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US Army Corps of Engineers
Kansas City District

Final Quality Assurance Project Plan

Remedial Investigation/ Feasibility Study
Raritan Bay Slag Superfund Site
Old Bridge/ Sayreville, New Jersey

USACE Contract No. W912DQ-08-D-0018
Task Order No. 018

October 2010

Final Quality Assurance Project Plan for Remedial Investigation/Feasibility Study Raritan Bay Slag Superfund Site Remedial Investigation/ Feasibility Study Old Bridge/ Sayreville, New Jersey

USACE CONTRACT No. W912DQ-08-D-0018

TASK ORDER No. 018

October 29, 2010

Prepared for:
U.S. Army Corps of Engineers
Kansas City District

Prepared by:
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October 29, 2010

Kansas City District Corps of Engineers
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Project: Contract No. W912DQ-08-D-0018

Subject: Final Remedial Investigation/ Feasibility Study Quality Assurance Project Plan
Remedial Investigation/ Feasibility Study
Raritan Bay Slag Superfund Site
Old Bridge/ Sayreville, New Jersey

Dear Ms. Stein and Ms. Mitchell:

CDM is pleased to submit the enclosed Final Remedial Investigation/ Feasibility Study Quality Assurance Project Plan for the Raritan Bay Slag Superfund Site in Old Bridge/ Sayreville, New Jersey.

Please feel free to contact me at (732) 590-4695 should you require additional information.

Very truly yours,

CDM FEDERAL PROGRAMS CORPORATION

Edward Leonard, CHMM
Task Order Manager

Enclosures

cc: L. Mauel, EPA (1 copy)
J. Mosher, CDM (letter only)
J. Oxford, CDM (1 copy)
J. Mayo, CDM (1 copy)
File

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Acronyms

AA	atomic absorption
ABS	absolute difference
AES	atomic emission spectrophotometry
Ag	silver
ANSETS	Analytical Services Tracking System
APP	accident prevention plan
ASC	analytical services coordinator
ATSDR	Agency of Toxic Substances and Disease Registry
ATV	all-terrain vehicle
bgs	below ground surface
BS	Bachelor of Science
BTAG	Biological Technical Assistance Group
C	Celsius
CA	corrective action
CCV	continuing calibration verification
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHMM	Certified Hazardous Materials Manager
CIH	certified industrial hygienist
CLP	contract laboratory program
COC	chain of custody
CQCP	contractor quality control plan
CQM	certified quality manager
CRQL	contract required quantitation limits
CSP	certified safety professional
DESA	Division of Environmental Science and Assessment
DO	dissolved oxygen
DQIs	data quality indicators
DQOs	data quality objectives
DV	data validation
DMC	deuterated monitoring compound
ECD	electron capture detector
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
ERA	ecological risk assessment
eV	electron volt
FASTAC	Field and Analytical Services Teaming Advisory Committee
FID	flame ionization detector
FS	feasibility study
FTL	field team leader
GC/ECD	gas chromatograph / electron capture detector
GC/MS	gas chromatograph / mass spectroscopy
GPS	global positioning system
H&S	health and safety

H_2SO_4	sulfuric acid
HCL	hydrochloric acid
HDPE	high density polyethylene
HHRA	human health risk assessment
HSM	health and safety site manager
ICP	inductively coupled plasma
ID	identification
IDW	investigation derived waste
IR	infra-red
L	liter
LAN	local area network
LCS	laboratory control samples
MDL	minimum detection limit
mL	milliliter
min	minute
MPC	measurement performance criteria
MW	monitoring well
MS	mass spectrophotometer
MS/ MSD	matrix spikes /matrix spike duplicates
mV	millivolt
NA	not applicable
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
ORP	oxidation reduction potential
OU	operable unit
PAL	project action limit
PC	personal computer
PCB	polychlorinated biphenyls
PE	professional engineer
PID	photo-ionization detector
PM	project manager
ppm	parts per million
PQL	project quantitation limit
PQLG	project quantitation limit goal
PQO	project quality objective
PTFE	polytetrafluoroethylene
QA	quality assurance
QAC	quality assurance coordinator
QAPP	quality assurance project plan
QC	quality control
QL	quantitation limit
QP	quality procedure
RA	remedial action
RAS	routine analytical services
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study

ROD	record of decision
RPD	relative percent difference
RPM	remedial project manager
RQAC	regional quality assurance coordinator
RRF	relative response factor
RSCC	Regional Sample Control Coordinator
RSD	relative standard deviation
SA	self assessment
S&A	sampling and analytical
SCBA	self contained breating apparatus
SIM	simultaneous ion monitoring
SOP	standard operating procedure
SOW	scope of work
SpC	specific conductivity
SSHO	site health and safety officer
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TOC	total organic carbon
TOM	task order manager
TRW	Technology Review Workgroup
TSOP	Technical Standard Operating Procedure
TSWP	Treatability Study Work Plan
µg	microgram
µg/kg	microgram per kilogram
µg/L	microgram per liter
UFP	Unified Federal Policy
USFWS	US Fish & Wildlife Service
VOA	volatile organic analysis
VOC	volatile organic compound
VTSR	verified time of sample receipt
°C	degrees Celsius
%	percent
%D	percent difference
%R	percent recovery

1.0 Introduction

Under the United States Army Corps of Engineers (USACE), Kansas City District, Contract No. W912DQ-08-D-0018, Task Order No. 018, CDM Federal Programs Corporation (CDM) has been tasked to provide technical services to complete a Remedial Investigation/Feasibility Study (RI/FS) for the Raritan Bay Slag Superfund Site (the site) located in Old Bridge and Sayreville, Middlesex County, New Jersey.

The overall purpose of this task order is to define the nature and extent of contaminant sources in sufficient detail to support preparation of the following reports:

- Remedial Investigation (RI) Report
- Human Health Risk Assessment (HHRA)
- Ecological Risk Assessment (ERA)
- Feasibility Study (FS)
- Record of Decision (ROD)

The media to be investigated during the RI include soil, surface water, sediment, biota, and groundwater.

This project-specific RI/FS Quality Assurance Project Plan (QAPP) has been prepared in accordance with the Uniform Federal Policy (UFP)-QAPP manual (EPA 2005) and is compliant with EPA's Requirements for Quality Assurance Project Plans QA/R-5 (EPA 2001) and EPA's Guidance for Quality Assurance Project Plans G-5 (EPA 2002). This project will be implemented in accordance with the quality procedures in CDM's QA Manual (CDM 2007) as modified by CDM's USACE contract (6400/6402) Quality Implementation Plan (CDM 2009) and this QAPP. This QAPP and the Accident Prevention Plan (APP) for the RI/FS field activities are the governing documents for execution of this work.

1.1 Site Overview

The Raritan Bay Slag Superfund Site is located in Old Bridge, Laurence Harbor, and Sayreville, New Jersey, encompassing wetlands, shoreline and beaches, upland areas adjacent to the shore, and sediments in the near-shore of Raritan Bay. Approximately 40 years ago, slag from a secondary lead smelter was used to construct a seawall along Raritan Bay and to augment a jetty on the western side of the Cheesequake Creek inlet. In the secondary lead smelter process, lead-acid batteries and other lead-containing material were melted in a smelter kettle. The valuable metals were skimmed from the top, and the residue on the bottom, the slag, formed a hard material when cooled. The dense rock-like properties of the slag made it an attractive material to use for seawall and jetty construction. QAPP Worksheet #10 and Section 1.2 below provide more information on the site description and history.

1.2 Site Background and Path Forward

In 2007, elevated levels of lead, antimony, arsenic, and copper were identified by the New Jersey Department of Environmental Protection (NJDEP) in the soil along the

seawall and at the edge of the beach near the western end of the seawall. A September 2008 EPA investigation included the collection of soil, sediment, water, biological, and waste samples from along the seawall in Laurence Harbor, the western jetty at the Cheesequake Creek Inlet, the beaches near these two locations, and the developed portion of the park. Analytical results from both investigations indicate that levels of lead and other heavy metals are present at concentrations exceeding applicable standards in the soils, sediment, and surface water in and around both the seawall and western jetty. Additionally, elevated levels of lead and other metals were detected to the east of the seawall in the Margaret's Creek wetland area during sampling associated with work done on a force main that traverses the area.

At the EPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency of Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the seawall in Laurence Harbor, the beach between the western end of the seawall and the first jetty, and the western jetty at the Cheesequake Creek Inlet, including the waterfront area immediately west of the inlet. As a result of this determination, EPA restricted access to these areas (by installing fences and posting signs) and provided public outreach to inform residents and those using these areas of the health hazard that exists.

The sampling and analysis activities proposed as part of this RI are intended to fill data gaps identified in the 2010 CDM Final (Revised) Data Gap Evaluation Technical Memorandum, and thus support potential response actions at the site, such as installation or construction of a jetty. A feasibility study will be prepared to evaluate remedial technologies and remedial alternatives for the site.

1.3 Additional Project Planning Documents

To expedite the field program, two QAPPs have been previously prepared and approved to conduct remedial investigation activitiels at the site. The Early Actions QAPP, dated April 12, 2010, included the slag distribution survey, which was a series of up to 30 test trenches, including collecting soil samples. Revision 1 to the Early RI QAPP, dated August 5, 2010, included the hydrologic assessment, current and sediment transport profiles, and topographic and bathymetric surveys. This Final RI QAPP covers remaining RI/FS activities, including: surface water sampling; sediment sampling, soil sampling; groundwater sampling; biota sampling; geochronology sampling; bioavailability sampling; Technical Working Group (TRW) soil sampling; background location sampling; and data management.

QAPP Worksheet #1
Title and Approval Page

FINAL QUALITY ASSURANCE PROJECT PLAN (QAPP)
for
Remedial Investigation/Feasibility Study
Raritan Bay Slag Superfund Site
Old Bridge/ Sayreville, New Jersey

Prepared by: CDM Federal Programs Corporation (CDM)
125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123

Date: October 29, 2010

CDM Task Order Manager: Edward Leonard

Signature _____

CDM QA Manager: Doug Updike

Signature _____

EPA Project Manager: Tanya Mitchell

Signature _____

USACE Project Manager: Kristine Stein

Signature _____

EPA QA Officer: William Sy

Signature _____

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project:	Raritan Bay Slag Superfund Site
Site Location:	Old Bridge/ Sayreville, New Jersey
Operable Unit:	NA
Site Number/Code:	NJN000206276
Contractor Name:	CDM
Contractor Number:	W912DQ-08-D-0018
Contract Title:	Unrestricted Indefinite Delivery/Indefinite Quantity, Multiple Award Contract, for Architect-Engineer (AE) Environmental Services for EPA Region 2 and the Corps of Engineers Northwestern Division
Task Order Number:	018
Guidance used to prepare QAPP:	Uniform Federal Policy for QAPPs and EPA QA/R-5
Regulatory Program:	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Approval Entity:	EPA Region 2, USACE-Kansas City District
Is QAPP Generic or Project Specific:	Project-Specific QAPP for Remedial Investigation
Dates of scoping sessions:	March 11, 2010 (See worksheet #9)

Dates and Titles of QAPP Documents Written for Previous Site Work, if Applicable:
April 12, 2010 Final Quality Assurance Project Plan for Early Actions – Test Pit Investigations
August 3, 2010 Revision 1 Final Quality Assurance Project Plan for Early Actions

Organizational Partners (stakeholders) and Connection with Lead Organization:
USACE, EPA

Data Users:
CDM, EPA Region 2, and USACE

Required QAPP elements and required information that are not applicable to the project, and an explanation for their exclusions:
N/A

QAPP Worksheet #2
QAPP Identifying Information
(continued)

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Worksheet No.
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications - Special Personnel Training Requirements	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 Introduction & 10 Figure 1 Figure 2
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 *Development of Project Quality* Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance *Criteria*	- Site-Specific PQOs - Measurement *Performance Criteria*	11 12
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations	13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation - Project Schedule/Timeline	14 15 Figure 10

QAPP Worksheet #2
QAPP Identifying Information
(continued)

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Worksheet No.
Project Management and Objectives		
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements - Analytical Methods/SOP Requirements - Field Quality Control Sample Summary - Sampling SOPs - Project Sampling SOP References - Field Equipment Calibration, Maintenance, Testing, and Inspection	17 Figures 3-8 Table 1 18 19 20 21 Appendix B 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References - Analytical Instrument Calibration - Analytical Instrument and Equipment Maintenance, Testing, and Inspection	23 24 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	26 Appendix B 27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples - Screening/Confirmatory Analysis Decision Tree	28 & 20

QAPP Worksheet #2
QAPP Identifying Information
(continued)

QAPP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to QAPP Worksheet No.
Project Management and Objectives		
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records - Analytical Services - Data Management SOPs	29 30 14
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments - Audit Checklists - Assessment Findings and Corrective Action Responses	31 32
4.2 QA Management Reports	- QA Management Reports	33
4.3 Final Project Report	- Final Report(s)	
Data Review		
5.1 Overview		NA
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process - Validation (Steps IIa and IIb) Process - Validation (Steps IIa and IIb) Summary - Usability Assessment	34 35 36 37
5.3 Streamlining Data Review 5.3.1 Data review steps to be streamlined 5.3.2 Criteria for streamlining data Review 5.3.3 Amounts and Types of Data appropriate for Streamlining	NA	NA

QAPP Worksheet #3
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address
Tanya Mitchell	Remedial Project Manager (RPM)	EPA	(212) 637-4362	(212) 637-3966	mitchell.tanya@epa.gov
William Sy	QA Officer	EPA	(732) 632-4766	(732) 321-6622	Sy.william@epa.gov
Kristine Stein	Project Manager	USACE-KC	(816) 389-3172	-	Kristine.M.Stein@usace.army.mil
Amy Darpinian	Project Chemist	USACE-KC	(816) 389-3897	-	Amy.F.Darpinian@usace.army.mil
Jackie Mosher	Contract Manager	CDM	(816) 444-8270	(816) 444-8232	Mosherjm@cdm.com
Edward Leonard	Task Order Manager (TOM)	CDM	(732) 590-4695	(732) 225-7851	leonardel@cdm.com
Scott Kirchner	Project Chemist/Analytical Services	CDM	(732) 590-4677	(732) 225-7851	kirchnersf@cdm.com
John Dougherty	Project Hydrogeologist	CDM	(732) 590-4652	(732) 225-7851	doughertyjn@cdm.com
Jeniffer Oxford	Regional QA Coordinator (RQAC)/ Project QA Officer	CDM	(212) 377-4536	(212) 785-6114	oxfordjm@cdm.com
Joseph Mayo	RI Task Leader/Senior Technical Reviewer	CDM	(212) 377-4517	(212) 785-6114	mayojj@cdm.com
Seth Kellogg	Geologist	CDM	(732) 590-4674	(732) 225-7851	kelloggds@cdm.com
Jeff Rakowski	Field Team Leader (FTL)	CDM	(732) 590-4665	(732) 225-7851	rakowskijj@cdm.com

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: CDM

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Jackie Mosher, P.E., BCEE	Contract Manager	(816) 444 8270		
Edward Leonard, CHMM	TOM	(732) 590-4695		
Scott Kirchner, CHMM	Project Chemist/Analytical Services	(732) 225-7000		
Joseph Mayo, CHMM	RI Task Leader/Senior Technical Reviewer	(212) 377-4517		
Seth Kellogg, PG	Geologist	(732) 590-4674		
Jeniffer Oxford, CHMM	RQAC	(212) 377-4536		
Jeff Rakowski	FTL	(732) 590-4665		

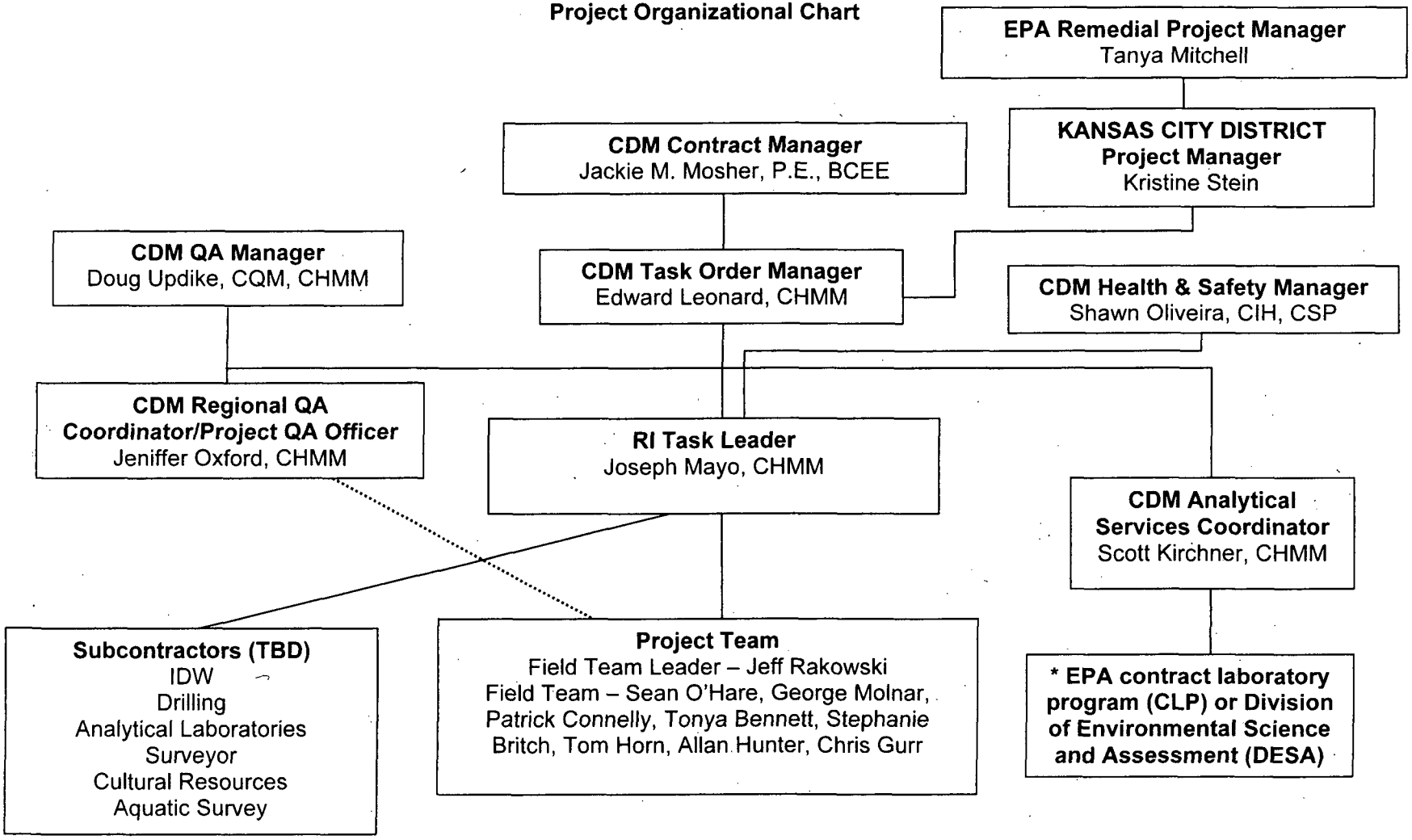
Organization: EPA

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Tanya Mitchell	RPM	(212) 637-4362		
William Sy	QA Officer	(732) 632-4766		

Organization: USACE

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Kristine Stein	Project Manager	(816) 389-3172		
Amy Darpinian	Project Chemist	(816) 389-3897		

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with USACE and EPA	CDM TOM	Edward Leonard	(732) 590-4695	All information about the project will be sent to Kristine Stein (USACE) and Tanya Mitchell (EPA) by the CDM TOM. Field changes will be discussed with the USACE PM and EPA Remedial Project Manager (RPM) prior to implementation.
Manage Field Tasks	RI Task Leader	Joseph Mayo	(212) 377-4517	Act as liaison to TOM concerning investigation activities. Daily communication with project team and TOM. Communicate implementation issues to FTL.
Facilitate Database Setup and Data Management Planning	FTL	Jeff Rakowski	(732) 590-4665	Provide sample location, sample ID, and analysis information prior to sample collection. Provide information on sample and analytical reporting groups, and types of report tables required for project.
QAPP Changes in the Field	FTL	Jeff Rakowski	(732) 590-4665	Notify RI Task Leader immediately and complete a Field Change Notification (FCN) form and/or corrected worksheets. Send FCN forms to QAC.
	RI Task Leader	Joseph Mayo	(212) 377-4517	Notify USACE PM, EPA RPM, CDM TOM and Analytical Services Coordinator (ASC) of delays or changes to field work.
Completion of Daily Summary Reports	FTL	Jeff Rakowski	(732) 590-4665	Complete on a daily basis and submit to TOM and RI Task Leader. TOM will forward to USACE PM and EPA RPM upon request.
Booking of Analytical Services	FTL	Jeff Rakowski	(732) 590-4665	Submit request to ASC before the timeframe below.
	Analytical Services Coordinator (ASC)	Scott Kirchner	(732) 225-7000	Book Division of Environmental Science and Assessment (DESA) and Contract Laboratory Program (CLP) analytical services through Regional Sample Control Center (RSCC) 3 weeks prior to sampling and 6 weeks prior to sampling for special requests.

QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Notification of Analytical Issues	ASC	Scott Kirchner	(732) 225-7000	Notify FTL of any sample collection/ shipment issues. Notify RSCC, DESA or subcontract laboratories to initiate corrective action.
Field Corrective Action	Field auditor, RI Task Leader, FTL, and Field Team	TBD, J Mayo, J. Rakowski	TBD, (212) 377-4517, (732) 590-4665	TOM, RI Task Leader, FTL, per CDM QA manual requirement corrective actions may also be identified by the field team. FTL initiates corrective action on identified field issues immediately or within QAM recommended timeframe.
Analytical Services Support	ASC	Scott Kirchner	(732) 225-7000	Act as liaison with RSCC for CLP laboratories, with John Birri for DESA, and with subcontract laboratory (ies).
Facilitate Data Management	FTL	Jeff Rakowski	(732) 590-4665	Provide electronic survey data, sample ID, locations and analyses. Transmit completed sample tracking information to data manager by the completion of each sampling case.
Reporting of Issues Relating to Analytical Data Quality (including ability to meet reporting limits, and usability of data)	ASC	Scott Kirchner	(732) 225-7000	Communicate to TOM as appropriate
	Data Assessor	Jeniffer Oxford	(212) 377-4536	Communicate to TOM as appropriate. Document situation and effect in a data quality report prepared prior to evaluation of data in the technical memorandum and remedial investigation (RI) report.
Release of Analytical Data	ASC	Scott Kirchner	(732) 225-7000	Receive and review data packages before data is used. Initiate data validation of subcontract laboratory data.
Site Health and Safety Issues	Site Health and Safety Officer	Jeff Rakowski	(732) 590-4665	Conduct Daily Health and Safety Meetings, make decisions regarding health and safety issues and upgrading PPE. Communicate to TOM, RI Task Leader, Health and Safety Manager, and field staff as appropriate

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Edward Leonard, CHMM	TOM	CDM	Oversee project and responds to EPA RPM. Manages subcontractors.	B.S., Biology; M.S., Environmental Science; 25 years of experience in environmental programs.
Joseph Mayo, CHMM	RI Task Leader	CDM	Oversees RI Tasks, responsible for implementing the field activities	B.S., Biology; MS. Environmental Science; 26 years experience in environmental investigations
Jeniffer Oxford, CHMM	QA Coordinator/ Project Chemist	CDM	Oversee adherence to QA requirements	B.S., Natural Sciences; 7 years experience in analytical chemistry; 20 years experience in environmental science
Thomas Matthew, P.E.	FS Task Manager	CDM	Oversees FS Tasks	B.S. Civil Engineering; M.S. Sanitary/Water Resources Engineering P.E.; 16 years experience in Environmental Engineering
Shawn Oliveira, CIH	Health and Safety Manager	CDM	Oversees adherence to Health and Safety requirements	B.S. Chemistry; M.S. Environmental Engineering; Certified Safety Professional (#18988); Certified Industrial Hygienist from the American Board of Industrial Hygiene.
Scott Kirchner, CHMM	ASC, Database Manager	CDM	Communicate with EPA RSCC, DESA and subcontract laboratories; oversee data management, validation and data packages.	B.S. Chemistry, Environmental Science Certified Hazardous Materials Manager, 20 years experience.
John Dougherty, PG	Project Hydrogeologist	CDM	Oversee and provide guidance on the drilling program and analyze the geologic data	B.S. Geosciences; P.G.; 24 years experience in hydrogeology

QAPP Worksheet #7
Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jeff Rakowski	FTL	CDM	Oversee all field investigation activities	B.A., Geography; 6 years field experience
George Molnar	Project Ecologist	CDM	Performs ecological risk assessment	M.S. Environmental Science, 16 years of field experience
Nai-chia Luke, PhD	Project Human Health Risk Assessor	CDM	Performs human health risk assessment	M.S. Plant Physiology; Ph.D. Plant Physiology; 29 years of experience in directing, managing, and performing environmental projects with emphasis on human health and ecological risk assessments.
Patrick Connelly, Tonya Bennett	Field Geologist	CDM	Performs field investigations	Degreed geologist with 3+ years of experience
Tom Horn, Sean O'Hare, Stephanie Britch	Field Sampler	CDM	Performs field investigations	Degreed field staff with 3+ years experience
Seth Kellogg, PG	Geologist	CDM	Responsible for implementing the field activities	M.S. Geology, 17 years of experience in environmental field
Christopher Gurr	Staff Scientist/Engineer	CDM	Performs feasibility study	B.S. Chemistry; M.S., M. Eng. Environmental Engineering; 8 years of experience in environmental field.

