tanks 81 A, B, and C. This site is being investigated and acted upon under the FDEP Petroleum Program [as published in Chapter 62-770 and Chapter 62-777, Florida Administrative Code (F.A.C)].

An Environmental Baseline Study (EBS) performed by ABB Environmental Services, Inc, in 1994 indicates that the buildings associated with the site were constructed approximately in 1952 and 1953. According to the EBS for former NAS Cecil Field, this site was on the eastern edge of an area called the Transportation and Fuel Management (TFM) compound. The TFM compound consisted of seven buildings (Buildings 49, 80, 80C, 178, 180, 384, and 584), also known as Site 25. Figure 2 shows the locations of those buildings to the southwest of the site. Automotive maintenance for the base was managed from the TFM compound. Immediately east of the TFM compound and separated from the TFM compound by a north-south fence, a series of buildings existed that housed the operations of a Navy subcontractor hired to handle plumbing, carpentry, general painting, and welding, electrical and light machine work related to general maintenance on base. This area was known as the Public Works Maintenance Area (PWMA). The central building of the PWMA was Building 81. Support buildings to the north and east of Building 81, shown on Figure 2, included Buildings 78, 98, 100, 101, 201, 247 and 929.

The actual construction date of the tanks is unknown. Former Tanks 81 A, B, and C consisted of three aboveground storage tanks (ASTs) located northwest of Building 81. Tanks 81 A, B, and C were contained in a secondary concrete containment pit that was approximately 2 feet deep. According to the SAR, there is limited available information about the construction of the three ASTs kept in this pit. No structures are currently located on the site. The location of the former Tanks 81 A, B, and C is a relatively flat area with both an asphalt parking lot and a grassy vacant lot. A topographic map of the area surrounding the site is presented in Figure 3. Currently no buildings are present at the site, and the

Florida Community College of Jacksonville is leasing the property from Jacksonville Aviation Authority to use as place to perform truck driving training classes.

10.2 HISTORY OF ENVIRONMENTAL INVESTIGATIONS AND ACTIONS

Beginning with the 1994 EBS in which petroleum contamination was detected at the Tanks 81 A, B, and C site, a series of environmental investigations was conducted to characterize the nature and extent of contamination (Tetra Tech, 2000, CH2MHILL, 2000, Tetra Tech, 2002, Tetra Tech, 2003, Tetra Tech, 2005, Tetra Tech, 2007a, Tetra Tech, 2007b, Tetra Tech, 2007c, Tetra Tech 2007d, Tetra Tech, 2009). These investigations spanned the time from 1999 to the present and were conducted under the oversight of FDEP. The investigations included groundwater and soil investigations at various times. During these investigations and associated remediation activities consisting of contaminated soil removal, the list of chemicals of concern (COCs) was reduced to include only isopropylbenzene in groundwater. The investigations have not completely delineated the extent of isopropylbenzene contamination. No free petroleum product has ever been detected at this site. Appendix A provides documentation of the soil removal at the site.

A SAR for this site (Tetra Tech, 2002) indicated the ASTs (81 A, B, and C) were contained in a secondary containment pit that was approximately 2 ft deep. Four other ASTs were located in a secondary containment structure immediately north of Tanks 81 A, B, and C. These four ASTs were used oil tanks that were in a bermed area that drained to the concrete pit for Tanks 81 A, B, and C, which in turn drained to oil/water separator (OWS) 80-OW4. 80-OWS1 was also contained in a secondary concrete containment pit which was designed to drain into the site. Another OWS, 80-OWS2, was also located near the site. The OWSs were used to hold waste oil and stormwater. Figures 4, 5, and 6 show the concentrations of isopropylbenzene detected during a 2009 DPT investigation, along with contours of the plumes at three depths, relative to the location of the former Tanks 81 A, B, and C, and the oil-water separators. These figures represent current site conditions related to isopropylbenzene contamination, and indicate that the groundwater isopropylbenzene contamination is limited to the intermediate and deep depths bgs.

10.3 CONCEPTUAL SITE MODEL

A summary of the conceptual site model (CSM) based on post-removal action site conditions at Tanks 81 A, B, and C, is shown on Figure 7. The text below describes the CSM.

10.3.1 Potential Sources of Contamination

Based on the environmental investigations and actions to date at Tanks 81 A, B, and C, the potential sources of contamination could be from the petroleum-based products stored in Tanks 81 A, B, and C or

from the any of the OWSs that were once located in the area of Building 81. Contaminants are likely to have been released to surface or subsurface soil in the form of liquid petroleum products containing isopropylbenzene.

Dioxins, TRPH, SVOCs, Pesticides, PCBs, and metal analyses are not required during this investigation because data from previous investigations indicated that these analytes were not detected at concentrations greater than FDEP GCTLs on a consistent basis.

10.3.2 Potential Contaminant Migration Mechanisms

The latest data indicate that isopropylbenzene contamination is located between 35 feet to 55 feet below land surface (bls), as shown on Figures 4 through 6, and as indicated by the 2009 DPT investigation at the site. Based on this information, the contamination could migrate in the intermediate and deep zones of the surficial aquifer. Soil leaching to groundwater under the influence of infiltrating precipitation does not seem to be occurring at the site because there is a clean intermediate well, but this is a possible potential contaminant migration mechanism. Upon entering the water column, dissolved isopropylbenzene may be carried with the flow of the groundwater to downgradient locations. Groundwater typically flows toward the west-northwest.

10.3.3 Land Uses and Potential Exposure

The Jacksonville Economic Development Commission (JEDC) Reuse Plan provides for continued industrial and/or commercial uses of the site.

Land use controls (LUCs) were developed for this site in January 2005 and identified that the Site has isopropylbenzene concentrations exceeding human health criteria in groundwater. The LUCs are as follows (Tetra Tech, 2007e):

- Groundwater may not be used for human consumption.
- Groundwater may not be used for industrial purposes.
- Tampering or damaging any Navy wells or remediation systems is prohibited.

Former NAS Cecil Field is supplied with public water; therefore, human exposure to potentially contaminated site groundwater as a result of potable water use is not a consideration. Ecological receptors are not exposed to groundwater; however, contamination remains onsite which exceeds FDEP criteria which are based on organoleptic considerations.

The Site is located in a highly developed area consisting largely of paved areas and buildings and does not allow for direct access for contact with groundwater. The resulting lack of ecological habitat and

complete exposure pathways preclude potential unacceptable risks for ecological receptors. Direct exposure of potential human receptors to soil and groundwater is prevented based upon the current and future land use.

SAP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process Statements (UFP-QAPP Manual Section 2.6.1)

11.1 PROBLEM DEFINITION

Isopropylbenzene remain in groundwater of the Tanks 81 A, B, and C area at concentrations that exceed FDEP GCTLs. The project team must determine the extent of the isopropylbenzene contamination in groundwater so an appropriate response can be formulated to mitigate the potential risk associated with this contamination.

11.2 INFORMATION INPUTS

Requirements for groundwater sampling and analysis methods are described below. Additional detail (e.g., the exact methods and SOPs to be used) is provided in Worksheets #15, #19, and #21.

Tanks 81 A, B, and C

Required Analyses

Matrix	Volatile Organic Compounds (VOCs)	Purpose
Groundwater	Isopropylbenzene only	Quarterly monitoring

Analytical Methods

Analytical methods were selected to be the same as those used previously or at least comparable to previously used analytical methods with respect to precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS parameters). See Worksheets #20 and #23 for a list of the analytical methods applicable to each site.

Sampling Methods

Sampling methods were selected to be the same as those used previously or to at least be consistent with the representativeness and comparability of data for each media being sampled at each site. See Worksheet #21 for a list of sampling methods.

Project Action Levels (PALs)

The PAL for isopropylbenzene in groundwater is included within Worksheet #15. The Project Quantitation Limit Goal (PQLG) is set as one-third of the PAL and project team strives to select analytical methods which are capable of detecting concentrations equal to or less than the PQLG. The BCT has ensured that the selected laboratory (Empirical) Method Detection Limit (MDL) for isopropylbenzene is low enough to measure concentrations in groundwater that are less than the PAL in order to conduct comparisons of site data to the PAL as the MDL is equal to the PQLG. Values less than the MDL will be

reported as the limit of detection (LOD) value with a "U" flag. Detectable results of a magnitude between the limit of quantitation (LOQ) and MDL will be "J" flagged to indicate that the reported results are less precise than results that are greater than the LOQ. The BCT will accept these analytical results as usable (without additional qualification) without qualification unless quality evaluations indicate that the data quality has been compromised. Laboratory MDLs change over time. If the PAL is less than the reported laboratory MDL in any sample, the BCT accepts the LOQ as the PAL for decision making purposes, as is suggested in "Guidance for the Selection of Analytical Methods for the Evaluation of Practical Quantitation Limits" (FDEP, 2004).

11.3 STUDY BOUNDARIES

The Tanks 81 A, B, and C area covers approximately 0.33 acres. The area is show in Figure 8. The vertical boundary extends from the shallow groundwater plume to 52 ft bgs. The groundwater isopropylbenzene contaminant plume is the population of interest and constitutes the spatial decision unit. Three areas were identified that represent the plume or define the boundaries of the plume:

- Upgradient – represents conditions in groundwater entering the site and is thus unaffected by the site.
- Plume – represents conditions in the known isopropylbenzene plume.
- Downgradient – represents uncontaminated groundwater that could become contaminated through migration of contamination.

The temporal decision unit is each round of monitoring when determining whether an exceedance of GCTL has occurred and it is two consecutive monitoring rounds when determining whether parameters or wells may be eliminated from monitoring. Based on knowledge of groundwater flow directions and past data establishing the extent of isopropylbenzene contamination in excess of GCTLs (see Figure 8), existing wells cover enough of the contaminated and potentially contaminated areas for delineating the extent of isopropylbenzene contamination and monitoring temporal concentration trends. The groundwater sampling frequency must be quarterly to satisfy project objectives.

11.4 ANALYTIC APPROACH

The following decision rules govern data use for the monitoring programs at Tanks 81 A, B, and C. Each decision rule must be applied to each well in each round of sampling. If the decision rules lead to a change in the list of wells that are to be sampled, the PM will review the change in the list of wells with the BCT and gain the approval of the team prior to using the new list in a sampling event. Concentration trends will be represented by the best fit line through the data points.

Decision Rule #1: If the measured isopropylbenzene concentrations in groundwater samples from any monitoring well within the plume are less than the GCTL for the two most recent sampling events, then recommend the well for removal from the monitoring program; but if the last two rounds of measured isopropylbenzene concentrations in groundwater samples from a well are not less than the GCTL, then continue long-term monitoring in that well until levels of isopropylbenzene are below the GCTL for two consecutive sampling rounds. At this point, the BCT will recommend removal of the well from the sampling program.

Decision Rule #2: If the measured isopropylbenzene concentrations in a groundwater sample from all upgradient and downgradient wells are less than the GCTL, then continue with the scheduled monitoring program; otherwise resample any well in which concentrations exceed GCTL for verification prior to the next scheduled sampling event. If the exceedance is not confirmed, then continue with the scheduled monitoring program. If the exceedance is confirmed, the BCT will convene to determine appropriate actions to address the exceedance such as 1) verify groundwater flow direction, 2) further delineation of the plume, 3) modification of the sampling plan.

Decision Rule #3: If all measured isopropylbenzene concentrations in all groundwater samples collected from the targeted monitoring wells are less than the GCTL for two consecutive sampling events, then recommend the site for NFA.

11.5 PERFORMANCE CRITERIA

Measured isopropylbenzene concentrations in individual samples and temporal isopropylbenzene concentration trends within individual wells will be compared to the project action level. If all data have been collected as planned and no data points are missing or rejected for quality reasons, the monitoring event completeness and quality will be considered satisfactory. Quality evaluations will be performed in accordance with Worksheets #35 through #37. If any data gaps are identified, including missing or rejected data, the BCT will assess whether a claim of having obtained project objectives is reasonable. This assessment will depend on the number and type of identified data gaps; therefore, a more detailed strategy cannot be presented. All stakeholders will be involved in rendering the final conclusion regarding adequacy of the data

11.6 PLAN FOR OBTAINING DATA

The plan for obtaining data at the Tanks 81 A, B, and C site is described in detail on Worksheet #17 along with the sampling designs and rationales.

SAP Worksheet #12 -- Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table – Field QC Samples –Groundwater

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S & A)
Trip Blanks	VOCs	One per cooler containing VOC samples.	Accuracy/Bias/ Contamination	No analytes ≥ ½ LOQ, except common lab contaminants, which must be < LOQ.	S&A
Field Duplicate	VOCs	One per 10 field samples collected.	Precision	Values > 5X LOQ: Relative Percent Difference (RPD) ≤30%[1]	S
Temperature Indicator	VOCs	One per cooler	Representativeness	Temperature between 2 and 6 degrees Celsius (°C) (4 ± 2 °C)	S
Rinsate Blank	VOCs	1 per 20 samples per sampling equipment	Accuracy / Bias Contamination	No analytes ≥ ½ LOQ, except common lab contaminants, which must be < LOQ.	S & A

1 – If duplicate values are < 5x LOQ, the absolute difference should be < 2x LOQ.

SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	**Data Source** (originating organization, report title, and date)	**Data Generator(s)** (originating organization, data types, data generation / collection dates)	**How Data Will Be Used**	**Limitations on Data Use**
Long-term monitoring data	GWMR Letter, Year 3 – 3rd Quarter for Tanks 81 A, B, and C, December 2008	Tetra Tech, Groundwater data, 2007 to 2008	Data will be used to check against current data to monitor progress of the contamination levels in the groundwater plume.	None.
Results from DPT investigation and subsequent monitoring well installation, presented to BCT Team in August 2009	Tetra Tech, August 2009	Tetra Tech, groundwater data, June 2009	Groundwater data collected from monitoring wells installed in June 2009, based on DPT results generated in March 2009. Data will be used to determine and monitor the stability of the location of the contamination plume through quarterly monitoring.	None.

SAP Worksheet #14 -- Summary of Project Tasks

(UFP-QAPP Manual Section 2.8.1)

Summary of Project Tasks

Long-term monitoring at the petroleum sites includes the following tasks:

- Mobilization/demobilization
- Site-specific health and safety training
- Monitoring equipment calibration
- Groundwater level measurements
- Groundwater sampling
- Investigation-derived waste (IDW) management
- Field decontamination procedures
- Field documentation procedures
- Analytical Tasks
- Data Management

Mobilization/Demobilization

Mobilization shall consist of the delivery of all equipment, materials, and supplies to the site, the complete assembly in satisfactory working order of all such equipment at the site, and the satisfactory storage at the site of all such materials and supplies. Tetra Tech will store the equipment and supplies at either the Tetra Tech office or at the IDW Storage Building. Site-specific Health and Safety Training will be provided to all Tetra Tech subcontractors as part of the site mobilization.

Demobilization shall consist of the prompt and timely removal of all equipment, materials, and supplies from the site following completion of the work. Demobilization includes the cleanup and removal of IDW generated during the conduct of the investigation.

Site-Specific Health and Safety Training

Site-specific health and safety training will be provided to all Tetra Tech field staff and subcontractors as part of the site mobilization and is also addressed in Worksheet # 8.

Monitoring Equipment Calibration

These procedures are described in Worksheet # 22.

Water Level Measurements

One synoptic round of water-level measurements will be conducted at the site as part of each groundwater sampling event to provide information regarding groundwater flow patterns and gradients. Water level measurements will be completed within the shortest time possible on the same day, and no sooner than 24 hours after a significant precipitation event to minimize the precipitation effects on the data sets. Water level measurements will be recorded to the nearest 0.01 foot and referenced to a top of casing notch or north side of the well casing, if there is no notch. The measurement instrument will be decontaminated prior to conducting the measurement event and between each monitoring well.

Groundwater Sampling

Groundwater samples will be collected using low-flow purging techniques (discharge rate of less than 1 liter per minute) with a peristaltic pump using Teflon™ tubing dedicated to each well. All groundwater samples will be collected using the procedures specified in FDEP FS 2200, Groundwater Sampling. Worksheets #17 and #18 specify the groundwater sample locations and analytes for this investigation. Worksheet # 23 specifies the analytical methods to be used.

Prior to groundwater sample collection, the monitoring wells will be purged. Both purging and sampling operations will be conducted at a flow rate that results in a groundwater turbidity measurement of 20 Nephelometric turbidity units (NTUs) or less (inherent turbidity will be minimized to the greatest extent possible using low flow techniques; individual well conditions and local geology may preclude meeting the 20 NTU criteria).

The sample aliquot for isopropylbenzene analysis will be collected last by slowly pulling the Teflon™ tubing out of the well to minimize agitation of the water in the monitoring well and then transferring the contents of the tubing to a VOC vial. After collection, the samples will be placed in a cooler, chilled with ice, and shipped under chain-of-custody protocol to the off-site laboratory for analysis.

Investigation Derived Waste (IDW) Management

IDW generated during the activities will be managed in accordance with the former NAS Cecil Field IDW Plan and will be conducted in an environmentally responsible manner consistent with former NAS Cecil Field requirements (e.g., designation of staging areas). The objectives of the IDW management are:

- Management of IDW in a manner that prevents contamination of uncontaminated areas (by IDW) and that is protective of human health and the environment.

- Minimization of IDW, thereby reducing costs and the potential for human or ecological exposure to contaminated materials.

- Compliance with federal and state requirements that are Applicable or Relevant and Appropriate Requirements (including 62-770.400, 62-770.650, 62-770.680, 62-770.690, 62-770.700, 62-770.750, 62-770.800, 62-770.890, 62-770.900 FAC).

Used personal protective equipment, such as gloves, will be bagged and disposed of as regular trash in an appropriate facility waste container.

Field Decontamination Procedure

Decontamination of major equipment and sampling equipment will be in general accordance with FDEP FC 1000, Cleaning / Decontamination Procedures.

Field Documentation Procedures

Pre-preserved, certified-clean bottleware will be supplied by the subcontracted laboratory. Matrix-specific sample logsheets will be maintained for each sample collected. In addition, sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to FDEP FS 1000, General Sampling Procedures.

Field documentation will be performed in accordance with Tetra Tech SOP SA-6.3 (Appendix C). A summary of all field activities will be properly recorded in a bound logbook with consecutively number pages that cannot be removed. Logbooks will be assigned to field personnel and will be stored in a secured area when not in use.

At a minimum, the following information will be recorded in the site logbook:

- Name of the person to whom the logbook is assigned.
- Project name.
- Project start date.
- Names and responsibilities of on-site project personnel including subcontractor personnel.
- Arrival/departure of site visitors.
- Arrival/departure of equipment.

- Sampling activities and sample log sheet references.
- Description of subcontractor activities.
- Sample pick-up information, including chain-of-custody numbers, air bill numbers, carrier, time, and date.
- Description of borehole or monitoring well installation activities and operations.
  - Health and safety issues.
  - Description of photographs including date, time, photographer, roll and picture number, location, and compass direction of photograph.

All entries will be written in ink and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; the person making the correction will initial and date the change.

Analytical Tasks

Chemical analysis will be performed by Empirical. Empirical is a current Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certified laboratory. A copy of the laboratory certification can be found in Appendix E. Analyses will be performed in accordance with the analytical methods identified in Worksheet #19. Empirical will meet the PAL as shown in Worksheet #15. Empirical will perform chemical analysis following laboratory-specific SOPs (Worksheets #19 and #23) developed based on the analytical methods listed in Worksheets #19 and #30. Copies of the laboratories SOPs are included in Appendix C.

Data Management

Data Handling and Management - After the field investigation is completed, the field sampling log sheets will be organized by date and media and filed in the project files. The field logbooks for this project will be used only for these sites, and will also be categorized and maintained in the project files 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 titled based on date and activity. The data handling procedures to be followed by the laboratories will meet the requirements of the technical specification. The electronic data results will be automatically downloaded into the Tetra Tech database in accordance with proprietary Tetra Tech processes.

Data Tracking and Control.-The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

- Data Tracking: Data is tracked from its generation to its archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to the subcontracted laboratory. Upon receipt of the data packages from the analytical laboratory, the Project Chemist will oversee the data validation effort, which includes verifying that the data packages are complete and results for all samples have been delivered by the analytical laboratory.

- Data Storage, Archiving, and Retrieval: The data packages received from the subcontracted laboratory are tracked in the data validation logbook. After the data are validated, the data packages are entered into the Tetra Tech CLEAN file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the FOL to be entered into the CLEAN file system prior to archiving in secure project files. The project files are audited for accuracy and completeness. At the completion of the Navy contract the records will be stored by Tetra Tech and eventually handed over to BRAC PMO.

- Data Security: The Tetra Tech project files are restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files. Access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Assessment and Oversight – Refer to Worksheet #32 for assessment findings and CAs and Worksheet #33 for QA management reports.

Data Review

- Data verification is described in Worksheet #34.
- Data validation is described in Worksheets #35 and #36.
- Usability assessment is described in Worksheet #37.

Monitoring Reports

Monitoring reports will be prepared after each groundwater monitoring event. The reports will include appropriate sections concerning site background, investigation activities, physical characteristics, nature and extent of contamination, and conclusions and recommendations.

Each report will be issued in draft to BRAC PMO SE as the presentation of the data at the quarterly BCT meetings. Comments received from the BCT during the BCT meetings will be addressed and the final report will be issued for regulatory review.

SAP Worksheet #15 -- Reference Limits for Groundwater

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater
Analytical Group: VOCs

Analyte	Chemical Abstract Service Number	Project Action Limit (1) (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (2) (µg/L)	Empirical		
					LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Isopropylbenzene	98-82-8	0.8	FDEP GCTL	0.3	1.0	0.50	0.3

1 FDEP GCTLs, April 2005.
2 The laboratory QL does not meet the PAL; however, the MDL is sufficiently low to detect isopropylbenzene below the FDEP GCTL. Results reported between the MDL and LOQ will be flagged by the laboratory and will be considered usable for decision-making.
µg/L = Micrograms per liter.

SAP Worksheet #16 -- Project Schedule/Timeline Table

(UFP-QAPP Manual Section 2.8.2)

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Year 1, 1st Quarter Event	Tetra Tech	4/15/10	4/15/10	GWMR	6/15/10
Year 1, 2nd Quarter Event	Tetra Tech	7/15/10	7/15/10	GWMR	9/15/10
Year 1, 3rd Quarter Event	Tetra Tech	10/15/2010	10/15/2010	GWMR	12/15/10
Year 1, 4th Quarter	Tetra Tech	1/15/11	1/15/11	GWMR	3/15/11
Year 2, 1st Semi-Annual	Tetra Tech	6/1/2011	6/1/2011	GWMR	8/15/11

Long-term monitoring will continue at Tanks 81 A, B, and C until the plume has naturally attenuated. The schedule above indicates the first five tentatively scheduled events.