Note:
1. An individual can fill as many roles as he or she is qualified.

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
All Field Activities	40-hour OSHA Training and Annual 8 hour refresher	40 hour - EPA or vendor;	various	All CDM and subcontractor personnel that will be onsite	CDM staff, subcontractors	CDM H&S database and on site
All Field Activities	Site Supervisor Training	H&S Manager	various	Site H&S officer	Site H&S officer	CDM H&S database and on site
Sample Collection	Trained in EPA CERCLA sampling methods, and field testing procedures	On-site training	various	All personnel that perform sample collection	All personnel that perform sample collection	CDM and onsite
Sample Analysis	Trained in EPA analytical methods	Laboratory and vendor training	various	Subcontract laboratory personnel - TBD	Laboratory personnel	Laboratory
Data Validation	Data validation RAS and non-RAS data	EPA	various	Data validators	DESA/EPA/CDM Data Validators	CDM DV staff files
Data Review/ Assessment	None, performed by experienced chemists	N/A	various	CDM chemists	All personnel used for project data review	CDM
QA Audits	EPA G-7 auditor training	CDM	various	CDM auditors	QAC and designated field auditors	CDM
Self Assessments (SA)	SA training	CDM Quality Assurance Coordinators (QACs)	various	Assigned project personnel	Assigned project personnel	CDM

Other tasks requiring specialized skills and training will be performed by appropriate subcontractors. Training, certification, and permit requirements will be outlined in separate scopes of work for each task and project.

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Projected Date(s) of Sampling: September 2010 through January 2011 **Task Order Manager:** Edward Leonard	**Site Name:** Raritan Bay Slag Site **Site Location:** Old Bridge/ Sayreville, NJ **Operable Unit**: NA
Scoping Session Purpose: RI/FS – March 11, 2010. Scoping	

Name	Affiliation	Phone #	E-mail Address	Project Role
Tanya Mitchell	EPA	(212) 637-4362	mitchell.tanya@epa.gov	RPM
Kristine Stein	USACE	(816) 389-3172	kristine.m.stein@usace.army.mil	PM
Edward Leonard	CDM	(732) 590-4695	leonardel@cdm.com	TOM
Joseph Mayo	CDM	(212) 377-4517	mayojj@cdm.com	RI Task Leader

Conference Call/ Email Discussions:

Date	Participants/ Email List	Topic/Discussion	Comments/Decisions
4/29/10	EPA RPM, USACE PM, NOAA, USFWS, NJDEP, CDM TOM and CDM RI Task Leader	Data Gap Technical Memorandum Presentation	Discussed the risk assessment approach. The sediment/soil interface definition was discussed. Margaret's Creek wetland southwest of Route 35 could be a background location.
6/9/10	EPA RPM, USACE PM, CDM TOM and CDM RI Task Leader	Next Steps Streamlining Meeting	Discussed options for streamlining the RI/FS. CDM agreed to review the schedule to identify ways to streamline the RI/FS.

QAPP Worksheet #10
Problem Definition

Problem Summary

The main objectives of the RI/FS include:

- Characterizing the nature and extent of contamination in site media
- Obtaining data to perform the HHRA and ERA
- Obtaining data to develop remedial alternatives for the site

This QAPP covers RI/FS activities. Early RI field activities were covered in the August 3, 2010 Revision 1 Final QAPP for Early Actions.

Site Description

Figure 1 shows the site location. The Site spans approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. The portion of the Site that is situated in Laurence Harbor is part of what is now called the Old Bridge Waterfront Park. The park is made up of walking paths, a playground area, several public beaches, and three jetties, not including the two jetties at the Cheesequake Creek Inlet. The park waterfront is protected by a seawall, which is partially constructed with pieces of slag. The western jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty are located in Sayreville and also contain slag. The seawall, jetties, beach area east of the Cheesequake Creek Inlet, and the western jetty at the Cheesequake Creek Inlet are popular fishing areas. The beaches east of the Cheesequake Creek Inlet and west of the seawall appear to be the most popular for swimming.

The site is divided into 11 Site Areas (Figure 2) based on areas identified in historical investigations and reports, site physical characteristics, and the locations of known or potential sources.

- Area 1: Laurence Harbor Seawall - The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
- Area 2: Laurence Harbor Beach - The beach area at the foot of Laurence Parkway between the western end of the seawall and the first jetty.
- Area 3: Laurence Harbor Playground - The park playground adjacent to the western end of the seawall.
- Area 4: Old Bridge Waterfront Park - The park area along the seawall (not including the playground) from the fence to the roadway.
- Area 5: Laurence Harbor Beach - The beach area between the first and third jetty.
- Area 6: Laurence Harbor Beach - The beach area between the third jetty and Cheesequake Creek Inlet eastern jetty.
- Area 7: Cheesequake Creek Inlet - The inlet between the eastern and western jetties from the Route 35 Bridge into Raritan Bay to the extent of sediment deposition.
- Area 8: Cheesequake Creek Inlet Western Jetty - The jetty west of the inlet in Sayreville..
- Area 9: Margaret's Creek - The wetlands associated with the Creek (between the beach and Route 35), including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
- Area 10: Background Area – The historical background sampling location.
- Area 11: Depositional Areas – The potential depositional areas associated with Areas 7 and 8.

QAPP Worksheet #10
Problem Definition

Site History
Approximately 40 years ago, slag from a secondary lead smelter was used to construct a seawall along Raritan Bay and to augment a jetty on the western side of the Cheesequake Creek inlet. The placement of the slag at the site has resulted in the leaching of heavy metals, including lead, arsenic, antimony, chromium, and copper, into the surrounding Raritan Bay surface water, sediments, and near-shore soils. Additionally, as the saltwater weathers the slag, particles from the slag erode and mix into the sediments and soils at the site. The Margaret's Creek wetland east of the seawall contains waste materials including lead-acid battery casings.

In 2007, elevated levels of lead, antimony, arsenic, chromium, and copper were identified by the NJDEP in the soil along the seawall and at the edge of the beach near the western end of the seawall. A September 2008 EPA investigation included the collection of soil, sediment, water, biological, and waste samples from along the seawall in Laurence Harbor, the western jetty at the Cheesequake Creek Inlet, the beaches near these two locations, and the developed portion of the park. Analytical results from both investigations indicate that levels of lead and other heavy metals are present at concentrations exceeding applicable standards in the soils, sediment, and surface water in and around both the seawall and western jetty. Additionally, elevated levels of lead and other metals were detected to the east of the seawall in the Margaret's Creek wetland area during sampling associated with work done on a force main that traverses the area.

At the EPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the seawall in Laurence Harbor, the beach between the western end of the seawall and the first jetty, and the western jetty at the Cheesequake Creek Inlet, including the waterfront area immediately west of the inlet. As a result of this determination, EPA restricted access to these areas (by installing fences and posting signs) and provided public outreach to inform residents and those using these areas of the health hazard that exists.

Project Description
CDM is tasked to define the nature and extent of contaminant in sufficient detail to support preparation of the following:
- Remedial Investigation (RI) Report
- Human Health Risk Assessment (HHRA)
- Ecological Risk Assessment (ERA)
- Feasibility Study (FS)
- Record of Decision (ROD)

The RI will evaluate the nature and extent of contamination in both the upland and wetland portions of Margaret's Creek. The media to be investigated during the RI include surface and subsurface soil, surface water, sediment, biota, and groundwater.

QAPP Worksheet #10
Problem Definition

A preliminary identification of sources of contamination, transport mechanisms, and likely areas of contaminant accumulation (including sediment depositional zones) was made by CDM during its June 2010 data gap evaluation, and summarized in the preliminary conceptual site model (CSM). Based upon a review of the CSM and existing data, the field investigation will be organized into three geographic regions associated with the known or suspected sources of contamination as follows:

- Seawall Sector: Upland, beach, and tidal areas potentially impacted by slag material in and around the seawall (Areas 1, 2, 3, 4, 5, and 6);
- Jetty Sector: Upland, beach, and tidal areas potentially impacted by slag material in and around the western Cheesequake Creek Inlet jetty (Areas 7, 8, and 11); and
- Margaret's Creek Sector: Upland, beach, and wetlands potentially impacted by unknown contamination in and around Margaret's Creek (Area 9).
- Area 10 has been identified as a location for the collection of site-specific soil, sediment, and surface water background samples.

Additional objectives include:

- characterize surface water flow patterns and sediment transport dynamics with current meters and geochronology samples;
- characterize groundwater-surface water interactions, vertical and horizontal groundwater flow, and provide a groundwater quality baseline;
- identify and quantify potential human health and ecological risks posed by exposure to contaminated soil, surface water, sediment, groundwater and biota;
- conduct treatability studies of the source material (slag) and contaminated soils and sediments in order to develop remedial alternatives;
- develop and screen remedial alternatives; and to conduct detailed analysis of a full range of appropriate remedial alternatives to support selection of a remedy and preparation of a ROD for the site

As a part of this RI/FS, CDM will perform activities described in this QAPP. The sampling activities will generate data to support conceptual site models, define the area and extent of contamination, and focus subsequent field investigation conducted as part of the RI/FS.

Worksheet #10
Problem Definition

Project Decision Conditions

1. If the soil samples collected during the RI field activities do not characterize the horizontal and vertical extent of contamination, then additional soil investigation activities will be discussed with USACE and EPA.
2. If the soil samples collected during the RI field investigation exceed the project action limits (PAL) (see worksheet #15), then remedial alternatives will be developed and evaluated in the FS.
3. If the surface water samples collected during the RI field activities do not characterize the extent of contamination, then additional surface water investigation activities will be discussed with USACE and EPA.
4. If the surface water samples collected during the RI field investigation exceed the PALs (see worksheet #15), then remedial alternatives will be developed and evaluated in the FS.
5. If the sediment samples collected during the RI field activities do not characterize the horizontal and vertical extent of contamination, then additional sediment investigation activities will be discussed with USACE and EPA.
6. If the sediment samples collected during the RI field investigation exceed the PALs (see worksheet #15), then remedial alternatives will be developed and evaluated in the FS.
7. If the groundwater samples collected during the RI field activities do not characterize the extent of contamination, then additional groundwater investigation activities will be discussed with USACE and EPA.
8. If the groundwater samples collected during the RI field investigation exceed the PAL (see worksheet #15), then remedial alternatives will be developed and evaluated in the FS.

If background samples collected during the RI field activities are not sufficient to support valid statistical analysis of data, then the need for more samples will be discussed with USACE and EPA.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

Who Will Use the Data? Data will be used by:
EPA, USACE, and CDM. Data Quality Objective (DQO) Tables for project objectives are included as Table 2.a through 2.g.

What Will the Data be Used For?
- To determine the presence and distribution of buried slag in areas adjacent to the seawall.
- To define levels of soil, sediment and surface water contamination at the site.
- To determine the exchange of sediments and contaminants in the area.
- To support the FS, HHRA, ERA, and RI activities.

What Type of Data is Needed?
Soil Investigation Samples: (See Worksheet #18)
- Target Analyte List (TAL) metals including mercury
- Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs)
- Hexavalent Chromium
- Total Organic Carbon (TOC), pH and grain size
- Bioavailabilty and Electron microprobe testing for Arsenic and Lead

Sediment Investigation Samples: (See Worksheet #18)
- TAL metals including mercury
- TCL VOCs, SVOCs, pesticides, and PCBs
- Hexavalent Chromium
- TOC, pH and grain size.
- Geochronology: Cesium -137, Berylium-7

Groundwater Samples: (See Worksheet #18)
- TAL metals including mercury
- TCL VOCs, SVOCs, pesticides, and PCBs
- Hexavalent Chromium
- Total Suspended Solids (TSS), pH, Chloride, Hardness, Alkalinity, Sulfate, Sulfide, Total Kjeldahl Nitrogen (TKN), nitrate, ammonia, and ferrous iron

Surface Water Samples: (See Worksheet #18)
- Total and dissolved metals including mercury
- Hexavalent Chromium

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

- TSS, pH, Chloride, Hardness, Alkalinity

TRW Samples (Sediment): (See Worksheet #18)
- Lead

Biota Samples: (See Worksheet #18)
- TAL Metals including mercury
- Lipids

How "good" do the data need to be in order to support the environmental decision?
The project-specific action limits and quantitation limits for each sampled media are specified on Worksheet #15. In addition, data will support the risk assessments. EPA's Field and Analytical Services Teaming Advisory Committee (FASTAC) policy for obtaining laboratory resources will be utilized for sampling events. Data must meet the DQOs that have been specified for the site as per Worksheets #12, 15 and 28. Definitive level data will be required for decisions characterizing the site and for the RI/FS. Data packages shall support level 4 data validation.

Where, when, and how should the data be collected?
The soil, surface water, and sediment samples will be collected from Areas 1, 2, 3, 4, 5, 6, 7, 8, 9 and 11. The groundwater samples will be collected from Areas 1, 5, 6, 8, and 9. Background surface water, sediment, and soil samples will be collected from Area 10 (Figure 7). Wetland sediment and surface water background samples will be collected from Whaler's Creek, a wetland similar to the Margaret's Creek wetland. Background groundwater samples will be collected from an upgradient monitoring well that will be drilled in residential area. Worksheet #17 presents the sampling program design and rationale. Worksheet # 18 presents the sampling locations and methods. Worksheet # 21 provides the standard operating procedures (SOPs) that govern the various types of sampling. Figure 10 shows the schedule of each activity.

Who will collect and generate the data?
CDM will collect the analytical samples that will be shipped to EPA's DESA and/or CLP laboratories for analysis, or to subcontract laboratories.

How will the data be reported?
Samples analyzed by the CLP will be validated by an EPA contractor or by EPA staff; EPA DESA staff will validate samples analyzed by the DESA laboratory. Samples analyzed by the subcontract laboratories will be validated by CDM validators. DESA and CLP-validated analytical data will be forwarded to CDM for evaluation and use in the RI, risk assessments, and FS reports. Analytical data will be received in electronic and hard copy. Analytical data will be uploaded to the Environmental Quality Information Systems (EQuIS) database, version [5.3.2]. The database query and reporting tools will be used to create a project data management system as specified by the project team. The reports will be submitted to USACE and EPA for review. CDM will use Geographic Information Systems (GIS) and other graphics software to facilitate spatial analysis of data and to generate figures for reports and presentations.

QAPP Worksheet #11
Project Quality Objectives /Systematic Planning Process Statements

How will the data be archived?

- Data (Form 1s) will be faxed or e-mailed to CDM within the specified turnaround time.
- Final CLP/DESA data will be submitted to CDM in electronic format and hard copy consistent with CLP deliverables.
- Electronic data will be input into the project's EQuIS database.
- EPA will archive CLP laboratory raw data in its document control system.
- Hard copies of field data including field logs will be archived in the project files.
- Hard copies of analytical data received by CDM will be archived in the project files for 10 years after contract expiration.
- At the end of the project all data in the database will be provided to the EPA. The data deliverable will meet EPA Region 2 electronic data deliverable (EDD) requirements.

QAPP Worksheet #12a
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TCL Volatile Organics
Concentration Level	Trace (µg/L)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2 Also refer to QAPP Worksheet #23	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
		Accuracy	Range is 28-155%R. See Worksheet #28	***DMCs; MS/MSD**	A

*Reference EPA Region 2 SOP No. 34 for Trace VOA - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**Optional MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 6 for Criteria – Not typically required for Region 2
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM01.2, Exhibit D, Table 5 for Criteria
Worksheet 15i and 15o shows the specific compounds for which trace VOC analysis required.

QAPP Worksheet #12b
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TCL Volatile Organics
Concentration Level	Low/Medium (µg/L)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
	Also refer to QAPP Worksheet #23	Accuracy	%R – see worksheet #28	***DMCs; MS/MSD**	A

*Reference EPA Region 2 SOP No. 33 for Low/Medium VOA - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**Optional MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 6 for Criteria – Not typically required for Region 2
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM01.2, Exhibit D, Table 5 for Criteria

QAPP Worksheet #12c
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TCL Semivolatiles
Concentration Level	Low/Medium (µg/L)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
		Accuracy	%R – see worksheet #28	***DMCs; MS/MSD**	A
	Also refer to QAPP Worksheet #23				

*Reference EPA Region 2 SOP No. 35/Low/Medium Semivolatile - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**Optional MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 6 for Criteria – Not typically required for Region 2
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM01.2, Exhibit D, Table 5 for Criteria

QAPP Worksheet #12d
Measurement Performance Criteria Table

Matrix	Aqueous				
Analytical Group	TCL Pesticides				
Concentration Level	Low/Medium (µg/L)				
Sampling Procedure	**Analytical Method/SOP**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Refer to QAPP Worksheet #21	SOM01.2 Also refer to QAPP Worksheet #23	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
		Accuracy	%R – see worksheet #28	***LCS; MS/MSD**	A

*Reference EPA Region 2 SOP No. 36/Low/Medium Pesticide - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 3 for Criteria – Not typically required for Region 2
***Laboratory Control Sample (LCS) – Reference CLP SOM01.2, Exhibit D, Table 2 for Criteria

QAPP Worksheet #12e
Measurement Performance Criteria Table

Matrix	Aqueous				
Analytical Group	TCL Aroclors (PCBs)				
Concentration Level	Low/Medium (µg/L)				
Sampling Procedure	**Analytical Method/SOP**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
	Also refer to QAPP Worksheet #23	Accuracy	%R – see worksheet #28	***LCS; MS/MSD**	A

*Reference EPA Region 2 SOP No. 37/Low/Medium Aroclor - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 1 for Criteria – Not typically required for Region 2
***Laboratory Control Sample (LCS) – Reference CLP SOM01.2, Exhibit D, Table 2 for Criteria

QAPP Worksheet #12f
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	TCL Volatiles
Concentration Level	Low/Medium (µg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2 Also refer to QAPP Worksheet #23	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
		Accuracy	%R – see worksheet #28	***DMCs; MS/MSD**	A

*Reference EPA Region 2 SOP No. 33/ VOCs (SIM/ Low/ Medium) - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**Optional MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 6 for Criteria – Not typically required for Region 2
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM01.2, Exhibit D, Table 5 for Criteria

QAPP Worksheet #12g
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	TCL Semivolatiles
Concentration Level	Low/Medium (µg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
	Also refer to QAPP Worksheet #23	Accuracy	%R – see worksheet #28	***DMCs; MS/MSD**	A

*Reference EPA Region 2 SOP No. 35/SVOCs - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**Optional MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 6 for Criteria – Not typically required for Region 2
***Deuterated Monitoring Compounds (DMCs) – Reference CLP SOM01.2, Exhibit D, Table 5 for Criteria

QAPP Worksheet #12h
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	TCL Pesticides
Concentration Level	Low/Medium (µg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
	Also refer to QAPP Worksheet #23	Accuracy	%R – see worksheet #28	***LCS; MS/MSD**	A

*Reference EPA Region 2 SOP No. 36/Low/Medium Pesticide - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 3 for Criteria – Not typically required for Region 2
***Laboratory Control Sample (LCS) – Reference CLP SOM01.2, Exhibit D, Table 2 for Criteria

QAPP Worksheet #12i
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	TCL Aroclors (PCBs)
Concentration Level	Low/Medium (µg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SOM01.2	Precision	%RPD – see worksheet #28	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	%RPD – see worksheet #28	Field Duplicate; MS/MSD**	S & A
	Also refer to QAPP Worksheet #23	Accuracy	%R – see worksheet #28	***LCS; MS/MSD**	A

*Reference EPA Region 2 SOP No. 36/Low/Medium Pesticide - Blank Type Criteria Table and refer to Worksheet 15 for the required quantitation limits.
**MS/MSD – Reference CLP SOM01.2, Exhibit D, Table 3 for Criteria – Not typically required for Region 2
***Laboratory Control Sample (LCS) – Reference CLP SOM01.2, Exhibit D, Table 2 for Criteria

QAPP Worksheet #12j
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TAL Metals, Hardness
Concentration Level	ICP-AES (µg/L)

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 25% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
	Also refer to QAPP Worksheet #23	Accuracy	75–125%; 80–120%	*** Matrix Spike LCSW****	A A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Duplicate Sample Criteria - (include absolute difference criteria)
***Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Spike Sample Criteria
****Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for aqueous Laboratory Control Sample (LCSW) Criteria w/exception of silver (Ag) and antimony (Sb)
Hardness results will be calculated by CDM using the TAL metals result.
Hardness = 2.497[Ca, mg/L] + 4.118[Mg, mg/L] = milligram equivalent $CaCO_3$/L. (Standard Methods for Examination of Water and Wastewater. 19th Edition. 1995).

QAPP Worksheet #12k
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TAL –Total Mercury
Concentration Level	Cold Vapor Atomic Absorption (CVAA)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 25% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
	Also refer to QAPP Worksheet #23	Accuracy	75–125%	*** Matrix Spike;	A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-MS for Duplicate Sample Criteria - - (include absolute difference criteria)
***Reference EPA CLP ILM05.4, Exhibit D of ICP-MS for Spike Sample Criteria

QAPP Worksheet #12I
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	TAL –Total Cyanide
Concentration Level	Colorimeter or Spectrophotometer

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 25% RPD*	*Field Duplicate*	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
		Accuracy	75–125%	*** Matrix Spike	A
	Also refer to QAPP Worksheet #23				

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP- (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-MS for Duplicate Sample Criteria - (include absolute difference criteria)
***Reference EPA CLP ILM05.4, Exhibit D of ICP-MS for Spike Sample Criteria

QAPP Worksheet #12m
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	TAL Metals
Concentration Level	ICP-AES (mg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 75% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
	Also refer to QAPP Worksheet #23	Accuracy	75–125%	*** Matrix Spike; LCS****	A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Duplicate Sample Criteria
***Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Spike Sample Criteria
****Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for solid Laboratory Control Sample (LCS) Note: Control Limits established by EPA for LCS

QAPP Worksheet #12n
Measurement Performance Criteria Table

Matrix	Tissue
Analytical Group	TAL Metals
Concentration Level	ICP-AES (mg/kg)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 75% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
	Also refer to QAPP Worksheet #23	Accuracy	75–125%	*** Matrix Spike; LCS****	A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Duplicate Sample Criteria
***Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Spike Sample Criteria
****Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for solid Laboratory Control Sample (LCS) Note: Control Limits established by EPA for LCS

QAPP Worksheet #12o
Measurement Performance Criteria Table

Matrix	*Soil/sediment*
Analytical Group	TAL –Total Mercury
Concentration Level	Cold Vapor Atomic Absorption (CVAA)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 75% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
		Precision	≤ 20% RPD*	Duplicate Sample **	A
	Also refer to QAPP Worksheet #23	Accuracy	75–125%	*** Matrix Spike; LCS****	A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP – (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Duplicate Sample Criteria
Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Spike Sample Criteria*Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for solid Laboratory Control Sample (LCS) Note: Control Limits established by EPA for LCS

QAPP Worksheet #12p
Measurement Performance Criteria Table

Matrix	Tissue
Analytical Group	TAL –Total Mercury and Cyanide
Concentration Level	Cold Vapor Atomic Absorption (CVAA)

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ILM05.4	Precision	≤ 75% RPD*	Field Duplicate	S & A
		Accuracy	No analyte > CRQL*	Field Blank	S & A
	Also refer to QAPP Worksheet #23	Precision	≤ 20% RPD* ≤35% RPD for cyanide	Duplicate Sample **	A
		Accuracy	75–125%	*** Matrix Spike; LCS****	A

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP – (include absolute difference criteria) and refer to Worksheet 15 for the required quantitation limits.
**Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Duplicate Sample Criteria
Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for Spike Sample Criteria*Reference EPA CLP ILM05.4, Exhibit D of ICP-AES for solid Laboratory Control Sample (LCS) Note: Control Limits established by EPA for LCS

QAPP Worksheet #12q
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Wet Chemistry
Concentration Level	Ion Chromatography

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Chloride by EPA 300 Also refer to QAPP Worksheet #23	Precision	≤ 25% RPD[3] ABS ≤ 5xQL	Field Duplicate	S & A
		Accuracy	No analyte > QL*	Field Blank	S & A
		Accuracy	≤ 10 degrees Celsius	Temperature Blank	S
		Precision	≤ 40% RPD[3]	Duplicate Sample	A
		Sensitivity	Detection limits meet project goals No analyte > QL*	Method Blank	A
		Accuracy	80–120%; 75–125%; 90-110% recovery	Laboratory Fortified Blank; Matrix Spike; Calibration Standard Verification	A
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).

*Refer to Worksheet 15 for the required quantitation limits and D for DESA's limits.

QAPP Worksheet #12r
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Wet Chemistry
Concentration Level	Colorimetry; Spectrophotometry

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Alkalinity Ammonia Nitrate Sulfate Sulfide Total Kjeldahl Nitrogen (TKN) Hexavalent Chromium Also refer to QAPP Worksheet #23	Precision	≤ 25% RPD[3] ABS ≤ 5xQL	Field Duplicate	S & A
		Accuracy	No analyte > QL*	Field Blank	S & A
		Accuracy	≤ 10 degrees Celsius	Temperature Blank	S
		Precision	≤ 40% RPD[3]	Duplicate Sample	A
		Sensitivity	Detection limits meet project goals No analyte > QL*	Method Blank	A
		Accuracy	75–125%; 80-120% recovery	Matrix Spike; LCS	A
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).

*Refer to Worksheet 15 for the required quantitation limits and Appendix D for DESA's limits.

QAPP Worksheet #12s
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Wet Chemistry
Concentration Level	Titration or potentiometer

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Alkalinity Method 310.2 Also refer to QAPP Worksheet #23	Precision	≤ 25% RPD[3] ABS ≤ 5xQL	Field Duplicate	S & A
		Accuracy	No analyte > QL*	Field Blank	S & A
		Accuracy	≤ 10 degrees Celsius	Temperature Blank	S
		Precision	≤ 40% RPD[3]	Duplicate Sample	A
		Sensitivity	Detection limits meet project goals No analyte > QL*	Method Blank	A
		Accuracy	80-120 % recovery	LCS	A
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).

*Refer to Worksheet 15 for the required quantitation limits and Appendix D for DESA's limits.

QAPP Worksheet #12t
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Wet Chemistry
Concentration Level	Gravimetry

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Total Suspended Solids SM2540D Also refer to QAPP Worksheet #23	Precision	≤ 25% RPD[3] ABS ≤ 5xQL	Field Duplicate	S & A
		Accuracy	No analyte > QL*	Field Blank	S & A
		Accuracy	≤ 10 degrees Celsius	Temperature Blank	S
		Precision	≤ 40% RPD[3]	Duplicate Sample	A
		Sensitivity	No analyte > QL*	Method Blank	A
		Accuracy	80-120% recovery	LCS	A
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[2] DESA worksheet in Appendix D and DESA's SOP contain the analytical criteria.
[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).

*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12u
Measurement Performance Criteria Table

Matrix	Soil/sediment
Analytical Group	Total Organic Carbon
Concentration Level	Organic Carbon Analyzer

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Lloyd Kahn	Precision	≤ 75% RPD[3] ABS ≤ 5xQL*	Field Duplicate	S & A
		Accuracy	80–120% 75–125%	Mid Range calibration verification standard; Near detection Limit Standard	
	Also refer to QAPP Worksheet #23	Precision	≤ 75% RPD[3]	Duplicate Sample	A
		Accuracy	< 3xStandard deviation	Quadruplicate analysis	A
		Accuracy	4± 6 degrees Celsius	Temperature Blank	S
		Completeness	≥ 90%	Data Assessment	S&A

[2] A subcontract laboratory will be utilized, the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).
*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12v
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	pH
Concentration Level	0-12

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SW-846, 9045D Also refer to QAPP Worksheet #23	*Precision*	≤ 75% RPD[3] ABS ≤ 5xQL*	Field Duplicate	S & A
		Precision	≤ 75% RPD[3]	Duplicate Sample	A
		Accuracy	± 0.05 pH units	Standard buffer solution	A
		Completeness	≥ 90%	Data Assessment	S&A

[2] A subcontract laboratory will be utilized, the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).
*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12w
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Grain size
Concentration Level	Hydrometer

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	ASTM D421-85 & D422-63	Precision	≤75% RPD[3] ABS ≤ 5xQL*	Field Duplicate	S & A
	Also refer to QAPP Worksheet #23	Precision	≤ 75% RPD	Duplicate Sample	A

[2] A subcontract laboratory will be utilized, the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).
*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12x
Measurement Performance Criteria Table

Matrix	*Soil/Sediment*
Analytical Group	Hexavalent Chromium
Concentration Level	Colorimeter or Spectrophotometer

Sampling Procedure	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SW-846 3060A and 7196A	Precision	≤75% RPD[3] ABS ≤ 5xQL*	*Field Duplicate*	S & A
		Accuracy	No analyte > QL*	Field Blank	S & A
		Precision	≤75% RPD	Duplicate Sample	A
		Accuracy	75–125%; 80-120% recovery	Matrix Spike; LCS	A
		Sensitivity	Detection limits meet project goals No analyte > QL*	Method Blank	A
	Also refer to QAPP Worksheet #23	Accuracy	4± 6 degrees Celsius	Temperature Blank	S
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[2] A subcontract laboratory will be utilized; the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results. The absolute difference (ABS) will be calculated for all results failing the RPD; where only one result is detected; or one or both results are reported below the quantitation limit (QL).
*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12y
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group	Geochronology - Cs-137 and Be-7
Concentration Level	Gamma Spectroscopy

Sampling Procedure[1]	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Awaiting information from the laboratory	TBD	Precision	TBD	Field Duplicate	S & A
		Accuracy		Field Blank	S & A
		Precision		Duplicate Sample	A
		Accuracy		Matrix Spike; LCS	A
		Sensitivity		Method Blank	A
		Accuracy		Temperature Blank	S
		Completeness		Data Assessment	S & A
		Comparability		Data Review	S & A

TBD = To be determined

QAPP Worksheet #12z
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	Wet Chemistry Field Test Kits
Concentration Level	HACH Test Kits

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	Ferrous Iron HACH Method 8146 Also refer to QAPP Worksheet #23	Precision	≤ 50% RPD[3]	Field Duplicate	S & A
		Precision	≤ 50% RPD for samples	Confirmatory versus Field Screening Sample	A
		Accuracy	80-120% recovery	LCS	A
		Sensitivity	Detection limits meet project goals No Analyte> QL	Method Blank	A
		Completeness	≥ 90%	Data Assessment	S & A
		Comparability	Similar Units (mg/L)	Data Review	S & A

[3] RPDs (relative percent difference) will be determined for all detected results.

QAPP Worksheet #12aa
Measurement Performance Criteria Table

Matrix	Soil/Sediment				
Analytical Group	Arsenic and Lead				
Concentration Level	In Vitro Assay/Electron Microprobe				
Sampling Procedure	**Analytical Method/SOP[1,2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Refer to QAPP Worksheet #21	*In Vitro* Bioaccessibility Geochemical Speciation EPA Method 9200.1-86 Also refer to QAPP Worksheet #23	Precision	≤ 50% RPD[3]	Field Duplicate	S & A
		Precision	≤ 10% RPD	Control Soil Sample	A
		Accuracy	75-125% recovery	Matrix Spike;	A
			85-115% recovery	LCSW	A
		Sensitivity	≤ 5 µg/L lead	Bottle Blank	A
			Arsenic – TDB[4]		

[1] Source: U.S. Environmental Protection Agency (EPA). 2008. *Standard Operating Procedure for an In Vitro Bioaccessibility Assay for Lead in Soil.* EPA 9200.1-86. November.
[2] If a subcontract laboratory is utilized, the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results.
[4] To be determined when laboratory subcontract is finalized

QAPP Worksheet #12ab
Measurement Performance Criteria Table

Matrix	Tissue
Analytical Group	Lipids
Concentration Level	N/A

Sampling Procedure	Analytical Method/SOP[1,2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Refer to QAPP Worksheet #21	SM2540B or equivalent Using the Bligh Dyer extraction procedure Also refer to QAPP Worksheet #23	Precision	RPD[3] ≤ 40% if concentration ≥5 CRQL*	Field duplicates	S & A
		Accuracy/Bias	75-125 %R or Per laboratory SOP	Certified Reference Material	A
		Precision	RPD ≤ 20%[3]	Lab Duplicate	A
		Accuracy/ Representativeness	<10 degrees Celsius (DV)	Temperature Blank checks or equivalent	S & A
		Comparability	*Comparable units, and methods*	*Evaluated during DQA*	S & A
		Completeness	≥ 90%	Evaluated during DQA	S & A
		Accuracy	Per laboratory SOP	Balance calibration	A

[1] Bligh,E.G. and Dyer,W.J. 1959. A rapid method for total lipid extraction and purification. Can.J.Biochem.Physiol. 37:911-917.
[2] If a subcontract laboratory is utilized, the laboratory will provide the SOP as part of the procurement.
[3] RPDs (relative percent difference) will be determined for all detected results.
*Refer to Worksheet 15 for the required quantitation limits.

QAPP Worksheet #12ac
Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group	In-field Measurements
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria*	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
[1]Refer to QAPP Worksheet #21	Manufacturer's Instruction manuals	Representativeness	± 0.1	pH (standard units)	S & A
			± 3%	Conductivity (µSiemens)	S & A
			± 10 mV	Redox potential (Eh) (millivolts)	S & A
			± 10%	Turbidity	S & A
			± 10%	Dissolved Oxygen	S & A
			Flow rate	Field monitored – rate as determined in project-specific QAPP	S & A

*Measurement Performance Criteria (MPC) are project specific. The MPC is expected to be between these values.

QAPP Worksheet # 13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Previous investigation sampling results	Chemical Assessment Report, Characterization of Slag/Waste Material, Fate and Transport of Contaminants, and Biomonitoring of Contaminants.	Lockheed Martin, June 2009	- Summarize the available historical data - Perform a preliminary evaluation of the quality of existing data and its suitability for use. - Determining gaps in the existing data in order to define the nature and extent of contamination. -Support the delineation of the nature and extent of the contamination for the RI and support the FS and risk assessments. -Propose data collection activities to address the data gaps.	Data generated by these investigations are usable for the RI/FS planning and assessments since the data have been validated and assessed appropriately.
	Trip Report: Raritan Bay Sediment Sampling	Lockheed Martin, August 2009		
	Technical Memorandum, Geophysical Survey for Raritan Bay Slag Site.	Lockheed Martin, July 2009		
	Summary Letter Report, Phase II, Raritan Bay Slag, Old Bridge and Sayreville, New Jersey.	Weston Solutions, Inc., January 2009		
	Summary Letter Report, Phase II, Raritan Bay Slag, Old Bridge and Sayreville, New Jersey.	Weston Solutions, Inc., June 2009		
	Test Excavation Data Summary Report	CDM, August 2010		

QAPP Worksheet #14
Summary of Project Tasks

Project Tasks:
The major elements of the field investigation to be conducted in the 4 sectors identified in the Work Plan and in Worksheet #10 of this QAPP as the Seawall Sector, the Jetty Sector, the Margaret's Creek Sector, and Area 10 for background sampling include:

- Sampling and analysis to determine statistically significant background concentrations of contaminants
- Sampling and analysis of sediments and soils
- Sampling and analysis of surface water
- Sampling and analysis of groundwater
- Sampling and analysis of tissues

Sampling Tasks:
Environmental sampling will be conducted to supplement the existing data set and delineate the horizontal and vertical extent of contamination at the site in order to address the data gaps identified during the Data Gap Evaluation. Environmental sampling will be conducted subsequent to the topographic and bathymetric surveys, the current and sediment transport profiles (all covered under a previous QAPP for the site), and the groundwater-surface water interactions study. Details regarding the media sampled, the number of locations per medium, the sampling depth intervals, sample rationale, and laboratory analysis are provided in Table 1. The location, depth or media classification of samples may be revised based on the results of the early RI investigation (currently in progress) including the results of the bathymetry, topography, current and sediment transport profiles, and the groundwater-surface water interactions study. The revised table will be added to the Final RI/FS QAPP via a field change notification (FCN) or addenda, as appropriate.

Tidal stage will be recorded in field logbooks during all sampling activities. It is anticipated that sampling locations will be readily accessible by boat or foot and will be reconnoitered prior to conducting sampling activities. Sampling locations are in upland, beach, and tidal areas. The Seawall and Jetty sectors may be impacted by slag materials. Margaret's Creek Sector may be impacted by unknown contamination.

Sediment Sampling
- Sediment sampling will be conducted in the Seawall Sector and all Areas in the Jetty and Margaret's Creek Sectors (Figures 4 to 6).
- Sediment samples will be collected by subcontractor with a vessel-mounted vibracore sampler in inundated areas and a platform-mounted vibracore sampler in non-inundated areas.
- Surface and subsurface sediment samples will be collected from cores recovered by the drilling subcontractor. Subsurface sediment samples will be collected from intervals between 24 and 48 inches below the ground surface (bgs).
- Extended depth sediment samples will be collected from intervals between 48 and 72 inches bgs.
- Sediment sample collection procedures are described in Worksheet #17d.

QAPP Worksheet #14
Summary of Project Tasks

Soil Sampling
- Soil sampling will be conducted at all sectors (Figures 4 to 6).
- Surface soil samples will be collected by hand or with a hand-held push-corer from the ground surface to 12 (for ERA) or 24 (for HHRA) inches bgs.
- Subsurface soil samples will be collected from direct push technology (DPT) soil cores recovered by the drilling subcontractor. Subsurface soil samples to be collected from intervals between 24 and 48 inches bgs.
- Extended depth soil samples will be collected from intervals between 48 and 72 inches bgs.
- Soil sample collection procedures are described in Worksheet #17e.

Surface Water Sampling
- Surface water sampling will be conducted in the Seawall Sector and all Areas in the Jetty and Margaret's Creek Sectors (Figures 4 to 6). Surface water samples in Seawall and Jetty Sectors will be collected from Raritan Bay. Surface water samples in Margaret's Creek Sector will be collected from Margaret's Creek and associated wetlands.
- Surface water quality parameters will be collected prior to sampling: dissolved oxygen (DO), pH, temperature, salinity, turbidity, specific conductance (SpC), and oxidation reduction potential (ORP).
- Sampling will be conducted while wading or from a boat (shallow draft for Margaret's Creek Sector).
- Surface water grab samples will be collected as close to the sediment surface as possible but sufficiently above it so as to minimize capture of sediment in the sample.
- Surface water sample collection procedures are described in Worksheet #17c.

Groundwater Sampling
- Groundwater sampling will be conducted at 22 new and 3 existing monitoring wells (Figure 9).
- Groundwater will be purged with a Grundfos Redi-Flo2 submersible pump in accordance with the procedures outlined in "Groundwater Sampling SOP for Raritan Bay Slag Site (Appendix C).
- Groundwater purging and sample collection procedures are described in Worksheet #17f.

Geochronology Sampling
- Geochronology sampling will be conducted in wetlands of Margaret's Creek Sector if environmental sampling results indicate that contamination may warrant remedial action, depositional zones in the wetlands are identified, and evidence of filling activities or disturbance in the core sample location has not been found or suspected.
- A subcontractor will collect sediment cores with a vessel-mounted vibracore sampler in inundated areas and a platform-mounted vibracore sampler in non-inundated areas.
- Cores will be sealed for shipment to the laboratory.
- Geochronology sampling will be conducted at known depositional zones at 3 different areas in Area 9 that are both contaminated and depositional.

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Summary of Project Tasks

- At each of the 3 locations, 3 cores will be collected from the top meter of sediments: 2 cores for laboratory analysis, 1 core for follow-up analyses – (total 9 cores).

Biota Sampling
Biota Sample collection procedures are described in Worksheet #17g.
Fish

- Collect approximately 10 samples of the of representative fish species at the site (possibly summer flounder (i.e., fluke), striped bass, bluefish, cunner, black sea bass, or sea robin) from the Raritan Bay and intertidal zones of the Seawall and Jetty Sectors in Areas 1, 2, 5, and 6 adjacent to the site and Cheesequake Creek jetty area. Sufficient mass will be collected to achieve analytical volume of 40 grams requirements for each sample.
- Fish will be collected using common fish collection methods (trawling, gill nets, or hook and line, as appropriate). A scientific collection permit will be obtained from the New Jersey Department of Environmental Protection (NJDEP) for collection of the fish species listed above.
- Each fish sample will be a composite of five (if possible) individuals of a single species. The fish will be taxonomically identified, and the weight and length of each individual will be recorded..
- Fish will be filleted, and fillets will be weighed and composited to achieve analytical volume requirements for each sample. Samples will be homogenized at the laboratory and a representative aliquot will be obtained for analysis.
- Filets will be frozen with dry ice and shipped to the laboratory for analysis.

Clams or Mussels

- Collect approximately 10 samples of hard clams (or mussels if the habitats are not suitable for clams) from the intertidal zone: 10 samples from Areas 1, 2, 5, and 6, and from the Cheesequake western jetty. Sufficient clams or mussels will be collected to achieve analytical volume requirements.
- Clams will be collected using a clam rake.
- As a goal, each sample will consist of ten individual clams, however, depending on availability, samples may consist of fewer individuals.
- Individual clams or mussels will be shucked, and the flesh and liquor will be composited by area, to the extent practical. Shells will be discarded.

Blue Crab

- Collect approximately 20 samples of crab tissue: 10 samples of crab muscle tissue and 10 samples of crab hepatopancreas tissue. Samples will be collected from Areas 1, 2, 5, and 6, and the western jetty. Samples will be collected from two locations within each area. As a goal, each sample will consist of a composite of tissue from five individuals. However, based on availability, fewer individuals may constitute a sample provided that sample mass requirements can be met.
- Crabs will be collected using standard recreational or commercial baited crab traps. Long-handled dip nets may also be used where appropriate such as along the western jetty or if crabs are visually located. Individuals will be placed in ziplock bags identifying the area of collection, and held on dry ice in a cooler for transport to a central processing area. Crabs will be dissected at the laboratory to isolate the muscle tissue and hepatopancreas tissue for analysis. Dissection will be done on frozen crabs to minimize cross-contamination between the muscle and hepatopancreas tissues. Each tissue will be homogenized prior to analysis.

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Bioavailability and Electron Microprobe Sampling

- Sediment and soil samples will be collected from the following four areas (Figure 8):
  - Upland sections of Areas 2, 5, and 6
  - Intertidal sections of Areas 2, 5, and 6
  - Area 3
  - Upland section of Area 9
- 10 sediment and soil samples from each area (total 40 samples) to be collected from 0 to 24 inches bgs.
- Approximately 50 grams of sample will be collected from each sampling location.
- Bioavailability and electron microprobe sample collection procedures are described in Worksheets #17d and e.

Technical Review Workgroup (TRW) Sampling

- Soil samples will be collected from the following four areas (Figure 3):
  - Area 2 (33 samples)
  - Area 3 (3 samples)
  - Area 5 (114 samples)
  - Area 6 (135 samples)
- Sampling will be conducted in accordance with the *Lead-Contaminated Residential Sites Handbook* (EPA 2003), prepared by the EPA Technical Review Workgroup for Metals and Asbestos Lead Sites (TRW).
- 5-point composite samples will be collected from ¼-acre sections. The locations of the centerpoints of these samples are depicted in attached Figure 3. The four surrounding points will be within 50 feet of the sample's respective centerpoint.
- Samples will be collected from 0 to 2 inches bgs.
- Samples will be sieved by the laboratory, so adequate volume will be collected to achieve sample volume requirements.
- TRW sample collection procedures are described in Worksheet #17d.

Background Sampling

- Background sampling will be conducted in Area 10, the Background Sector (Figure 7).
- Soil samples will be collected from the following three areas:
  - 10 locations above the mean high tide line
  - 10 locations in the intertidal zone above Spring Tide low tide line and below mean high tide line
  - 10 locations above the Spring Tide low tide line
- Sediment samples will be collected from the following four areas:
  - 10 locations in the intertidal zone above Spring Tide low tide line and below mean high tide line
  - 10 locations above the Spring Tide low tide line
  - 10 locations in organic sediments in Margaret's Creek wetlands (depth to be evaluated in field but is anticipated to be 0 to 6 inches bgs)
  - 10 locations in inorganic sediments in Margaret's Creek wetlands (depth to be evaluated in the field)

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Summary of Project Tasks

- 10 surface water samples collected as close to the sediment surface as possible but sufficiently above it so as to minimize capture of sediment in the sample.
- One upgradient groundwater sample will be collected at a location to be determined during an on-site reconnaissance (Figure 9).
- Background sample collection procedures are described in Worksheets #17c, d, e, and f.

Analysis Tasks: See Worksheets #11 and 20. Analysis will be performed by EPA and subcontract laboratory(ies) as required. Crabs will be dissected by the laboratory to separate muscle tissues and hepatopancreas. Fish and clams will be homogenized and extracted prior to analysis.

Quality Control Tasks: See Worksheet #20 for Field QA/QC samples and Worksheet #28 for specific method QA/QC requirements.

Secondary Data:
Secondary data listed in Worksheet #13 have been reviewed and used to plan sample locations.

Data Management Tasks:
Analytical data will be imported into the EQuIS database after validation. Field measurements will also be added to the database.

- Form I data will be e-mailed or faxed to CDM within the specified turn-around-time.
- All final laboratory data will be submitted to CDM in electronic format consistent with CLP deliverables. The ASC will review all analytical data.
- Hard copies of analytical data received by CDM will be archived in the project file.
- Electronic data will be uploaded into the CDM database system.
- Electronic data will be consistent with EPA Region 2 requirements for electronic data deliverable (EDDs).
- Electronic analytical data will be archived on CDs and copies of CDs will be forwarded to USACE and EPA.
- At the end of the project all data in the database will be provided to EPA. The data deliverable will meet EPA Region 2 electronic data deliverable (EDD) requirements.