SAP Worksheet #17 -- Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

The sampling design and rationale for Tanks 81 A, B, and C is presented below. The objective of the sampling design is to obtain data that fulfills the DQOs presented in Worksheet #11. The BCT has selected a biased sampling approach appropriate for LTM at Tanks 81 A, B, and C. The numbers of selected sampling points are based on the available wells and a need to obtain comprehensive spatial coverage over the area of interest. Upgradient and downgradient sampling locations have been selected to monitor the source areas or contaminated groundwater plumes at each site and to execute the decision rules presented in Worksheet #11 (Section 11.4). The samples will be collected according to field sampling procedures presented in Worksheet #21.

The wells to be sampled were chosen based on consideration of historical groundwater flow data, detections of the isopropylbenzene in the wells, and whether they are downgradient or upgradient from the contamination plume. The seven wells that will be sampled are all intermediate or deep wells, because the extent of contamination is well-defined in the shallow depth. One of the well clusters to be sampled will be located within the isopropylbenzene plume. A sidegradient well, an upgradient well, a well downgradient of the isopropylbenzene plume, and a well downgradient of all former samples will also be sampled in order to best delineate the groundwater plume. The well locations to be sampled are designated with yellow highlight on Figure 8. The intent was to include wells within the plume that will indicate whether contaminant concentrations are naturally attenuating by tracking isopropylbenzene concentrations, and downgradient wells to verify that the plume is delineated at all depths and verify that contaminants are not migrating offsite. The sampling locations are detailed in Worksheet #18.

.

SAP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Sampling Location / Identification Number	Matrix	Screen Interval	Analytical Group	Number of Samples (identify field duplicates)(1)	Sampling SOP Reference(2)
Upgradient well CEF-81-04I; Plume well CEF-81-22I; Plume well CEF-81-24I; Plume well CEF-81-25I; Downgradient well CEF-81-26I;	Groundwater	30-35 feet below ground surface (bgs)	VOCs (isopropyl-benzene only)	7 plus 1 duplicate	FDEP FS 2200, 2008; Tetra Tech, SA-1.1, April 2008
Downgradient well CEF-81-27D; and Plume well CEF-81-28D		45 to 55 feet bgs			

1 Field duplicates may be consolidated across events at the FOL's discretion so as to yield one field duplicate per 10 environmental samples

2 SOP that describes the sample collection procedures.

SAP Worksheet #19 -- Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume [2] (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time [3] (preparation / analysis)
Groundwater and Aqueous quality control blanks	VOC (isopropyl-benzene only)	SW-846 5030/8260B, Empirical SOP-202	3 x 40 milliliter (mL) clear glass vials with septum	3 x 40 mL	Hydrochloric acid (HCl) to pH<2; Cool to 4 (± 2) °C; no headspace	14 days to analysis

1 The appropriate reference letter or number is from Worksheet #23
2 The minimum sample volume or mass requirements are provided where different from the container volume.
3 Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

mL = Milliliter.

SAP Worksheet #20 -- Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Number of Rinsate Blanks	Number of Equipment Blanks	Number of (Volatile Organic Aromatic) Trip Blanks	Number of Proficiency Testing Samples	Total Number of Samples to Lab
Groundwater	VOC (isopropyl-benzene only)	7	1	1/1	1	0	1	0	12

SAP Worksheet #21 -- Project Sampling SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date and/or Number[1]	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
FS2200	Groundwater Sampling, current version	FDEP	Peristaltic pump	Y	None.
FT1000 (plus series)	Field Testing General and Series including pH, Specific Conductance, Salinity, Temperature, Dissolved Oxygen, and Turbidity, current version	FDEP	Multi-parameter water quality meter	Y	None
FC1000	Field Decontamination, current version	FDEP	Decontamination Equipment (scrub brushes, phosphate free detergent, de-ionized water)	Y	None.
SA-6.1	Non-Radiological Sample Handling Rev. 3, February 2004	Tetra Tech	NA	N	None.
SA-6.3	Field Documentation Rev. 3, March 2009	Tetra Tech	NA	N	None.
CT-04	Sample Nomenclature Rev. 2, March 2009	Tetra Tech	NA	Y	Project specific nomenclature is listed in Worksheet # 18
SA-1.1	Groundwater Sample Acquisition and Onsite Water Quality Testing Rev. 7, April 2008	Tetra Tech	Peristaltic pump, Multi-parameter water quality meter	N	None.
SA-7.1	Decontamination of Field Equipment Rev. 6, January 2009	Tetra Tech	Decontamination Equipment (scrub brushes, phosphate free detergent, de-ionized water)	Y	Nitric acid is removed from the decontamination procedure. Isopropyl Alcohol to be used, if field conditions warrant.

1 FDEP SOPs can be downloaded from http://www.floridadep.org/labs/qa/sops.htm. Tetra Tech SOPs are located in Appendix C.

SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
Photoionization Detector	Calibration and Visual Inspection	Daily	Manufacturer's Guidance	Replace	FOL or designee	Manufacturer's Guidance	None.
Depth to Water Meter	Visual Inspection	Daily	Manufacturer's Guidance	Replace	FOL or designee	Manufacturer's Guidance	None.
Multi-Parameter Water Quality Meter	Visual Inspection, Calibration	Daily	Manufacturer's Guidance	Replace	FOL or designee	FDEP FT 1000 through 1500 and Manufacturer's Guidance	None.
LaMotte Model 2008 (or similar) Turbidity Meter	Visual Inspection, Calibration	Daily	RPD of ±10% (6 measurements of 2 successive samples of a 20 NTU standard) Accuracy of ±10% at 20 NTU (Mean of the measured values must be 18 to 22 NTU)	Replace	FOL or designee	FT 1600, Field Measurement of Turbidity (FDEP) and Manufacturer's Guidance	If an acceptable turbidity meter model is not used, submittal of an Alternate Test Procedure application is required

SAP Worksheet #23 -- Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?(1) (Y/N)
Empirical SOP-202	Gas Chromatograph/ Mass Spectrometer (GC/MS) Volatiles by Method 624 and SW846 Method 8260B (Revision 21, 9/11/08)	Definitive	Groundwater and aqueous QC blanks/ VOCs (isopropylbenzene only)	GC/MS	Empirical	N

SAP Worksheet #24 -- Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC/MS Isopropyl-benzene	Initial Calibration	Calibrate the instrument when it is received and after a major change or if the daily calibration fails. A minimum 5 point calibration is required.	The percent relative standard deviation (RSD) for each Calibration Check Compound (CCC) must be ≤ 30%. The minimum mean response factor (RF) for each System Performance Check Compound (SPCC) must meet that stated in 8260B. If the RSD for an analyte is > 15%, use a linear curve (≥ 0.995 correlation) or quadratic curve (≥ 0.99 correlation, minimum 6 points) for quantitation	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-202
	Continuing Calibration	Analyze a standard at the beginning of each 12 hour shift after a 4-bromofluoro-benzene (bfb) tune.	The minimum RF for SPCCs must meet that stated in method. The CCCs must be < 20 percent difference.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	
	Initial calibration Verification	Once after each initial calibration	The percent recovery (%R) of all analytes must be within 80-120% of true value.	Identify source of problem, correct, repeat calibration, rerun samples	Analyst/ Supervisor	
	Tune Verification – Bromofluoro-benzene (BFB)	At the beginning of each 12-hour analytical sequence.	Must meet the ion abundance criteria required by the method. No samples may be accepted without a valid tune.	Retune and/or clean source.	Analyst/ Supervisor	

SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.2.3)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS	Clean the source and replace the filaments. Replace the seal, liner and septum. Change the column.	Isopropyl benzene	Check the gas supply. Check the seal, liner, and septum.	Source cleaning is performed when the instrument response deteriorates. Other instrument maintenance is done as needed to keep the instrument performing at peak performance.	The minimum RF for SPCCs must meet that stated in method. The CCCs must be < 20 percent difference.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-202

SAP Worksheet #26 -- Sample Handling System

(UFP-QAPP Manual Appendix A)

SAMPLE HANDLING SYSTEM
SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FOL, Tetra Tech, Jacksonville, Florida
Sample Packaging (Personnel/Organization): FOL, Tetra Tech, Jacksonville, Florida
Coordination of Shipment (Personnel/Organization): FOL, Tetra Tech, Jacksonville, Florida
Type of Shipment/Carrier: Federal Express
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians, Empirical Laboratories
Sample Custody and Storage (Personnel/Organization): Sample Custodians, Empirical Laboratories
Sample Preparation (Personnel/Organization): Preparation Laboratory Staff (organic / inorganic), Empirical Laboratories
Sample Determinative Analysis (Personnel/Organization): GC/MS, GC, VOC Laboratory Staff, Empirical Laboratories
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): 60 days from submittal of final data report.
Sample Extract/Digestate Storage (Number of days from extraction/digestion): 6 months from submittal of final data report
Biological Sample Storage (Number of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians, Empirical Laboratories

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Tetra Tech CT-04 Sample Nomenclature, Tetra Tech SA-1.1 Groundwater Sampling, Tetra Tech SA-6.1 Non-Radiological Sample Handling
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Empirical SOP-404 Laboratory Sample Receiving Log-In and Storage Standard Operating Procedures Rev. 13; Empirical SOP-405 Analytical Laboratory Waste Disposal, Rev. 5; Empirical SOP-410 Standard Operating Procedures for Laboratory Sample Storage, Secure Areas and Sample Custody, Rev. 7
Sample Identification Procedures: Empirical SOP-404 Laboratory Sample Receiving Log-In and Storage Standard Operating Procedures Rev. 13
Chain-of-custody Procedures: Empirical SOP-410 Standard Operating Procedures for Laboratory Sample Storage, Secure Areas and Sample Custody, Rev. 7

SAMPLE CUSTODY REQUIREMENTS

Field Chain of Custody

To ensure the integrity of a sample from collection through analysis, an accurate, written record that traces the possession and handling of the sample is necessary. This documentation is referred to as the chain of custody form. Chain of custody begins at the time of sample collection. A sample is under custody if any of the following conditions apply:

- It is in the owner's actual possession,
- It is in the owner's view, after being in his/her physical possession,
- It was in the owner's possession and was locked or sealed it up to prevent tampering,
- It is in a secure area.

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part chain of custody form is used with each page of the form signed and dated by the recipient of a sample or portion of sample. The person releasing the sample and the person receiving the sample each will retain a copy of the chain of custody form each time a sample transfer occurs.

Preservation of the integrity of the samples collected during the site investigation will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report. Sample custody is described in Worksheet # 27.

The FOL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain of custody form. This form documents the

sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Field chain of custody requirements are provided in SOP-03. Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the laboratory SOP included in Appendix D.

Laboratory Chain of Custody

The Laboratory Sample Custody Procedures (Receipt of Samples, Archiving, and Disposal) documented in the selected laboratories SOPs will be followed. At a minimum, the following items will be included in the selected laboratories SOPs. Coolers will be received and checked for proper temperature. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain of custody will be checked against the sample containers for correctness. Samples will be logged into the laboratory information management system and given a unique log number which can be tracked through processing. The client will be notified of any problems.

.

SAP Worksheet #28 -- Laboratory QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix	Groundwater and aqueous field quality control samples
Analytical Group	VOCs (isopropylbenzene)
Analytical Method/ SOP Reference	SW-846 8260B/SOP-202

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No target compounds should be ≥1/2 the LOQ except common laboratory contaminants which should be < LOQ.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, then report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Supervisor and Data Validator	Bias / Contamination	Same as Method/SOP QC Acceptance Limits.
Surrogates	4 per sample	%Rs: Dibromofluoromethane 85-120 1,2-dichloroethane-d4 80-135 Toluene-d8 85-115 BFB 85-120	(1) Re-prepare and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Control Spike	One is performed for each batch of up to 20 samples.	The %R must be 80-120%.	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12 hour clock and acceptable, then narrate. If the Laboratory Control Sample (LCS) %Rs are high, but the sample results are <LOQ, then narrate. Otherwise, re-prepare and reanalyze the LCS and all associated samples.	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Groundwater and aqueous field quality control samples
Analytical Group	VOCs (isopropylbenzene)
Analytical Method/ SOP Reference	SW-846 8260B/SOP-202

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Internal Standards	Every field sample, standard, and QC sample - three per sample- Fluorobenzene Chlorobenzene-d5 1,4-dichlorobezene-d4	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each internal standard.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per sample delivery group (SDG) or every 20 samples.	The %R must be 80-120%.	CAs will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD %Rs are unacceptable, then re-prepare the samples and QC.	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias	Same as Method/SOP QC Acceptance Limits.

SAP Worksheet #29 -- Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Field Documents Field Logbook (and sampling notes) Field Sample Forms (e.g., boring logs, sample log sheets, drilling logs, etc.) Chain-of-Custody Records Sample Shipment Air Bills Equipment Calibration Logs Photographs Field Task Modification Forms This SAP HASP	Field documents will be maintained in the Tetra Tech project file, results will be discussed in the project report.
Laboratory Documents Sample Receipt, Custody, and Tracking Record Standards Traceability Logs Equipment Calibration Logs Sample Preparation Logs Analysis Run Logs Equipment Maintenance, Testing, and Inspection Logs CA Forms Reported Field Sample Results Reported Results for Standards, QC Checks, and QC Samples Sample Storage and Disposal Records Telephone Logs Extraction/Clean-up Records Raw Data Data Completeness Checklist	Laboratory documents will be included in the hardcopy and PDF deliverables from the laboratory. Laboratory data deliverables will be maintained in the Tetra Tech project file and in long-term data package storage at a third-party professional document storage firm. Electronic data results will be maintained in a database on a password protected Structured Query Language (SQL) server.
Assessment Findings Field Sampling Audit Checklist (if conducted) Analytical Audit Checklist (if conducted) Data Validation Memoranda (includes tabulated data summary forms)	All assessment documents will be maintained in the Tetra Tech project file.
Reports Quarterly Long-term Monitoring Reports	All versions of the reports and all support documents (e.g., Data Validation Reports) will be stored in hardcopy in the Tetra Tech project file and electronically in the server library.

SAP Worksheet #30 -- Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization
Aqueous	VOCs (isopropyl-benzene only)	See Worksheet #18	SW-846 8260B	21 Days	Empirical Laboratories, LLC 621 Mainstream Dr. Nashville, TN 37228 Kim Kostzer 615-345-1115	Not applicable

SAP Worksheet #31 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Person(s) Responsible for Performing Assessment** (title and organizational affiliation)	**Person(s) Responsible for Responding to Assessment Findings** (title and organizational affiliation)	**Person(s) Responsible for Identifying and Implementing CAs** (title and organizational affiliation)	**Person(s) Responsible for Monitoring Effectiveness of CA** (title and organizational affiliation)
Laboratory System Audit[1]	3 years	External	DoD ELAP	DoD ELAP Accrediting Body Auditor	Laboratory QA Manager or Laboratory Manager, Empirical	Laboratory QAM or Laboratory Manager, Empirical	Laboratory QAM or Laboratory Manager, Empirical
Field Sampling Systems Audit	One per contract year	Internal	Tetra Tech	Auditor, Tetra Tech	PM, Tetra Tech	Auditor and QAM, Tetra Tech	QAM, Tetra Tech

1 Empirical has successfully completed the laboratory evaluation process required as part of the DoD Quality Systems Manual (QSM). A copy of the DOD ELAP accreditation letter is included in Appendix E.

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field Sampling System Audit [1]	Audit checklist (as per Navy Installation Restoration Chemical Data Quality Manual [IRCDQM]) and written audit report	Rob Simcik, PM, Tetra Tech; Kara Wimble, FOL, Tetra Tech; John Trepanowski, Program Manager, Tetra Tech ; and Tom Johnston, QAM, Tetra Tech	Dependent on findings; if major, a stop work maybe issued immediately; however, if minor, within 1 week of audit	Written memo	Tom Johnston, QAM, Tetra Tech, or QAM Designee/Auditor Tetra Tech; and John Trepanowski, Program Manager, Tetra Tech	Within 48 hours of notification
Laboratory Systems Audit	Written audit report	Randy Ward, Laboratory QAM, Empirical	Not specified by DoD ELAP	Letter	DoD ELAP Accrediting Body	Specified by DoD ELAP Accrediting Body

1 Audits are scheduled at the Tetra Tech program level at a frequency of one per contract year and may or may not include this project.

SAP Worksheet #33 -- QA Management Reports Table

(UFP QAPP Manual Section 4.2)

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Data Validation Report	Per SDG	After validation is complete	DVM or designee, Tetra Tech	PM, Tetra Tech; project file
Major Analysis Problem Identification (Internal Memorandum)	When persistent analysis problems are detected	Immediately	QAM, Tetra Tech	PM, Tetra Tech; project file
Project Monthly Progress Report	Monthly for duration of the project	Monthly	PM, Tetra Tech	PM, Tetra Tech; QAM, Tetra Tech; Program Manager, Tetra Tech; project file
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately	Laboratory PM, Empirical	PM, Tetra Tech; project file

SAP Worksheet #34 -- Verification (Step I) Process Table

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-custody forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. See SOP SA-6.3	Internal	Sampler and FOL, Tetra Tech
SAP sample tables	Verify that all proposed samples listed in the SAP tables have been collected.	Internal	FOL or designee, Tetra Tech
Sample log sheets	Verify that information recorded in the log sheets is accurate and complete.	Internal	FOL or designee, Tetra Tech
Sample coordinates	Verify that sample locations are correct and in accordance with the SAP proposed locations.	Internal	FOL or designee, Tetra Tech
Field SOPs/Field logs/Sample collection	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and MPCs have been achieved. Particular attention should be given to verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented.	Internal	Tetra Tech PM or designee
Analytical SOPs	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied.	Internal	Laboratory QAM, Empirical
Documentation of method QC results	Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the laboratory will contact Tetra Tech for guidance prior to report preparation.	Internal	Laboratory QAM, Empirical

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Field QC Samples	Check that field QC samples listed in Worksheet #20 were collected as required.	Internal	Tetra Tech FOL or designee
Chain-of-custody forms	The Empirical and Microseeps Laboratory Sample Custodians will review the sample shipment for completeness, integrity, and sign accepting the shipment. The Tetra Tech Data Validators will check that the chain-of-custody form was signed/dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	Internal/ External	1 – Laboratory Sample Custodian, Empirical and 2 - Data Validators, Tetra Tech
Analytical data package	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM, Empirical
	The data package will be verified for completeness by Tetra Tech Data Validators. Missing information will be requested from the laboratory and validation will be suspended until missing data are received.	External	Data Validators, Tetra Tech
Electronic data deliverables	The electronic data will be verified against the chain-of-custody and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the method detection limit and the reporting limit will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the validation qualifier.	External	Data Validators, Tetra Tech

SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table

(UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Step IIa / IIb	Validation Input	Description	**Responsible for Validation** (name, organization)
IIa	Chain-of-custody	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded.	Project Chemist or Data Validators, Tetra Tech
IIa	Holding times	Review that the samples were shipped and store at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times listed in Worksheet #19.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Laboratory data results for accuracy	Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the measurement performance criteria listed in Worksheet #12 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Laboratory Duplicate Analyses for Precision	Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the methods and project MPC accuracy goals listed in Worksheet #12.	Tetra Tech Project Chemist or Data Validators
IIa/IIb	Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	PALs	Discuss the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as non-detected. Document this usability issue and inform the Tetra Tech PM.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	Data validation report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of the project database qualified data depicting data qualifiers and data qualifier codes that summarize the reason for data qualifications. Determine if the data met the MPC and determine the impact of any deviations on the technical usability of the data.	Project Chemist or Data Validators, Tetra Tech

Step IIa / IIb	Validation Input	Description	**Responsible for Validation** (name, organization)
IIa, IIb	SAP QC sample documentation	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	PM or designee, Tetra Tech
IIa, IIb	Documentation of analytical reports for completeness	Review the chain-of-custody form generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as per Worksheet #36. Check that all data have been transferred correctly and completely to the final SQL database.	Project Chemist or Data Validators, Tetra Tech
IIa/IIb	PALs	Review and add project action limits to the laboratory electronic data deliverable. Flag samples and notify Tetra Tech PM of samples that exceed project action limits as listed on Worksheet #15.	PM or designee, Tetra Tech
IIb	PQLs for sensitivity	Ensure that the project QLs listed in Worksheet #15 were achieved.	Project Chemist or Data Validators, Tetra Tech
IIb	Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results.	Project Chemist or Data Validators, Tetra Tech

SAP Worksheet #36 -- Validation Data Validation (Steps IIa and IIb) Summary Table

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa and IIb	Groundwater	VOC (isopropyl-benzene only)	Validation will be performed using criteria for SW-846 8260B listed in Worksheets #12, #15, #24, #25, and #28, and the DoD QSM. If not included in the aforementioned, the logic outlined in USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review USEPA-540/R-99-008, October 1999 will be used to apply qualifiers to data to the extent possible.	Tetra Tech Data Validation Specialist

SAP Worksheet #37 -- Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment
The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics: **Completeness** For each matrix that was scheduled to be sampled, the FOL, acting on behalf of the Project Team, will prepare a table listing planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified the Tetra Tech PM and Project Risk Assessor will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other Project Team members, as necessary (determined by the Navy RPM), to develop appropriate CAs. **Precision** The Project Chemist, acting on behalf of the Project Team, will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #12 and #28. This will also include a comparison of field and laboratory precision with the expectation that field duplicate results will be no less precise than laboratory duplicate results. If the goals are not met, or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report. **Accuracy** The Project Chemist, acting on behalf of the Project Team, will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries of LCS, LCS Duplicate, MS/MSD, and surrogate compounds to accuracy goals identified in Worksheet #28. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, matrix spike, and laboratory control samples. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report. **Representativeness** A Project Scientist, identified by the Tetra Tech PM and acting on behalf of the Project Team, will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with the SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required. Temporal concentration trends will be reviewed for anomalies that may indicate a lack of representativeness for a particular well or sampling round.

Comparability

The Project Chemist, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. In addition, temporal concentration trends will be reviewed for anomalies that may indicate a lack of comparability for a particular sampling round. This will not require quantitative comparisons unless professional judgment of the Project Chemist indicates that such quantitative analysis is required.

Sensitivity

The Project Chemist, acting on behalf of the Project Team, will determine whether project sensitivity goals listed in Worksheet #15 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described. The Project Chemist will enlist the help of the Project Risk Assessor to evaluate deviations from planned sensitivity goals. The project team will be especially sensitive to potential for sample-specific detection limits to be greater than the PAL and shall scrutinize these situations to determine whether attainment of project objectives is compromised if sensitivity goals are not achieved.

Project Assumptions and Data Outliers

The Tetra Tech PM and designated team members will evaluate whether project assumptions are valid. Statistical tests for outliers may be conducted at the discretion of the PM using standard statistical techniques appropriate for this task. Potential outliers will be removed if a review of the associated indicates that the results have an assignable cause the renders them inconsistent with the rest of the data. During this evaluation, the team will consider whether outliers could be indications of unanticipated site conditions. Consideration will be given to whether outliers represent an unanticipated site condition.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

After completion of the data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and simple statistical summaries will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The Project Team members identified by the Tetra Tech PM will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data. Although rejected data will generally not be used, there may be reason to use them in a weight of evidence argument, especially when they supplement data that have not been rejected. If rejected data are used, their use will be supported by technically defensible rationales.