CDM's FTL is responsible for tracking samples from the point of field collection to submittal for laboratory analysis and the subsequent data validation and data management efforts. The sample handling and custody requirements, including field logs and generation of sample paperwork, sample labels and custody seals (TSOP 1-2) discussed in Worksheets #26 and #27, will be followed. Trip reports discussed in Worksheet #34 will be prepared by the FTL and reviewed and submitted by the ASC within 7 days of sampling completion. Worksheet #34 further addresses trip reports. The laboratory QA requirements including laboratory audits and contract compliance screening will be followed according to procedures described below and in Worksheet #23. Routine analytical services (RAS) data and non-RAS data will be validated by DESA or EPA; EPA will be responsible for tracking and maintaining custody of the laboratory data packages through the data validation process. Data validation will be conducted in accordance with the procedures described in Worksheets #35 and #36 of this QAPP. Once the data is validated, it will be input into CDM's database.

FORMS II Lite, a project-specific electronic spreadsheet will be developed for sample tracking purposes prior to field activities. The tracking system will be initiated in the field during sample collection and will be updated during the sample analysis and data validation phases. The data will be

QAPP Worksheet #14
Summary of Project Tasks

entered by project staff and then checked by the ASC for accuracy. This tracking system will ensure that no data is lost during the data management process.

The following information is recorded in the tracking system:
Sample Number
I. Area of Concern
II. Sample Matrix
III. SDG Number
IV. CLP Case No.
V. CLP No.
VI. Analytical Parameter
VII. Collection Date
VIII. Shipment Date
IX. Date Received from Lab
X. Date Submitted for Data Validation
XI. Name of Data Validator
XII. Date of Data Validation Completion
XIII. Database Entry Date
XIV. Database QC Date
XV. Comments (i.e., MS/D designation, duplicate samples).

Analytical data collected during the field effort will be entered into an EQuIS database management system. This management system will include location and environmental data. The database management system will provide data storage, retrieval, and analytical capabilities. The system will be able to meet a full range of site and media sampling requirements since it will be able to interface with a variety of spreadsheet, word processing, statistical, and graphics software packages.

To facilitate the use of the database, CDM will provide the laboratories with a detailed format specification for the delivery of analytical data in an EDD. Once it is uploaded into the database, validated analytical data will be organized, formatted, and input into the database for use in the data evaluation phase. A 100 percent QC check will be performed to ensure accuracy of all hand-entered data (i.e., data qualifiers added by CDM validators on subcontract laboratory data, sample field notations).

Data tables that compare the results of the various phases of sampling efforts will be prepared and evaluated. Data will be evaluated to determine the extent of contamination and will be evaluated against the project specific objectives listed in Worksheet #11. Analytical data results will interface with graphics packages to illustrate contaminants detected. As a QC check, reports, tables, and graphical figures will be compared to the sample tracking system for errors and omissions. A data usability assessment will be prepared prior to use and reporting of the data in measurement reports. CDM will provide EPA with final analytical data on electronic media.

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Summary of Project Tasks

Data management will utilize personal computers (PC), local area networks (LAN), and electronic communications (ex: the World Wide Web) to support the database management system software. CDM will set up PC stations on which the database management system and commercial software will run in compliance with those software licensing requirements. CDM will take reasonable care to protect the data and will perform periodic backups to prevent wholesale loss of project data. Control of the computer hardware and software will be as per CDM quality procedure (QP) 4.1.

After the CLP data have been validated, the package is returned to the EPA RPM. CLP data packages forwarded to the CDM ASC will then have copies made of the Region 2 chain-of-custody/data transfer log, validated Form Is, data validation assessment and data validation checklist for distribution to the project manager. The original CLP data package with all associated forms is retained by EPA for archival purposes.

Documentation and Records:
Sample information will be recorded in site field logs, including geographic coordinates. Any changes that are made to the field logs shall be initialed and dated. Documents will be maintained in the project files and/or the RAC 2 document control system. Monitoring well purge water data forms will be completed for each groundwater sample collected. The tidal stage will be recorded in the field logbooks during all sample collections activities. Chain-of-Custody (COC) forms and airbills will also be completed for each sampling event.

Field Change Notifications:
In the event that anticipated conditions are different from those encountered once the field work is under way, it may be necessary to implement a deviation from the approved QAPP. When such changes are required, the proposed change will be documented on a FCN Form by the CDM Field Team Leader and approved by CDM's PM. An e-mail copy of the FCN form will be sent to the USACE PM and EPA RPM and will serve as documentation of communication with USACE and EPA. A copy of the FCN Form is included in Appendix A. A copy of the FCN will be kept on site along with the approved QAPP. A copy of the FCN form will be distributed to the authorizing parties, the field staff, and the CDM QAC in order to keep all staff informed of the change and to allow QAC oversight of any changes.

When significant field changes occur, the QAPP will be revised. Modifications will be carried out via revised pages to the QAPP. Minor changes will be made through formal memoranda from the CDM PM to the USACE PM and EPA RPM and will be included as addenda to the QAPP. The complete sign-off procedure will be followed if, in the judgment of the CDM PM, major revisions to the QAPP are required. All revisions to the QAPP will be subject to CDM's internal review process. All major changes will be approved by USACE prior to their implementation.

QAPP Worksheet #15a
Reference Limits and Evaluation Table - Soil VOCs

Volatile Organic Compounds (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable DESA Laboratory Limits*	
				MDLs	CRQL		Project-Specific Option		
					SOM01.2 Low Soil	SOM01.2 Medium Soil		MDLs	QLs
1,1,1-Trichloroethane	71-55-6	200	100	N/A	5	250	Low soil except if sample results exceed the upper calibration limit.	0.3	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5	N/A	5	250		0.4	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	910,000	455,000	N/A	5	250		0.8	5
1,1,2-Trichloroethane	79-00-5	10	5	N/A	5	250		0.3	5
1,1-Dichloroethane	75-34-3	200	100	N/A	5	250		0.7	5
1,1-Dicholoroethene	75-35-4	5	5	N/A	5	250		0.7	5
1,2,3-Trichlorobenzene	87-61-6	4,890	2445	N/A	5	250		1.5	5
1,2,4-Trichlorobenzene	120-82-1	400	200	N/A	5	250		1.5	5
1,2-Dibromo-3-chloropropane	96-12-8	5	5	N/A	5	250		0.5	5
1,2-Dibromoethane	106-93-4	5	5	N/A	5	250		0.4	5
1,2-Dichlorobenzene	95-50-1	2,960	1,480	N/A	5	250		1	5
1,2-Dichloroethane	107-06-2	5	5	N/A	5	250		0.5	5
1,2-Dichloropropane	78-87-5	5	5	N/A	5	250		0.5	5
1,3-Dichlorobenzene	541-73-1	12,000	6,000	N/A	5	250		1.1	5
1,4-Dichlorobenzene	106-46-7	546	273	N/A	5	250		1.2	5
1,4-Dioxane	123-91-1	44,100	22,050	N/A	100	5,000		NL	NL
2-Butanone	78-93-3	600	300	N/A	10	500		1.2	10
2-Hexanone	591-78-6	12,600	6,300	N/A	10	500		0.5	10
4-Methyl-2-pentanone	108-10-1	443,000	221,500	N/A	10	500		0.6	10
Acetone	67-64-1	2,500	1,250	N/A	10	500		4	10
Benzene	71-43-2	5	5	N/A	5	250		0.5	5
Bromochloromethane	74-97-5	NL	NA	N/A	5	250		0.6	5
Bromodichloromethane	75-27-4	5	5	N/A	5	250		0.5	5
Bromoform	75-25-2	20	10	N/A	5	250		0.6	5
Bromomethane	74-83-9	30	15	N/A	5	250		1.3	5
Carbon Disulfide	75-15-0	94	47.05	N/A	5	250		0.8	5
Carbon tetrachloride	56-23-5	5	5	N/A	5	250		1.9	5
Chlorobenzene	108-90-7	400	200	N/A	5	250		0.8	5
Chloroethane	75-00-3	220,000	110,000	N/A	5	250		0.9	5
Chloroform	67-66-3	200	100	N/A	5	250		0.3	5

QAPP Worksheet #15a
Reference Limits and Evaluation Table - Soil VOCs

Volatile Organic Compounds (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable DESA Laboratory Limits*	
				MDLs	CRQL		Project-Specific Option	MDLs	QLs
					SOM01.2 Low Soil	SOM01.2 Medium Soil			
Chloromethane	74-87-3	4,000	2,000	N/A	5	250	Low soil except if sample results exceed the upper calibration limit.	2.2	5
cis-1,2-Dichloroethene	156-59-2	200	100	N/A	5	250		0.6	5
cis-1,3-Dichloropropene	10061-01-5	5	5	N/A	5	250		0.6	5
Cyclohexane	110-82-7	117,000	58,500	N/A	5	250		0.4	5
Dibromochloromethane	124-48-1	5	5	N/A	5	250		0.5	5
Dichlorodifluoromethane	75-71-8	18,400	9,200	N/A	5	250		0.7	5
Ethylbenzene	100-41-4	5,160	2,580	N/A	5	250		0.6	5
Isopropylbenzene	98-82-8	205,000	102,500	N/A	5	250		0.6	5
m, p-Xylene **	1330-20-7	10000	5,000	N/A	5	250		1.1	5
Methyl acetate	79-20-9	14,000	7,000	N/A	5	250		1.6	5
Methyl tert-butyl ether	1634-04-4	200	100	N/A	5	250		0.3	5
Methylcyclohexane	108-87-2	NL	NA	N/A	5	250		0.8	5
Methylene chloride	75-09-2	7	7	N/A	5	250		0.6	5
o-Xylene **	1330-20-7	10000	5000	N/A	5	250		0.7	5
Styrene	100-42-5	2,000	1000	N/A	5	250		0.7	5
Tetrachloroethene	127-18-4	5	5	N/A	5	250		0.5	5
Toluene	108-88-3	4,000	2,000	N/A	5	250		1.2	5
trans-1,2-Dichloroethene	156-60-5	400	200	N/A	5	250		0.5	5
trans-1,3-Dichloropropene	10061-02-6	5	5	N/A	5	250		0.6	5
Trichloroethene	79-01-6	7	7	N/A	5	250		0.6	5
Trichlorofluoromethane	75-69-4	16,400	8,200	N/A	5	250		0.4	5
Vinyl Chloride	75-01-4	5	5	N/A	5	250		*	5

* Values are from DESA's generic QAPP (Appendix D)
** See Appendix F for individual standards
Footnotes are included at the end of worksheet 15e

QAPP Worksheet #15b
Reference Limits and Evaluation Table - Soil SVOCs

Semi-Volatile Organic Compounds (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method					Achievable DESA Laboratory Limits*	
				MDLs	CRQL			Project-Specific Option	MDLs	QLs
					SOM01.2 Low Soil	SOM01.2 Med. Soil	SOM01.2 Low-SIM			
1,1'-Biphenyl	92-52-4	90,000	45,000	N/A	170	5,000		Low soil except if sample results exceed the upper calibration limit. Compounds highlighted require SIM (see footnotes) or method modification to achieve the PQLGs.	N/A	120
1,2,4,5-Tetrachlorobenzene	95-94-3	1,830	915	N/A	170	5,000			N/A	120
2,2'-Oxybis (1-chloropropane)	108-60-1	4,570	2,285	N/A	170	5,000			N/A	NL
2,3,4,6-Tetrachlorophenol	58-90-2	NL	NA	N/A	170	5,000			N/A	120
2,4,5-Trichlorophenol	95-95-4	9,000	4,500	N/A	170	5,000			N/A	120
2,4,6-Trichlorophenol	88-06-2	200	170	N/A	170	5,000			N/A	120
2,4-Dichlorophenol	120-83-2	200	170	N/A	170	5,000			N/A	120
2,4-Dimethylphenol	105-67-9	10	**10**	N/A	170	5,000			N/A	120
2,4-Dinitrophenol	51-28-5	60.9	**60.9**	N/A	330	10,000			N/A	800
2,4-Dinitrotoluene	121-14-2	200	170	N/A	170	5,000			N/A	120
2,6-Dinitrotoluene	606-20-2	32.8	**32.8**	N/A	170	5,000			N/A	120
2-Chloronapthalene	91-58-7	12.2	**12.2**	N/A	170	5,000			N/A	120
2-Chlorophenol	95-57-8	243	243	N/A	170	5,000			N/A	120
2-Methylnapthalene	91-57-6	3,240	1,620	N/A	170	5,000	3.3		N/A	120
2-Methylphenol	95-48-7	306,000	153,000	N/A	170	5,000			N/A	120
2-Nitroaniline	88-74-4	39,000	19,500	N/A	330	10,000			N/A	120
2-Nitrophenol	88-75-5	1,600	800	N/A	170	5,000			N/A	120
3,3'-Dichlorobenzidine	91-94-1	200	170	N/A	170	5,000			N/A	120
3-Nitroaniline	99-09-2	3,160	1,580	N/A	330	10,000			N/A	120
4,6-Dinitro-2-methylphenol	534-52-1	144	**144**	N/A	330	10,000			N/A	400
4-Bromophenyl-phenylether	101-55-3	NL	NA	N/A	170	5,000			N/A	120
4-Chloro-3-methylphenol	59-50-7	611,000	305,500	N/A	170	5,000			N/A	120
4-Chloroaniline	106-47-8	1,100	550	N/A	170	5,000			N/A	120
4-Chlorophenyl-phenyl ether	7005-72-3	NL	NA	N/A	170	5,000			N/A	120
4-Methylphenol	106-44-5	30,600	15,300	N/A	170	5,000			N/A	120
4-Nitroaniline	100-01-6	21,900	10,950	N/A	330	10,000			N/A	120
4-Nitrophenol	100-02-7	5,120	2,560	N/A	330	10,000			N/A	400
Acenaphthene	83-32-9	20,000	10,000	N/A	170	5,000	3.3		N/A	120
Acenaphthylene	208-96-8	29,000	14,500	N/A	170	5,000	3.3		N/A	120
Acetophenone	98-86-2	2,000	1,000	N/A	170	5,000			N/A	120
Anthracene	120-12-7	29,000	14,500	N/A	170	5,000	3.3		N/A	120
Atrazine	1912-24-9	200	200	N/A	170	5,000			N/A	120

QAPP Worksheet #15b
Reference Limits and Evaluation Table - Soil SVOCs

Semi-Volatile Organic Compounds (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method				Project-Specific Option	Achievable DESA Laboratory Limits*	
				MDLs	CRQL				MDLs	QLs
					SOM01.2 Low Soil	SOM01.2 Med. Soil	SOM01.2 Low-SIM			
Benzaldehyde	100-52-7	782,000	391,000	N/A	170	5,000		Low soil except if sample results exceed the upper calibration limit. Compounds highlighted require SIM (see footnotes) or method modification to achieve the PQLGs.	N/A	120
Benzo (a) anthracene	56-55-3	148	**148**	N/A	170	5,000	**3.3**		N/A	120
Benzo (a) pyrene	50-32-8	14.8	**14.8**	N/A	170	5,000	**3.3**		N/A	120
Benzo (b) fluoranthene	205-99-2	148	**148**	N/A	170	5,000	**3.3**		N/A	120
Benzo (g,h,i) perylene	191-24-2	1,100	550	N/A	170	5,000	3.3		N/A	120
Benzo (k) fluoranthene	207-08-9	1,480	740	N/A	170	5,000	3.3		N/A	120
Bis (2-chloroethoxy) methane	111-91-1	302	302	N/A	170	5,000			N/A	120
Bis (2-ethylhexyl) phthalate	117-81-7	925	462.5	N/A	170	5,000			N/A	120
bis-(2-chloroethyl) ether	111-44-4	200	170	N/A	170	5,000			N/A	120
Butylbenzylphthalate	85-68-7	239	239	N/A	170	5,000			N/A	120
Caprolactam	105-60-2	8,000	4,000	N/A	170	5,000			N/A	120
Carbazole	86-74-8	24,000	12,000	N/A	170	5,000			N/A	120
Chrysene	218-01-9	1,100	550	N/A	170	5,000	3.3		N/A	120
Dibenzo (a,h)-anthracene	53-70-3	14.8	**14.8**	N/A	170	5,000	**3.3**		N/A	120
Dibenzofuran	132-64-9	7,820	3,910	N/A	170	5,000			N/A	120
Diethylphthalate	84-66-2	24,800	12,400	N/A	170	5,000			N/A	120
Dimethylphthalate	131-11-3	734,000	367,000	N/A	170	5,000			N/A	120
***Di*-n-butylphthalate**	84-74-2	150	**150**	N/A	170	5,000			N/A	120
Di-n-octylphthalate	117-84-0	709,000	354,500	N/A	170	5,000			N/A	120
Fluoranthene	206-44-0	1,100	550	N/A	170	5,000	3.3		N/A	120
Fluorene	86-73-7	29,000	14,500	N/A	170	5,000	3.3		N/A	120
Hexachlorobenzene	118-74-1	199	199	N/A	170	5,000			N/A	120
Hexachlorobutadiene	87-68-3	39.8	**39.8**	N/A	170	5,000			N/A	120
Hexachlorocyclopentadiene	77-47-4	755	377.5	N/A	170	5,000			N/A	120
Hexachloroethane	67-72-1	200	170	N/A	170	5,000			N/A	120
Indeno (1,2,3-cd)-pyrene	193-39-5	148	**148**	N/A	170	5,000	**3.3**		N/A	120
Isophorone	78-59-1	200	200	N/A	170	5,000			N/A	120
Naphthalene	91-20-3	99.4	**99.4**	N/A	170	5,000	3.3		N/A	120
Nitrobenzene	98-95-3	200	170	N/A	170	5,000			N/A	120
N-Nitroso-di-n propylamine	621-64-7	69.4	**69.4**	N/A	170	5,000			N/A	120
N-Nitrosodiphenylamine	86-30-6	200	170	N/A	170	5,000			N/A	120
Pentachlorophenol	87-86-5	119	**119**	N/A	330	10,000	**6.7**		N/A	400
Phenanthrene	85-01-8	29,000	14,500	N/A	170	5,000	3.3		N/A	120
Phenol	108-95-2	5,000	2,500	N/A	170	5,000			N/A	120
Pyrene	129-00-0	1,100	550	N/A	170	5,000	3.3		N/A	120

* Values are from DESA's generic QAPP (Appendix D).

** See Appendix E for individual standards

Low SIM analysis required for benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, dibenzo (a,h)-anthracene, indeno (1,2,3-cd)-pyrene, pentachlorophenol, 2-methylnapthalene, acenapthene, acenaphthylene, anthracene, benzo (g,h,i) perylene, benzo (k) fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene and pyrene.
Other footnotes are included at the end of worksheet 15e.

QAPP Worksheet #15c
Reference Limits and Evaluation Table - Soil Pesticides

Pesticides and PCBs (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable DESA Laboratory Limits*	
				MDLs	CRQL Analytical Method - SOM01.2 Soil	MDLs	QLs
4,4'-DDD	72-54-8	21	11	N/A	3.3	1.35	5
4,4'-DDE	72-55-9	21	11	N/A	3.3	1.92	5
4,4'-DDT	50-29-3	3.5	3.5	N/A	3.3	1.52	5
Aldrin	309-00-2	3.32	3.3	N/A	1.7	1.66	2.5
alpha-BHC	319-84-6	2	2	N/A	1.7	2.15	2.5
alpha-Chlordane	5103-71-9	200	100	N/A	1.7	1.01	2.5
beta-BHC	319-85-7	2	1.7	N/A	1.7	1.35	2.5
delta-BHC	319-86-8	2	1.7	N/A	1.7	1.51	2.5
Dieldrin	60-57-1	4.9	4.9	N/A	3.3	1.91	5
Endosulfan I	959-98-8	119	60	N/A	1.7	1.16	2.5
Endosulfan II	33213-65-9	119	60	N/A	3.3	1.27	5
Endosulfan sulfate	1031-07-8	35.8	18	N/A	3.3	1.24	2.5
Endrin	72-20-8	10.1	5	N/A	3.3	1.84	5
Endrin aldehyde	7421-93-4	10.5	5	N/A	3.3	2.24	5
Endrin ketone	53494-70-5	600	300	N/A	3.3	1.18	2.5
gamma-BHC (Lindane)	58-89-9	2	2	N/A	1.7	1.89	2.5
gamma-Chlordane	5103-74-2	200	100	N/A	1.7	0.96	2.5
Heptachlor	76-44-8	5.98	3	N/A	1.7	2.05	2.5
Heptachlor epoxide	1024-57-3	53.3	27	N/A	1.7	1.34	2.5
Methoxychlor	72-43-5	19.9	20	N/A	17	8	25
Toxaphene	8001-35-2	119	**119**	N/A	170	75.9	190

* Values are from DESA's generic QAPP (Appendix D).
** See Appendix E for individual standards
Footnotes are included at the end of worksheet 15e

QAPP Worksheet #15d
Reference Limits and Evaluation Table - Soil Aroclors (PCBs)

Aroclors (All units: µg/kg)	CAS Number	Project Action Limit**	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable DESA Laboratory Limits*	
				MDLs	CRQL Analytical Method - SOM01.2 Soil	MDLs	QLs
Aroclor-1016	12674-11-2	1,000	333	N/A	33	N/A	31
Aroclor-1221	11104-28-2	1,000	333	N/A	33	N/A	62
Aroclor-1232	11141-16-5	1,000	333	N/A	33	N/A	31
Aroclor-1242	53469-21-9	1,000	333	N/A	33	29.9	31
Aroclor-1248	12672-29-6	1,000	333	N/A	33	N/A	31
Aroclor-1254	11097-69-1	1,000	333	N/A	33	N/A	31
Aroclor-1260	11096-82-5	1,000	333	N/A	33	N/A	31
Aroclor-1262	37324-23-5	1,000	333	N/A	33	N/A	31
Aroclor-1268	11100-14-4	1,000	333	N/A	33	N/A	31

* Values are from DESA's generic QAPP (Appendix D).
** See Appendix E for individual standards

QAPP Worksheet #15e
Reference Limits and Evaluation Table -Soil Inorganics (Metals)°

Inorganics (All units: mg/kg)	CAS Number	Project Action Limit****	*Project Quantitation Limit Goal (PQLG)*	Analytical Method		Achievable DESA Laboratory Limits*	
				MDLs	CRQL ICP-AES CRQL for Soil *(ILM05.4)*	MDLs	QLs
Aluminum	7429-90-5	3,900	1,950	N/A	20	**	100
Antimony	7440-36-0	0.142	**0.14**	N/A	6	0.22	2
Arsenic	7440-38-2	0.389	**0.39**	N/A	1	0.35	0.8
Barium	7440-39-3	1.04	**1.04**	N/A	20	0.24	10
Beryllium	7440-41-7	0.5	0.50	N/A	0.5	0.02	0.3
Cadmium	7440-43-9	0.00222	**0.0022**	N/A	0.5	0.02	0.3
Calcium	7440-70-2	995	**498**	N/A	500	12.57	50
Chromium	7440-47-3	0.4	**0.4**	N/A	1	0.34	0.5
Cobalt	7440-48-4	0.14	**0.1**	N/A	5	0.03	2
Copper	7440-50-8	5.4	2.7	N/A	2.5	0.26	1
Iron	7439-89-6	5,480	2,740	N/A	10	**	5
Lead	7439-92-1	0.0537	**0.05**	N/A	1	0.23	0.8
Magnesium	7439-95-4	673	**337**	N/A	500	5.06	50
Manganese	7439-96-5	42	21	N/A	1.5	0.33	0.5
Mercury	7439-97-6	0.00051	**0.0005**	N/A	0.1	0.0043	0.05
Nickel	7440-02-0	12.3	6	N/A	4	0.09	2
Potassium	7440-09-7	1,750	875	N/A	500	12.36	50
Selenium	7782-49-2	0.0276	**0.03**	N/A	3.5	0.22	2
Silver	7440-22-4	1	1	N/A	1	0.06	0.5
Sodium	7440-23-5	NL	N/A	N/A	500	22.48	100
Thallium	7440-28-0	0.0569	**0.06**	N/A	2.5	3.14	2
Vanadium	7440-62-2	0.548	**0.55**	N/A	5	0.4	2
Zinc	7440-66-6	6.62	**3.31**	N/A	6	1.57	2
	CAS Number	**Project Action Limit****	**PQLG**	**Method MDL**	**Method QL**	**Lab MDL**	**Lab QL**
Chromium (hexavalent)	18540-29-9	0.293	**0.3**	N/A	2***	N/A	N/A
Total Organic Carbon	10-19-5	N/A	100.00	N/A	100	N/A	N/A

QAPP Worksheet #15e
Reference Limits and Evaluation Table -Soil Inorganics (Metals)[e]

Inorganics (All units: mg/kg)	CAS Number	Project Action Limit****	*Project Quantitation Limit Goal (PQLG)*	Analytical Method		Achievable DESA Laboratory Limits*	
				MDLs	CRQL ICP-AES CRQL for Soil (ILM05.4)	MDLs	QLs
pH (standard units)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grain Size	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* *Values are from DESA's generic QAPP (Appendix D).*
** MDL study cannot be successfully performed on these analytes because of high background levels in matrix (sand).
*** This is the limit using SW-846 analysis method 7196A or 218.4 after soil digestion by method 3060A
**** See Appendix E for individual standards
Historically high concentrations of metals have been detected on site. The laboratory shall screen the sample for lead, arsenic and chromium for high concentrations.