For statistical comparisons and mathematical manipulations, non-detected values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate samples will be used to represent the concentration at a particular sampled location.

Identify the personnel responsible for performing the usability assessment:

The Tetra Tech PM, Project Chemist, FOL, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM, the USEPA RPM, and the FDEP RPM. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest re-sampling or other CAs, if necessary.

REFERENCES

CH2MHILL (CH2MHILL Constructors, Inc.), 2000. Source Removal Report, Underground Storage Tank Removal at Building 81. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. May.

Tetra Tech (Tetra Tech NUS, Inc.), 2000. Confirmatory Sampling Report for Building 81, A, B, & C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. September.

Tetra Tech, 2002. Site Assessment Report for Building 81 Tanks 81, A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. July.

Tetra Tech, 2003. Groundwater Monitoring Report, 1st Quarter, 1st Year (January 2003), Building 81, Tanks 81 A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. November.

Tetra Tech, 2005. Supplemental Site Assessment Letter Report, Building 81 A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. August.

Tetra Tech, 2007a. Site Assessment Report Addendum, Building 81 A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. May.

Tetra Tech, 2007b. Groundwater Monitoring Report, 1st Quarter, 2nd Year (February 2007), Building 81 A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. June.

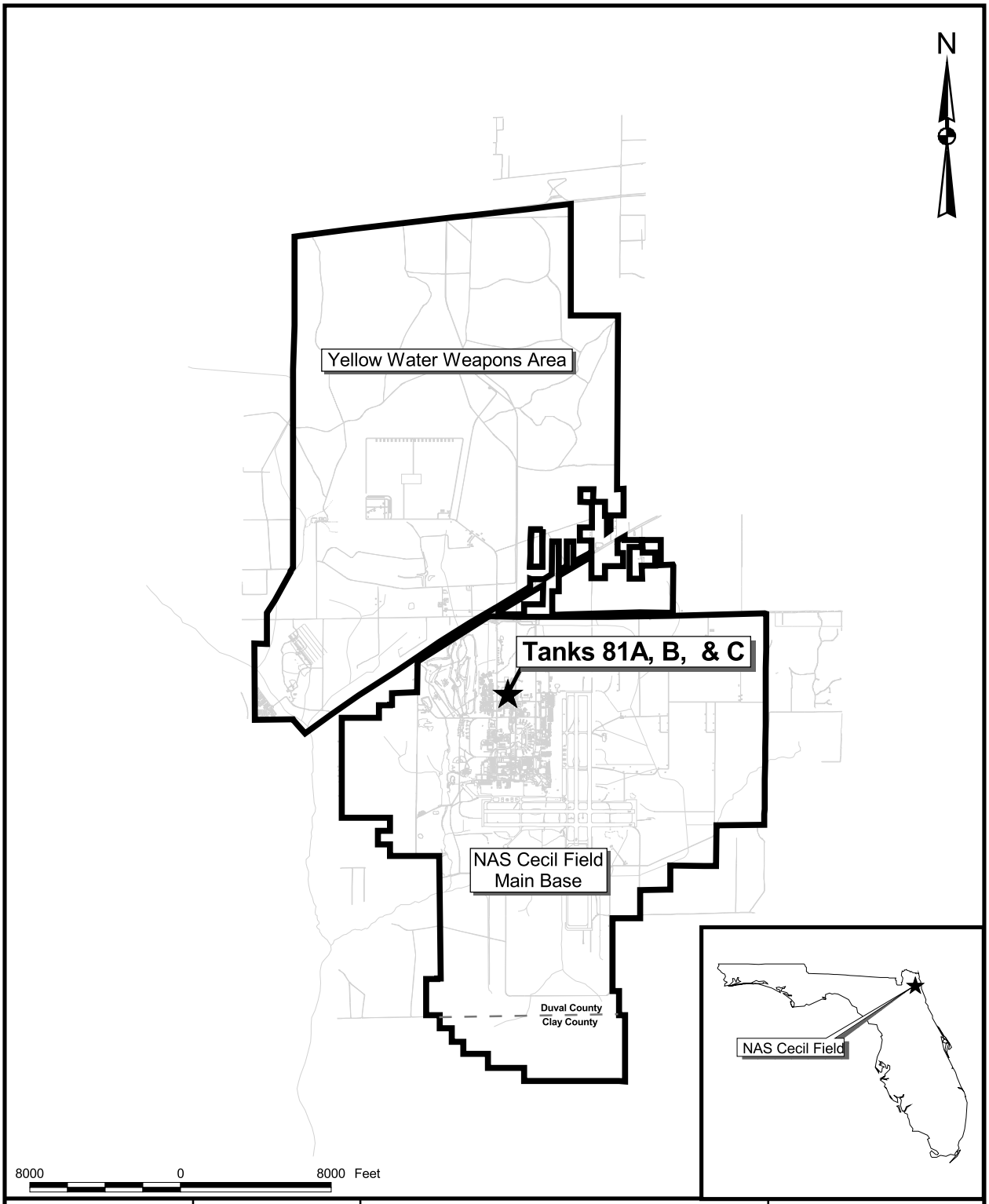
Tetra Tech, 2007c. Groundwater Monitoring Report, 2nd Quarter, 2nd Year (June 2007), Building 81 A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. September.

Tetra Tech, 2007d. Natural Attenuation Monitoring Plan, Building 81, Tanks A, B, and C. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. November.

Tetra Tech, 2007e. Cecil Field Land Use Controls Binder. Naval Air Station Cecil Field, Jacksonville, Florida. Prepared for Naval Facilities Engineering Command Southeast. November.

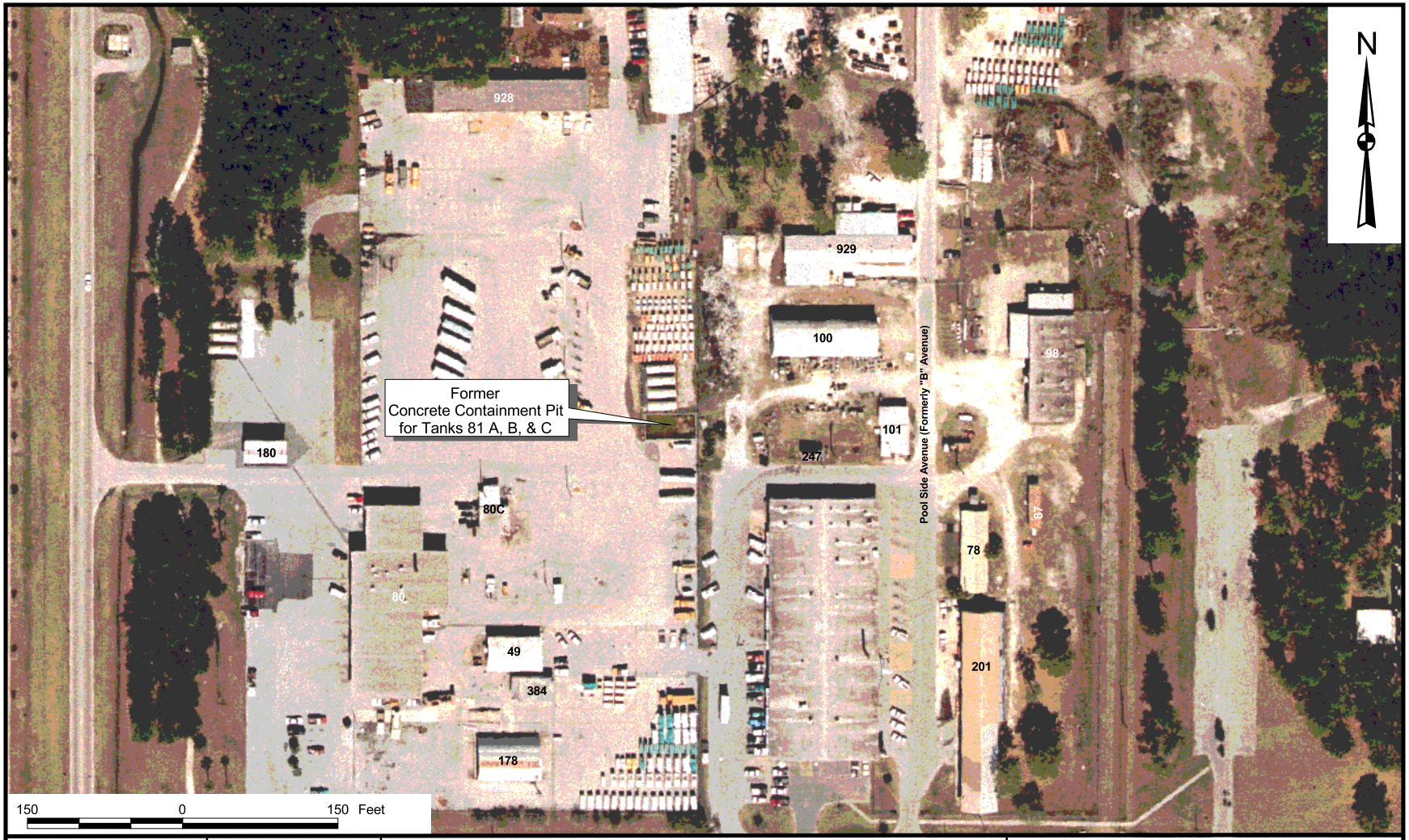
Tetra Tech, 2009. DPT Investigation Work Plan, Operable Unit 7, Site 16 and Building 81, Tanks 81A/B/C. Naval Air Station Cecil Field, Jacksonville, Florida. March.

FIGURES



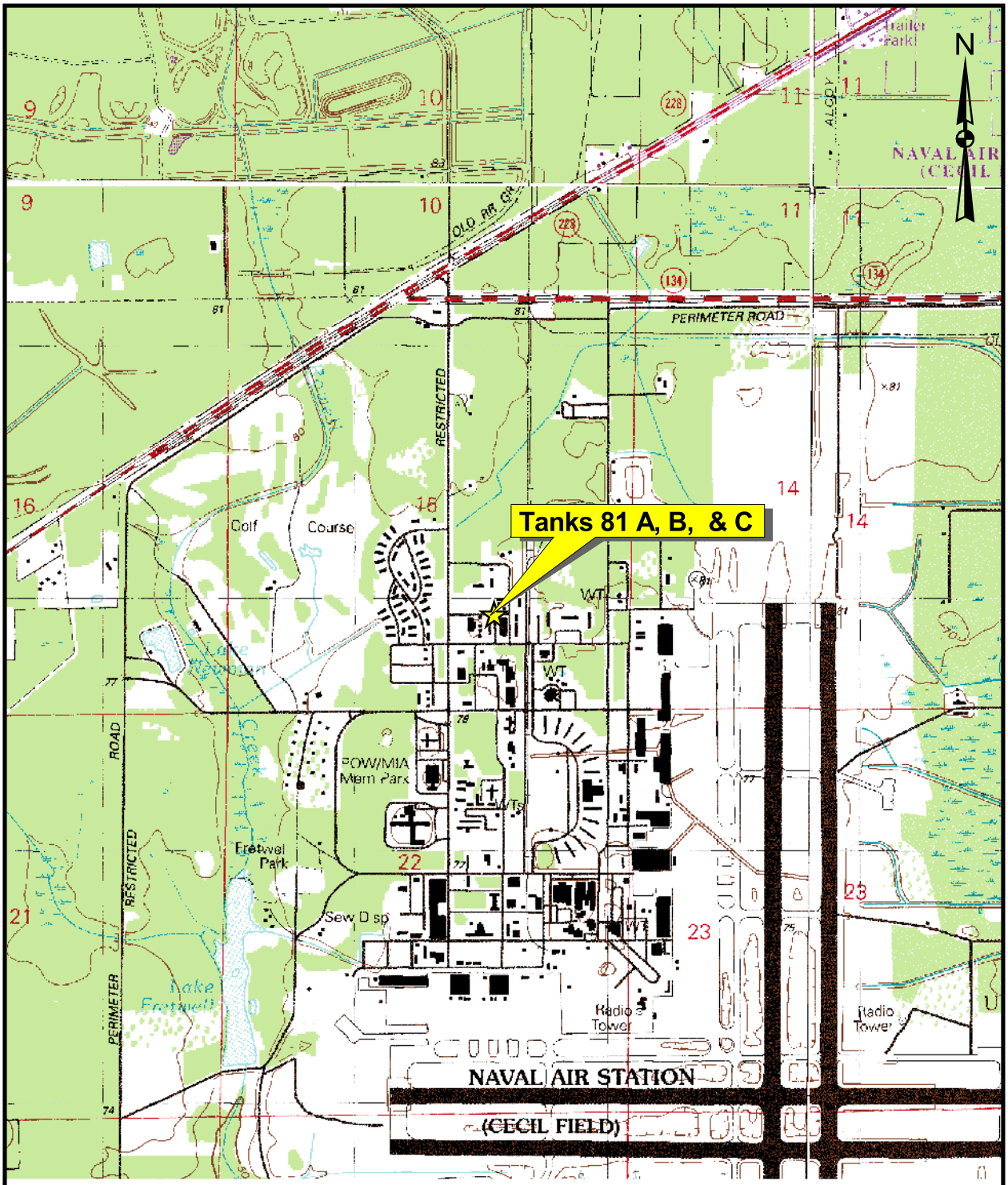
DRAWN BY MJJ	DATE 08Jan10	GENERAL LOCATION MAP TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 08Feb10 MJJ Layout01



DRAWN BY MJJ	DATE 08Jan10	FORMER LAND USE MAP TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 08Feb10 MJJ Layout10



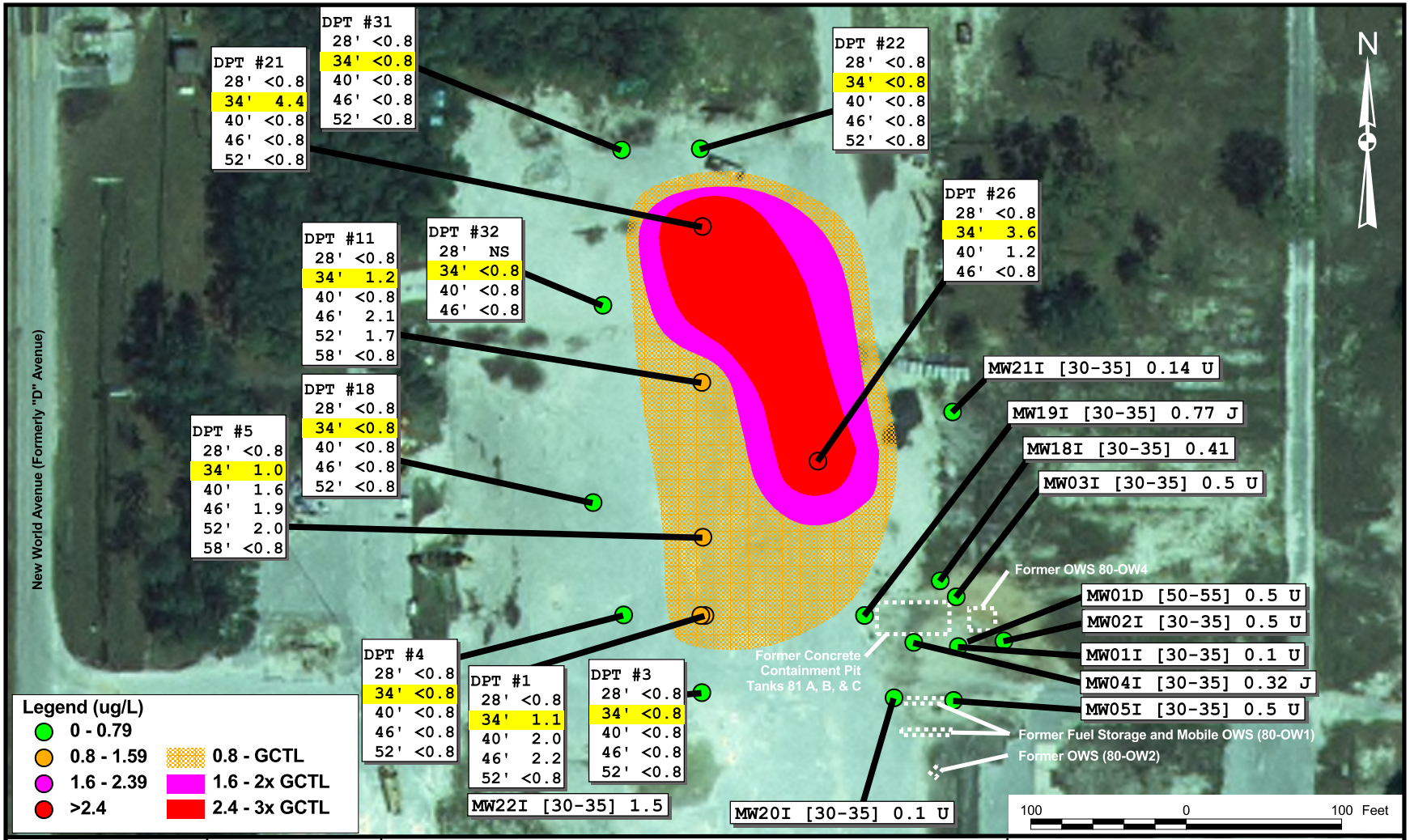
2000 0 2000 Feet

Source: USGS Fiftone Florida 7.5-Minute Topographic Quadrangle, 1993.

DRAWN BY MJJ	DATE 08Jan10	TOPOGRAPHIC MAP TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3 / REV 0

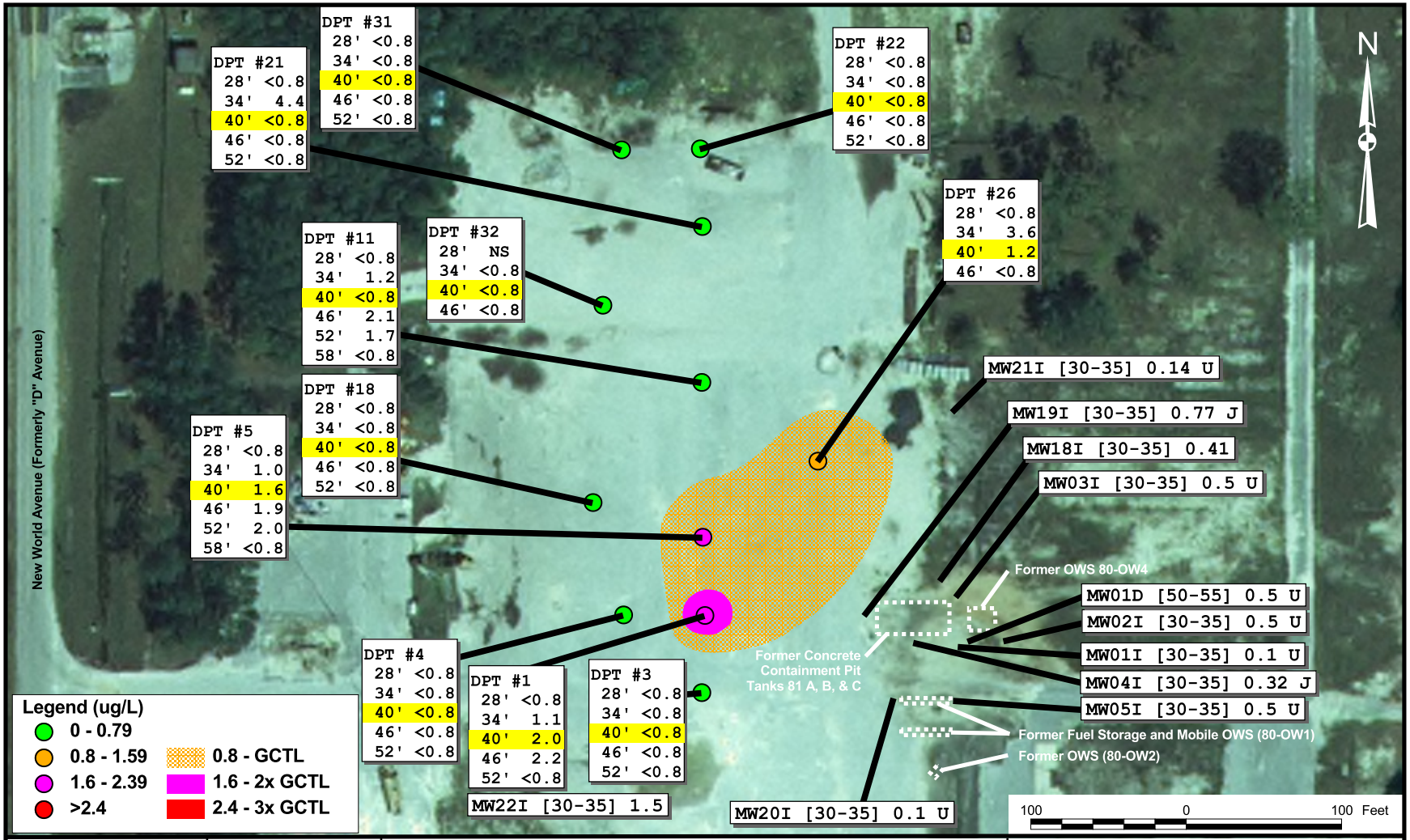
NAVFAC

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 08Feb10 MJJ Layout02



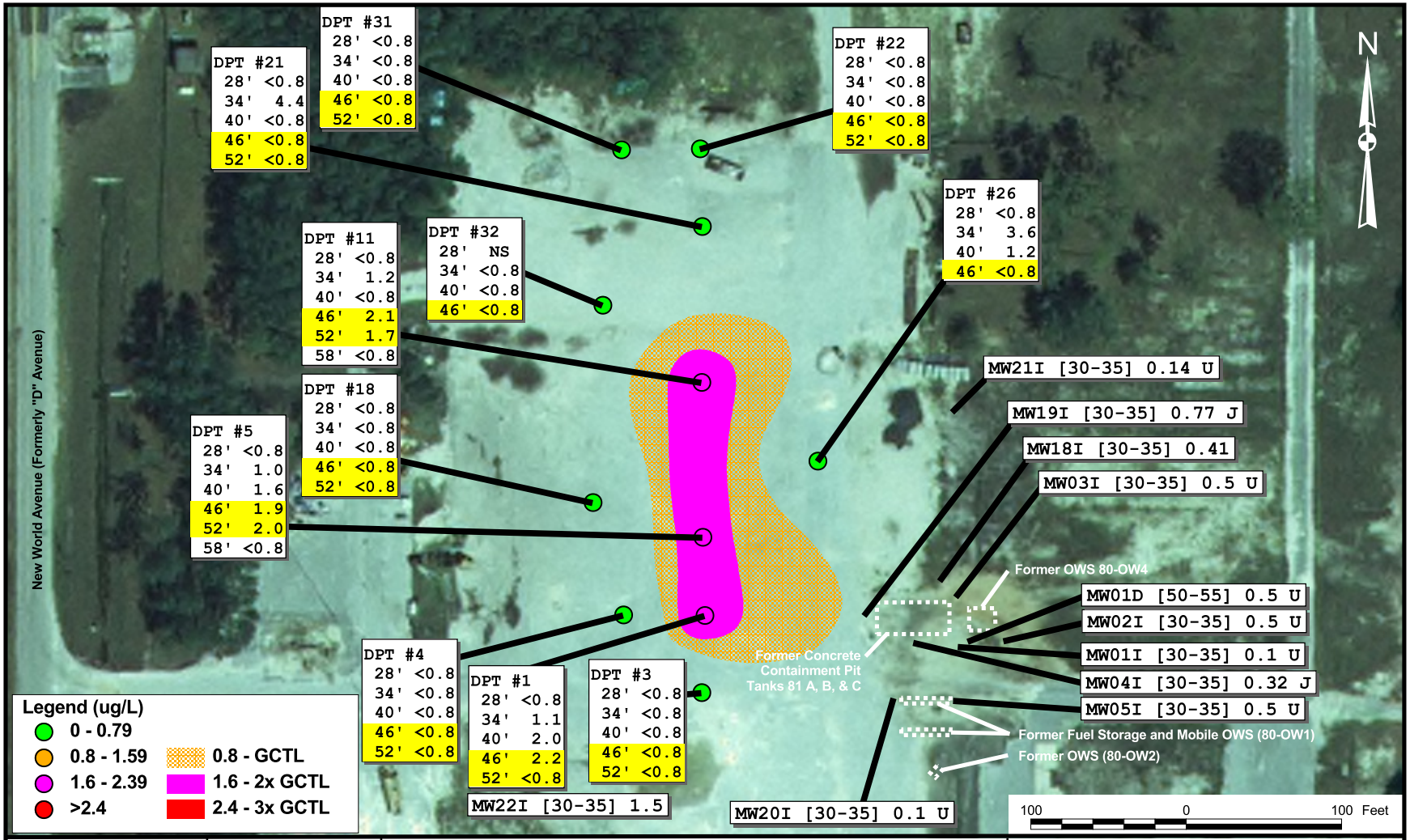
DRAWN BY MJJ	DATE 08Jan10	ISOPROPYLBENZENE CONOTURS (34' BGS) TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 25Feb10 MJJ Layout16



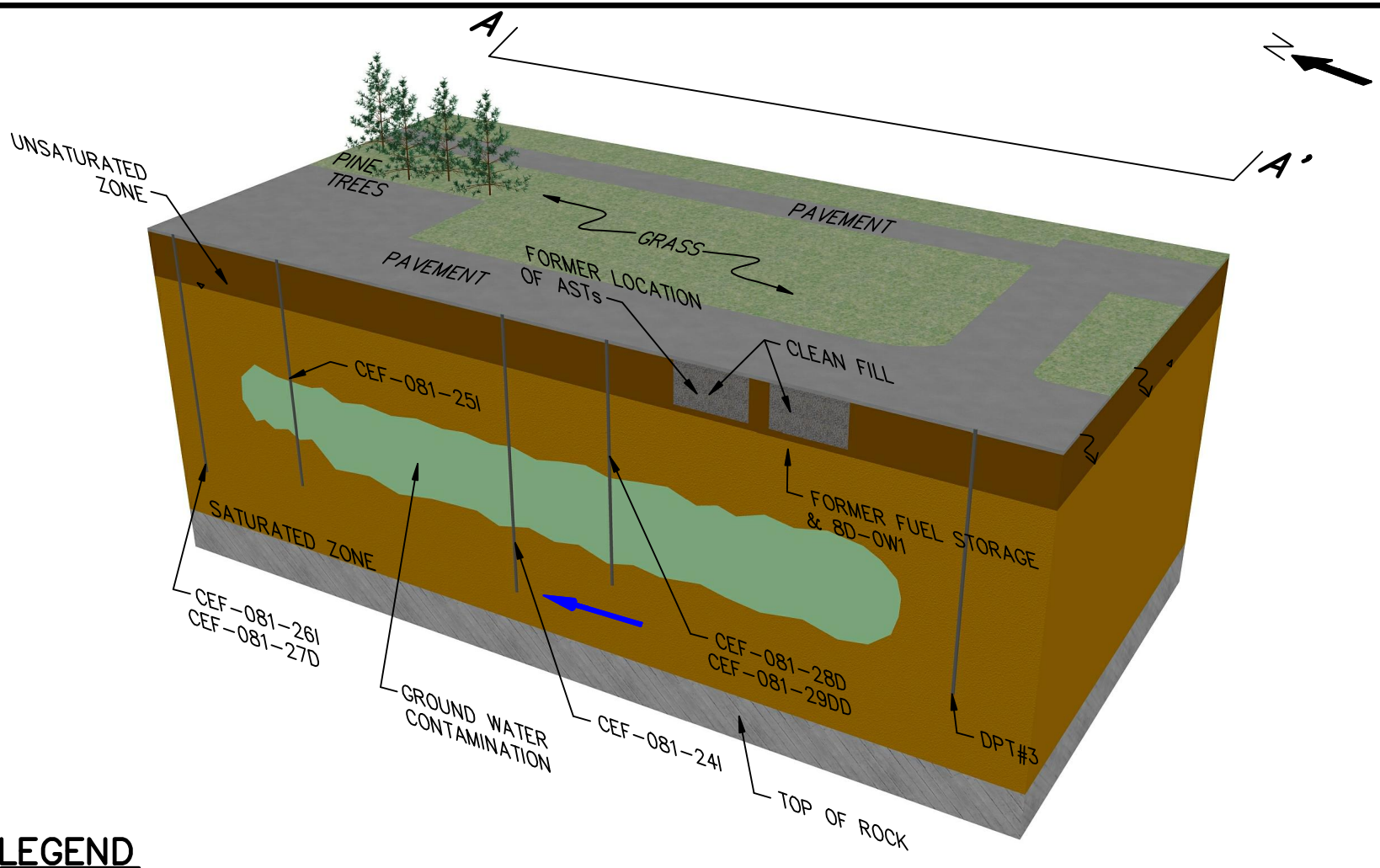
DRAWN BY MJJ	DATE 08Jan10	ISOPROPYLBENZENE CONOTURS (40' BGS) TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 5 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 25Feb10 MJJ Layout17



DRAWN BY MJJ	DATE 08Jan10	ISOPROPYLBENZENE CONOTURS (46' & 52' BGS) TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 2267
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED	NAVFAC		DRAWING NO. FIGURE 6 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 25Feb10 MJJ Layout18



LEGEND

RAINWATER INFILTRATION

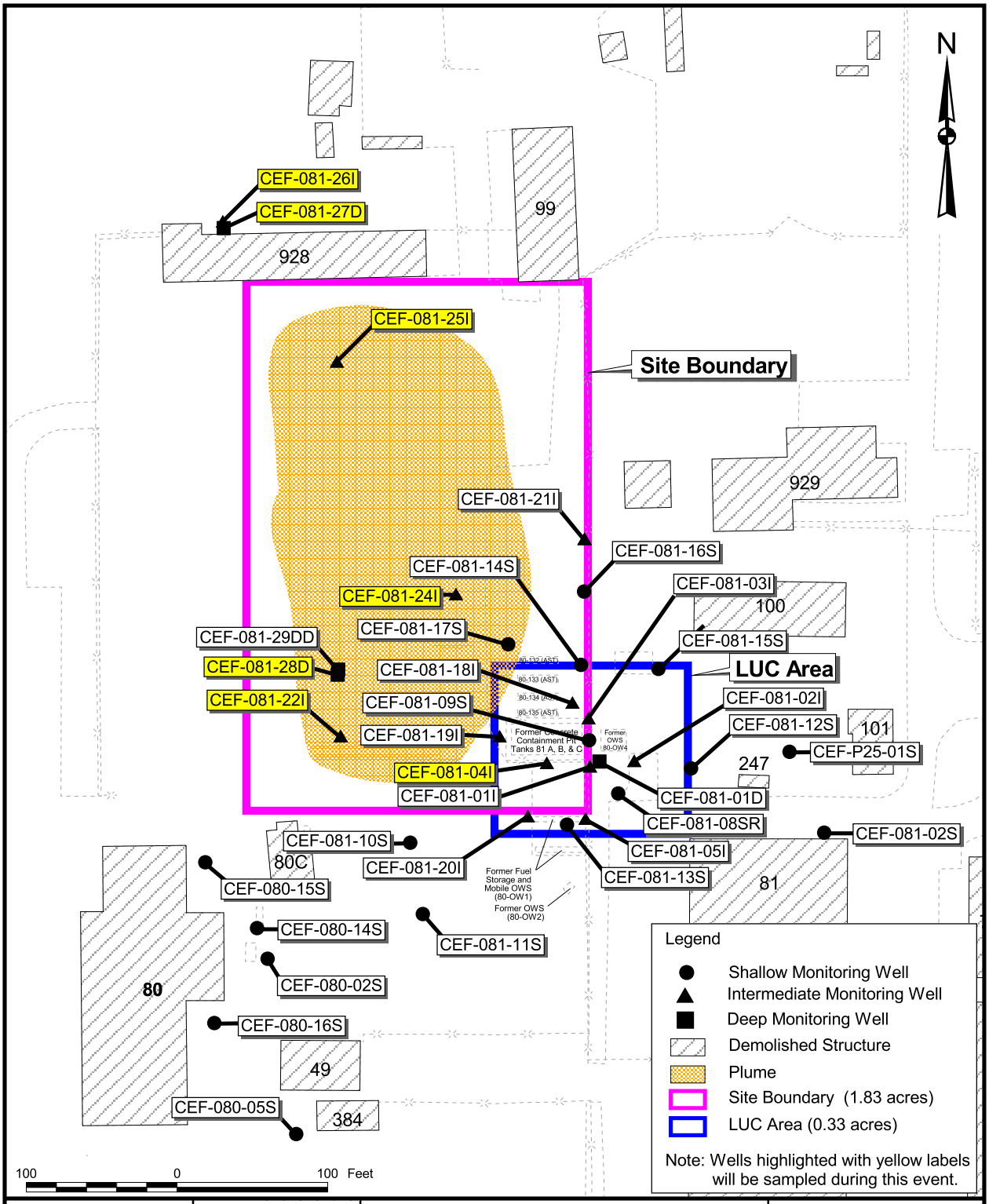
TOP OF WATER TABLE

DIRECTION OF GROUNDWATER

DRAWN BY SPC	DATE 1/14/10	CONCEPTUAL SITE MODEL TANKS 81A, B, & C NAS CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NO. 2267
CHECKED BY BP	DATE 1/14/10		OWNER NO.
REVISED BY ---	DATE ---		APPROVED BY --- / DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 7 / REV. 0

NAVFAC

R:\2267\CSM\2267CSM014.dwg PIT CARLY.KRAMER 2/22/2010 1:39:04 PM



DRAWN BY MJJ	DATE 08Jan10		CONTRACT NUMBER 2267
CHECKED BY	DATE	MONITORING WELL LOCATION MAP TANKS 81 A, B, & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 8 / REV 0

P:\GIS\NAS_CecilField\Tank_81abc_20100108.apr 25Feb10 MJJ Layout12

APPENDIX A

SUPPORTING DOCUMENTATION

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

October 20, 2000

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding Officer
Mr. Nick Ugolini, Code 1843
SOUTHNAVFACENGCOM
Post Office Box 190010
North Charleston, SC 29419-0068

RE: Confirmation Sampling Report, Building 81, Tanks 81 A, B & C, Naval Air Station Cecil Field, Florida.

Dear Mr. Ugolini:

I have completed the technical review of the Confirmation Sampling Report for Tanks 81 A, B & C, dated September 2000 (received October 4, 2000), prepared and submitted by Tetra Tech NUS. Based on the information supplied in the report, I cannot concur with the recommendation for No Further Action. Elevated OVA concentrations were detected mainly in soils collected just above the water table. While residential and leachability soil cleanup target levels were not exceeded in a soil sample collected from the location with the highest OVA concentration, I believe installing a monitoring well in the location most likely to have been impacted from petroleum products is warranted. It was also noted that Tanks 81 A, B and C were assessed, rather than Tank 81 as was written in the *Sampling and Analysis Plan for Site Assessment and Confirmatory Sampling at Various UST and AST Sites* (Tetra Tech, March 2000).

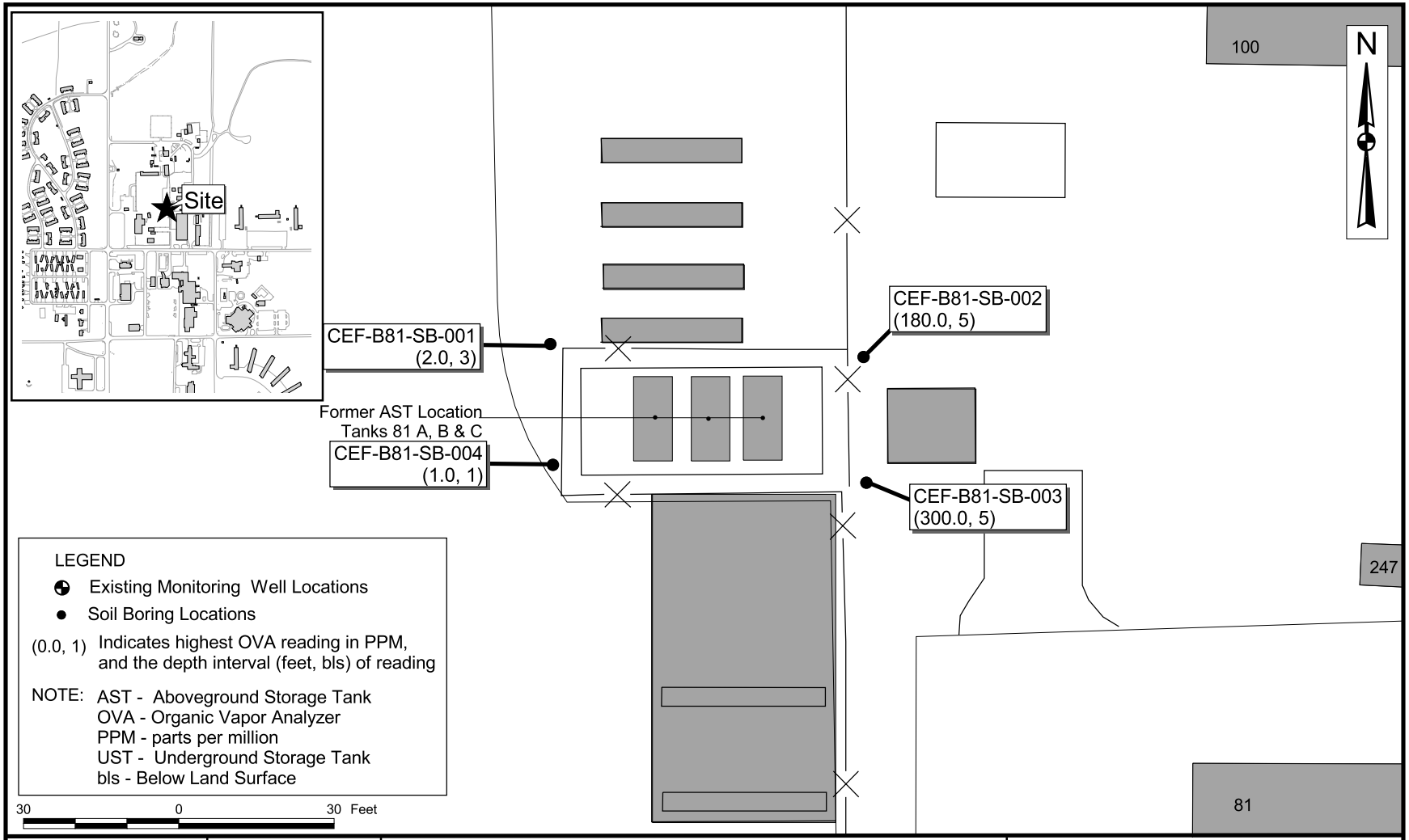
If you have any concerns regarding this letter, please contact me at (850) 488-3693.

Sincerely,

David P. Grabka
Remedial Project Manager

cc: Brian Cheary, FDEP Northeast District
Debbie Vaughn-Wright, USEPA - Atlanta
John Flowe, City of Jacksonville
Scott Glass, SOUTHNAVFACENGCOM
Joe Logan, TtNUS, Pittsburgh

TJB B JJC JJC ESN JJC



DRAWN BY MJJ	DATE 23Mar00	SOIL BORING LOCATIONS DATA CONFIRMATORY SAMPLING REPORT BUILDING 81, TANKS 81 A,B & C NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA	CONTRACT NUMBER 121
CHECKED BY	DATE		APPROVED BY DATE
COST/SCHEDULE-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-1 / REV 0

P:\GIS\CECIL\tank_81-1.apr 07Sept00 MJJ Layout1

APPENDIX B

DQO MEETING MINUTES

UFP SAP QAPP Project Team Kick-Off Meeting
Meeting Minutes

August 13, 2009

Attendance:

Art Sanford – BRAC PMO RPM
Ron Kotun – Tetra Tech DQO UFP Facilitator
Doyle Brittian – US EPA
Dave Grabka - FDEP
Rob Simcik – Tetra Tech NUS Project Manager (note taker)
Kara Wimble – Tetra Tech NUS Petroleum Lead
Mark Jonnet – Tetra Tech NUS EGIS
Mike Halil – CH2MHill RAC PM BCT Team Member

Additional Tetra Tech project team members not in attendance:
Joe Samchuck – Project Chemist
Megan Ritchie – IR Site SAP Lead

DQO Process Overview.
Ron provided an overview of the process and goals of today's presentation/discussion. Worksheets 10 and 11 will be reviewed for the 10 sites currently scoped for UFP (Uniform Federal Policy) SAPs (Sampling Analysis Plans).

Worksheet 10: Problem Definition
- Site Description and History
- History of Environmental Investigations and Actions
- Conceptual Site Model
- Potential Sources of Contamination
- Potential Contamination Migration Mechanisms
- Land Use and Problem Definitions
- Problem Definition

Worksheet 11: Identification of Study Goals
- Decision Statement
- Information Inputs
- Study Boundaries
- Analytic Approach
- Decision Rule
- Performance Criteria
- Plan for Sampling

There are five IR sites and five Petroleum sites scoped to have UPF SAPs prepared. The information for the worksheets 10 and 11 has been pulled together. Each site will be discussed.

It was identified that all of these sites are in long term monitoring programs and that the process for decision-making are already in place and the objective of this effort is to take the process that is working for Cecil field in put it in the UFP format. Doyle identified that the national guidance identified for QAPP is and has been followed. These procedures will now be put into the UFP format.

QAPP Discussion:

Petroleum Sites:

<u>Tank 81 a,b,c</u>
Problem Definition

- Contaminant plumes of isopropyl benzene are located northwest of the original site in the intermediate (30-35' bls) and deep (45-55' bls) zones of the aquifer.
- Long-term monitoring is necessary to ensure that the plume location is stable for an extended period of time.
- Once the plume location is stable, consistent data over a certain period of time is necessary to consider an RMO II award.

COCs

- Isopropyl benzene (cumene)
    - USEPA Method 8260
    - GCTL = 0.8 µg/L
    - NADC = 8.0 µg/L
    - PQL = 2.0 ug/L

Decision Statement

- Determine whether the groundwater COC concentration exceeds its GCTL and if the plume location is stable.
- If the COC exceeds its action level or the plume location moves as determined by compliance wells, the exceedence will be verified, and if confirmed to exceed then further delineation of the plume boundaries will be required.
- If the COC does not exceed its GCTL for 2 consecutive events in all wells being monitored, an NFA will be recommended.
- Typically if the COC incerased to mor than its Natural Attenuation Default Concentrations (NADC) remediation would be evaluated however because the isopropylbenzene GCTL is based on organoleptic concerns, it was identified that FDEP would be agreeable to continue groundwater monitoring even if its NADC was exceeded in source wells.

Decision Rule

- If the isopropyl benzene concentration is greater than its GCTL in non-compliance/source wells, long-term monitoring will continue.
- If any sign that concentration of isopropyl benzene is greater than its GCTL in the compliance wells, then additional delineation will be required.

- If any isopropyl benzene concentration exceeds the GCTL, but no migration is detected outside of the compliance wells for four consecutive monitoring events, then a permanent groundwater restriction can be considered (RMO II).
- If all concentrations of isopropyl benzene are below action levels for 2 consecutive quarters in all wells, then an NFA will be recommended.

Discussion on Boundary

- Wells to be included in sampling plan will be: CEF-81-04I; CEF-81-22I; CEF-81-24I; CEF-81-25I; CEF-81-26I; CEF-81-27D; and CEF-81-28D
- Delineation of the plume will continue as needed within the boundaries of the former NAS Cecil Field property.

<u>Hangar 815 Wash Rack</u>

Problem Definition

- Naphthalene groundwater contamination remains in the area of the former wash rack to the north of Building 815.
- Long-term monitoring verified no contaminant migration is occurring.
- The source of contamination is no longer contributing to the plume.

COCs

- Naphthalene
    - USEPA Method 8270
    - GCTL = 14 µg/L
    - NADC = 140 µg/L
    -

Decision Statement

- Determine whether the groundwater COC concentration exceeds its GCTL and if the plume location is stable.
- If the COC exceeds its action levels or the plume location moves as determined by compliance wells, then further delineation of the plume boundaries will be required
- If the COC does not exceed its GCTL for 2 consecutive events, then an NFA will be recommended.
- If the COC increases to above the NADCs, then in accordance with 62-770 rule, the well will be resample to verify the exceedance. Then there are 3 options: supplemental assessment (attempt to locate a previously undetected source), continue monitoring (with different concentrations as triggers), or pursue active remediation by submitting a RAP.

Decision Rule

- If the naphthalene concentration is greater than its GCTL in non-compliance/source wells, long-term monitoring will continue.
- If any sign that concentration of naphthalene is greater than the GCTL in the compliance wells, then additional delineation will be required.

- If any naphthalene concentration exceeds the GCTL, but no migration is detected outside of the compliance wells for four consecutive monitoring events, then a permanent groundwater restriction will be considered (RMO II).
- If all concentrations of naphthalene are below action levels for 2 consecutive quarters in all wells, then an NFA will be recommended.