QAPP Worksheet # 15f
Reference Limits and Evaluation Table - Sediment VOCs

Volatile Organic Compounds	CAS Number	Project Action Limit[1,2] (µg/kg)	Project Quantitation Limit Goal (µg/kg)	Analytical Method[3]		Achievable Laboratory Limits[4]	
				MDLs	CRQLs SOM01.2 Low Soil (µg/kg)	MDLs	QLs
1,1,1-Trichloroethane	71-55-6	30.2	6	N/A	5	N/A	N/A
1,1,2,2-Tetrachloroethane	**79-34-5**	**1.36**	**1**	**N/A**	**5**	**N/A**	**N/A**
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NL	5	N/A	5	N/A	N/A
1,1,2-Trichloroethane	**79-00-5**	**1.24**	**1**	**N/A**	**5**	**N/A**	**N/A**
1,1-Dichloroethane	**75-34-3**	**0.575**	**0.5**	**N/A**	**5**	**N/A**	**N/A**
1,1-Dichloroethylene	75-35-4	31	5	N/A	5	N/A	N/A
1,2,3-Trichlorobenzene	87-61-6	858	171.6	N/A	5	N/A	N/A
1,2,4-Trichlorobenzene	120-82-1	210	42	N/A	5	N/A	N/A
1,2-Dibromo-3-chloropropane	96-12-8	NL	5	N/A	5	N/A	N/A
1,2-Dibromoethane	106-93-4	NL	5	N/A	5	N/A	N/A
1,2-Dichlorobenzene	95-50-1	16.5	8.25	N/A	5	N/A	N/A
1,2-Dichloroethane	107-06-2	260	52	N/A	5	N/A	N/A
1,2-Dichloropropane	78-87-5	481	96.2	N/A	5	N/A	N/A
1,3-Dichlorobenzene	541-73-1	2,460	492	N/A	5	N/A	N/A
1,4-Dichlorobenzene	106-46-7	318	63.6	N/A	5	N/A	N/A
2-Butanone	78-93-3	NL	10	N/A	10	N/A	N/A
2-Hexanone	591-78-6	58.2	11.64	N/A	10	N/A	N/A
4-Methyl-2-pentanone	108-10-1	25.1	10	N/A	10	N/A	N/A
Acetone	67-64-1	9.9	10	N/A	10	N/A	N/A
Benzene	71-43-2	142	28.4	N/A	5	N/A	N/A
Bromochloromethane	74-97-5	NL	5	N/A	5	N/A	N/A
Bromodichloromethane	75-27-4	NL	5	N/A	5	N/A	N/A
Bromoform	75-25-2	492	98.4	N/A	5	N/A	N/A
Bromomethane	74-83-9	NL	5	N/A	5	N/A	N/A
Carbon Disulfide	**75-15-0**	**0.851**	**0.8**	**N/A**	**5**	**N/A**	**N/A**
Carbon Tetrachloride	56-23-5	64.2	12.84	N/A	5	N/A	N/A
Chlorobenzene	108-90-7	8.42	5	N/A	5	N/A	N/A
Chloroethane	75-00-3	NL	5	N/A	5	N/A	N/A
Chloroform	67-66-3	121	24.2	N/A	5	N/A	N/A
Chloromethane	74-87-3	NL	5	N/A	5	N/A	N/A
cis-1,2-Dichloroethene	156-59-2	NL	5	N/A	5	N/A	N/A
cis-1,3-Dichloropropene	10061-01-5	NL	5	N/A	5	N/A	N/A
Cyclohexane	110-82-7	NL	5	N/A	5	N/A	N/A
Dibromochloromethane	124-48-1	NL	5	N/A	5	N/A	N/A

QAPP Worksheet # 15f
Reference Limits and Evaluation Table - Sediment VOCs

Volatile Organic Compounds	CAS Number	Project Action Limit[1,2] (µg/kg)	Project Quantitation Limit Goal (µg/kg)	Analytical Method[3]		Achievable Laboratory Limits[4]	
				MDLs	CRQLs SOM01.2 Low Soil (µg/kg)	MDLs	QLs
Dichlorodifluoromethane	75-71-8	NL	5	N/A	5	N/A	N/A
Ethylbenzene	100-41-4	175	35	N/A	5	N/A	N/A
Isopropylbenzene	98-82-8	86	17.2	N/A	5	N/A	N/A
Methyl Acetate	79-20-9	NL	5	N/A	5	N/A	N/A
Methyl Tert-Butyl Ether	1634-04-4	NL	5	N/A	5	N/A	N/A
Methylcyclohexane	108-87-2	NL	5	N/A	5	N/A	N/A
Methylene Chloride	75-09-2	159	31.8	N/A	5	N/A	N/A
m-Xylene	108-38-3	25.2	5.04	N/A	5	N/A	N/A
o-Xylene	95-47-6	NL	5	N/A	5	N/A	N/A
p-Xylene	106-42-3	NL	5	N/A	5	N/A	N/A
Styrene	100-42-5	254	50.8	N/A	5	N/A	N/A
Tetrachloroethene	127-18-4	468	93.6	N/A	5	N/A	N/A
Toluene	108-88-3	1,220	244	N/A	5	N/A	N/A
trans-1,2-Dichloroethene	156-60-5	654	130.8	N/A	5	N/A	N/A
trans-1,3-Dichloropropene	10061-02-6	NL	5	N/A	5	N/A	N/A
Trichloroethene	79-01-6	96.9	19.38	N/A	5	N/A	N/A
Trichlorofluoromethane	75-69-4	NL	5	N/A	5	N/A	N/A
Vinyl Chloride	75-01-4	31	6.2	N/A	5	N/A	N/A
Xylenes (total)	1330-20-7	433	86.6	N/A	N/A	N/A	N/A

Notes

Source

1. U.S. EPA Region 3, December 2005, BTAG Freshwater Sediment Screening Benchmarks

The criteria used for the Project Action Limit is the lower value of 1. and 2.

The individual screening levels and standards are shown on Tables 1 through 4 in Appendix E.

2. Persaud, D., Jaagumagi, T and Hayton, A, Aug., 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario.
3. SOM01.2 Low Soil Option. Highlighted and bolded VOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.
4. DESA achievable limits are listed in Appendix D

Acronyms:

BTAG - Biological Technical Assistance Group
CRQL - Contract Required Quantitation Limit
MDL - method detection limit
N/A - Not applicable
ND - The criteria for this compound is below any detection limit
NL - Chemical name not listed or screening value of this type not listed for the chemical
PQLG - Project Quantitation Limit Goal
µg/kg - microgram per kilogram dry weight

QAPP Worksheet # 15g
Reference Limits and Evaluation Table - Sediment SVOCs

Semivolatile Organics	CAS Number	Project Action Limit (µg/kg)[1-5]	Project Quantitation Limit Goal (µg/kg)	Analytical Method[6]			Achievable Laboratory Limits[7]	
				MDLs	CRQLs (µg/kg)	Method Option	MDLs	QLs
1,1'Biphenyl	92-52-4	1,220	244	N/A	170	Low	N/A	N/A
2,2'-oxybis(1-Chloropropane)	108-60-1	NL	170	N/A	170	Low	N/A	N/A
2,4,5-Trichlorophenol	95-95-4	NL	170	N/A	170	Low	N/A	N/A
2,4,6-Trichlorophenol	88-06-2	208	170	N/A	170	Low	N/A	N/A
2,4-Dichlorophenol	**120-83-2**	**81.7**	**80**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2,4-Dimethylphenol	**105-67-9**	**29**	**20**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2,4-Dinitrophenol	**51-28-5**	**7.51**	**5**	**N/A**	**330**	**Low**	**N/A**	**N/A**
2,4-Dinitrotoluene	**121-14-2**	**14.4**	**10**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2,6-Dinitrotoluene	**606-20-2**	**39.8**	**30**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2-Chloronaphthalene	91-58-7	417	170	N/A	170	Low	N/A	N/A
2-Chlorophenol	**95-57-8**	**42.5**	**40**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2-Methylnaphthalene	91-57-6	20.2	4.04	N/A	3.3	SIM	N/A	N/A
2-Methylphenol	**95-48-7**	**55.4**	**50**	**N/A**	**170**	**Low**	**N/A**	**N/A**
2-Nitroaniline	88-74-4	NL	330	N/A	330	Low	N/A	N/A
2-Nitrophenol	88-75-5	NL	330	N/A	330	Low	N/A	N/A
3,3'-Dichlorobenzidine	**91-94-1**	**28.2**	**20**	**N/A**	**170**	**Low**	**N/A**	**N/A**
3-Nitroaniline	99-09-2	NL	330	N/A	330	Low	N/A	N/A
4,6-Dinitro-2-methylphenol	534-52-1	NL	330	N/A	330	Low	N/A	N/A
4-Bromophenyl-phenylether	101-55-3	1,230	246	N/A	170	Low	N/A	N/A
4-Chloro-3-methylphenol	59-50-7	NL	170	N/A	170	Low	N/A	N/A
4-Chloroaniline	**106-47-8**	**146**	**100**	**N/A**	**170**	**Low**	**N/A**	**N/A**
4-Chlorophenyl-phenylether	7005-72-3	NL	170	N/A	170	Low	N/A	N/A
4-Methylphenol	106-44-5	670	670	N/A	170	Low	N/A	N/A
4-Nitroaniline	100-01-6	NL	330	N/A	330	Low	N/A	N/A
4-Nitrophenol	100-02-7	NL	330	N/A	330	Low	N/A	N/A
Acenaphthene	83-32-9	150.0	30	N/A	3.3	SIM	N/A	N/A
Acenaphthylene	208-96-8	5.9	3.3	N/A	3.3	SIM	N/A	N/A

QAPP Worksheet # 15g
Reference Limits and Evaluation Table - Sediment SVOCs

Semivolatile Organics	CAS Number	Project Action Limit (µg/kg)[1-5]	Project Quantitation Limit Goal (µg/kg)	Analytical Method[6]			Achievable Laboratory Limits[7]	
				MDLs	CRQLs (µg/kg)	Method Option	MDLs	QLs
Acetophenone	98-86-2	NL	170	N/A	170	Low	N/A	N/A
Anthracene	**120-12-7**	**57.2**	**50**	**N/A**	**170**	**Low**	**N/A**	**N/A**
Atrazine	**1912-24-9**	**6.62**	**6**	**N/A**	**170**	**Low**	**N/A**	**N/A**
Benzaldehyde	100-52-7	NL	330	N/A	170	Low	N/A	N/A
Benzo(a)anthracene	56-55-3	108	21.6	N/A	3.3	SIM	N/A	N/A
Benzo(a)pyrene	50-32-8	150	30	N/A	3.3	SIM	N/A	N/A
Benzo(b)fluoranthene	205-99-2	10,400	2080	N/A	170	Low	N/A	N/A
Benzo(g,h,i)perylene	191-24-2	170	170	N/A	170	Low	N/A	N/A
Benzo(k)fluoranthene	207-08-9	240	240	N/A	170	Low	N/A	N/A
bis(2-Chloroethoxy)methane	111-91-1	NL	170	N/A	170	Low	N/A	N/A
bis(2-Chloroethyl)ether	111-44-4	3,520	704	N/A	170	Low	N/A	N/A
bis(2-Ethylhexyl)phthalate	117-81-7	180	170	N/A	170	Low	N/A	N/A
Butylbenzylphthalate	85-68-7	1,970	394	N/A	170	Low	N/A	N/A
Caprolactam	105-60-2	NL	170	N/A	170	Low	N/A	N/A
Carbazole	86-74-8	NL	170	N/A	170	Low	N/A	N/A
Chrysene	218-01-9	166	33.2	N/A	3.3	SIM	N/A	N/A
Dibenz(a,h)anthracene	53-70-3	33	6.6	N/A	3.3	SIM	N/A	N/A
Dibenzofuran	132-64-9	415	170	N/A	170	Low	N/A	N/A
Diethylphthalate	84-66-2	590	170	N/A	170	Low	N/A	N/A
Dimethylphthalate	131-11-3	NL	170	N/A	170	Low	N/A	N/A
Di-n-butylphthalate	84-74-2	4,012	802.4	N/A	170	Low	N/A	N/A
Di-n-octyl phthalate	117-84-0	40,600	8,120	N/A	170	Low	N/A	N/A
Fluoranthene	206-44-0	423	170	N/A	170	Low	N/A	N/A
Fluorene	86-73-7	35.0	7	N/A	3.3	SIM	N/A	N/A
Hexachlorobenzene	**118-74-1**	**20**	**20**	**N/A**	**170**	**Low**	**N/A**	**N/A**
Hexachlorobutadiene	87-68-3	1380	276	N/A	170	Low	N/A	N/A
Hexachlorocyclopentadiene	77-47-4	901	180.2	N/A	170	Low	N/A	N/A
Hexachloroethane	67-72-1	876	170	N/A	170	Low	N/A	N/A
Indeno(1,2,3-cd)pyrene	193-39-5	200	200	N/A	170	Low	N/A	N/A
Isophorone	78-59-1	432	170	N/A	170	Low	N/A	N/A

QAPP Worksheet # 15g
Reference Limits and Evaluation Table - Sediment SVOCs

Semivolatile Organics	CAS Number	Project Action Limit (µg/kg)[1-5]	Project Quantitation Limit Goal (µg/kg)	Analytical Method[6]			Achievable Laboratory Limits[7]	
				MDLs	CRQLs (µg/kg)	Method Option	MDLs	QLs
Naphthalene	91-20-3	176	170	N/A	170	Low	N/A	N/A
Nitrobenzene	98-95-3	250	200	N/A	170	Low	N/A	N/A
N-Nitroso-di-n-propylamine	621-64-7	NL	170	N/A	170	Low	N/A	N/A
N-Nitrosodiphenylamine	86-30-6	2,680	536	N/A	170	Low	N/A	N/A
Pentachlorophenol	87-86-5	504	330	N/A	330	Low	N/A	N/A
Phenanthrene	85-01-8	204	170	N/A	170	Low	N/A	N/A
Phenol	**108-95-2**	**49.1**	**40**	**N/A**	**170**	**Low**	**N/A**	**N/A**
Pyrene	129-00-0	195	170	N/A	170	Low	N/A	N/A

Notes:

1. Long ER and Morgan LG, 1991. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA 175pp.
2. Persaud, D., Jaagumagi, T and Hayton, A, Aug., 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Water Resources Branch, Ontario Ministry of Environment, Toronto, 27pp.
3. MacDonald, D.D., Ingersoil, C.G., and Berger, T.A. 2000. Development and evaluation of concensus-based sediment quality guidelines for freshwater ecosystem. Archives of Environmental Contamination and Toxicology 39:20-31
4. U.S. EPA Region 3. December 2005, BTAG Freshwater Sediment Screening Benchmarks.
5. U.S. EPA. Region 5. July 2003. RCRA Ecological Screening Levels

The criteria used for the Project Action Limit is the lowest value of 1., 2., 3., 4., and 5.

6. SOM01.2 Low Soil Option. Highlighted and bolded SVOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve project goals.
7. DESA achievable limits are included in Appendix D

Low SIM analysis required for 2-methylnaphthalene, acenaphthene, acenaphthylene, benzaldehyde, benzo(a)anthracene, diben(a,h)anthracene, and fluorene.

Acronyms:

BTAG - Biological Technical Assistance Group
SVOC - semi-volatile organic compound
CRQL - Contract Required Quantitation Limit
MDL - Method Detection Limit
N/A - Not applicable
ND - The criteria for this compound is below any detection limit
NL - Chemical name not listed or screening value of this type not listed for the chemical
PQLG - Project Quantitation Limit Goal
RCRA - Resource Conservation and Recovery Act
µg/kg - microgram per kilogram dry weight

QAPP Worksheet # 15h
Reference Limits and Evaluation Table - Sediment Pesticides and PCBs

Compound	CAS Number	Project Action Limit (µg/kg)[1-7]	Project Quantitation Limit Goal (µg/kg)	Analytical Method[8]		Achievable Laboratory Limits[9]	
				MDLs	CRQLs (µg/kg)	MDLs	QLs
Pesticides							
4,4'-DDD	**72-54-8**	**2**	**2**	**N/A**	**3.3**	**N/A**	**N/A**
4,4'-DDE	**72-55-9**	**2**	**2**	**N/A**	**3.3**	**N/A**	**N/A**
4,4'-DDT	**50-29-3**	**1**	**1**	**N/A**	**3.3**	**N/A**	**N/A**
Aldrin	309-00-2	2	2	N/A	1.7	N/A	N/A
alpha-BHC	319-84-6	6	3	N/A	1.7	N/A	N/A
alpha-Chlordane	5103-71-9	3.24	2.43	N/A	1.7	N/A	N/A
beta-BHC	319-85-7	5	2.5	N/A	1.7	N/A	N/A
delta-BHC	319-86-8	16,400	8,200	N/A	1.7	N/A	N/A
Dieldrin	**60-57-1**	**1.9**	**1.9**	**N/A**	**3.3**	**N/A**	**N/A**
Endosulfan I	959-98-8	2.9	2.5	N/A	1.7	N/A	N/A
Endosulfan II	**33213-65-9**	**1.94**	**1.9**	**N/A**	**3.3**	**N/A**	**N/A**
Endosulfan sulfate	1031-07-8	5.4	4	N/A	3.3	N/A	N/A
Endrin	**72-20-8**	**2.22**	**2**	**N/A**	**3.3**	**N/A**	**N/A**
Endrin aldehyde	7421-93-4	480	240	N/A	3.3	N/A	N/A
Endrin ketone	53494-70-5	NL	3.3	N/A	3.3	N/A	N/A
gamma-BHC (Lindane)	58-89-9	2.37	2	N/A	1.7	N/A	N/A
gamma-Chlordane	5103-74-2	3.24	3	N/A	1.7	N/A	N/A
Heptachlor	76-44-8	68	34	N/A	1.7	N/A	N/A
Heptachlor epoxide	1024-57-3	2.47	2	N/A	1.7	N/A	N/A
Methoxychlor	**72-43-5**	**13.6**	**12**	**N/A**	**17**	**N/A**	**N/A**
Toxaphene	**8001-35-2**	**0.109**	**0.100**	**N/A**	**170**	**N/A**	**N/A**
PCBs							
Aroclor-1016	**12674-11-2**	**7**	**7**	**N/A**	**33**	**N/A**	**N/A**
Aroclor-1221	**11104-28-2**	**12**	**12**	**N/A**	**33**	**N/A**	**N/A**
Aroclor-1232	11141-16-5	600	300	N/A	33	N/A	N/A
Aroclor-1242	53469-21-9	170	85	N/A	33	N/A	N/A
Aroclor-1248	**12672-29-6**	**30**	**30**	**N/A**	**33**	**N/A**	**N/A**
Aroclor-1254	11097-69-1	60	36	N/A	33	N/A	N/A
Aroclor-1260	11096-82-5	50	40	N/A	33	N/A	N/A

QAPP Worksheet # 15h
Reference Limits and Evaluation Table - Sediment Pesticides and PCBs

Notes:

1. Long ER and Morgan LG, 1991. The potential for biologial effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Adminstration, Seattle, WA, 175pp

2. Persaud, D., Jaagumagi, R. and Hayton, A. Aug.,1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Water Resources Branch, Ontario Ministry of Environment, Toronto, 27pp.

3. MacDonald, D.D., Ingersoll, C.G., and Berger, T.A. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology 39:20-31

4. Suter, G.W. II, and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota:1996 Revision. ES/ER/TM-96/R2

5. U.S. EPA Region 3, December 2005, BTAG Freshwater Sediment Screening Benchmarks

6. U.S. EPA. Region 5, July 2003. RCRA Ecological Screening Levels

7. Suter, G.W. II, and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota:1996 Revision. ES/ER/TM-96/R2

The criteria used for the Project Action Limit is the lowest value of 1., 2., 3., 4., 5., 6., and 7.

8. SOM01.2 Low Soil Option applicable. Highlighted and bolded SVOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve project goals.

9. DESA achievable limits are included in Appendix D

Acronyms:

BTAG - Biological Technical Assistance Group
SVOC - semi-volatile organic compound
RCRA - Resource Conservation Recovery Act
CRQL - Contract Requirement Quantitation Limit
MDL - Method Detection Limit
N/A - Not applicable
NL - Chemical name not listed or screening value of this type not listed for the chemical
PQLG - Project Quantitation Limit Goal
µg/kg - microgram per kilogram dry weight

QAPP Worksheet # 15i
Reference Limits and Evaluation Table - Sediment Inorganics

Inorganic Analytes	CAS Number	Project Action Limit (mg/kg)[1-3]	Project Quantitation Limit Goal (mg/kg)	Analytical Method[4]		Laboratory Limits[5]	
				MDLs	CRQLs mg/kg	MDLs	QLs
Aluminum	7429-90-5	NL	20	N/A	20	N/A	N/A
Antimony	**7440-36-0**	**2**	**2**	**N/A**	**6**	**N/A**	**N/A**
Arsenic	7440-38-2	6	2	N/A	1	N/A	N/A
Barium	7440-39-3	NL	20	N/A	20	N/A	N/A
Beryllium	7440-41-7	NL	0.5	N/A	0.5	N/A	N/A
Cadmium	7440-43-9	0.6	0.6	N/A	0.5	N/A	N/A
Calcium	7440-70-2	NL	500	N/A	500	N/A	N/A
Chromium[2]	7440-47-3	26	13	N/A	1	N/A	N/A
Cobalt	7440-48-4	50	25	N/A	5	N/A	N/A
Copper	7440-50-8	16	8	N/A	2.5	N/A	N/A
Cyanide	**57-12-5**	**0.1**	**0.1**	**N/A**	**2.5**	**N/A**	**N/A**
Iron	7439-89-6	20,000	10,000	N/A	10	N/A	N/A
Lead	7439-92-1	31	15.5	N/A	1	N/A	N/A
Magnesium	7439-95-4	NL	500	N/A	500	N/A	N/A
Manganese	7439-96-5	460	230	N/A	1.5	N/A	N/A
Mercury	7439-97-6	0.2	0.1	N/A	0.1	N/A	N/A
Nickel	7440-02-0	16	8	N/A	4	N/A	N/A
Potassium	7440-09-7	NL	500	N/A	500	N/A	N/A
Selenium	**7782-49-2**	**2**	**2**	**N/A**	**3.5**	**N/A**	**N/A**
Silver	7440-22-4	1	1	N/A	1	N/A	N/A
Sodium	7440-23-5	NL	500	N/A	500	N/A	N/A
Thallium	7440-28-0	NL	2.5	N/A	2.5	N/A	N/A
Vanadium	7440-62-2	NL	5	N/A	5	N/A	N/A
Zinc	7440-66-6	120	24	N/A	6	N/A	N/A
	CAS Number	**Project Action Limit***	**PQLG**	**Method MDL**	**Method QL**	**Lab MDL**	**Lab QL**
Chromium (hexavalent)	18540-29-9	0.293	**0.3**	N/A	**2****	N/A	N/A
Total Organic Carbon	10-19-5	N/A	100.00	N/A	100	N/A	N/A
pH (standard units)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grain Size	N/A	N/A	N/A	N/A	N/A	N/A	N/A

QAPP Worksheet # 15i
Reference Limits and Evaluation Table - Sediment Inorganics

* See Appenidix E for individual standards

**This is the contractual limit using SW-846 analysis method 7196A or 218.4 after soil digestion by method 3060A

Notes:

1. Long ER and Morgan LG, 1991. The potential for biologial effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Adminstration. Seattle, WA, 175pp

2. Persaud, D., Jaagumagi, R. and Hayton, A. Aug. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Water Resources Branch, Ontario Ministry of Environment, Toronto, 27pp.