<u>North South Apron Plume (NSAP)</u>

Problem Definition

- Benzene groundwater contamination remains in the area of the North-South Apron Site. Concentrations exceed FDEP GCTLs.
- Long-term monitoring verified no contaminant migration is occurring.
- Source of contamination is unknown and the plume appears to be contained.
- Frequency of groundwater monitoring is semi-annual

COCs

- Benzene
    - USEPA Method 8260
    - GCTL = 1 µg/L
    - NADC = 100 µg/L

Decision Statement

- Determine whether the groundwater COC concentration exceeds its GCTL and if the plume location is stable.
- If the COC exceeds action levels or the plume location moves as determined by compliance wells, further delineation of the plume boundaries will be required
- If the COC does not exceed its GCTL for 2 consecutive events, an NFA will be recommended.
- If the COC increases to above the NADCs, then in accordance with 62-770 rule, the well will be resample to verify the exceedance. Then there are 3 options: supplemental assessment (attempt to locate a previously undetected source), continue monitoring (with different concentrations as triggers), or pursue active remediation by submitting a RAP.

Decision Rule

- If the benzene concentration is greater than the GCTLs in non-compliance/source wells, long-term monitoring will continue.
- If any sign that concentration of benzene is greater than the GCTL in the compliance well, then additional delineation will be required.
- If any benzene concentration exceeds the GCTL, but no migration is detected outside of the compliance wells for four consecutive quarters, then a permanent groundwater restriction will be considered (RMO III).
- If all concentrations of benzene are below action levels for 2 consecutive quarters in all wells, then an NFA will be recommended.

Tank G82

Problem Definition

- Contaminant concentrations in source area wells (CEF-G82-2S) exceed action levels.
- There is still soil contamination remaining at this site that exceeds leachability. This impacted soil was not accessible for removal due to proximity to Building 82 and is now capped with concrete handicap ramp.

Concentrations of the following contaminants exceeded their respective GCTLs at the site:

- Benzene
- naphthalene
- isopropyl benzene
- 1,2,4-trimethylbenzene
- 1-methylnaphthalene
- and 2-methylnaphthlene

COCs

COCs	**Method**	**GCTLs (µg/L)**	**NADCs (µg/L)**
Benzene	EPA 8260	1	100
Naphthalene	EPA 8270	14	140
Isopropyl benzene PQL = 2.0 µg/L	EPA 8260	0.8	8
1,2,4-Trimethylbenzene	EPA 8260	10	100
1-Methylnaphthalene	EPA 8270	28	280
2-Methylnaphthalene	EPA 8270	28	280

Decision Statement

- Determine whether groundwater COC concentrations exceed their respective GCTLS and if the plume location is stable.
- If COCs exceed action levels in the compliance wells, further delineation of the plume boundaries will be required
- If COCs do not exceed GCTLs for 2 consecutive events, an NFA will be recommended
- If the COC increases to above the NADCs, then in accordance with 62-770 rule, the well will be resample to verify the exceedance. Then there are 3 options: supplemental assessment (attempt to locate a previously undetected source), continue monitoring (with different concentrations as triggers), or pursue active remediation by submitting a RAP.

Decision Rule

- If any COC concentrations are greater than the GCTLs in the source wells, long-term monitoring will continue.
- If any sign that any COC concentrations are greater than their respective GCTLs in the compliance wells, then additional delineation will be required.
- If COC concentrations exceed the GCTLs, but no migration is detected outside of the compliance wells for four consecutive quarters, then a permanent groundwater restriction will be considered (RMO III).
- If all COC concentrations are below action levels for 2 consecutive quarters in all wells, then an NFA will be recommended.

<u>BP Wells</u>

Problem Definition

- The COCs exceeded their action levels (GCTLs and NADCs)
- Contaminant concentrations appear to be increasing and migrating downgradient.
- The current downgradient well (CEF-BP-6S) exceeded the GCTL from July 2008 to July 2009 and has not shown GCTL exceedances prior to July 2008.

COCs

COC	**Method**	**GCTL (µg/L)**	**NADC (µg/L)**
Ethylbenzene	EPA 8260	30	300
2-Methylnaphthalene	EPA 8270	28	280
Isopropyl benzene PQL = 2 µg/L	EPA 8260	0.8	8
Naphthalene	EPA 8270	14	140
1,2,4-Trimethylbenzene	EPA 8260	10	100
1,3,5-Trimethylbenzene	EPA 8260	10	100
Total Xylenes	EPA 8260	20	200

Decision Statement

- Determine whether groundwater COC concentrations exceed action levels (GCTLs and NADCs) and if the plume location is stable.
- If COCs exceed action levels or the plume location moves as determined by compliance wells, further delineation of the plume boundaries will be required.
- Currently at the point of verifying the exceedance at the compliance well.
- If COCs do not exceed GCTLs for 2 consecutive events, an NFA will be recommended

- If the COC increases to above the NADCs, then in accordance with 62-770 rule, the well will be resample to verify the exceedance. Then there are 3 options: supplemental assessment (attempt to locate a previously undetected source), continue monitoring (with different concentrations as triggers), or pursue active remediation by submitting a RAP.
- If COCs are between GCTLs and NADCs in the source wells, then a Monitoring Only Plan will be developed.

Decision Rule

- If any COC concentrations are greater than the GCTLs in the source wells, long-term monitoring will continue;
- If any sign that any COC concentrations are greater than its GCTL in the compliance well, then additional delineation will be required.
- If COC concentration exceed the GCTLs, but no migration is detected outside of the compliance wells for four consecutive quarters, then a permanent groundwater restriction will be considered (RMO III).
- If all COC concentrations are below action levels for 2 consecutive quarters in all wells, then an NFA will be recommended.
- If COCs are between GCTLs and NADCs in the source wells, then a Monitored Natural Attenuation Plan will be developed.

Installation Restoration (IR) Sites:

<u>Site 1&2 - Old Landfill and Recent Landfill</u>

Problem Definition

- Land use controls have been implemented to prevent the disturbance of the landfill area, the Site 2 tributary, Rowell Creek, and the site's adjacent wetlands.
- The selected remedial alternative allows contaminants to remain on site.
- A detailed evaluation of the site is conducted every 5 years. Annual monitoring is conducted to verify contaminants do not migrate off site in the interim.

Decision Statements

- Determine whether the landfills are adversely impacting the surface water and/or sediments of Rowell Creek. If the surface water and/or sediments of Rowell Creek are not adversely impacted then monitoring will continue as identified in the monitoring plan. If the surface water and/or sediments in Rowell Creek are adversely impacted then additional actions will be evaluated.

Surface Water Inputs (Annual Events)

- Collect SW samples from 3 locations; RR-08, RR-10, and RR-17.
- Analyze for aluminum, cadmium, chromium, copper, cyanide, iron, lead, manganese, vanadium, and zinc by SW-846 6010B.
- Compare SW results to:
  - -EPA Region 4 Surface Water Screening Levels
  - -Florida Surface Water Quality Standards
  - -EPA Tier II value

-IBDS values

Surface Water Inputs (5-Year Event)

- Collect SW samples from 11 locations; RR-01, RR-02, RR-03, RR-04, RR-07, RR-08, RR-09, RR-10, RR-11, RR-14, and RR-17.
- Analyze for 4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin, Endrin, Chlordane, gamma-Chlordane, gamma-BHC (Lindane), and Toxaphene by SW-846 8081.
- Analyze for Aroclor-1254 and Aroclor-1260 by SW-846 8082.
- Analyze for Arsenic, Barium, Cadmium, Chromium, Copper, Iron, Lead, and Zinc by SW-846 6010B.
- Compare SW results to the same action levels as the annual event.

Sediment Inputs (Annual Event)

- Collect sediment samples from 3 locations; RR-08, RR-10, and RR-17.
- Analyze for acetone by SW-846 8260B.
- Analyze for PAHs by SW-846 8270C.
- Analyze for 4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin, Endrin, Chlordane, gamma-Chlordane, gamma-BHC (Lindane), and Toxaphene by SW-846 8081.
- Analyze for Aroclor-1254 and Aroclor-1260 by SW-846 8082.
- Analyze for Arsenic, Barium, Cadmium, Chromium, Copper, Iron, Lead, and Zinc by SW-846 6010B.
- Compare sediment results to:

-EPA Region 4 Sediment Screening Levels --Sediment Quality in Florida Coastal Groundwater (every five years)

-ORNL Screening Levels

-IBDS Values

-EPA Sediment Quality Benchmarks

Sediment Inputs (5- Year Event)

- Collect sediment samples from 11 locations; RR-01, RR-02, RR-03, RR-04, RR-07, RR-08, RR-09, RR-10, RR-11, RR-14, and RR-17.
- Analyze for the same analytes as the annual monitoring.
- Compare sediment results to the same action levels as the annual event.

Decision Rules

- If the surface water and/or sediment concentration in the compliance points of Rowell Creek are less than or equal to the action level (as identified above), the monitoring will continue on an annual or five-year basis.
- If the surface water and/or sediment concentration in the compliance points of Rowell Creek is greater than or equal to the action level (as identified above), then resampling will be conducted to verify the exceedance. If the exceedences are verified then appropriate actions may be taken to mitigate adverse impact on Rowell Creek and downgradient receptors.

<u>Site 32 – Hazardous Material Warehouse Storage Area</u>

Problem Definition

- PAHs, 4-methylphenol, and metals contamination remains in the paved area soil. Contaminants of concern are limited to only those which exceed leachability

which includes 4-methylphenol and specific metals (antimony, arsenic, barium, cadmium, lead, nickel, selenium, and vanadium).
- Concentrations of contaminants in soil exceed leachability FDEP SCTLs.
- Exposure to contaminants is limited by the asphalt cap.
- Long-term monitoring will consist of the periodic collection and analysis of groundwater samples to verify that no soil contaminant migration to groundwater is occurring.

Decision Statement
- Determine if contaminated soil beneath the asphalt parking lot is impacting groundwater.
- If COCs in groundwater exceed action levels, then soil contaminant migration to groundwater may be occurring, so the BCT will determine the next course of action to delineate the impact or mitigate the contamination.
- If COCs are below action levels, no action is required, so groundwater monitoring will continue on a five-year basis as outlined in the ROD.

Inputs to the Decision
- Collect groundwater samples from onsite monitoring well CEF-1032-01 and down gradient monitoring well CEF-1033-02.
- In accordance with the FTMR the analyze was revised 4-Methylphenol by SW-846 Method 8270C and seleced metals (antimony, arsenic, barium, cadmium, lead, nickel, selenium, and vanadium by SW-846 Method 6010B).
- Compare results to FDEP GCTLs and IBDS.

Decision Rules
- If any COC concentration in groundwater exceeds the greater of the IBDS or FDEP GCTL, then soil contaminant migration to groundwater may be occurring, so the BCT will determine the next course of action to delineate the impact or mitigate the contamination.
- If all COC concentrations are below the greater of the IBDS or FDEP GCTL, no action will be taken and groundwater monitoring will continue on a five-year basis.

<u>Site 45 - Steam Generating Plant</u>

Problem Definition
- Long-term monitoring will consist of the periodic collection and analysis groundwater samples in downgradient wells to verify that no contaminant migration is occurring either from soil to groundwater or within the surficial aquifer. Long-term monitoring will be used to assess natural attenuation of groundwater contamination.
- Soil needs to be identified.

Decision Statements
- Determine whether vanadium concentrations in source area groundwater exceed action levels. If > AL, then resample in 5 years. If ≤ AL, then follow up with confirmatory sample one year later. If confirmatory sample is ≤ AL, then pursue

NFA. If confirmatory sample is > AL, then continue monitoring on the 5-year schedule.

- Determine whether vanadium concentrations in downgradient groundwater exceed action levels. If > AL, confirm exceedance. If confirmatory sample is > AL, delineate. If ≤ AL, continue with annual monitoring.

Groundwater Inputs

- Collect groundwater samples every 5 years from onsite monitoring wells CEF-007-01SA, CEF-F11-01SA, CEF-P45-02S, CEF-P45-03S, and CEF-P45-04S.
- Collect groundwater samples annually from five down gradient monitoring wells CEF-P45-06S, CEF-P45-12S, CEF-F11-02SB, CEF-P45-08S, and CEF-P45-13S.
- Analyze for vanadium by SW-846 Method 6010B.
- Compare groundwater vanadium results to FDEP GCTL of 49 µg/L.

Decision Rules [rework these to reflect decision statement]

- If any groundwater vanadium concentration from a source area well is > the FDEP GTCL action level of 49 micrograms per liter (µg/L), groundwater monitoring will continue on a five-year basis. If all source area groundwater vanadium concentrations are ≤ the AL then follow up with confirmatory sample one year later. If confirmatory sample is ≤ AL, then pursue NFA. If confirmatory sample is > AL, then continue monitoring on the 5-year schedule.

- If any groundwater vanadium concentration from a down gradient well is > the FDEP GTCL action level of 49 micrograms per liter (µg/L), confirm exceedance. If confirmatory sample is > AL, delineate. If all down gradient groundwater vanadium concentrations are ≤ the AL, continue with annual monitoring.

<u>Site 36/37 – Control Tower TCE Plume and Hangars 13 and 14 DCE Plume</u>

Problem Definition

- Investigations indicated the presence of groundwater contamination from past operating practices. This contamination could pose an unacceptable human health risk if the groundwater was used as a potable water source. Potential migration of contaminated groundwater to surface drainage ditches and, eventually to Sal Taylor Creek could also cause adverse effects on aquatic organisms.

- Based on data from the first 8 years of groundwater monitoring, the following is recommended:
    - Hot Spot 1 –Semi-annual monitoring program, including the monitoring to determine if concentrations remain less than system action levels.
    - Hot Spot 2 – Continuation of the offline status of the AS system to evaluate rebound. Continuation of monitoring with an emphasis on the deep downgradient wells due to increasing trends in benzene and TCE concentrations.
    - Hot Spot 3 - The modified AS system will be returned to operation and will include a deeper sparging component. When the new AS system is operational source area wells and new wells will be sampled quarterly.

Decision Statement

- Determine whether Hot Spot 1 groundwater COC concentrations exceed remedial action levels (RALs). If concentrations are greater than RALs, then install/operate an AS system. If they are less than or equal to the RAL, continue monitoring. The RALs for benzene and TCE needs to be included.
- Determine whether Hot Spots 2 and 3 groundwater COC concentrations exceed RALs. If concentrations are greater than RALs, then continue operating the AS system. If they are less than or equal to the RALs, turn off the system and continue PARM for one year. If PARM concentrations are greater than RALS, the turn AS back on. If PARM concentrations are less than or equal to RALs, monitor for natural attenuation.
- Determine whether COC concentrations in groundwater exceed GCTLs. If concentrations in gw monitoring wells in the LTM program at Site 36/37 are less than or equal to GCTLs for 2 consecutive monitoring events, then pursue NFA. If they are greater than GCTLs, continue monitoring.
- Determine whether the contaminant plumes are migrating. If concentrations in sentinel wells less than or equal to GCTLs, then continue monitoring. If concentrations in sentinel well are greater than GCTLs, further delineate the plume.

Inputs to the Decision

- Collect groundwater samples from shallow, intermediate, and deep zones (see map).
- Analyze for COCs (see list) by SW-846 Methods.
- Analyze for TRPH by FL-PRO.
- Analyze for NA parameters by various methods.
- Compare results to RALs for benzene (1,000 µg/L) and TCE (100 µg/L).
- Compare results to FDEP GCTLs for all other organics.
- Compare results to IBDS values for Fe and Mn.

Contaminants of Concern

VOCs by SW-846 8260B

- BTEX
- PCE
- 1,1,2- TCA
- TCE
- 1,2- DCA
- 1,1-DCA
- 1,1-DCE
- cis-1,2-DCE
- VC

SVOCs by SW-846 8270C

- Naphthalene
- 1-Methylnaphthalene
- 2-Methylnaphthalene
- 2-Methylphenol
- 3-Methylphenol

- 4-Methylphenol

Metals by SW-846 6010B
- Fe
- Mn

Additional Parameters
- TRPH
- NA Parameters including:
  alkalinity
  chloride
  dissolved iron
  methane/ethane/ethene
  nitrate
  nitrite
  orthophosphate
  sulfate
  dissolved sulfide
  TOC
- Field tests including:
  pH
  specific conductance
  temperature
  turbidity
  DO
  hydrogen sulfide
  sulfide
  carbon dioxide
  ferrous iron
  ORP
  alkalinity

Decision Rules
- If Hot Spot 1 groundwater COC concentrations > RALs, then install/operate an AS system. If they are ≤ RAL, continue monitoring.

- If Hot Spots 2 and 3 groundwater COC concentrations > RALs, then continue operating the AS system. If they are ≤ RALs, turn off the system and continue PARM for one year. If PARM concentrations are > RALS, the turn AS back on. If PARM concentrations are ≤ RALs, monitor for natural attenuation.

- If concentrations in groundwater monitoring wells in the LTM program at Site 36/37 are ≤ GCTLs for 2 consecutive monitoring events, then pursue NFA. If they are > GCTLs, continue monitoring.

- If concentrations in sentinel wells ≤ GCTLs, then continue monitoring. If concentrations in sentinel well are > GCTLs, further delineate the plume.

Site 59 – Building 324/Hangar 1845

Problem Definition

- Investigations indicated groundwater contains TCE at concentrations greater than the FDEP GCTL and EPA MCL from past operating practices. This contamination could pose an unacceptable human health risk if the groundwater was used as a potable water source. Potential migration of contaminated groundwater could occur.
- Monitoring will consist of regularly collecting and analyzing groundwater samples from within and downgradient of the TCE Plumes and TCE Hot Spots to assess the performance of in-situ biological treatment and natural attenuation and to evaluate potential TCE migration.
- Active remediation is being conducted at locations which exceed the NADC for TCE (300 ug/L) This value is established as the RAL.

Decision Statement

- Determine whether COC concentrations in groundwater exceed GCTLs. If concentrations in gw monitoring wells in the LTM program at Site 59 are less than or equal to GCTLs for 2 consecutive monitoring events, then pursue NFA. If they are greater than GCTLs, continue monitoring.
- Determine whether the contaminant plumes are migrating. If concentrations in sentinel wells less than or equal to GCTLs, then continue monitoring. If concentrations in sentinel well are greater than GCTLs, further delineate the plume.

Inputs to the Decision

- Collect groundwater samples from site monitoring wells.
- Analyze all samples for COCs by SW-846 8260B.
- Analyze select wells for NA parameters by various methods.
- Compare TCE results to FDEP GCTL of 3 µg/L and degradation products to FDEP GCTLs.

Contaminants of Concern

VOCs by SW-846 8260B

- TCE
- cis-1,2-DCE
- trans-1,2-DCE
- VC

NA Parameters including:

alkalinity
chloride
dissolved iron and sodium
methane/ethane/ethene
sulfate
dissolved sulfide
TOC

Metabolic Acids

Decision Rules

- If concentrations in groundwater monitoring wells in the LTM program at Site 59 are ≤ GCTLs for 2 consecutive monitoring events, then pursue NFA. If they are > GCTLs, continue monitoring.

- If concentrations in sentinel wells ≤ GCTLs, then continue monitoring. If concentrations in sentinel well are > GCTLs, further delineate the plume.

APPENDIX C

FIELD STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **2**

5.0 PROCEDURES **2**

5.1 INTRODUCTION 2
5.2 SAMPLE IDENTIFICATION FIELD REQUIREMENTS 3
5.3 EXAMPLE SAMPLE FIELD DESIGNATIONS 4
5.4 EXAMPLES OF SAMPLE NOMENCLATURE 5
5.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SAMPLE NOMENCLATURE) 6
5.6 EXAMPLES OF FIELD QA/QC SAMPLE NOMENCLATURE 6

6.0 DEVIATIONS **6**

1.0 PURPOSE

The purpose of this document is to specify a consistent sample nomenclature system that will facilitate subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix.
- Sorting of data by depth.
- Maintenance of consistency (field, laboratory, and data base sample numbers).
- Accommodation of all project-specific requirements.
- Accommodation of laboratory sample number length constraints (maximum of 20 characters).

2.0 SCOPE

The methods described in this procedure shall be used consistently for all projects requiring electronic data.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Program Manager - It shall be the responsibility of the Program Manager (or designee) to inform contract-specific Project Managers of the existence and requirements of this Standard Operating Procedure.

Project Manager - It shall be the responsibility of the Project Manager to determine the applicability of this Standard Operating Procedure based on: (1) program-specific requirements, and (2) project size and objectives. It shall be the responsibility of the Project Manager (or designee) to ensure that the sample nomenclature is thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and is consistent with this Standard Operating Procedure if relevant. It shall be the responsibility of the project manager to ensure that the Field Operations Leader is familiar with the sample nomenclature system.

Field Operations Leader - It shall be the responsibility of the Field Operations Leader to ensure that all field technicians or sampling personnel are thoroughly familiar with this Standard Operating Procedure and the project-specific sample nomenclature system. It shall be the responsibility of the Field Operations Leader to ensure that the sample nomenclature system is used during all project-specific sampling efforts.

5.0 PROCEDURES

5.1 Introduction

The sample identification (ID) system can consist of as few as 8 but not more than 20 distinct alpha-numeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the lab has three segments and shall be as follows where "A" indicates "alpha," and "N" indicates "numeric":

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters
Site Identifier	Sample Type	Sample Location

Additional segments may be added as needed. For example:

(1) Soil and Sediment Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	NNNN 4-Characters
Site Identifier	Sample Type	Sample Location	Sample Depth

(2) Aqueous (groundwater or surface water) Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	NN 2-Characters	-A
Site Identifier	Sample type	Sample Location	Round Number	Filtered Sample only

(3) Biota Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	AA 2-Characters	NNN 3-Characters
Site Identifier	Sample Type	Sample Location	Species Identifier	Sample Group Number

5.2 Sample Identification Field Requirements

The various fields in the sample ID will include but are not limited to the following:

- Site Identifier
- Sample Type
- Sample Location
- Sample Depth
- Sampling Round Number
- Filtered
- Species Identifier
- Sample Group Number

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary since many facilities/sites have multiple individual sites, SWMUs, operable units, etc. Several examples are presented in Section 5.3 of this SOP.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3 of this SOP.

The sample location must be at least a three-character field but may have up to six-characters (alpha, numeric, or a mixture). The six-characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to

three-characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

A two-digit round number will be used to track the number of aqueous samples taken from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3 of this SOP.