3. U.S. EPA Region 3. December 2005. BTAG Freshwater Sediment Screening Benchmarks
The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. ILM05.4 ICP-AES. Highlighted and bolded inorganics have CRQLs above their PQGLs. Where possible, a contract modification will be requested to achieve the PQLGs.

5. DESA achievable limits are included in Appendix D

Acronyms:

CRQL - Contract Required Quantitation Limit
MDL - Method Detection Limit
N/A - Not Applicable
NL - Chemical name not listed or screening value of this type not listed for the chemical.
PQLGs - Project Quantitation Limit Goals
µg/kg - microgram per kilogram dry weight

QAPP Worksheet #15j
Reference Limits and Evaluation Table - Surface Water VOCs

Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method					Achievable Laboratory Limits***	
				MDLs	CRQL			*Project Selected Option*	MDLs	QLs
					Analytical Method - SOM01.2 Trace Water by SIM	Analytical Method - SOM01.2 Trace Water	Analytical Method - SOM01.2 Low Water			
1,1,1-Trichloroethane	71-55-6	120	40	N/A	NL	0.5	5	Trace	N/A	N/A
1,1,2,2-Tetrachloroethane	79-34-5	4.7	1.57	N/A	NL	0.5	5	Trace	N/A	N/A
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
1,1,2-Trichloroethane	79-00-5	13	4.33	N/A	NL	0.5	5	Trace	N/A	N/A
1,1-Dichloroethane	75-34-3	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
1,1-Dicholoroethene	75-35-4	5	1.57	N/A	NL	0.5	5	Trace	N/A	N/A
1,2,3-Trichlorobenzene	87-61-6	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
1,2,4-Trichlorobenzene	120-82-1	21	7	N/A	NL	0.5	5	Trace	N/A	N/A
1,2-Dibromo-3-chloropropane	96-12-8	NL	5	N/A	0.05	0.5	5	Trace	N/A	N/A
1,2-Dibromoethane	106-93-4	NL	5	N/A	0.05	0.5	5	Trace	N/A	N/A
1,2-Dichlorobenzene	95-50-1	2,000	667	N/A	NL	0.5	5	Trace	N/A	N/A
1,2-Dichloroethane	**107-06-2**	**0.29**	**0.29**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
1,2-Dichloropropane	78-87-5	0.5	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
1,3-Dichlorobenzene	541-73-1	2,200	733	N/A	NL	0.5	5	Trace	N/A	N/A
1,3-Dichloropropene (cis and trans)	**542-75-6**	**0.34**	**0.34**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
1,4-Dichlorobenzene	106-46-7	550	183	N/A	NL	0.5	5	Trace	N/A	N/A
1,4-Dioxane	123-91-1	NL	100	N/A	NL	NL	100	Trace	N/A	N/A
2-Butanone	78-93-3	NL	10	N/A	NL	5	10	Trace	N/A	N/A
2-Hexanone	591-78-6	NL	10	N/A	NL	5	10	Trace	N/A	N/A
4-Methyl-2-pentanone	108-10-1	NL	10	N/A	NL	5	10	Trace	N/A	N/A
Acetone	67-64-1	NL	10	N/A	NL	5	10	Trace	N/A	N/A
Benzene	**71-43-2**	**0.15**	**0.15**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
Bromochloromethane	74-97-5	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Bromodichloromethane	75-27-4	0.55	0.5	N/A	NL	0.5	5	Trace	N/A	N/A

QAPP Worksheet #15j
Reference Limits and Evaluation Table - Surface Water VOCs

Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method					Achievable Laboratory Limits***	
				MDLs	CRQL			Project Selected Option	MDLs	QLs
					Analytical Method - SOM01.2 Trace Water by SIM	Analytical Method - SOM01.2 Trace Water	Analytical Method - SOM01.2 Low Water			
Bromoform	75-25-2	4.3	1.43	N/A	NL	0.5	5	Trace	N/A	N/A
Bromomethane	74-83-9	47	15.67	N/A	NL	0.5	5	Trace	N/A	N/A
Carbon Disulfide	75-15-0	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Carbon tetrachloride	**56-23-5**	**0.3**	**0.3**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
Chlorobenzene	108-90-7	210	70	N/A	NL	0.5	5	Trace	N/A	N/A
Chloroethane	75-00-3	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Chloroform	67-66-3	68	23	N/A	NL	0.5	5	Trace	N/A	N/A
Chloromethane	74-87-3	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
cis-1,2-Dichloroethene	156-59-2	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
cis-1,3-Dichloropropene	10061-01-5	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Cyclohexane	110-82-7	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Dibromochloromethane	**124-48-1**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
Dichlorodifluoromethane	75-71-8	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Ethylbenzene	100-41-4	530	177	N/A	NL	0.5	5	Trace	N/A	N/A
Isopropylbenzene	98-82-8	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
m, p-Xylene *	1330-20-7	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Methyl acetate	79-20-9	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Methyl tert-butyl ether	1634-04-4	70	23	N/A	NL	0.5	5	Trace	N/A	N/A
Methylcyclohexane	108-87-2	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Methylene chloride	75-09-2	2.5	1	N/A	NL	0.5	5	Trace	N/A	N/A
o-Xylene **	1330-20-7	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Styrene	100-42-5	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Tetrachloroethene	**127-18-4**	**0.34**	**0.34**	**N/A**	**NL**	**0.5**	**5**	**MA**	**N/A**	**N/A**
Toluene	108-88-3	1,300	433	N/A	NL	0.5	5	Trace	N/A	N/A
trans-1,2-Dichloroethene	156-60-5	590	197	N/A	NL	0.5	5	Trace	N/A	N/A
trans-1,3-Dichloropropene	10061-02-6	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Trichloroethene	79-01-6	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Trichlorofluoromethane	75-69-4	NL	5	N/A	NL	0.5	5	Trace	N/A	N/A
Vinyl Chloride	75-01-4	0.58	0.5	N/A	NL	0.5	5	Trace	N/A	N/A

QAPP Worksheet #15j
Reference Limits and Evaluation Table - Surface Water VOCs

Notes:

1. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
2. NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). January 2010.
3. NJDEP Specific Groundwater Quality Criteria Standards (http://www.nj.gov/dep/standards/ground%20water.pdf). May 2010.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded VOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

* m-xylene and p-xylene reported as one compound under S0M01.2. Xylene (total) was used for m,p-xylene criteria.

** Xylene (total) was used for o-xylene criteria.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = microgram per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring

QAPP Worksheet #15k
Reference Limits and Evaluation Table - Surface Water SVOCs

Semi-Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		Project Selected Option	MDLs	QLs
					Analytical Method - SOM01.2 Low Water by SIM	Analytical Method - SOM01.2 Low Water			
1,1'-Biphenyl	92-52-4	NL	5	N/A	NL	5	Low	N/A	N/A
1,2,4,5-Tetrachlorobenzene	**95-94-3**	**0.97**	**0.97**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
2,2'-Oxybis (1-chloropropane)	108-60-1	1400	467	N/A	NL	5	Low	N/A	N/A
2,3,4,6-Tetrachlorophenol	58-90-2	NL	5	N/A	NL	5	Low	N/A	N/A
2,4,5-Trichlorophenol	95-95-4	1800	600	N/A	NL	5	Low	N/A	N/A
2,4,6-Trichlorophenol	**88-06-2**	**0.58**	**0.58**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
2,4-Dichlorophenol	120-83-2	77	26	N/A	NL	5	Low	N/A	N/A
2,4-Dimethylphenol	105-67-9	380	127	N/A	NL	5	Low	N/A	N/A
2,4-Dinitrophenol	51-28-5	69	23	N/A	NL	10	Low	N/A	N/A
2,4-Dinitrotoluene	**121-14-2**	**0.11**	**0.11**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
2,6-Dinitrotoluene	606-20-2	NL	5	N/A	NL	5	Low	N/A	N/A
2-Chloronapthalene	91-58-7	1000	333	N/A	NL	5	Low	N/A	N/A
2-Chlorophenol	95-57-8	81	27	N/A	NL	5	Low	N/A	N/A
2-Methylnapthalene	91-57-6	NL	5	N/A	0.1	5	Low	N/A	N/A
2-Methylphenol	95-48-7	NL	5	N/A	NL	5	Low	N/A	N/A
2-Nitroaniline	88-74-4	NL	10	N/A	NL	10	Low	N/A	N/A
2-Nitrophenol	88-75-5	NL	5	N/A	NL	5	Low	N/A	N/A
3,3'-Dichlorobenzidine	**91-94-1**	**0.021**	**0.021**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
3-Nitroaniline	99-09-2	NL	10	N/A	NL	10	Low	N/A	N/A
4,6-Dinitro-2-methylphenol	534-52-1	13	10	N/A	NL	10	Low	N/A	N/A
4-Bromophenyl-phenylether	101-55-3	NL	5	N/A	NL	5	Low	N/A	N/A
4-Chloro-3-methylphenol	59-50-7	NL	5	N/A	NL	5	Low	N/A	N/A
4-Chloroaniline	106-47-8	NL	5	N/A	NL	5	Low	N/A	N/A
4-Chlorophenyl-phenyl ether	7005-72-3	NL	5	N/A	NL	5	Low	N/A	N/A
4-Methylphenol	106-44-5	NL	5	N/A	NL	5	Low	N/A	N/A
4-Nitroaniline	100-01-6	NL	10	N/A	NL	10	Low	N/A	N/A
4-Nitrophenol	100-02-7	NL	10	N/A	NL	10	Low	N/A	N/A
Acenaphthene	83-32-9	670	223	N/A	0.1	5	Low	N/A	N/A
Acenaphthylene	208-96-8	NL	5	N/A	0.1	5	Low	N/A	N/A
Acetophenone	98-86-2	NL	5	N/A	NL	5	Low	N/A	N/A
Anthracene	120-12-7	8300	2767	N/A	0.1	5	Low	N/A	N/A
Atrazine	1912-24-9	NL	5	N/A	NL	5	Low	N/A	N/A

QAPP Worksheet #15k
Reference Limits and Evaluation Table - Surface Water SVOCs

Semi-Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - SOM01.2 Low Water by SIM	Analytical Method - SOM01.2 Low Water			
Benzaldehyde	100-52-7	NL	5	N/A	NL	5	Low	N/A	N/A
Benzo (a) anthracene	**56-55-3**	**0.038**	**0.038**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (a) pyrene	**50-32-8**	**0.0038**	**0.0038**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (b) fluoroanthene	**205-99-2**	**0.038**	**0.038**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (g,h,i) perylene	191-24-2	NL	5	N/A	0.1	5	Low	N/A	N/A
Benzo (k) fluoroanthene	207-08-9	0.38	0.1	N/A	0.1	5	SIM	N/A	N/A
Bis (2-chloroethoxy) methane	111-91-1	NL	5	N/A	NL	5	Low	N/A	N/A
Bis (2-ethylhexyl) phthalate	**117-81-7**	**1.2**	**1**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
bis-(2-chloroethyt) ether	**111-44-4**	**0.03**	**0.03**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Butylbenzylphthalate	85-68-7	150	50	N/A	NL	5	Low	N/A	N/A
Caprolactam	105-60-2	NL	5	N/A	NL	5	Low	N/A	N/A
Carbazole	86-74-8	NL	5	N/A	NL	5	Low	N/A	N/A
Chrysene	218-01-9	3.8	1.27	N/A	0.1	5	SIM	N/A	N/A
Dibenzo (a,h)-anthracene	**53-70-3**	**0.0038**	**0.004**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Dibenzofuran	132-64-9	NL	5	N/A	NL	5	Low	N/A	N/A
Diethylphthalate	84-66-2	17000	5667	N/A	NL	5	Low	N/A	N/A
Dimethylphthalate	131-11-3	NL	5	N/A	NL	5	Low	N/A	N/A
Di-n-butylphthalate	84-74-2	2000	667	N/A	NL	5	Low	N/A	N/A
Di-n-octylphthalate	117-84-0	NL	5	N/A	NL	5	Low	N/A	N/A
Fluoranthene	206-44-0	130	43	N/A	0.1	5	Low	N/A	N/A
Fluorene	86-73-7	1100	367	N/A	0.1	5	Low	N/A	N/A
Hexachlorobenzene	**118-74-1**	**0.00028**	**0.003**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Hexachlorobutadiene	**87-68-3**	**0.44**	**0.44**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Hexachlorocyclo-pentadiene	77-47-4	40	13	N/A	NL	5	Low	N/A	N/A
Hexachloroethane	**67-72-1**	**1.4**	**1.4**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Indeno (1,2,3-cd)-pyrene	**193-39-5**	**0.038**	**0.038**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Isophorone	78-59-1	35	12	N/A	NL	5	Low	N/A	N/A
Napthalene	91-20-3	NL	5	N/A	0.1	5	Low	N/A	N/A
Nitrobenzene	98-95-3	17	6	N/A	NL	5	Low	N/A	N/A
N-Nitroso-di-n propylamine	**621-64-7**	**0.005**	**0.005**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
N-Nitrosodiphenylamine	**86-30-6**	**3.3**	**3.3**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Pentachlorophenol	**87-86-5**	**0.27**	**0.27**	**N/A**	**0.2**	**10**	**SIM**	**N/A**	**N/A**
Phenanthrene	85-01-8	NL	5	N/A	0.1	5	Low	N/A	N/A
Phenol	108-95-2	10000	3333	N/A	NL	5	Low	N/A	N/A
Pyrene	129-00-0	NL	5	N/A	0.1	5	Low	N/A	N/A

QAPP Worksheet #15k
Reference Limits and Evaluation Table - Surface Water SVOCs

1. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
2. NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). January 2010.
3. NJDEP Specific Groundwater Quality Criteria Standards (http://www.nj.gov/dep/standards/ground%20water.pdf). May 2010.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded SVOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

Low SIM analysis required for benzo (k) fluoroanthene and chrysene.

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = microgram per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring

QAPP Worksheet #15I
Reference Limits and Evaluation Table - Surface Water Pesticides

Pesticides (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable Laboratory Limits***	
				MDLs	CRQL Analytical Method - SOM01.2 Water	MDLs	QLs
4,4'-DDD	**72-54-8**	**0.00031**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
4,4'-DDE	**72-55-9**	**0.00022**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
4,4'-DDT	**50-29-3**	**0.00022**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
Aldrin	**309-00-2**	**0.000049**	**0.05**	**N/A**	**0.05**	**N/A**	**N/A**
alpha-BHC	**319-84-6**	**0.0026**	**0.05**	**N/A**	**0.05**	**N/A**	**N/A**
alpha-Chlordane	5103-71-9	NL	0.05	N/A	0.05	N/A	N/A
beta-BHC	**319-85-7**	**0.0091**	**0.05**	**N/A**	**0.05**	**N/A**	**N/A**
delta-BHC	319-86-8	NL	0.05	N/A	0.05	N/A	N/A
Dieldrin	**60-57-1**	**0.000052**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
Endosulfan I	959-98-8	0.056	0.05	N/A	0.05	N/A	N/A
Endosulfan II	**33213-65-9**	**0.056**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
Endosulfan (alpha and beta)	115-29-7	0.056	0.05	N/A	0.05	N/A	N/A
Endosulfan sulfate	1031-07-8	62	20.67	N/A	0.1	N/A	N/A
Endrin	**72-20-8**	**0.036**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
Endrin aldehyde	**7421-93-4**	**0.059**	**0.1**	**N/A**	**0.1**	**N/A**	**N/A**
Endrin ketone	53494-70-5	NL	0.1	N/A	0.1	N/A	N/A
gamma-BHC (Lindane)	58-89-9	0.98	0.05	N/A	0.05	N/A	N/A
gamma-Chlordane	5103-74-2	NL	0.05	N/A	0.05	N/A	N/A
Heptachlor	**76-44-8**	**0.000079**	**0.05**	**N/A**	**0.05**	**N/A**	**N/A**
Heptachlor epoxide	**1024-57-3**	**0.000039**	**0.05**	**N/A**	**0.05**	**N/A**	**N/A**
Methoxychlor	**72-43-5**	**0.03**	**0.5**	**N/A**	**0.5**	**N/A**	**N/A**
Toxaphene	**8001-35-2**	**0.0002**	**5**	**N/A**	**5**	**N/A**	**N/A**

Notes for QAPP Worksheet #15I
Reference Limits and Evaluation Table - Surface Water Pesticides

1. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
2. NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). January 2010.
3. NJDEP *Specific Groundwater Quality Criteria Standards (http://www.nj.gov/dep/standards/ground%20water.pdf)*. May 2010.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded Pesticides have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit

QAPP Worksheet #15m
Reference Limits and Evaluation Table - Surface Water Aroclors

Aroclors (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable Laboratory Limits***	
				MDLs	CRQL Analytical Method - SOM01.2 Water	MDLs	QLs
Aroclor-1016	12674-11-2	0.014	1	N/A	1	N/A	N/A
Aroclor-1221	11104-28-2	0.014	1	N/A	1	N/A	N/A
Aroclor-1232	11141-16-5	0.014	1	N/A	1	N/A	N/A
Aroclor-1242	53469-21-9	0.014	1	N/A	1	N/A	N/A
Aroclor-1248	12672-29-6	0.014	1	N/A	1	N/A	N/A
Aroclor-1254	11097-69-1	0.014	1	N/A	1	N/A	N/A
Aroclor-1260	11096-82-5	0.014	1	N/A	1	N/A	N/A
Aroclor-1262	37324-23-5	0.014	1	N/A	1	N/A	N/A
Aroclor-1268	11100-14-4	0.014	1	N/A	1	N/A	N/A

Notes:

1. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
2. NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). January 2010.
3. NJDEP Specific Groundwater Quality Criteria Standards (http://www.nj.gov/dep/standards/ground%20water.pdf). May 2010.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded Aroclors have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = microgram per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit

QAPP Worksheet #15n
Reference Limits and Evaluation Table - Surface Water Inorganics (Metals and Cyanide)

Inorganics (All units: µg/L unless specified)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs*	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - ILM05.4 ICP-AES	Analytical Method - ILM05.4 ICP-MS			
Aluminum	7429-90-5	NL	NL	N/A	200	NL	AES	N/A	N/A
Antimony	7440-36-0	5.6	2.00	N/A	60	2	MS	N/A	N/A
Arsenic	**7440-38-2**	**0.017**	**0.02**	**N/A**	**10**	**1**	**MA**	**N/A**	**N/A**
Barium	7440-39-3	2000	666.67	N/A	200	10	AES	N/A	N/A
Beryllium	7440-41-7	6	2.00	N/A	5	1	MS	N/A	N/A
Cadmium	**7440-43-9**	**0.25**	**0.25**	**N/A**	**5**	**1**	**MA**	**N/A**	**N/A**
Calcium	7440-70-2	NL	NL	N/A	5000	NL	AES	N/A	N/A
Chromium, Total	7440-47-3	92	30.67	N/A	10	2	AES	N/A	N/A
Cobalt	7440-48-4	NL	NL	N/A	50	1	AES	N/A	N/A
Copper	7440-50-8	9	5.00	N/A	25	2	MS	N/A	N/A
Iron	7439-89-6	NL	NL	N/A	100	NL	AES	N/A	N/A
Lead	7439-92-1	2.5	1.00	N/A	10	1	MS	N/A	N/A
Magnesium	7439-95-4	NL	NL	N/A	5000	NL	AES	N/A	N/A
Manganese	7439-96-5	NL	NL	N/A	15	1	AES	N/A	N/A
Mercury	**7439-97-6**	**0.05**	**0.05**	**N/A**	**0.2**	**NL**	**MA**	**N/A**	**N/A**
Nickel	7440-02-0	52	20.00	N/A	40	1	MS	N/A	N/A
Potassium	7440-09-7	NL	NL	N/A	5000	NL	AES	N/A	N/A

QAPP Worksheet #15n
Reference Limits and Evaluation Table - Surface Water Inorganics (Metals and Cyanide)

Inorganics (All units: µg/L unless specified)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs*	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - ILM05.4 ICP-AES	Analytical Method - ILM05.4 ICP-MS			
Selenium	7782-49-2	5	5.00	N/A	35	5	MS	N/A	N/A
Silver	7440-22-4	170	56.67	N/A	10	1	AES	N/A	N/A
Sodium	7440-23-5	NL	NL	N/A	5000	NL	AES	N/A	N/A
Thallium	***7440-28-0***	***0.24***	***0.24***	***N/A***	***25***	***1***	***MA***	***N/A***	***N/A***
Vanadium	7440-62-2	NL	NL	N/A	50	5	AES	N/A	N/A
Zinc	7440-66-6	120	40.00	N/A	60	2	MS	N/A	N/A
Chromium VI	18540-29-9	92	30.7	N/A	N/A	N/A	N/A	N/A	10 µg/L
Alkalinity	14797-55-8 14797-65-0	20000	6667	N/A	N/A	N/A	N/A	N/A	1 mg/L
Chloride	16887-00-6	230000	76,667	N/A	N/A	N/A	N/A	N/A	1 mg/L
Hardness	--	N/A	NA	N/A	N/A	N/A	N/A	N/A	N/A
TSS	--	N/A	NA	N/A	N/A	N/A	N/A	N/A	N/A

QAPP Worksheet #15n
Reference Limits and Evaluation Table - Surface Water Inorganics (Metals and Cyanide)

1. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
2. NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). January 2010.
3. NJDEP Specific Groundwater Quality Criteria Standards (http://www.nj.gov/dep/standards/ground%20water.pdf). May 2010.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded Inorganics have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

* This method does not provide MDLs

*** DESA limits are included in Appendix D

AES = atomic emission spectroscopy
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
EPA = United States Environmental Protection Agency
L = liter
MA = modified analyses
MS = mass spectroscopy
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed
PAL= Project Action Limit
µg/L = microgram per liter
MDL = method detection limit