The three digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individual caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a given location will be assigned the sample group number 001 and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

5.3 Example Sample Field Designations

Examples of each of the fields are as follows:

Site Identifier - Examples of site numbers/designations are as follows:

A01 - Area of Concern Number 1
125 - Solid Waste Management Unit Number 125
000 - Base or Facility Wide Sample (e.g., upgradient well)
BBG - Base Background

The examples cited are only suggestions. Each Project Manager (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample Type - Examples of sample types are as follows:

AH - Ash Sample
AS - Air Sample
BM - Building Material Sample
BSB - Biota Sample Full Body
BSF - Biota Sample Fillet
CP - Composite Sample
CS - Chip Sample
DS - Drum Sample
DU - Dust Sample
FP - Free Product
IDW - Investigation Derived Waste Sample
LT - Leachate Sample
MW - Monitoring Well Groundwater Sample
OF - Outfall Sample
RW - Residential Well Sample
SB - Soil Boring Sample
SD - Sediment Sample
SC - Scrape Sample

SG - Soil Gas Sample
SL - Sludge Sample
SP - Seep Sample
SS - Surface Soil Sample
ST - Storm Sewer Water Sample
SW - Surface Water Sample
TP - Test Pit Sample
TW - Temporary Well Sample
WC - Well Construction Material Sample
WP - Wipe Sample
WS - Waste/Solid Sample
WW - Wastewater Sample

Sample Location - Examples of the location field are as follows:

001 - Monitoring Well 1
N32E92 - Grid location 32 North and 92 East
D096 - Investigation derived waste drum number 96

Species Identifier - Examples of species identifier are as follows:

BC - Blue Crab
GB - Blue Gill
CO - Corn
SB - Soybean

5.4 Examples of Sample Nomenclature

The first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F.

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140001. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full body analysis the first time a minnow trap was checked at grid location A25 of SWMU 1415 three small blue gills were captured, collected and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415) the sample ID designation given was 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash "-F".

5.5 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature)

Field QA/QC will be designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric 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	-F
QC Type	Date	Sequence Number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank (Equipment Blank)
FD = Field Duplicate
AB = Ambient Conditions Blank
WB = Source Water Blank

The sampling time recorded on the Chain-of-Custody Form, labels, and tags 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 routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log sheet (see SOP on Field Documentation).

5.6 Examples of Field QA/QC Sample Nomenclature

The first duplicate of the day for a filtered ground water sample collected on June 3, 2000 would be designated as FD06030001-F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003 would be designated as FD11170303.

The first trip blank associated with samples collected on October 12, 2000 would be designated as TB10120001.

The only rinsate blank collected on November 17, 2001 would be designated as RB11170101.

6.0 DEVIATIONS

Any deviation from this SOP must be addressed in detail in the site specific planning documents.

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **2**

5.0 PROCEDURES **3**

5.1 GENERAL 3
5.2 SAMPLING, MONITORING, AND EVACUATION EQUIPMENT 4
5.3 CALCULATIONS OF WELL VOLUME 4
5.4 EVACUATION OF STATIC WATER (PURGING) 5
5.4.1 General 5
5.4.2 Evacuation Devices 5
5.5 ONSITE WATER QUALITY TESTING 6
5.5.1 Measurement of pH 7
5.5.2 Measurement of Specific Conductance 9
5.5.3 Measurement of Temperature 10
5.5.4 Measurement of Dissolved Oxygen 11
5.5.5 Measurement of Oxidation-Reduction Potential 12
5.5.6 Measurement of Turbidity 13
5.5.7 Measurement of Salinity 14
5.6 SAMPLING 15
5.6.1 Sampling Plan 15
5.6.2 Sampling Methods 16
5.7 LOW FLOW PURGING AND SAMPLING 17
5.7.1 Scope & Application 17
5.7.2 Equipment 17
5.7.3 Purging and Sampling Procedure 18

6.0 REFERENCES **20**

ATTACHMENTS

A PURGING EQUIPMENT SELECTION 21
B GROUNDWATER SAMPLE LOG SHEET 24
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 ±0.2 standard units
- Specific conductance ±10%
- Temperature ±10%
- Turbidity less than 10 NTUs
- Dissolved oxygen ±10%

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.

6.0 REFERENCES

American Public Health Association, 1989. Standard Methods for the Examination of Water and Wastewater, 17th Edition, APHA, Washington, D.C.

Barcelona, M. J., J. P. Gibb and R. A. Miller, 1983. A guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling. ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

Johnson Division, UOP, Inc. 1975. Ground Water and Wells, A Reference Book for the Water Well Industry. Johnson Division, UOP, Inc., Saint Paul, Minnesota.

Nielsen, D. M. and G. L. Yeates, 1985. A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells. Ground Water Monitoring Review 5:83-98.

Scalf, M. R., J. F. McNabb, W. J. Dunlap, R. L. Crosby and J. Fryberger, 1981. Manual of Ground Water Sampling Procedures. R. S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Ada, Oklahoma.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

U.S. EPA, 1980. Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities. Office of Solid Waste, United States Environmental Protection Agency, Washington, D.C.

U.S. EPA, 1994. Groundwater Sampling Procedure - Low Flow Purge and Sampling (Draft Final). U.S. Environmental Protection Agency, Region I.

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___

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **3**

5.0 PROCEDURES **3**

5.1 SAMPLE CONTAINERS 3
5.2 SAMPLE PRESERVATION 3
5.2.1 Overview 4
5.2.2 Preparation and Addition of Reagents 4
5.3 FIELD FILTRATION 5
5.4 SAMPLE PACKAGING AND SHIPPING 6
5.4.1 Environmental Samples 6

6.0 REFERENCES **7**

ATTACHMENTS

A GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS 8
B ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES 9

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 (~~y~~261.30 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 (~~y~~261.20 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

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

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 SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	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 SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	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% $Na_2S_2O_3$.

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS **2**

5.0 PROCEDURES **2**

5.1 SITE LOGBOOK 2
5.1.1 General 2
5.1.2 Photographs 3
5.2 FIELD NOTEBOOKS 3
5.3 FIELD FORMS 4
5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results. 4
5.3.2 Hydrogeological and Geotechnical Forms 5
5.3.3 Equipment Calibration and Maintenance Form 6
5.4 FIELD REPORTS 6
5.4.1 Daily Activities Report 7
5.4.2 Weekly Status Reports 7

6.0 LISTING OF FIELD FORMS ON THE TtNUS INTRANET SITE **7**

ATTACHMENTS

A TYPICAL SITE LOGBOOK ENTRY **9**
B SAMPLE LABEL **10**
C CHAIN-OF-CUSTODY RECORD FORM **11**
D CHAIN-OF-CUSTODY SEAL **12**

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, Inc. (TtNUS) field activities.

2.0 SCOPE

Documents presented within this SOP (or equivalents) shall be used for all TtNUS 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 AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - The PM 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 FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

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 on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration

- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving TtNUS or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM or designee for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- TtNUS 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, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

5.1.2 Photographs

Sequentially number movies, slides, or photographs taken of a site or any monitoring location to correspond to logbook/notebook entries. Enter the name of the photographer, date, time, site location, site description, and weather conditions 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 because they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend on the subject matter, type of camera (digital or film), and the processing it requires. Follow chain-of-custody procedures for film used for aerial photography, confidential information, or criminal investigation. After processed, consecutively number the slides of photographic prints and label them according to the logbook/notebook descriptions. Docket the site photographs and associated negatives and/or digitally saved images to compact disks 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 TtNUS 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, subject to 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 SOPs.

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. Complete a sample log sheet 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. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record

The chain-of-custody 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 as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site:

- Retain one carbonless copy of the completed chain-of custody form in the field.
- Send one copy is sent to the PM (or designee)
- Send the original to the laboratory with the associated samples. Place the original (top, signed copy) of the chain-of custody form inside a large Ziploc®-type bag taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one chain-of custody form, send the form with the cooler containing vials for volatile organic compound (VOC) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of custody form (any discrepancies between the sample labels and chain-of custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the TtNUS PM). The chain-of custody form is signed and copied. The laboratory will retain the copy, and 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 that 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. Sign and date custody seals

and affix them across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Complete Field Analytical Log Sheets 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

Complete a Groundwater Level Measurement Sheet 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. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.

5.3.2.3 Packer Test Report Form

Complete a Packer Test Report Form for each well at which a packer test is conducted.

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form 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

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists forms that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet – use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet – use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) – use this form to document deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist – used these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements but are useful tools 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 ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, 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. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

5.4 FIELD REPORTS

The primary means of recording on-site 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 used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

5.4.1 Daily Activities Report

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

5.4.1.1 Description

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that 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 DAR to the FOL for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.

All TtNUS field forms can be found on the company's intranet site at http://intranet.ttnus.com under Field Log Sheets.

6.0 LISTING OF FIELD FORMS ON THE TtNUS INTRANET SITE

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request
- Field Analytical Log sheet - Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Test Data Sheet
- Low Flow Purge Data Sheet
- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction Flush Mount
- Bedrock Monitoring Well Construction Open Hole
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record

- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction Flush Mount
- Overburden Monitoring Well Construction Stick Up
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- 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
SAMPLE LABEL

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
CHAIN-OF-CUSTODY RECORD FORM

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

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED
TYPE OF ANALYSIS

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										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**

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **3**

5.0 PROCEDURES **3**

5.1 DECONTAMINATION DESIGN/CONSTRUCTIONS CONSIDERATIONS 3
5.1.1 Temporary Decontamination Pads 3
5.1.2 Decontamination Activities at Drill Rigs/DPT Units 4
5.1.3 Decontamination Activities at Remote Sample Locations 5
5.2 EQUIPMENT DECONTAMINATION PROCEDURES 5
5.2.1 Monitoring Well Sampling Equipment 5
5.2.2 Down-Hole Drilling Equipment 6
5.2.3 Soil/Sediment Sampling Equipment 6
5.3 CONTACT WASTE/MATERIALS 7
5.3.1 Decontamination Solutions 7
5.4 DECONTAMINATION EVALUATION 7

1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The objective/purpose of this SOP is intended to protect site personnel, general public, and the sample integrity through the prevention of cross contamination onto unaffected persons or areas. It is further intended through this procedure to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment.

2.0 SCOPE

This procedure applies to all equipment including drilling equipment, heavy equipment, monitoring well materials, as well as chemical sampling and field analytical equipment decontamination that may be used to provide access/acquire environmental samples. Where technologically and economically feasible, single use sealed disposable equipment will be employed to minimize the potential for cross contamination. This procedure also provides general reference information on the control of contaminated materials.

3.0 GLOSSARY

Acid - For decontamination of equipment when sampling for trace levels of inorganics, a 10% solution of nitric acid in deionized water should be used. Due to the leaching ability of nitric acid, it should not be used on stainless steel.

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - Is a solution selected/identified within the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Deionized water is tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet CAP and NCCLS specifications for reagent grade, Type I water.

Potable Water - Tap water used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Employs high pressure pumps and nozzle configuration to create a high pressure spray of potable water. High pressure spray is employed to remove solids.

Solvent - The solvent of choice is pesticide-grade Isopropanol. Use of other solvents (methanol, acetone, pesticide-grade hexane, or petroleum ether) may be required for particular projects or for a particular purpose (e.g. for the removal of concentrated waste) and must be justified in the project planning documents. As an example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - This method employs a high pressure spray of heated potable water. This method through the application of heat provides for the removal of various organic/inorganic compounds.

4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

Site Health and Safety Officer (SHSO) - The SHSO exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on-site (as part of the equipment inspection), leaving the site, moving between locations are required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Failure to meet these objectives are sufficient to restrict equipment from entering the site/exiting the site/ or moving to a new location on the site until the objectives are successfully completed.

5.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or the isolation of contaminants. In order to accomplish this activity a level of preparation is required. This includes site preparation, equipment selection, and evaluation of the process. Site contaminant types, concentrations, media types, are primary drivers in the selection of the types of decontamination as well as where it will be conducted. For purposes of this SOP discussion will be provided concerning general environmental investigation procedures.

The decontamination processes are typically employed at:

- Temporary Decontamination Pads/Facilities
- Sample Locations
- Centralized Decontamination Pad/Facilities
- Combination of some or all of the above

The following discussion represents recommended site preparation in support of the decontamination process.

5.1 Decontamination Design/Constructions Considerations

5.1.1 Temporary Decontamination Pads

Temporary decontamination pads are constructed at satellite locations in support of temporary work sites. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soils generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations

- Site Location – The site selected should be within a reasonable distance from the work site but should avoid:

  - Pedestrian/Vehicle thoroughfares
  - Areas where control/custody cannot be maintained
  - Areas where a potential releases may be compounded through access to storm water transport systems, streams or other potentially sensitive areas.
  - Areas potentially contaminated.

- Pad – The pad should be constructed to provide the following characteristics

  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination.

  - Slope – An adequate slope will be constructed to permit the collection of the water and potentially contaminated soils within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks.

  - Sidewalls – The sidewalls should be a minimum of 6-inches in height to provide adequate containment for wash waters and soils. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls maybe constructed of wood, inflatables, sand bags, etc. to permit containment.

  - Liner – Depending on the types of equipment and the decontamination method the liner should be of sufficient thickness to provide a puncture resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. Achieving the desired thickness maybe achieved through layering lighter constructed materials. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner a light coating of sand maybe applied to provide traction as necessary.

  - Wash/drying Racks – Auger flights, drill/drive rods require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process. A minimum ground clearance of 2-feet is recommended.

  - Maintenance – The work area should be periodically cleared of standing water, soils, and debris. This action will aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross contamination. Hoses should be gathered when not in use to eliminate potential tripping hazards.

5.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and direct push activities decontamination of drive rods, Macro Core Samplers, split spoons, etc. are typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected media. Drying racks will be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/re-use.

5.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations sampling devices such as trowels, pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition.

5.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

5.2.1 Monitoring Well Sampling Equipment

5.2.1.1 Groundwater sampling pumps – This includes pumps inserted into the monitoring well such as Bladder pumps, Whale pumps, Redi-Flo, reusable bailers, etc.

1) Evacuate to the extent possible, any purge water within the pump.

2) Scrub using soap and water and/or steam clean the outside of the pump and tubing, where applicable.

3) Insert the pump and tubing into a clean container of soapy water. Pump a sufficient amount of soapy water through the pump to flush any residual purge water. Once flushed, circulate soapy water through the pump to ensure the internal components are thoroughly flushed.

4) Remove the pump and tubing from the container, rinse external components using tap water. Insert the pump and tubing into a clean container of tap water. Pump a sufficient amount of tap water through the pump to evacuate all of the soapy water (until clear).

5) Rinse equipment with pesticide grade isopropanol

6) Repeat item #4 using deionized water through the hose to flush out the tap water and solvent residue as applicable*.

7) Drain residual deionized water to the extent possible, allow components to air dry.

8) Wrap pump in aluminum foil or a clear clean plastic bag for storage.

5.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing with the extracted tape and probe with deionized water and wiping the surface of the extracted tape is acceptable. However, periodic full decontamination should be conducted as indicated below.

---

* - The solvent should be employed when samples contain oil, grease, PAHs, PCBs, and other hard to remove materials. If these are not of primary concern, the solvent step may be omitted. In addition, do not rinse PE, PVC, and associated tubing with solvents.

1) Wash with soap and water
2) Rinse with tap water
3) Rinse with deionized water

Note: In situations where oil, grease, free product, other hard to remove materials are encountered probes and exposed tapes should be washed in hot soapy water.

5.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) should be cleaned per manufacturer's instructions. This generally includes wiping down the sensor housing and rinsing with tap and deionized water.

Coolers/Shipping Containers employed to ship samples are received from the lab in a variety of conditions from marginal to extremely poor. Coolers should be evaluated prior to use for

- Structural integrity – Coolers missing handles or having breaks within the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples will not be attempted and request a replacement unit.

- Cleanliness – As per protocol only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or associated with noticeable odors it should be decontaminated prior to use.

  1) Wash with soap and water
  2) Rinse with tap water
  3) Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and notify the laboratory to provide a replacement unit.

5.2.2 Down-Hole Drilling Equipment

This includes any portion of the drill rig that is over the borehole including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. This procedure is to be employed prior to initiating the drilling/sampling activity, then between locations.

1) Remove all soils to the extent possible using shovels, scrapers, etc. to remove loose soils.
2) Through a combination of scrubbing using soap and water and/or steam cleaning remove visible dirt/soils.
3) Rinse with tap water.
4) Rinse equipment with pesticide grade isopropanol
5) To the extent possible allow components to air dry.
6) Wrap or cover equipment in clear plastic until it is time to be used.

5.2.3 Soil/Sediment Sampling Equipment

This consists of soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1) Remove all soils to the extent possible.

2) Through a combination of scrubbing using soap and water and/or steam cleaning remove visible dirt/soils.

3) Rinse with tap water.

4) Rinse equipment with pesticide grade isopropanol

5) Rinse with deionized water

6) To the extent possible allow components to air dry.

7) If the device is to be used immediately, screen with a PID/FID to insure all solvents (if they were used) and trace contaminants have been adequately removed.

8) Once these devices have been dried wrap in aluminum foil for storage until it is time to be used.

5.3 Contact Waste/Materials

During the course of field investigations disposable/single use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.) broken sample containers.

With the exception of the broken glass, single use articles should be cleaned (washed and rinsed) of visible materials and disposed of as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned should be containerized for disposal in accordance with applicable federal state and local regulations.

5.3.1 Decontamination Solutions

All waste decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. These containers must be appropriately labeled.

5.4 Decontamination Evaluation

Determining the effectiveness of the decontamination process will be accomplished in the following manner

- Visual Evaluation – A visual evaluation will be conducted to insure the removal of particulate matter. This will be done to insure that the washing/rinsing process is working as intended.

- Instrument Screening – A PID and/or an FID should be used to evaluate the presence of the contaminants or solvents used in the cleaning process. The air intake of the instrument should be passed over the article to be evaluated. A positive detection requires a repeat the decontamination process. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instruments capabilities.

- Rinsate Blanks – It is recommended that Rinsate samples be collected to

  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.

  - Single use disposable equipment – The number of samples should represent different types of equipment as well as different Lot Numbers of single use articles.

The collection and the frequency of collection of rinsate samples are as follows:

- Per decontamination method
- Per disposable article/Batch number of disposable articles

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and in an effort to avoid using a contaminated batch of single use articles. It is recommended that a follow up sample be collected during the execution of the project to insure those conditions do not change. Lastly, rinsate samples collection may be driven by types of and/or contaminant levels. Hard to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.

APPENDIX D

LABORATORY STANDARD OPERATING PROCEDURES

GC/MS VOLATILES
BY EPA METHOD 624 AND
SW-846 METHOD 8260B
INCLUDING APPENDIX IX COMPOUNDS

SOP NUMBER: **SOP-202**

REVISION NUMBER: **21**

APPROVED BY:

SECTION MANAGER

QUALITY ASSURANCE OFFICER

EFFECTIVE DATE: **09/11/08**

DATE OF LAST REVIEW **09/11/08**

GC/MS VOLATILES
BY EPA METHOD 624 AND SW-846 METHOD 8260B

1.0 SCOPE AND APPLICATION

Please see Appendix for definitions.
This SOP (based primarily on SW-846 Method 8260B) is used for the analysis of volatile organic compounds in a variety of matrices (soils, sediments, waters, etc.). Methods SW-846 Method 8000B; *Federal Register* Method 624; and CLP Method for Volatiles have also been used in the development of this SOP. The analyses by these various methods are clearly defined in the respective regulatory manuals. A good understanding of these different methods is essential to the performance of each method. The normal laboratory list of analytes with their typical LCS limits is found attached in the appendix. Other compounds may be analyzed by this SOP as detailed in section 1.0 of SW-846 Method 8260B. Any questions left by this SOP should be answered by reading the methods, paying close attention to SW-846 8000B/8260B, EPA 624 and CLP. If questions still remain unanswered, check with the Organic Lab Manager, QA/QC Officer and/or the Technical Director.

2.0 METHOD SUMMARY

After sample preparation, the sample is introduced into the GC/MS generally using purge and trap but sometimes using direct injection (see SW-846 Methods 5030B, 5035 and 3585 for preparation). In purge and trap, the analytes are stripped from the sample using helium and trapped on an adsorbent tube. The tube is heated while being backflushed with helium to carry the analytes to the GC/MS system. The analytes are separated in the gas chromatograph by a combination of the temperature program and the capillary column. The analytes are then detected by the mass spectrometer. Analytes are identified by comparing the mass spectra of known standards with the mass spectra of the sample. Analytes are quantitated relative to known standards using the internal standard method.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Section 3.0 and tables 3-1 and 3-2 of the Empirical Laboratories, LLC Quality Assurance Manual include details concerning sample preservation, containers and handling of volatile samples. All water and non-quarantined soil volatile samples are stored in the Hobart in the sample storage room at a temperature of 4°C. Quarantined soil volatile samples are stored in the dorm-size refrigerator in the sample receiving/log-in room at a temperature of 4°C. Non-preserved water volatile samples have a holding time of 7 days from date of sampling. Preserved water samples and soil volatile samples have a holding time of 14 days from date of sampling (unless otherwise specified for the project).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Section 3.0 of SW-846 Method 8260B details interferences and potential problems which may be encountered when dealing with volatile analyses.

5.0. EQUIPMENT AND APPARATUS

5.1 GC : HP 5890 or 6890, temperature programmable, suitable for split or splitless injection.

5.2 Column: DB-VRX 60 meter x 0.25 mm I.D. 1.4 µm film thickness or 20 meter x 0.18 mm ID 1.0 µm film thickness silicon coated fused silica capillary column or equivalent.

5.3 M.S. : HP 5971, 5972 or 5973 capable of scanning 35 to 500 amu every one second or less, using 70 volts electron energy in electron impact ionization mode. The MS is capable of producing a mass spectrum for p-Bromofluorobenzene, BFB, which meets all tuning criteria for EPA methods [when 1 µL (50 ng) of the GC/MS tuning standard are injected through the GC.]

5.4 Purge and Trap Unit

5.4.1 Concentrators: Tekmar LSC 2000 or Tekmar/Dohrmann 3000/3100 Sample Concentrator equipped with Supelco trap number 2-1066-U or 2-4920-U VOCARB 3000 providing good delivery for all target compounds.

5.4.2 Autosamplers: Varian Archon 51 position programmable autosampler with 5ml to 25ml water and heated soil capability.

5.5 Acquisition Software: HP chemstation system interfaced to the GC/MS. The system acquires and stores data throughout the chromatographic programs.

5.6 Data Processing Software: TargetDB on Windows NT data system interfaced to the HP Chemstation. The system accepts and stores acquired data. It plots by extracted ion current profile (EICP). The system is also capable of integrating the abundances of any EICP between specified time or scan-number limits. The most recent NBS mass spectral library is installed.

5.7 Microsyringes – 1.0, 5.0,10, 25, 100, 250, 500 and 1000 µL.

5.8 Syringes – 5, 25 and 50 mL, gas-tight with Luer end.

5.9 Balance - analytical, 0.0001 g; top-loading, 0.1 g.

5.10 Disposable pasteur pipets.

5.11 Volumetric flasks, Class A - 2 mL, 5 mL, 10 mL, 50 mL, 100 mL and 250 mL with ground-glass stoppers.

5.12 Spatula - stainless steel.

5.13 Glass scintillation vials - 20mL with screw caps.

5.14 Nitrile Gloves

5.15 pH paper (measures pH from 0-14).