QAPP Worksheet #15o
Reference Limits and Evaluation Table - Groundwater VOCs

Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method					Achievable Laboratory Limits***	
				MDLs	CRQL			*Project Selected Option*	MDLs	QLs
					Analytical Method - SOM01.2 Trace Water by SIM	Analytical Method - SOM01.2 Trace Water	Analytical Method - SOM01.2 Low Water			
1,1,1-Trichloroethane	71-55-6	30	10	N/A	NL	0.5	5	Low	N/A	N/A
1,1,2,2-Tetrachloroethane	79-34-5	1	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NL	NL	N/A	NL	0.5	5	Low	N/A	N/A
1,1,2-Trichloroethane	79-00-5	3	1	N/A	NL	0.5	5	Trace	N/A	N/A
1,1-Dichloroethane	75-34-3	50	17	N/A	NL	0.5	5	Low	N/A	N/A
1,1-Dicholoroethene	75-35-4	1	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
1,2,3-Trichlorobenzene	87-61-6	NL	NL	N/A	NL	0.5	5	Low	N/A	N/A
1,2,4-Trichlorobenzene	120-82-1	9	3	N/A	NL	0.5	5	Trace	N/A	N/A
1,2-Dibromo-3-chloropropane	**96-12-8**	**0.02**	**0.02**	**N/A**	**0.05**	**0.5**	**5**	**SIM**	**N/A**	**N/A**
1,2-Dibromoethane	**106-93-4**	**0.0004**	**0.0004**	**N/A**	**0.05**	**0.5**	**5**	**SIM**	**N/A**	**N/A**
1,2-Dichlorobenzene	95-50-1	600	200	N/A	NL	0.5	5	Low	N/A	N/A
1,2-Dichloroethane	**107-06-2**	**0.3**	**0.3**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
1,2-Dichloropropane	78-87-5	1	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
1,3-Dichlorobenzene	541-73-1	600	200	N/A	NL	0.5	5	Low	N/A	N/A
1,4-Dichlorobenzene	106-46-7	75	25	N/A	NL	0.5	5	Low	N/A	N/A
1,4-Dioxane	123-91-1	NL	NL	N/A	NL	NL	100	Low	N/A	N/A
2-Butanone	78-93-3	300	100	N/A	NL	5	10	Low	N/A	N/A
2-Hexanone	591-78-6	100	33	N/A	NL	5	10	Low	N/A	N/A
4-Methyl-2-pentanone	108-10-1	NL	NL	N/A	NL	5	10	Low	N/A	N/A
Acetone	67-64-1	6,000	2,000	N/A	NL	5	10	Low	N/A	N/A
Benzene	**71-43-2**	**0.2**	**0.2**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
Bromochloromethane	74-97-5	NL	NL	N/A	NL	0.5	5	Low	N/A	N/A
Bromodichloromethane	75-27-4	1	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
Bromoform	75-25-2	4	1.33	N/A	NL	0.5	5	Trace	N/A	N/A
Bromomethane	74-83-9	10	3.33	N/A	NL	0.5	5	Trace	N/A	N/A
Carbon Disulfide	75-15-0	700	233	N/A	NL	0.5	5	Low	N/A	N/A
Carbon tetrachloride	**56-23-5**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**

QAPP Worksheet #15o
Reference Limits and Evaluation Table - Groundwater VOCs

Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project *Quantitation* Limit Goal (PQLG)	Analytical Method					Achievable Laboratory Limits***	
				MDLs	CRQL			*Project Selected Option*	MDLs	QLs
					Analytical Method - SOM01.2 Trace Water by SIM	Analytical Method - SOM01.2 Trace Water	Analytical Method - SOM01.2 Low Water			
Chlorobenzene	108-90-7	50	17	N/A	NL	0.5	5	Low	N/A	N/A
Chloroethane	75-00-3	100	33	N/A	NL	0.5	5	Low	N/A	N/A
Chloroform	67-66-3	70	23	N/A	NL	0.5	5	Low	N/A	N/A
Chloromethane	74-87-3	NL	NL	N/A	NL	0.5	5	Low	N/A	N/A
cis-1,2-Dichloroethene	156-59-2	70	23	N/A	NL	0.5	5	Low	N/A	N/A
cis-1,3-Dichloropropene	**10061-01-5**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
Cyclohexane	110-82-7	100	33	N/A	NL	0.5	5	Low	N/A	N/A
Dibromochloromethane	**124-48-1**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
Dichlorodifluoromethane	75-71-8	1,000	333	N/A	NL	0.5	5	Low	N/A	N/A
Ethylbenzene	100-41-4	700	233	N/A	NL	0.5	5	Low	N/A	N/A
Isopropylbenzene	98-82-8	700	233	N/A	NL	0.5	5	Low	N/A	N/A
m, p-Xylene *	1330-20-7	1,000	333	N/A	NL	0.5	5	Low	N/A	N/A
Methyl acetate	79-20-9	7,000	2333	N/A	NL	0.5	5	Low	N/A	N/A
Methyl tert-butyl ether	1634-04-4	70	23	N/A	NL	0.5	5	Low	N/A	N/A
Methylcyclohexane	108-87-2	NL	NL	N/A	NL	0.5	5	Low	N/A	N/A
Methylene chloride	75-09-2	3	1	N/A	NL	0.5	5	Trace	N/A	N/A
o-Xylene **	1330-20-7	1,000	333	N/A	NL	0.5	5	Low	N/A	N/A
Styrene	100-42-5	100	33	N/A	NL	0.5	5	Low	N/A	N/A
Tetrachloroethene	**127-18-4**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
Toluene	108-88-3	600	200	N/A	NL	0.5	5	Low	N/A	N/A
trans-1,2-Dichloroethene	156-60-5	100	33	N/A	NL	0.5	5	Low	N/A	N/A
trans-1,3-Dichloropropene	**10061-02-6**	**0.4**	**0.4**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**
Trichloroethene	79-01-6	1	0.5	N/A	NL	0.5	5	Trace	N/A	N/A
Trichlorofluoromethane	*75-69-4*	*2,000*	*667*	*N/A*	*NL*	*0.5*	*5*	*Low*	*N/A*	*N/A*
Vinyl Chloride	**75-01-4**	**0.08**	**0.08**	**N/A**	**NL**	**0.5**	**5**	**Trace**	**N/A**	**N/A**

QAPP Worksheets #15o
Reference Limits and Evaluation Table - Groundwater VOCs

1. EPA National Primary Drinking Water Standards (web page http://www.epa.gov/safewater/contaminants/index.html), EPA 816-F-03-016, June 2003. last updated November 28, 2006.
2. New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded August 4, 2010
3. New Jersey Drinking Water Standards, February 2005 (http://www.state.nj.us/dep/watersupply/standard.htm), downloaded August 4, 2010

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. *Highlighted and bolded VOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.*

* m-xylene and p-xylene reported as one compound under S0M01.2. Xylene (total) was used for m,p-xylene criteria.

** Xylene (total) was used for o-xylene criteria.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = micrograms per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring
TOGS = Technical and Operational Guidance Series

QAPP Worksheet #15p
Reference Limits and Evaluation Table - Groundwater SVOCs

Semi-Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - SOM01.2 Low Water by SIM	Analytical Method - SOM01.2 Low Water			
1,1'-Biphenyl	92-52-4	400	133	N/A	NL	5	Low	N/A	N/A
1,2,4,5-Tetrachlorobenzene	95-94-3	NL	NL	N/A	NL	5	Low	N/A	N/A
2,2'-Oxybis (1-chloropropane)	108-60-1	300	100	N/A	NL	5	Low	N/A	N/A
2,3,4,6-Tetrachlorophenol	58-90-2	200	67	N/A	NL	5	Low	N/A	N/A
2,4,5-Trichlorophenol	95-95-4	700	233	N/A	NL	5	Low	N/A	N/A
2,4,6-Trichlorophenol	**88-06-2**	**1**	**1**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
2,4-Dichlorophenol	120-83-2	20	7	N/A	NL	5	Low	N/A	N/A
2,4-Dimethylphenol	105-67-9	100	33	N/A	NL	5	Low	N/A	N/A
2,4-Dinitrophenol	51-28-5	10	10	N/A	NL	10	Low	N/A	N/A
2,4-Dinitrotoluene	**121-14-2**	**0.05**	**0.05**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
2,6-Dinitrotoluene	606-20-2	NL	NL	N/A	NL	5	Low	N/A	N/A
2-Chloronapthalene	91-58-7	600	200	N/A	NL	5	Low	N/A	N/A
2-Chlorophenol	95-57-8	40	13	N/A	NL	5	Low	N/A	N/A
2-Methylnapthalene	91-57-6	NL	NL	N/A	0.1	5	Low	N/A	N/A
2-Methylphenol	95-48-7	NL	NL	N/A	NL	5	Low	N/A	N/A
2-Nitroaniline	88-74-4	NL	NL	N/A	NL	10	Low	N/A	N/A
2-Nitrophenol	88-75-5	NL	NL	N/A	NL	5	Low	N/A	N/A
3,3'-Dichlorobenzidine	**91-94-1**	**0.08**	**0.08**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
3-Nitroaniline	99-09-2	NL	NL	N/A	NL	10	Low	N/A	N/A
4,6-Dinitro-2-methylphenol	534-52-1	NL	NL	N/A	NL	10	Low	N/A	N/A
4-Bromophenyl-phenylether	101-55-3	NL	NL	N/A	NL	5	Low	N/A	N/A
4-Chloro-3-methylphenol	59-50-7	NL	NL	N/A	NL	5	Low	N/A	N/A
4-Chloroaniline	106-47-8	30	10	N/A	NL	5	Low	N/A	N/A
4-Chlorophenyl-phenyl ether	7005-72-3	NL	NL	N/A	NL	5	Low	N/A	N/A
4-Methylphenol	106-44-5	NL	NL	N/A	NL	5	Low	N/A	N/A
4-Nitroaniline	100-01-6	NL	NL	N/A	NL	10	Low	N/A	N/A
4-Nitrophenol	100-02-7	NL	NL	N/A	NL	10	Low	N/A	N/A
Acenaphthene	83-32-9	400	133	N/A	0.1	5	Low	N/A	N/A
Acenaphthylene	208-96-8	NL	NL	N/A	0.1	5	Low	N/A	N/A
Acetophenone	98-86-2	700	233	N/A	NL	5	Low	N/A	N/A
Anthracene	120-12-7	2000	667	N/A	0.1	5	Low	N/A	N/A
Atrazine	**1912-24-9**	**3**	**3**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Benzaldehyde	100-52-7	NL	NL	N/A	NL	5	Low	N/A	N/A
Benzo (a) anthracene	**56-55-3**	**0.05**	**0.05**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (a) pyrene	**50-32-8**	**0.005**	**0.005**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (b) fluoroanthene	**205-99-2**	**0.05**	**0.05**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Benzo (g,h,i) perylene	191-24-2	NL	NL	N/A	0.1	5	Low	N/A	N/A
Benzo (k) fluoroanthene	207-08-9	0.5	0.1	N/A	0.1	5	SIM	N/A	N/A
Bis (2-chloroethoxy) methane	111-91-1	NL	NL	N/A	NL	5	Low	N/A	N/A

QAPP Worksheet #15p
Reference Limits and Evaluation Table - Groundwater SVOCs

Semi-Volatile Organic Compounds (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		Project Selected Option	MDLs	QLs
					Analytical Method - SOM01.2 Low Water by SIM	Analytical Method - SOM01.2 Low Water			
Bis (2-ethylhexyl) phthalate	**117-81-7**	**2**	**2**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Bis-(2-chloroethyl) ether	**111-44-4**	**0.03**	**0.03**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Butylbenzylphthalate	85-68-7	100	33	N/A	NL	5	Low	N/A	N/A
Caprolactam	105-60-2	NL	NL	N/A	NL	5	Low	N/A	N/A
Carbazole	86-74-8	NL	NL	N/A	NL	5	Low	N/A	N/A
Chrysene	218-01-9	5	0.1	N/A	0.1	5	SIM	N/A	N/A
Dibenzo (a,h)-anthracene	**53-70-3**	**0.005**	**0.005**	**N/A**	**0.1**	**5**	**SIM**	**N/A**	**N/A**
Dibenzofuran	132-64-9	NL	NL	N/A	NL	5	Low	N/A	N/A
Diethylphthalate	84-66-2	6000	2000	N/A	NL	5	Low	N/A	N/A
Dimethylphthalate	131-11-3	NL	NL	N/A	NL	5	Low	N/A	N/A
Di-n-butylphthalate	84-74-2	700	233	N/A	NL	5	Low	N/A	N/A
Di-n-octylphthalate	117-84-0	100	33	N/A	NL	5	Low	N/A	N/A
Fluoranthene	206-44-0	300	100	N/A	0.1	5	Low	N/A	N/A
Fluorene	86-73-7	300	100	N/A	0.1	5	Low	N/A	N/A
Hexachlorobenzene	**118-74-1**	**0.02**	**0.02**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Hexachlorobutadiene	**87-68-3**	**0.4**	**0.40**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Hexachlorocyclo-pentadiene	77-47-4	40	13	N/A	NL	5	Low	N/A	N/A
Hexachloroethane	**67-72-1**	**2**	**2**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
Indeno (1,2,3-cd)-pyrene	193-39-5	0.05	0.1	N/A	0.1	5	SIM	N/A	N/A
Isophorone	78-59-1	40	13	N/A	NL	5	Low	N/A	N/A
Napthalene	91-20-3	300	100	N/A	0.1	5	Low	N/A	N/A
Nitrobenzene	**98-95-3**	**4**	**4**	**N/A**	**NL**	**5**	**Low**	**N/A**	**N/A**
N-Nitroso-di-n propylamine	***621-64-7***	***0.005***	***0.005***	***N/A***	***NL***	***5***	***Low***	***N/A***	***N/A***
N-Nitrosodiphenylamine	86-30-6	7	5	N/A	NL	5	Low	N/A	N/A
Pentachlorophenol	87-86-5	0.3	0.2	N/A	0.2	10	SIM	N/A	N/A
Phenanthrene	85-01-8	NL	NL	N/A	0.1	5	Low	N/A	N/A
Phenol	108-95-2	2000	667	N/A	NL	5	Low	N/A	N/A
Pyrene	129-00-0	200	67	N/A	0.1	5	Low	N/A	N/A

QAPP Worksheet #15p
Reference Limits and Evaluation Table - Groundwater SVOCs

1. EPA National Primary Drinking Water Standards (web page http://www.epa.gov/safewater/contaminants/index.html), EPA 816-F-03-016, June 2003. last updated November 28, 2006.
2. New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded August 4, 2010
3. New Jersey Drinking Water Standards, February 2005 (http://www.state.nj.us/dep/watersupply/standard.htm), downloaded August 4, 2010
4. The maximum contaminant level determination for the sum of principal organic contaminants (POC) and unspecified organic contaminants (UOC) is 100 ug/L.
5. Highlighted and bolded SVOCs have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals. Pentachlorophenol will require SIM analysis to achieve PQLG.

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = microgram per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring
TOGS = Technical and Operational Guidance Series

QAPP Worksheet #15q
Reference Limits and Evaluation Table - Groundwater Pesticides

Pesticides (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable Laboratory Limits***	
				MDLs	CRQL Analytical Method - SOM01.2 Water	MDLs	QLs
4,4'-DDD	72-54-8	0.1	0.1	N/A	0.1	N/A	N/A
4,4'-DDE	72-55-9	0.1	0.1	N/A	0.1	N/A	N/A
4,4'-DDT	50-29-3	0.1	0.1	N/A	0.1	N/A	N/A
Aldrin	**309-00-2**	**0.002**	**0.002**	**N/A**	**0.05**	**N/A**	**N/A**
alpha-BHC	**319-84-6**	**0.006**	**0.006**	**N/A**	**0.05**	**N/A**	**N/A**
alpha-Chlordane	**5103-71-9**	**0.01**	**0.01**	**N/A**	**0.05**	**N/A**	**N/A**
beta-BHC	**319-85-7**	**0.02**	**0.02**	**N/A**	**0.05**	**N/A**	**N/A**
delta-BHC	319-86-8	NL	0.05	N/A	0.05	N/A	N/A
Dieldrin	**60-57-1**	**0.002**	**0.002**	**N/A**	**0.1**	**N/A**	**N/A**
Endosulfan I	959-98-8	40	0.05	N/A	0.05	N/A	N/A
Endosulfan II	33213-65-9	40	0.1	N/A	0.1	N/A	N/A
Endosulfan sulfate	1031-07-8	40	0.1	N/A	0.1	N/A	N/A
Endrin	72-20-8	2	0.1	N/A	0.1	N/A	N/A
Endrin aldehyde	7421-93-4	0	0.1	N/A	0.1	N/A	N/A
Endrin ketone	53494-70-5	0	0.1	N/A	0.1	N/A	N/A
gamma-BHC (Lindane)	58-89-9	0.03	0.05	N/A	0.05	N/A	N/A
gamma-Chlordane	**5103-74-2**	**0.01**	**0.01**	**N/A**	**0.05**	**N/A**	**N/A**
Heptachlor	**76-44-8**	**0.008**	**0.008**	**N/A**	**0.05**	**N/A**	**N/A**
Heptachlor epoxide	**1024-57-3**	**0.004**	**0.004**	**N/A**	**0.05**	**N/A**	**N/A**
Methoxychlor	72-43-5	40	0.5	N/A	0.5	N/A	N/A
Toxaphene	**8001-35-2**	**0.03**	**0.03**	**N/A**	**5**	**N/A**	**N/A**

QAPP Worksheet #15q
Reference Limits and Evaluation Table - Groundwater Pesticides

1. EPA National Primary Drinking Water Standards (web page http://www.epa.gov/safewater/contaminants/index.html), EPA 816-F-03-016, June 2003. last updated November 28, 2006.
2. New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded August 4, 2010
3. New Jersey Drinking Water Standards, February 2005 (http://www.state.nj.us/dep/watersupply/standard.htm), downloaded August 4, 2010

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded Pesticides have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = micrograms per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring
TOGS = Technical and Operational Guidance Series

QAPP Worksheet #15r
Reference Limits and Evaluation Table - Groundwater Aroclors

Aroclors (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method		Achievable Laboratory Limits***	
				MDLs	CRQL		
					Analytical Method - SOM01.2 Water	MDLs	QLs
Aroclor-1016	12674-11-2	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1221	11104-28-2	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1232	11141-16-5	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1242	53469-21-9	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1248	12672-29-6	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1254	11097-69-1	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1260	11096-82-5	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1262	37324-23-5	0.02	0.02	N/A	1	N/A	N/A
Aroclor-1268	11100-14-4	0.02	0.02	N/A	1	N/A	N/A

QAPP Worksheet #15r
Reference Limits and Evaluation Table - Groundwater Aroclors (PCBs)

1. EPA National Primary Drinking Water Standards (web page http://www.epa.gov/safewater/contaminants/index.html), EPA 816-F-03-016, June 2003. last updated November 28, 2006.
2. New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded August 4, 2010
3. New Jersey Drinking Water Standards, February 2005 (http://www.state.nj.us/dep/watersupply/standard.htm), downloaded August 4, 2010

The criteria used for the Project Action Limit is the lowest value of 1., 2., and 3.

4. Highlighted and bolded Aroclors have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

EPA = United States Environmental Protection Agency
CAS = Chemical abstract service
CRQL = Contract Required Quantitation Limit
MDL = method detection limit
µg/L = microgram per liter
N/A = Not Applicable
NJDEP = New Jersey Department of Environmental Protection
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
SIM = selective ion monitoring
TOGS = Technical and Operational Guidance Series

QAPP Worksheet #15s
Reference Limits and Evaluation Table - Groundwater Inorganics (Metals and Cyanide)

Inorganics (All units: µg/L)	CAS Number	Project Action Limit (PAL)	Project Quantitation Limit Goal (PQLG)	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - ILM05.4 ICP-AES	Analytical Method - ILM05.4 ICP-MS			
Aluminum	7429-90-5	200	66.67	N/A	200	NL	AES	N/A	N/A
Antimony	7440-36-0	6	2.00	N/A	60	2	MS	N/A	N/A
Arsenic	**7440-38-2**	**0.02**	**0.02**	**N/A**	**10**	**1**	**MA**	**N/A**	**N/A**
Barium	7440-39-3	6000	666.67	N/A	200	10	AES	N/A	N/A
Beryllium	7440-41-7	1	2.00	N/A	5	1	MS	N/A	N/A
Cadmium	**7440-43-9**	**0.25**	**0.25**	**N/A**	**5**	**1**	**MA**	**N/A**	**N/A**
Calcium	7440-70-2	NL	NL	N/A	5000	NL	AES	N/A	N/A
Chromium, Total	7440-47-3	70	23.33	N/A	10	2	AES	N/A	N/A
Cobalt	7440-48-4	100	33.33	N/A	50	1	AES	N/A	N/A
Copper	7440-50-8	9	5.00	N/A	25	2	MS	N/A	N/A
Iron	7439-89-6	300	NL	N/A	100	NL	AES	N/A	N/A
Lead	7439-92-1	2.5	1.00	N/A	10	1	MS	N/A	N/A
Magnesium	7439-95-4	NL	NL	N/A	5000	NL	AES	N/A	N/A
Manganese	7439-96-5	50	16.67	N/A	15	1	AES	N/A	N/A
Mercury	**7439-97-6**	**0.77**	**0.7**	**N/A**	**0.2**	**NL**	**MA**	**N/A**	**N/A**
Nickel	7440-02-0	52	20.00	N/A	40	1	MS	N/A	N/A
Potassium	7440-09-7	NL	NL	N/A	5000	NL	AES	N/A	N/A
Selenium	7782-49-2	5	5.00	N/A	35	5	MS	N/A	N/A
Silver	7440-22-4	40	56.67	N/A	10	1	AES	N/A	N/A
Sodium	7440-23-5	50000	16666.67	N/A	5000	NL	AES	N/A	N/A
Thallium	**7440-28-0**	**0.5**	**0.5**	**N/A**	**25**	**1**	**MA**	**N/A**	**N/A**
Vanadium	7440-62-2	NL	NL	N/A	50	5	AES	N/A	N/A
Zinc	7440-66-6	120	40.00	N/A	60	2	MS	N/A	N/A

QAPP Worksheet #15s
Reference Limits and Evaluation Table - Groundwater Inorganics

Inorganics (All units: µg/L)	CAS Number	Project Action Limit (PAL)	*Project Quantitation Limit Goal (PQLG)*	Analytical Method				Achievable Laboratory Limits***	
				MDLs	CRQL		*Project Selected Option*	MDLs	QLs
					Analytical Method - ILM05.4 ICP-AES	Analytical Method - ILM05.4 ICP-MS			
Chromium VI	18540-29-9	70	10	N/A	N/A	N/A	N/A	N/A	N/A
Alkalinity	14797-55-8 14797-65-0	N/A	1,000	N/A	N/A	N/A	N/A	N/A	N/A
Chloride	16887-00-6	250,000	75,000	N/A	N/A	N/A	N/A	N/A	1 mg/L
Ferrous Iron	--	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hardness	--	N/A	1,000	N/A	N/A	N/A	N/A	N/A	N/A
TSS	--	N/A	4,000	N/A	N/A	N/A	N/A	N/A	N/A

QAPP Worksheet #15s
Reference Limits and Evaluation Table - Groundwater Inorganics (Metals and Cyanide)

1. EPA National Primary Drinking Water Standards (web page http://www.epa.gov/safewater/contaminants/index.html), EPA 816-F-03-016, June 2003. last updated November 28, 2006.
2. EPA National Recommended Water Quality Criteria. (web page http://www.epa.gov/waterscience/criteria/wqctable/). 2009
3. EPA National Secondary Water Quality Standards (web page http://edocket.access.gpo.gov/cfr_2002/julqtr/40cfr143.3.htm) 2002.
4. New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded August 4, 2010

The criteria used for the Project Action Limit is the lowest value of 1., 2., 3. and 4.

5. Highlighted and bolded Inorganics have CRQLs above their PQLGs. A contract modification will be requested to achieve the project goals.