6.0 REAGENTS AND SOLUTIONS

6.1 Organic-free reagent water - obtained from a modulab system.

6.2 Methanol - Purge and trap grade (EM-Omnisolv EM-0482-6 or equivalent)

6.3 Methanol - suitable for use in gas chromatography (B&J Omnisolv MX0484-1, or equivalent)

6.4 Sodium bisulfate, $NaHSO_4$ – ACS reagent grade, or equivalent. Available from Aldrich (Part No. 30,782-3).

6.5 Stock standards are purchased in mixtures from reputable vendors. The date they are received is noted on the label. The date they are opened is noted on the label and recorded in the VOA standards and reagents logbook along with their lot number and vendor. Each standard that is prepared is recorded in the VOA standards and reagents logbook and given a sequential number. Each standard label is completed with the standard number, name, preparation date, expiration date, solvent and analyst initials. Stock standards, when opened, have an expiration date of 6 months, **except for gas standards for South Carolina samples which have a one week expiration date**. All stocks and standards are stored in the freezer at a temperature of -15°C ± 5°C or less from the date they are received/prepared. The freezer temperature is monitored daily with an annually calibrated thermometer and recorded with calibration correction in the VOA refrigerator/freezer logbook. Makeup of common standards is detailed below. See the VOA standards log book for makeup of other standards.

6.5.1 The Bromofluorobenzene (BFB) tuning standard is prepared as follows: Using a 50µL syringe, 40µL of standard (BFB @ 2500ng/µL) is injected into a 2mL volumetric flask containing approximately 1.0mL P&T methanol (Vendor,Lot) and diluted to volume with same making a 50ng/µL standard. After capping and inverting 3 times, the solution is transferred to a labeled 2ml, teflon-lined, screw-capped vial and stored in the freezer at -15°C ± 5°C or less for up to 6 months(1 week for South Carolina samples). A direct injection of 1µL is used to tune the instrument.

6.5.2 The internal and surrogate standard is prepared as follows: Using the indicated syringe, the indicated amount of standard is injected into a 50 mL volumetric flask containing P&T methanol (Vendor,Lot) and diluted to volume with same making a 150ng/µL standard. After capping and inverting 3 times, the solution is transferred to the Archon standard vial and stored under helium for 1 month or less. Each 8260/624 sample is automatically injected with 1µL of this standard. The internal standard/surrogate solution will be replaced if the –50%-200% criteria fails in the CCV.

Standard	Conc. (ng/µL)	Syringe (µL)	Amount (µL)
8260 ISTD/Surr. Mix (Vendor,Lot)	2500	1000	3000

6.5.3 Calibration standards are prepared from the vendor stock standards at appropriate concentrations as follows. Occasionally unusual compounds are added to the mix so it is best to check the VOA standards log book for exact standard makeup. Note: for laboratory control spikes (LCS), alternate sources or lot numbers from the main calibration standard are used to make the LCS standard. See the appendix for analytes in the main mixes.

6.5.3.1 Primary Standard: Using the indicated syringe, the indicated amount of standard is injected into a 2mL volumetric flask containing approximately 1.0mL P&T methanol (Vendor,Lot) and diluted to volume with same to make a 100-500ng/µL standard. After capping and inverting 3 times, the solution is transferred into 2ml amber vial w/mini-inert valve and stored in the freezer at -15°C ± 5°C for 1 week. A 50µg/L (5mL purge) standard is made using 25µL of this standard to 50mLof reagent water.

Stock Standard(CCV)	Conc (ng/µL)	Syringe(µL)	Amount(µL)	Final Conc (ng/µL)
2-CEVE **(Cat#30265)** (Vendor, Lot)	20000	25	20	200
Vinyl Acetate **(#3766)** (Vendor, Lot)	5000	100	80	200
Ketones **(cat#30006)** (Vendor, Lot)	5000	100	80	200
Liquid mix **(C-349H-07)** (Vendor, Lot)	2000	100	100	100
Custom mix **(CCS-1037)** (Vendor, Lot)	5000	50	40	100
Gases **(cat#30042)** (Vendor, Lot)	2000	100	100	100
Acrolein/Acrylonitrile **(CC2098.10)** (Vendor, Lot)	20,000	50	50	500

Additional compounds may be added such as Appendix IX. Refer to standards log.

6.5.4 ICV/LCS/MATRIX SPIKE MIX: A second source standard is to check the validity of the gas and primary calibration standards used in analyzing the calibration curve. Using the indicated syringe, the indicated amount of standard is injected into a 2mL volumetric flask containing approximately 1.0mL P&T methanol (Vendor,Lot) and diluted to volume with same to make a 100-500ng/µL standard. After capping and inverting 3 times, the solution is transferred into 2ml amber vial w/mini-inert valve and stored in the freezer at -15°C ± 5°C for 1 week. A 50µg/L (5mL purge) ICV/LCS/Matrix Spike is made using 25µL of this standard to 50mLof reagent water/Sample Matrix.

Stock Standard(ICV/LCS)	Conc (ng/µL)	Syringe(µL)	Amount(µL)	Final Conc (ng/µL)
2-CEVE(Vendor,Lot#)	20,000	25	20	200
Vinyl Acetate(Vendor,Lot#)	5000	100	80	200
Ketones(Vendor,Lot#)	5000	100	80	200
Liquid mix (Vendor,Lot#)	2000	100	100	100
Custom Mix(Vendor,Lot#)	5000	50	40	100
Gases (Vendor,Lot#)	2000	100	100	100
Acrolein/Acrylonitrile (Vendor,Lot#)	50,000	50	50	500

7.0 PROCEDURE

7.1 Chromatographic conditions – Refer to corresponding instrument maintenance log for current gas chromatograph, mass spectrometer, and concentrator conditions.

7.2 System Bakeout - Prior to analysis, the autosampler purge and trap unit is stepped to bake and an instrument blank is analyzed.

NOTE: Further cleaning may be accomplished by backflushing the lines with methanol and then analyzing blanks overnight.

7.3 Tuning - Prior to any calibration or analysis, BFB tuning criteria must be met for a 1.0µL injection of the tuning standard [see below]. Tune must be met every 12 hours sample analysis is to be performed (every 24 hours for *Federal Register* Method 624 except for South Carolina which only allows 12 hours). The mass spectrum of BFB is acquired as follows: by using one scan at the apex peak, or by using the mean of the apex and the preceding and following scans or mean of a symmetric pattern of scans about the apex, or using the average across the entire peak. Background subtraction is accomplished using a single scan no more than 20 scans prior to the elution of BFB.

m/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

7.4 Calibration: Calibration standards are made up in water using the appropriate amount of the methanol standard. Calibration for soils for South Carolina requires that 5mL of sodium bisulfate solution is added to each calibration standard made if the samples will be preserved with sodium bisulfate. All calibration standard integrations must be checked for acceptability.

7.4.1 Initial Calibration - An initial calibration curve at no less than five concentration levels must be analyzed and shown to meet the initial calibration criteria before any sample analysis may be performed. For Arizona samples the surrogates must also be calibrated at a minimum of five concentrations. Method 624 requires that the %RSD be less than 35% to use the average response factor for quantitation, the curve is to be used otherwise and should have a correlation coefficient (***r***) of $\geq$0.995. Method 8260B requires that the %RSD be less than 15% to use the average response factor for quantitation, the curve is to be used otherwise as long as ***r*** is $\geq$0.995 linear or $\geq$ 0.99 quadratic. In addition, there are calibration check compounds (CCCs) listed below which must have a %RSD less than 30% and five system performance check compounds (SPCCs) which must meet the average response factor criteria listed below. The lowest standard must be less than or equal to the reported quantitation limit and the highest standard must not exceed the linear range of the detector. Any manual integrations are documented by inclusion of the integrated signals (**before and after manual integration**) initialed, dated, and reason with the quantitation report and chromatograms. Any response factors less than 0.050 must be supported by the mass spectrum of the lowest standard. **No quadratic curves for South Carolina.**

CCCs:	1,1-Dichloroethene	Toluene
	Chloroform	Ethylbenzene
	1,2-Dichloropropane	Vinyl chloride

SPCCs:	Chloromethane	0.10
	1,1-Dichloroethane	0.10
	Bromoform	0.10
	Chlorobenzene	0.30
	1,1,2,2-Tetrachloroethane	0.30

7.4.2 Initial Calibration Verification - A second source standard at the 50 µg/L (5mL purge) level is used to check the validity of the curve. The standard recovery for all analytes must be between 75 and 125%. If the second source recovery is above 125%, the main standard has probably deteriorated for that compound. That standard must be replaced and a new curve generated. If the second source recovery is below 75%, the second source standard has probably deteriorated for that compound and must be replaced. Any manual integrations are documented by inclusion of the integrated signals with the quantitation report and chromatogram.

7.4.3 Continuing Calibration Verification (every 12 hours) - A midpoint calibration standard (generally 50 µg/L - 5mL purge) must be analyzed and calculated against the initial calibration curve, then shown to meet the

calibration check criteria before any sample analysis may be performed. Acceptance criteria for method 8260B consists of the same SPCC criteria as above and ≤20% drift or difference (calculations given in section 7.10) for the CCCs as listed above. The internal standards must also be evaluated as listed below. Any manual integrations are documented by inclusion of the integrated signals with the quantitation report and chromatogram. Samples are then quantitated against the initial calibration curve. Note: If any compound in the continuing calibration not subject to the criteria above exceeds 30% D, it must be evaluated and initialed by the organic section manager. If deemed acceptable, the analyst may continue analysis.
NOTE: Acceptance criteria for method 624 consists of meeting recovery limits found in table 5 of the method for a QC check sample. This QC check sample is made from a separate source or lot number than the calibration standard at a concentration of 20 µg/L.

Internal standard checks

7.4.3.1.1 Retention time - The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

7.4.3.1.2 Response - If the EICP area for any of the internal standards in the calibration verification standard changes by a factor of two (-50% to + 100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

7.5 LCS - An LCS is analyzed every 12 hour tune.Using standards prepared from an alternate vendor or lot number, blank water is spiked at the 50 µg/L (5mL/soil) or 10 µg/L (25mL) level. See section 8.3 below for criteria and corrective action. Note: the concentration of the LCS will be 20 µg/L when analyzing 624 samples (QC Check Sample). **When analyzing samples for DOD QSM Version 3, DOD limits will be used.**

7.6 Method Blank - Prior to sample analysis, the system must be shown to be free of contamination through analysis of a method blank. See section 8.4 below for criteria and corrective action.

7.7 Sample Analysis - Prior to analysis, the samples are prepared for chromatography using the appropriate sample preparation method (5mL water, 25mL water, low soil,

high soil, etc.) See SOP-225 for preparation of a 5035 soil sample. For a 5mL/25mL water sample, use the following procedure:

7.7.1. Load the vial into the Archon autosampler in the expected position.

7.7.2. Program the Archon for the loaded vial range and necessary dilutions, making sure the programmed method is set for the same volume as the purge vessel on the front of the LSC 2000 or 3000/3100 and that the Chemstation sequence matches the Archon sequence. Note: TCLP samples are analyzed at a 10x dilution. One TCLP sample is spiked per matrix.

7.7.3. After analysis of the sample has been completed, check the pH of the sample using pH paper and verify it to be less than a pH of 2. If it is not, record the pH and generate a corrective action report. The sample report will have to be flagged for preservation if the analysis is being performed more than 7 days after sampling. [Note: TCLP samples do not require a pH check.]

7.8 Instrument sequence

An example of a typical instrument sequence log follows:
1-BFB Tune (12:00 am)
2-CCV
3-LCS
4-Method Blank
5-Sample
6-Sample
7-Sample
8-Sample
9-Sample
10-Sample
11-Sample
12-Sample
13-Sample
14-Sample
15-Sample
16-Sample
17-Sample MS
18-Sample MSD
19-BFB (12:00pm - 12 hours since last BFB/CCV)
20-CCV
21-LCS
22-Method Blank
23-Sample
24-Sample

7.9 Data Reduction/Evaluation - Each sample analysis sequence is documented using the computer run log generated on the chemstation. This run log is signed, dated and paginated then placed in a 3 ring binder for that instrument. After the sample has been analyzed, the data is processed through the TargetDB on Windows NT data system. Quantitative measurements are performed using the calculations found in section 7.10 below. The following must be checked to determine if the sample will

need any reanalysis or dilution. Formal data evaluation is detailed in SOP-200 (documented using the USACE Analyst Data Review Checklist for USACE projects). **See SOP-224 for guidance on manual integrations.**

7.9.1 Internal Standards - Areas should be within 50 to 200 percent of the area of the continuing calibration. Retention time should be within 30 seconds of the retention time of the continuing calibration. Note: criteria applies to the continuing calibration, not samples, but is used as an indication of the sample analysis validity. If not, the sample and historical data should be evaluated to determine the cause of the problem. Reanalysis is expected if it appears to be from a leak. If matrix effect is confirmed by reanalysis or historical data, complete a corrective action report and flag the affected compounds on the final report for matrix effect.

7.9.2 Surrogates – Control limits are determined by charting LCSs and method blanks. All of the surrogates must be within these limits in order for the analysis to be in control. If not, the reason for the malfunction must be determined and reanalysis may be necessary. If historical data indicates matrix, the sample would be flagged appropriately. When the surrogates exceed either the control limits, a corrective action report must be completed. *Federal Register* Method 624 contains no criteria for surrogate recovery. **When analyzing samples for DOD QSM Version 3, DOD limits will be used.**

Surrogate	WATER	SOIL/SEDIMENT
Dibromofluoromethane	85-120	80-120
1,2-Dichloroethane-d4	85-130	75-140
Toluene-d8	85-115	80-120
Bromofluorobenzene	80-120	80-125

7.9.3 Analyte concentration must be within the range of the calibration curve after rounding to 2 significant figures. If an analyte exceeds the curve, a dilution must be performed, the next sample must be checked for carryover and the sparge position must be checked for contamination through the analysis of a system blank. Any dilution should keep the concentration of the analyte in question within the mid-range of the curve.

7.9.4 Qualitative identification is made as indicated below.

7.9.4.1 The mass spectra are compared to reference spectra in a user-created data base especially compiled to contain relatively uncontaminated mass spectra of each target compound. Note: Such a file cannot be obtained from the daily calibrations during each 12 hour analytical period due to overlapping peaks in the mixes.

7.9.4.2 The GC/MS analyst uses intelligence guided by experience to make the identifications.In uncontaminated spectra where ions are missing due to low concentration, if the major ions are present in the correct ratios at the correct retention time, the identification will be

considered positive. In contaminated spectra, special emphasis will be placed upon higher mass ions, and the major ions will usually need to be present as major components of the spectrum (either unsubtracted or subtracted) for the identification to be positive. All assessments of relative intensities of ions will be made by visual estimates from the spectra.

7.10 Calculations:

7.10.1 The RF is calculated as follows:

$$RF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

where:

A_s = Peak area (or height) of the analyte or surrogate.

A_{is} = Peak area (or height) of the internal standard.

C_s = Concentration of the analyte or surrogate.

C_{is} = Concentration of the internal standard.

7.10.2 Calibration verification involves the calculation of the percent drift (linear) or the percent difference (average) of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the calibration procedure used.

$$\% \text{ Drift} = \frac{(\text{Calculated concentration} - \text{Theoretical concentration}) * 100}{\text{Theoretical Concentration}}$$

where the calculated concentration is determined from the initial calibration and the theoretical concentration is the concentration at which the standard was prepared.

$$\% \text{ Difference} = \frac{(\text{CCV RF} - \text{Average RF}) * 100}{\text{Average RF}}$$

where CCV RF is the response factor from the analysis of the verification standard and Average RF is the average response factor from the initial calibration. The % difference or % drift calculated for the calibration verification standard must be within ±20% for each CCC analyte, or for all target analytes if the CCCs are not target analytes, before any sample analyses may take place.

7.10.3 Concentration in water samples is calculated as follows: [Note: Using the units specified here for these terms will result in a concentration in units of ng/mL, which is equivalent to ug/L.]

$$\text{Concentration } (\mu g/L) = \frac{(A_s)(C_{is})(D)(V_i)}{(A_{is})(\overline{RF})(V_s)(1000)}$$

where:

A_s = Area (or height) of the peak for the analyte in the sample.

A_{is} = Area (or height) of the peak for the internal standard.

C_{is} = Concentration of the internal standard in the volume purged in ug/L.

D = Dilution factor, if the sample was diluted prior to analysis. If no dilution was made, D = 1. The dilution factor is always dimensionless.

V_i = For purge-and-trap analysis, V_i is not applicable and is set at 1.

$\overline{RF}$ = Mean response factor from the initial calibration.

V_s = Volume of the aqueous sample purged (mL). If units of liters are used for this term, multiply the results by 1000.

7.10.4 Concentration in non-aqueous samples is calculated as follows: [Note: Using the units specified here for these terms will result in a concentration in units of ng/g, which is equivalent to ug/kg.]

$$\text{Concentration } (\mu\text{g/kg}) = \frac{(A_s)(C_{is})(D)(V_i)}{(A_{is})(\overline{RF})(W_s)(1000)}$$

where: A_s,

A_{is}, C_{is}, D, and $\overline{RF}$ are the same as for aqueous samples, and

W_s = Weight of sample extracted (g). Either a dry weight or wet weight may be used, depending upon the specific application of the data. If units of kilograms are used for this term, multiply the results by 1000.

8.0 QUALITY ASSURANCE/QUALITY CONTROL/CORRECTIVE ACTIONS

8.1 Internal Standards - All samples and QC are spiked with internals. See section 7.9.1 above for criteria and corrective action.

8.2 Surrogates - All samples and QC are spiked with surrogates. The surrogate recoveries from method blanks and LCS are used to generate control limits. See section 7.9.2 above for criteria and corrective action.

8.3 LCS Sample - An LCS is analyzed every 12 hour tune. To prepare the LCS, a blank is spiked with standards prepared from an alternate vendor or lot number from the calibration standards. Note: the concentration of the LCS will be 20 µg/L when analyzing 624 samples (QC Check Sample). The recoveries are used to generate control limits. See the LCS report forms in the appendix for the laboratory generated limits. The limits are in-house generated matrix spike limits or client specified limits for matrix spike analytes and 70-130% (or client specified limits) recovery for waters or soils for all other analytes if limits have not been generated. Limits for 624 LCSs are taken from table 5 of method 624. If the LCS compound has a recovery above the upper limit, but the same compound is not detected in any of the batch samples, no corrective action is required. For all other

situations, the LCS should be reanalyzed for the failed analytes only. If the second analysis fails, all associated samples should be reanalyzed for the failed analytes only. **When analyzing samples for DOD QSM Version 3, DOD limits will be used. South Carolina limits are 70-130% except for poor purgers which are 60-140%.**

8.4 Method Blanks - The concentration for most method target analytes must be < ½ the reporting limit. Common laboratory contaminants, such as acetone and methylene chloride, must be < the reporting limit. The first step of corrective action is to assess the affect on the samples. If an analyte is found only in the method blank, but not in any batch samples, no further corrective action may be necessary. Steps should be taken to find/reduce/eliminate the source of this contamination in the method blank. If an analyte is found in the method blank and some, or all, of the other batch samples, then corrective action is required. The source of contamination must be investigated and appropriate action taken and documented to find/reduce/eliminate the source of this contamination. The method blank, and any samples containing the same contaminant, would likely be reanalyzed. For the common laboratory contaminants, meeting the above requirements is not practical. Random cases of contamination are difficult to control, however, daily contamination is not acceptable and corrective action is essential. If a contaminant is found in the method blank and the samples, the compound concentration must be flagged with a 'B' on the final report unless the concentration is greater than 10x that found in the method blank. A method blank is analyzed every 12 hour tune.

8.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample - 1 in 20 samples are spiked for an MS/MSD with the LCS standard. Criteria for the MS/MSD recoveries are the same as the LCS limits. Limits for the RPDs are 30% RPD for water and soil.. Samples that do not meet these criteria due to matrix must be flagged on the final report for QC problems. Generally, batch control is not based on MS/MSD results unless general method failure is determined to be the problem. In that case, the samples and associated QC would be reanalyzed for the failed analytes only. MS data evaluation must include the consideration of the following factors. **When analyzing samples for DOD QSM Version 3, DOD limits will be used.**

8.5.1 Sample matrix - If the sample is a soil, grab sample or sequentially collected water sample it may affect the %R and RPD of the MS/MSD. A water sample which was taken from the same VOA vial for the original sample and the MS/MSD should have very good RPDs unless there has been a method problem. Corrective action must be taken in the form of reanalysis if a method problem is indicated.

8.5.2 Original sample concentration - If a spiked compound has a problem and the concentration of that compound in the original sample was two or more times the concentration of the spike, no further corrective action may be necessary other than the generation of a corrective action report to document the problem.

8.5.3 MS vs. MSD - If a spiked compound has a problem in both the MS and MSD, review the LCS and if acceptable no further action may be necessary since it is attributable to matrix effect.

8.5.4 Non-target Interference - The presence of significant non-target interference should be brought to the immediate attention of your supervisor who should discuss the problem with the client/project manager to determine the action to be taken.

8.6 Demonstration of Capability (DOC) – Each new analyst must complete a demonstration of capability by analyzing four LCSs with acceptable precision and accuracy. This also must be done when a new instrument is installed or a significant change to the method has been made.

CHROMATOGRAPHIC COND.	**VOA1**	**VOA3**	**VOA4**	**VOA5**
GC	**5890 SERIES II**	**6890**	**5890 SERIES II**	**5890 SERIES II**
MS	**5971**	**5973**	**5972**	**5972**
GC COLUMN	RTX-VRX-60mX0.25mmX1.4um	RTX-VRX-60mX0.25mmX1.4um	DBVRX-60mX0.25mmX1.4um	RTX-VRX-60mX0.25mmX1.4um
INJECTOR LINER	1.0MM	1.0MM	2.0MM	2.0MM
INJECTOR TEMPERATURE	150deg C	150deg C	150deg C	150deg C
TRANSFER LINE TEMP.	250deg C	**150deg C**	250deg C	250deg C
COLUMN PRESSURE	9.0PSI	X	X	X
COLUMN FLOW	X	1.1 ml/min	1.1 ml/min	1.2 ml/min
SPLIT FLOW/RATIO	19ml/min@50deg C	43.3ml/min (40:1)	20ml/min@50deg C	20ml/min@50deg C
INITIAL TEMPERATURE	**45deg C**	**50deg C**	**50deg C**	**50deg C**
INITIAL HOLD TIME	**5.0 min**	**10 min**	**10 min**	**10 min**
RAMP1	**9deg C / min**	**25deg C / min**	**25deg C / min**	**25deg C / min**
TEMPERATURE 1 / TIME 1	**240deg C/ 6.1 min**	**220deg C/ 6.0 min**	**220deg C/ 7.2 min**	**220deg C/ 6.0 min**
RAMP2	X	X	X	X
TEMPERATURE 2 / TIME 2	X	X	X	X
TOTAL RUN TIME	32.7 min	23.0 min	24.2 min	23.0 min
CONCENTRATOR	**(Tekmar 2000)**	**(Tekmar 3100)**	**(Tekmar 3000)**	**(Tekmar 3100)**
ARCHON PURGE COND.				
VALVE/LINE TEMP.	125deg / 125deg C	110deg / 110deg C	130deg / 130deg C	130deg / 130deg C
PURGE TIME	11.0 min	11.0 min	11.0 min	11.0 min
PURGE FLOW	45ml/min	40ml/min	40ml/min	40ml/min
DRY PURGE TIME	2.0 min	2.0 min	2.0 min	2.0 min
DESORB PREHEAT	245deg C	255deg C	255deg C	255deg C
DESORB TEMPERATURE	250deg C	260deg C	260deg C	260deg C
DESORB TIME	**2.0 min**	**1.0 min**	**1.0 min**	**1.0 min**
BAKE TEMPERATURE	270deg C	270deg C	270deg C	270deg C
BAKE TIME	9.0 min	10.0 min	10.0 min	10.0 min

RTX columns are from RESTEK & DBVRX columns are from J&W.

9.0 HEALTH AND SAFETY

9.1 Care should be used in handling all samples. Safety glasses must be worn in the lab at all times. The use of blue nitrile gloves and lab coats is highly recommended.

9.2 Research into expected sample content and concentration should be done in order to be prepared for additional safety considerations. Generally, any samples that need special consideration have applicable notes on the sample logs.

9.3 MSDS sheets are available for all reagents and standards that have been purchased. These are located in the office next to the technical director.

10. WASTE MANAGEMENT AND POLLUTION PREVENTION

10.1 Please see Waste Disposal, SOP-210 and SOP-405 for proper disposal of waste coming from this area within our laboratory.

10.2 Quantity of chemicals purchased should be based on expected usage during its shelf-life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

11.0 EXAMPLE FORMS

Definitions and examples of the instrument run log, LCS report sheets (624, water and soil) and the USACE analyst data review checklist are located in the following Appendix.
When analyzing samples for DOD QSM Version 3, DOD limits will be used for surrogates, LCS, and MS/MSD.

APPENDIX

TABLE OF DEFINITIONS

1. amu- atomic mass unit
2. BFB- Bromofluorobenzene
3. °C- degrees Centigrade
4. CCC- Calibration Check Compound
5. CCV- Continuing Calibration Verification
6. CLP- Contract Laboratory Program
7. %D- percent difference
8. EICP- extracted ion current profile
9. EPA- Environmental Protection Agency
10. g- gram or grams
11. GC- Gas Chromatograph
12. GC/MS- Gas Chromatograph/Mass Spectrometer
13. ICV- Initial Calibration Verification
14. I.D.- inner diameter
15. ISTD- internal standard
16. LSC- Laboratory Sample Concentrator
17. MDL- method detection limit
18. MS- Matrix Spike
19. MSD- Matrix Spike Duplicate
20. M.S.- Mass Spectrometer
21. µm- micometer
22. µL- microliter
23. mL- milliliter
24. mm- millimeter
25. ng- nanogram
26. P&T- purge and trap
27. QC- quality control
28. %R- percent recovery
29. RPD- relative percent difference
30. %RSD- percent relative standard deviation
31. SOP- Standard Operating Procedure
32. Surr.- surrogate
33. SPCC- System Performance Check Compound
34. TCLP- Toxicity Characteristic Leaching Procedure
35. USACE- United States Army Corps Of Engineers
36. VOA- volatile organic analysis
37. LCS- Lab Control Sample

REFERENCES

1. *40 CFR, Part 136*; Appendix A
2. *Test Methods for Evaluating Solid Waste*, SW-846, Third Edition
3. *National Environmental Laboratory Accreditation Conference*; CH. 5, 2001
4. USACE, *EM 200-1-3; Appendix 1; Shell*, 2/2001
5. *DOD Quality Systems Manual for Environmental Laboratories*, 6/2002

FORM 3

WATER VOLATILE LAB CONTROL SAMPLE (624)

Lab Name: Empirical Laboratories, LLC Contract: ELAB

Lab Code: NA Batch No.: NA SAS No.: NA SDG No.:

Matrix Spike - Client Sample No.:

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC #	QC. LIMITS REC.
Acrolein	100.00	0.0000	100.000	100	NML
Acrylonitrile	100.00	0.0000	100.000	100	NML
Benzene	20.00	0.0000	20.000	100	64-136
Bromodichloromethane	20.00	0.0000	20.000	100	66-134
Bromoform	20.00	0.0000	20.000	100	71-129
Bromomethane	20.00	0.0000	20.000	100	14-186
Carbon tetrachloride	20.00	0.0000	20.000	100	73-127
Chlorobenzene	20.00	0.0000	20.000	100	66-134
Chloroethane	20.00	0.0000	20.000	100	38-162
2-Chloroethyl vinyl eth	40.00	0.0000	40.000	100	D-224
Chloroform	20.00	0.0000	20.000	100	68-132
Chloromethane	20.00	0.0000	20.000	100	D-204
Dibromochloromethane	20.00	0.0000	20.000	100	68-132
1,2-Dichlorobenzene	20.00	0.0000	20.000	100	63-137
1,3-Dichlorobenzene	20.00	0.0000	20.000	100	73-127
1,4-Dichlorobenzene	20.00	0.0000	20.000	100	63-137
1,1-Dichloroethane	20.00	0.0000	20.000	100	73-127
1,2-Dichloroethane	20.00	0.0000	20.000	100	68-132
1,1-Dichloroethene	20.00	0.0000	20.000	100	51-149
trans-1,2-Dichloroethen	20.00	0.0000	20.000	100	70-130
1,2-Dichloropropane	20.00	0.0000	20.000	100	34-166
cis-1,3-Dichloropropene	20.00	0.0000	20.000	100	24-176
trans-1,3-Dichloroprope	20.00	0.0000	20.000	100	50-150
Ethylbenzene	20.00	0.0000	20.000	100	59-141
Methylene chloride	20.00	0.0000	20.000	100	61-139
1,1,2,2-Tetrachloroetha	20.00	0.0000	20.000	100	61-139
Tetrachloroethene	20.00	0.0000	20.000	100	74-126
Toluene	20.00	0.0000	20.000	100	75-125
1,1,1-Trichloroethane	20.00	0.0000	20.000	100	75-125
1,1,2-Trichloroethane	20.00	0.0000	20.000	100	71-129
Trichloroethene	20.00	0.0000	20.000	100	67-133
Trichlorofluoromethane	20.00	0.0000	20.000	100	48-152
Vinyl chloride	20.00	0.0000	20.000	100	4-196

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

NML = No Method Limits

COMMENTS: _____

VOA Water Limits

	In-House	DOD Limits		South Carolina
1,1,1 Trichloroethane	80-125	65-130		70-130
1,1,1,2-Tetrachlorethane	70-140	80-130		70-130
1,1,2,2-Tetrachloroethane	70-130	65-130		70-130
1,1,2-Trichloroethane	80-130	75-125		70-130
1,1-Dichloroethane	75-130	70-135		70-130
1,1-Dichloroethene	70-125	70-130		70-130
1,2,4 Trichlorobenzene	45-135	65-135		70-130
1,2-Dibromo-3-chloropropane	70-130	50-130		70-130
1,2-Dibromoethane	75-130	80-120		70-130
1,2-Dichlorobenzene	70-130	70-120		70-130
1,2-Dichloroethane	70-135	70-130		70-130
1,2-Dichloropropane	75-130	75-125		70-130
1,3-Dichlorobenzene	65-125	75-125		70-130
1,4-Dichlorobenzene	70-125	75-125		70-130
2-Butanone	65-145	30-150		60-140*
2-Hexanone	70-140	55-130		60-140*
4-Methyl-2-pentanone	75-135	60-135		60-140*
Acetone	35-175	40-140		60-140*
Benzene	75-125	80-120		70-130
Bromochloromethane	80-125	65-130		70-130
Bromodichloromethane	85-135	75-130		70-130
Bromoform	70-140	70-130		70-130
Bromomethane	45-150	30-145		70-130
Carbon disulfide	65-130	35-160		70-130
Carbon tetrachloride	75-135	65-140		70-130
Chlorobenzene	75-120	80-120		70-130
Chloroethane	65-145	60-135		70-130
Chloroform	75-125	65-135		70-130
Chloromethane	45-145	40-125		70-130
Cis-1,2-Dichloroethene	80-120	70-125		70-130
Cis-1,3-Dichloropropene	75-130	70-130		70-130
Dibromochloromethane	80-140	60-135		70-130
Dibromomethane	65-140	75-125		70-130
Dichlorodifluoromethane	40-160	30-155		70-130
Ethylbenzene	75-130	75-125		70-130
Methylene chloride	70-130	55-140		70-130
M,p-Xylene	75-125	75-130		70-130
o-Xylene	75-130	80-120		70-130
Styrene	75-125	65-135		70-130
Tetrachloroethene	70-125	45-150		70-130
Toluene	75-125	75-120		70-130
Trans-1-2 Dichlorethene	70-125	60-140		70-130
Trans-1-3-Dichloropropene	70-130	55-140		70-130
Trichloroethene	80-125	70-125		70-130
Trichloroflurormethane	70-140	60-145		70-130
Vinyl chloride	65-140	50-145		70-130
MTBE	75-125	65-125		70-130

Naphthalene	45-135	55-140		70-130

*** - Poor Purger**

VOA Soil Limits

	Soil	DOD Limits		
1-1-1-2 Tetrachloroethane	75-125	75-125		
1-1-1-Trichloroethane	65-140	70-135		
1-1-2-2-Tetrachloroethane	65-130	55-130		
1-1-2-Trichloroethane	70-130	60-125		
1-1-Dichloroethane	70-135	75-125		
1-1-Dichloroethene	65-135	65-135		
1-2-4-Trichlorobenzene	55-135	65-130		
1-2-Dibromo-3-chloropropane	55-145	40-135		
1-2-Dibromoethane	70-135	70-125		
1-2-Dichlorobenzene	75-125	75-120		
1-2-Dichloroethane	65-140	70-135		
1-2-Dichloropropane	70-135	70-120		
1-3-Dichlorobenzene	70-125	70-125		
1-4-Dichlorobenzene	70-125	70-125		
2-Butanone	50-145	30-160		
2-Hexanone	50-140	45-145		
4-Methyl-2-pentanone	55-145	45-145		
Acetone	30-155	20-160		
Benzene	70-130	75-125		
Bromochloromethane	75-130	70-125		
Bromodichloromethane	70-145	70-130		
Bromoform	60-130	55-135		
Bromomethane	50-160	30-160		
Carbon disulfide	65-145	45-160		
Carbon tetrachloride	65-140	65-135		
Chlorobenzene	70-120	75-125		
Chloroethane	60-145	40-155		
Chloroform	65-135	70-125		
Chloromethane	50-150	50-130		
Dibromochloromethane	70-140	65-130		
Dibromomethane	75-125	75-130		
Dichlorodifluoromethane	35-155	35-135		
Ethylbenzene	75-125	75-125		
Methylene chloride	55-155	55-140		
Styrene	70-125	75-125		
Tetrachloroethene	65-130	65-140		
Toluene	55-140	70-125		
Trichloroethene	60-145	75-125		
Trichlorofluoromethane	60-140	25-185		
Vinyl Acetate	50-135			
Vinyl chloride	60-145	60-125		
cis-1-2-Dichlorethene	70-135	65-125		
cis-1-3-Dichloropropene	75-135	70-125		
m-p-Xylene	70-125	80-125		

o-Xylene	70-125	75-125		
trans-1-2-Dichloroethene	65-140	65-135		
trans-1-3--Dichloropropene	65-125	65-125		
MTBE	55-150			
Naphthalene	55-145	40-125		

VOA MIXES

LIQUID MIX (2000PPM)
C-610H (PRIMARY STANDARD)
M-502A-R-10X (ICV/LCS/MATRIX SPIKE)
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
n-Butylbenzene
sec-Butylbenzene
tert-butylbenzene
Carbon tetrachloride
Chlorobenzene
Chloroform
2- & 4-Chlorotoluene
Trichloroethene
Dibromochloromethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,1- & 1,2-Dichloroethane
1,1,2-Trichloroethene
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2- & 1,3-Dichloropropane
1,2,3-Trichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene
Isopropyltoluene
Methylene Chloride
Naphthalene
n-Propylbenzene
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,2,3-Trichlorobenzene

GASES MIX (2000PPM)
#30042 (PRIMARY STANDARD)
M-502B-R-10X (ICV/LCS/MATRIX SPIKE)
Bromomethane
Chloroethane
Vinyl chloride
Chloromethane
Dichlorodifluoromethane
Trichlorofluoromethane

C610H-PRIMARY STANDARD
M60310X (ICV/LCS/MATRIX SPIKE)
Acrolein (10,000PPM)
Acrylonitrile (10,000PPM)

CCS1037-PRIMARY CUSTOM MIX (5000PPM)
#557102- ICV/LCS CUSTOM MIX (5000PPM)
Tetrahydrofuran
MTBE
Methyl metacrylate
Ethyl methacrylate
1,1,2-Trichlorotrifluoroethane
Cyclohexane
Methylcyclohexane
Methyl acetate
Carbon disulfide
Iodomethane

PRIMARY and ICV/LCS STANDARD-neat
Vinyl acetate (5000PPM)

PRIMARYand ICV/LCS STANDARD-neat
2-Chloroethyl vinyl ether (20000PPM)

KETONES MIX (5000PPM)
#30006 (PRIMARY STANDARD and ICV/LCS) different lots
Acetone
2-butanone
2-hexanone
4-methyl-2-pentanone

1,2,3-Trimethylbenzene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
m-,p- & o-Xylene
1,1,1-Trichloroethene

VOA CALIBRATIONS RANGE FOR EPA8260B/624(AQUEOUS)

Liquid mix, Gases mix & primary custom mix is calibrated at these levels - 0.5ppb, 1.0ppb, 2.0ppb, 10ppb, 20ppb, 50ppb, 100ppb & 200ppb. The ketones mix, 2-chloroethyl vinyl ether & vinyl acetate are calibrated at these levels - 1.0ppb, 2.0ppb, 4.0ppb, 20ppb, 40ppb, 100ppb, 200ppb & 400ppb. Acrolein & Acrylonitrile are calibrated at these levels – 2.5ppb, 5.0ppb, 10ppb, 50ppb, 100ppb, 250ppb, 500ppb, 1000ppb.

VOA CALIBRATIONS RANGE FOR EPA8260B(SOLIDS)

Liquid mix, Gases mix & primary custom mix is calibrated at these levels – 2.0ppb, 5.0ppb, 10ppb, 20ppb, 50ppb, 100ppb & 200ppb. The ketones mix, 2-chloroethyl vinyl ether & vinyl acetate are calibrated at these levels - 2.0ppb, 10ppb, 20ppb, 40ppb, 100ppb, 200ppb & 400ppb. Acrolein & Acrylonitrile are calibrated at these levels – 5.0ppb, 10ppb, 50ppb, 100ppb, 250ppb, 500ppb, 1000ppb.

VOA LCS/ICV/MATRIX SPIKE LEVEL FOR EPA8260B

Liquid mix, Gases mix, Ethyl methacrlate, Metyl methacrylate, Tetrahydrofuran, MTBE, Trichlorotrifluoroethane, Cyclohexane, Methylcyclohexane & Methyl acetate are spiked at 50ppb level. Acrolein & Acrylonitrile spiked at 250ppb level. Acetone, 2-Butanone, 2-Hexanone, Carbon disulfide, 2-Chloroethyl vinyl ether, 4-Methyl-2-pentanone, Vinyl acetate & Iodomethane are spiked at 100ppb level.

INTERNAL STANDARD ASSOCIATION / QUANT ION TABLE

COMPOUND	QUANT MASS	* I.S.	COMPOUND	QUANT MASS	* I.S.
			Dibromomethane	93	1
*Fluorobenzene **(1)**	96		1,1,2-Trichloroethane	83	2
*Chlorobenzene-d5 **(2)**	117		1,2,3-Trichloropropane	110	2
*1,4-Dichlorobenzene-d4 **(3)**	152		Hexachlorobutadiene	225	3
			Isopropylbenzene	105	2
Bromomethane	94	1	Isopropyltoluene	119	3
Chloroethane	64	1	Methylene Chloride	84	1
Vinyl chloride	62	1	Naphthalene	128	3
Chloromethane	50	1	Propionitrile	54	1
Dichlorodifluoromethane	85	1	n-Propylbenzene	91	3
Acetonitrile	41	1	Styrene	104	2
Allyl chloride	41	1	1,1,1,2-Tetrachloroethane	131	2
Trichlorofluoromethane	101	1	1,1,2,2-Tetrachloroethane	83	3
Benzene	78	1	Tetrachloroethene	166	2
Bromobenzene	156	3	Toluene	92	2
Bromochloromethane	128	1	1,2,3-Trichlorobenzene	180	3
Bromodichloromethane	83	2	1,2,4-Trichlorobenzene	180	3
Bromoform	173	2	1,2,4-Trimethylbenzene	105	3
n-Butylbenzene	91	3	1,3,5-Trimethylbenzene	105	3
sec-Butylbenzene	105	3	m-Xylene	91	2
tert-butylbenzene	119	3	p-Xylene	91	2
Carbon tetrachloride	117	1	o-Xylene	91	2
Chlorobenzene	112	2	Acrolein	56	1
Chloroform	83	1	Acrylonitrile	53	1
Chloroprene	53	1	Tetrahydrofuran	42	1
2-Chlorotoluene	91	3	MTBE	73	1
4-Chlorotoluene	91	3	Methacrylonitrile	41	1
Dibromochloromethane	129	2	Methyl methacrylate	41	1
1,2-Dibromo-3-chloropropane	157	3	Ethyl methacrylate	69	2
1,2-Dibromoethane	107	2	1,1,2-Trichlorotrifluoroethane	101	1
1,2-Dichlorobenzene	146	3	Cyclohexane	56	1
1,3-Dichlorobenzene	146	3	Methylcyclohexane	83	1
1,4-Dichlorobenzene	146	3	Methyl acetate	43	1
1,1-Dichloroethane	63	1	Carbon disulfide	76	1
1,2-Dichloroethane	62	1	Iodomethane	142	1
1,1-Dichloroethene	96	1	Vinyl acetate	43	1
cis-1,2-Dichloroethene	96	1	2-Chloroethyl vinyl ether	63	1
trans-1,2-Dichloroethene	96	1	Acetone	43	1
trans-1,4-Dichloro-2-butene	53	3	2-butanone	43	1
1,2-Dichloropropane	63	1	2-hexanone	43	2
1,3-Dichloropropane	76	2	Isobutyl alcohol	43	1
2,2-Dichloropropane	77	1	1,4-Dioxane	88	1
1,1-Dichloropropene	75	1	4-methyl-2-pentanone	43	1
cis-1,3-Dichloropropene	75	1	Dibromofluoromethane (S)	111	1
trans-1,3-Dichloropropene	75	2	1,2-Dichloroethane-d4 (S)	102	1
Ethylbenzene	91	2	Toluene-d8 (S)	98	2
1,1,1-Trichloroethane	97	1	Bromofluorobenzene (S)	95	2
Trichloroethene	95	1			

***I.S=internal Standard.**
S=surrogate.

ANALYST DATA REVIEW CHECKLIST

Sample Number(s):	
Batch Number(s):	
Method:	**8260B/8270C (Circle One)**

QA/QC Item	Yes	No	NA	Second Level Review
1. Is the BFB/DFTPP tune performed every 12 hours and is the tuning criteria met?				
2. Are the RRFs and % RSDs within QC limits for appropriate analytes for the initial calibration? Check the retention times for compounds with the same spectra. Check compounds with different conc.(eg. m/p-xylene, ketones,etc.).				
3. Was the initial calibration curve verified by a second source calibration standard (ICV) and have criteria been met?				
4. Does the Continuing Calibration Standard (CCV) meet the criteria for the CCCs and SPCCs.				
5. Is the Method Blank run at the desired frequency and is its concentration for target analytes less than the MDLs?				
6. Are the LCS, MS, MSD within control limits and run at the desired frequency?				
7. Are all sample holding times met, analytes within calibration range, IS areas and surrogate recoveries within QC limits?				
8. Was the Method Blank, LCS, MS, MSD and samples loaded to the GCMS_LFSYS Tablespace within the Target DB Database?				

Comments on any "No" response:

Primary-Level Review: _____ Date: _____

Second-Level Review: _____ Date: _____

APPENDIX E

LABORATORY CERTIFICATION

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Scope of Accreditation For Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
1-877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2012**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Di-isopropyl ether
GC/MS	8260B	ETBE
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	t-Butyl alcohol
GC/MS	8260B	tert-Amyl methyl ether
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	Caprolactam
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA
GC/ECD	8151A	MCPP (Mecoprop)
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	3,5-Dinitroaniline
HPLC/UV	8330A	PETN
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	8011	1,2-Dibromoethane (EDB)
GC/ECD	8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7470A	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium
ICP	6010B/C	Vanadium
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Titanium
IC	300.0	Chloride
IC	300.0	Fluoride

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	300.0	Nitrate
IC	300.0	Nitrite
IC	300.0	Sulfate
IC	9056A	Chloride
IC	9056A	Fluoride
IC	9056A	Nitrate
IC	9056A	Nitrite
IC	9056A	Sulfate
Titration	SM 2320B 20th ed.	Alkalinity
ISE	SM 4500 B, D, 20th ed.	Ammonia
UV/Vis	7196A	Hexavalent Chromium
Colorimetric	353.2	Nitrate/Nitrite
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th edition	Total Phosphorus
UV/Vis	SM 4500 PE, 20th edition	Ortho-Phosphorus
TOC	9060A/SM5310C, 20th edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th edition	TDS
Colorimetric	9012A/B	Cyanide
Physical	1010A	Ignitability
Physical	9095B	Paint Filter
Probe	9040B/C	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	3005A	Metals digestion
Preparation	3010A	Metals digestion
Preparation	3510C	Organics Liquid Extraction
Preparation	5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	Caprolactam

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA
GC/ECD	8151A	MCPP (Mecoprop)

Solid and Chemical Materials

Technology	Method	Analyte
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	PETN
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7471A/B	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	6010B/C	Vanadium
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Titanium
UV/Vis	7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	9034	Sulfide
Probe	9045D	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	3050B	Metals Digestion
Preparation	3546	Organics Microwave Extraction
Preparation	3541	Organics Soxhlet Extraction
Preparation	3550B	Organics Sonication
Preparation	SM 2540B 20th edition	Percent Solids (Percent Moisture)
Preparation	5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: November 30, 2009

R. Douglas Leonard
Chief Technical Officer

Issued: 11/30/09