*** DESA limits are included in Appendix D

AES = atomic emission spectroscopy
CRQL = Contract Required Quantitation Limit
EPA = United States Environmental Protection Agency
MDL = method detection limit
MS = mass spectroscopy
N/A = Not Applicable
NL = Not Listed or chemical name listed but no value available
PAL= Project Action Limit
NJDEP = New Jersey Department of Environmental Protection
SIM = selective ion monitoring
TOGS = Technical and Operational Guidance Series
µg/L = microgram per liter

QAPP Worksheet #15t
Reference Limits and Evaluation Table -Tissues (Inorganics)

Inorganics (All units: mg/kg)	CAS Number	Project Action Limit	*Project Quantitation Limit Goal (PQLG)*	Analytical Method		Achievable Laboratory Limits	
		EPA Regional Screening Levels (1)		MDLs	CRQLs	MDLs	QLs
Aluminum	7429-90-5	140	28	N/A	N/A	N/A	20
Antimony	7440-36-0	0.054 [a]	0.054	N/A	N/A	N/A	0.054
Arsenic	7440-38-2	0.0021	0.0021	N/A	N/A	N/A	0.0021
Barium	7440-39-3	27	5.4	N/A	N/A	N/A	20
Beryllium	7440-41-7	0.27	0.27	N/A	N/A	N/A	0.27
Cadmium	7440-43-9	0.14	0.14	N/A	N/A	N/A	0.14
Calcium	7440-70-2	N/A	N/A	N/A	N/A	N/A	500
Chromium	7440-47-3	200	40	N/A	N/A	N/A	N/A
Chromium (hexavalent)	18540-29-9	0.0063 [b]	0.0063	N/A	N/A	N/A	0.0063[b]
Cobalt	7440-48-4	0.041	0.041	N/A	N/A	N/A	0.041
Copper	7440-50-8	5.4	5.4	N/A	N/A	N/A	2.5
Cyanide	57-12-5	2.7	2.7	N/A	N/A	N/A	N/A
Iron	7439-89-6	95	19	N/A	N/A	N/A	10
Lead	7439-92-1	N/A	N/A	N/A	N/A	N/A	1
Magnesium	7439-95-4	N/A	N/A	N/A	N/A	N/A	500
Manganese	7439-96-5	19	19	N/A	N/A	N/A	1.5
Mercury	7439-97-6	0.041 [c]	0.041	N/A	N/A	N/A	0.041[c]
Nickel	7440-02-0	2.7 [d]	2.7	N/A	N/A	N/A	2.7[d]
Potassium	7440-09-7	N/A	N/A	N/A	N/A	N/A	500
Selenium	7782-49-2	0.68	0.68	N/A	N/A	N/A	0.68
Silver	7440-22-4	0.68	0.68	N/A	N/A	N/A	0.68
Sodium	7440-23-5	N/A	N/A	N/A	N/A	N/A	500
Thallium	7440-28-0	N/A	N/A	N/A	N/A	N/A	2.5
Vanadium	7440-62-2	0.68 [e]	0.68	N/A	N/A	N/A	0.68[e]
Zinc	7440-66-6	41	8.2	N/A	N/A	N/A	6

(1) EPA Regional Screening Levels for Fish Ingestion based on carcinogenic target risk of 10^{-6} and noncarcinogenic hazard index of 0.1
[a] screening level for antimony (metallic)
[b] screening level for chromium(VI) used
[c] screening level for mercury, inorganic salts
[d] screening level for nickel soluble salts
[e] screening level for vanadium and compound

QAPP Worksheet #15u*
Reference Limits and Evaluation Table -Bioavailability and Electron Microprobe Samples

Inorganics (All units: mg/kg)	CAS Number	Project Action Limit**	*Project Quantitation Limit Goal (PQLG)*	Analytical Method		Achievable Laboratory Limits	
				MDLs	QL	MDLs	QLs
Arsenic	7440-38-2	0.389	**0.39**	N/A	TBA	NA	NA
Lead	7439-92-1	0.0537	**0.05**	N/A	TBA	NA	NA

* The reference limits and evaluations table for Bioavailability and Electon Microprobe samples will be submitted as a field change notification upon procurement of laboratory

** See Appendix E for individual standards
Historically high concentrations of metals have been detected on site. The laboratory shall screen the samples for high concentrations.

N/A = Not Applicable

QAPP Worksheet #15v*

Reference Limits and Evaluation Table - Geochronology:Radiological Isotopes (Sediment)

Radiological (All units: pCi/kg)	CAS Number	Project Action Limit	*Project Quantitation Limit Goal (PQLG)*	Analytical Method		Achievable DESA Laboratory Limits	
				MDLs	CRQL	MDLs	QLs
Cs-137	N/A	N/A	N/A				
Be-7	N/A	N/A	N/A				

* The reference limits and evaluations table for Bioavailability and Electon Microprobe samples will be submitted as a field change notification upon procurement of laboratory

N/A = Not Applicable

QAPP Worksheet #16
Project Schedule Timeline Table

See Figure 10

QAPP Worksheet # 17
Sampling Design and Rationale

The objectives to be achieved during the RI/FS are to define the nature and extent of contamination in site media; characterize surface water flow patterns and sediment transport dynamics with current meters and geochronology samples; characterize groundwater-surface water interactions, vertical and horizontal groundwater flow, and provide a groundwater quality baseline; obtain data to perform the HHRA and ERA; develop and screen remedial alternatives; and to conduct detailed analysis of a full range of appropriate remedial alternatives to support selection of a remedy and preparation of a ROD for the site.

The field program will include:

- Site Reconnaissance **(Worksheet 17a)**
- Mobilization and Demobilization **(Worksheet 17b)**
- Surface Water Sampling **(Worksheet 17c)**
- Sediment Sampling **(Worksheet 17d)**
- Soil Sampling **(Worksheet 17e)**
- Groundwater Sampling **(Worksheet 17f)**
- Biota Sampling **(Worksheet 17g)**
- Investigation Derived Waste **(Worksheet 17h)**
- Field Blank Collection **(Worksheet 17i)**
- Decontamination Procedures **(Worksheet 17j)**
- Treatability Study **(Worksheet 17k)**
- Water Level Measurement **(Worksheet 17l)**

QAPP Worksheet # 17b
Sampling Design and Rationale
Mobilization and Demobilization

Mobilization and Demobilization
Mobilization and demobilization activities will include site preparation and restoration, access support, field personnel orientation, field office and equipment mobilization and demobilization, and field supply ordering, staging, and transport to the site for the field events.

Site Preparation
Prior to commencement of field work, each site worker will review the QAPP and APP. All site workers will be oriented to the target Sector areas (Seawall, Jetty, Margaret's Creek, and Background Area) of the Site and the residential neighborhood. Equipment used to monitor the air for particulate matter and organic vapors should be ready to use before commencement of any intrusive site activity.

Existing roadway rights-of-way, open space, and clearings will be used to the maximum extent possible, for sampling locations. However, it will be necessary to clear some areas of vegetation in order to access the sampling locations. The drilling or vibracore subcontractor will be responsible for clearing vegetation, as necessary, to access the sampling locations.

Health and safety work zones including personnel decontamination areas will be established in accordance with the site-specific Accident Prevention Plan (APP), Section 3. Local authorities such as the police and fire departments will be notified prior to the start of field activities.

Field Planning Meetings
Prior to field activities, each field team member will review all project plans and participate in a field planning meeting, conducted by the CDM RI Task Leader and Field Team Leader (FTL), to become familiar with the history of the Site, health and safety requirements, field procedures, and related QC requirements. Field personnel (including subcontractors) will also attend on-site tailgate kick-off meetings immediately prior to the commencement of each step of field activities. All new field personnel will receive comparable briefing if they were not at the initial field planning meeting and/or the tailgate kick-off meetings.

Field Equipment and Supplies
Equipment and field supply mobilization, governed by CDM's Quality Procedures (QP) section 2.1, *Procuring Measurement and Test Equipment* and section 5.3, Inspection of Items, will entail ordering, renting, and purchasing all equipment and supplies needed for each part of the RI field investigation. This will also include staging and transferring all equipment and supplies to and from the site. Measurement and Test Equipment forms will be completed for rental or purchase of equipment (instruments) that will be utilized to collect field measurements. The field equipment will be inspected for acceptability, and instruments calibrated as required prior to use. This task also involves the construction of a decontamination area for sampling equipment and personnel. A separate decontamination pad will be constructed by the subcontractor for the drilling equipment.

Investigation Derived Waste (IDW)
IDW procedures are covered in Worksheet #17h.

QAPP Worksheet # 17b
Sampling Design and Rationale
Mobilization and Demobilization

Demobilization
Demobilization will involve removing of all equipment and overseeing removal of IDW from the site. All drilling and sampling locations will be restored as near as practicable to their original condition. Photographs will be taken of drilling and vibracore locations before and after drilling or coring activities to document the original site condition and the restoration measures. Site restoration will be performed by the applicable subcontractor under the direction of CDM.

Personal Protective Equipment
- Cut-resistant outer gloves
- Nitrile glove liners/undergloves
- Steel-toed and steel-shanked work boots
- Safety glasses or goggles
- Hard hat

Field Procedures for these Activities are detailed in:
- TSOP 2-2 Guide to Handling Investigation Derived Waste
- TSOP 5-1 Control of Measurement and Test Equipment

QAPP Worksheet # 17c
Sampling Design and Rationale
Surface Water Sampling

Surface Water Sampling

Surface water samples are proposed to supplement the previously collected data and to help evaluate the horizontal and vertical extents of site-related contamination. Bathymetry, topography, current and sediment transport profiles and the groundwater-surface water interactions study results may be used to adjust the location, depth or media classification of the sediment and soil samples. Soil and sediment classifications are based on their location relative to the spring high and spring low tide lines. The topographic and bathymetric survey will be used to define these lines and soil and sediment sample designations will be adjusted based on the lines. The surface water samples are co-located with the sediment samples and will be relocated accordingly. Additionally, if a sediment sample is relocated into a depositional area based on the results of the current study, sediment transport profiles, or the groundwater-surface water interaction study, the surface water sample will be relocated as well. All changes will be documented in a Field Change Notification.

Additionally, sampling locations in the Seawall Sector will depend upon the results of the EPA pre-RI sampling and the beach re-sampling and trench excavation early actions activities. Background sample locations for Margaret's Creek will be determined following the characterization of sediment dynamics, conducted as part of early RI activities. A figure identifying the adjusted surface water sampling locations and the spring low tide and mean high tide lines will be prepared prior to the commencement of intrusive field activities and appended to the QAPP. Sampling locations will be identified in the figure with symbols unique to each of the four sectors. Field crews also will be supplied with weekly tidal charts for the area to assist in the planning of daily sampling activities.

Surface water samples will be collected from Raritan Bay in the Seawall, Jetty, Margaret's Creek, and the Background Sectors. Access to these locations will be possible either by foot while wading or by boat. Prior to sample collection, water quality parameters, including dissolved oxygen (DO), pH, temperature, salinity, turbidity, specific conductance (SpC) and oxidation reduction potential (ORP) will be recorded. Additionally, the tidal stage will be recorded in the field logbooks during surface water sampling activities. Sample collection methods will be determined based upon the depth of the water. In shallow areas, procedures in Section 5.2 of TSOP 1-1 will be followed and in deep areas, the procedures in Section 5.3 of TSOP 1-1 will be followed.

Geographic coordinates for the surface water sampling locations will be measured with a hand-held, or equivalent, global positioning system (GPS) unit. Additionally, surface water sampling locations will be both noted on a hardcopy site plan and recorded in the field logbook. Photographs should be taken at each sampling location to photo-document observed surface water quality conditions, location, and weather.

Sample Collection Methods

For the Seawall and Jetty Sectors, grab samples will be collected from the water column, close to the sediment surface, but sufficiently above the sediment surface to limit capturing sediment in the samples, on foot while wading or from a boat. Sampling locations in and around Area 7 of the Jetty Sector will be biased to net depositional zones (i.e. where deposition is greater than erosion). In the Margaret's Creek Sector, grab samples will be collected during low tide from the water column, close to the sediment surface, but sufficiently above the sediment surface to limit capturing sediment in the samples, on foot while wading or from a shallow-draft boat. Background surface water samples will be collected in a manner similar to the environmental samples. Surface water samples (with the exception of TAL metals analysis) will either be collected directly into the sample

QAPP Worksheet # 17c
Sampling Design and Rationale
Surface Water Sampling

bottles or by using a disposable hydrasleeve or an equivalent sampler. The number and locations of surface water samples are detailed by Sector and Area in Table 1.

Surface water samples for TAL metals analysis will be filtered through a nitrocellulose based membrane filter of 0.45 um (micron) nominal pore size using the following procedure:

1) Collect the surface water sampling into a new, clean polyethylene sample container.
2) Place clean, unused polyethylene tubing in the peristaltic pump.
3) Connect the in-line filter to the outlet side of the peristaltic pump.
4) Place the polyethylene tubing from the inlet side of the pump into the sample.
5) Obtain a waste container and the sample bottle and turn the pump on.
6) Discharge the first 100-200 milliliters (ml) of filtered sample into the waste container.
7) Fill the sample container provided by the subcontract laboratory with the required volume of filtered sample.
8) Samples should be filtered only once, they are not to be passed through repeatedly until they are free of turbidity.
9) Turn the pump off, add the required preservative to the sample, and secure the sample container lid. Discard the empty 1 liter polyethylene bottle with PPE. It should not be reused for other samples.
10) Remove and discard the used filter and polyethylene tubing.
11) Connect new polyethylene tubing and filter to the pump for the next sample.
12) Clearly document on the chain of custody that the samples have been filtered.

QC samples will be collected in addition to the surface water samples. The number and type of QC samples are detailed in Worksheets #20 and #28.

Sample Analyses
Analyses for all surface water samples are detailed by Sector and Area in Table 1.

Field Procedures for these Activities are detailed in:
- TSOP 1-1 – Surface Water Sampling
- TSOP 1-2 – Sample Custody
- TSOP 2-1 – Packaging and Shipping Environmental Samples
- TSOP 4-1 – Field Logbook Content and Control
- TSOP 4-2 – Photographic Documentation of Field Activities
- Worksheet 17j Decontamination Procedures
- Worksheet 18 Sampling Locations and Methods/ SOP Requirements
- Worksheet 21 Project Sampling SOP References
- Worksheet 28 QC Samples Table

QAPP Worksheet # 17d
Sampling Design and Rationale
Sediment Sampling

Environmental Sediment Sampling

Sediment samples are proposed to help evaluate the horizontal and vertical extents of site-related contamination and to support the HHRA and ERA. Sediment sampling locations will depend upon the results of the topographic and bathymetric surveys, the current and sediment transport profiles, and the groundwater-surface water interaction study (covered under a previous QAPP for the site). Bathymetry, topography, current and sediment transport profiles and the groundwater-surface water interactions study results will be used to adjust the location, depth or media classification of the sediment samples. Classifying a sample as "sediment" is currently based on the estimated locations of the sample relative to the spring high and spring low tide lines. The topographic and bathymetric survey will define the tide lines and sediment samples will be adjusted based on the lines. Additionally, sediment samples may be relocated into depositional area based on the results of the current study, sediment transport profiles, or the groundwater-surface water interaction study. All changes will be documented in a Field Change Notification.

Sampling locations in the Seawall Sector will further depend upon the results of the EPA pre-RI sampling and the beach re-sampling and trench excavation early actions activities. Background sample locations for Margaret's Creek will be determined following the characterization of sediment dynamics. A figure identifying the adjusted sediment sampling locations and the spring low tide and mean high tide lines will be prepared prior to the commencement of intrusive field activities and appended to the QAPP. Sampling locations will be identified in the figure with symbols unique to each of the four sectors. Field crews also will be supplied with weekly tidal charts for the area to assist in the planning of daily sampling activities.

Sediment samples will be collected from Raritan Bay in the Seawall, Jetty, Margaret's Creek, and the Background Sectors. Access to these locations will be possible either by foot while wading or by boat. Prior to sampling, the lithology of the sample will be described in accordance with TSOP 3-5. Prior to sediment sample collection, the tidal stage will be recorded in the field logbooks. Samples will be collected and processed in accordance with TSOP 1-11, Section 5.3.

Geographic coordinates for the sediment sampling locations will be measured with a hand-held, or equivalent, GPS unit. Additionally, sediment sampling locations will be both noted on a hardcopy site plan and recorded in the field logbook. Photographs should be taken at each sampling location to photodocument observed conditions, location, and weather.

Environmental Sediment Sample Collection Methods

Sediment samples will be collected by a subcontractor using a vessel-mounted vibracore sampler in inundated areas and a platform-mounted vibracore sampler in non-inundated areas. The actual structure supporting the vibracore will be determined by the subcontractor, based on site conditions. Samples will be collected from the surface (0 to 6 inches bgs), subsurface (24 to 48 inches bgs), and extended depth and (48 to 72 inches) sediments in selected areas. The number of locations, sample depths and analyses for sediment samples are detailed by area in Table 1.

In addition to the proposed locations in the Margaret's Creek Sector, an additional five sediment samples may be collected in areas where slag or other contamination is observed. Sediment samples in open water areas will be collected by a subcontractor using a vibracore on a shallow-draft boat, or platform-mounted on an all-terrain vehicle (ATV) in shallow water areas. At sample locations with dense vegetation, the platform-mounted vibracore and ATV will be utilized. Cores will be collected from 0 to 4 feet bgs. The number of locations and sample depths for sediment samples are detailed by area in Table 1.

QAPP Worksheet # 17d
Sampling Design and Rationale
Sediment Sampling

QC samples will be collected in addition to the sediment samples. The number and type of QC samples are detailed in Worksheet #28.

Sediment Sample Analyses
Analyses for all sediment samples are detailed by Sector and Area in Table 1. To prepare for the possibility of having to conduct a geochronology study, surface sediments collected from the Margaret's Creek Sector will also be analyzed for Be-7.

Geochronology Study
Geochronology sediment samples will be collected in the Margaret's Creek Sector if 1) the results of the environmental sediment sampling indicate the presence of contamination at concentrations warranting remediation, 2) depositional zones in the wetlands are identified, and 3) evidence of filling activities or disturbance in the core sample location has not been found or suspected.

Geochronology sediment core samples will be collected from known depositional areas in order to determine the sediment accumulation rate and contaminant loading rate. Three 1-meter long cores will be collected in three separate depositional zones of Margaret's Creek, for a total of nine cores. The locations will be determined by an overlay of the contaminant data and the Beryllium-7 (Be-7) data gathered during the preceding environmental sediment sampling efforts. Areas that are determined to be both contaminated and depositional will be considered for geochronology sampling. The cores will be collected by the subcontractor using a vibracore sampler and will be sealed for shipment to the laboratory. The core tube will be decanted to remove water and will be capped air tight. The laboratory will be responsible for slicing the core into one centimeter sections, labeling the samples with the core location and sample depth, and analyzing each section for TAL metals, mercury, hexavalent chromium and cesium-137 (Cs-137). Two cores will be utilized for the laboratory analysis, and the third core will be kept in cold-storage for any needed follow-on analysis. Table 1 lists the type of analysis and number of samples for the geochronology samples.

Bioavailability Study
Sediment and soil will be collected from Areas 2, 3, 5, 6 and 9 for *in vitro* bioavailability and electron microprobe analysis for lead and arsenic. This data will be used to adjust toxicity criteria used in risk assessments. As shown in Figure 8 and detailed in Table 1, the sediment and soil will be collected as follows:

- 10 locations in upland Area 9
- 10 locations in upland Areas 2, 5, and 6
- 10 locations in intertidal zone Areas 2, 5, and 6
- 10 locations in Area 3.

The locations represent a range of different sediment/soil types and composition, a range of expected contaminant concentrations, as well as different areas for human exposure. Approximately 50 grams of material will be collected from the 0 to 24-inch interval at each location. Because this study involves the analysis of both sediment and soil, this section is duplicated in Worksheet #17e. In total, 40 samples will be collected during this study.

QAPP Worksheet # 17d
Sampling Design and Rationale
Sediment Sampling

Field Procedures for these Activities are detailed in:

- TSOP 1-2 – Sample Custody
- TSOP 1-11 – Sediment/Sludge Sampling, Section 5.3
- TSOP 2-1 – Packaging and Shipping Environmental Samples
- TSOP 4-1 – Field Logbook Content and Control
- TSOP 4-2 – Photographic Documentation of Field Activities
- Worksheet 17j Decontamination Procedures
- Worksheet 18 Sampling Locations and Methods/ SOP Requirements
- Worksheet 21 Project Sampling SOP References
- Worksheet 28 QC Samples Table

QAPP Worksheet # 17e
Sampling Design and Rationale
Soil Sampling

Environmental Soil Sampling

Soil samples are proposed to help evaluate the horizontal and vertical extents of site-related contamination and to support the HHRA and ERA. Soil sampling locations will depend upon the results of the topographic and bathymetric surveys (covered under a previous QAPP for the site). Sampling locations in the Seawall Sector will further depend upon the results of the EPA pre-RI sampling and the beach re-sampling and trench excavation early actions activities. Background sample locations for Margaret's Creek will be determined following the characterization of sediment dynamics. A figure identifying the adjusted soil sampling locations and the spring low tide and mean high tide lines will be prepared prior to the commencement of intrusive field activities and appended to the QAPP. Sampling locations will be identified in the figure with symbols unique to each of the four sectors. Field crews also will be supplied with weekly tidal charts for the area to assist in the planning of daily sampling activities.

Soil samples will be collected by a drilling subcontractor with a direct push sampler, either mounted on an ATV or powered by a hand-held, compressor-driven jackhammer. It is possible that the drilling subcontractor may need to utilize a track-mounted rig in the Margaret's Creek Sector. Some locations where only surface soil samples are required may be collected by hand or using a hand-held push-corer. Soil samples will be collected to a maximum depth of 4 feet bgs. The number of locations, sample depths, and analyses for soil samples are detailed by Sector and area in Table 1. Prior to sampling, the lithology of the sample will be described in accordance with TSOP 3-5.

Geographic coordinates for the soil sampling locations will be measured with a hand-held, or equivalent, GPS unit. Additionally, soil sampling locations will be both noted on a hardcopy site plan and recorded in the field logbook. Photographs should be taken at each sampling location to photodocument observed conditions, location, and weather.

Environmental Soil Sample Collection Methods

Soil samples will be collected in accordance with TSOPs 1-3 (Section 5.2.1) and 1-4 (Section 5.2.3), Surface and Subsurface Soil Sampling, from surface (0 to 12 inches bgs to support the ERA and 0 to 24 inches to support the HRRA) and subsurface (24 to 48 inches bgs) soils. Subsurface samples will be collected using direct push technology (TSOP 3-1, Section 5.1)In addition to the proposed locations in the Margaret's Creek Sector, an additional five soil samples may be collected from areas where slag or other contamination is observed. The number of locations and sample depths for both surface and subsurface soil samples are detailed by area in Table 1.

QC samples will be collected in addition to the soil samples. The number and type of QC samples are detailed in Worksheet #28.

Technical Review Workgroup (TRW) Study

To support evaluation of lead contamination in the human health risk assessment, additional soil sampling for lead will be performed in accordance with the Superfund *Lead-Contaminated Residential Sites Handbook* (EPA 2003). This document, prepared by the EPA Technical Review Workgroup for Metals and Asbestos (TRW) Lead Sites Workgroup, provides guidance for assessing and managing risks associated with lead-contaminated residential sites. For purposes of evaluating soil lead contamination, the TRW handbook considers park areas as residential properties. The beaches in Areas 2, 5, and 6 are used for recreational purposes, and are therefore, subject to the guidance.

QAPP Worksheet # 17e
Sampling Design and Rationale
Soil Sampling

The handbook recommends dividing properties into 0.25-acre sections (approximately 10,000 square feet), and collecting one five-point composite soil sample from each section. The proposed sampling is detailed on Table 1, and Figure 3 shows the centerpoints of the 0.25-acre sections in Areas 2, 5, and 6. Since low tides expose soil in the intertidal zone, sampling will extend to the spring low tide line. Composite samples will be collected from the 0 to 2 inch interval. The analytical laboratory will sieve each sample to isolate the soil fraction less than 250 microns; therefore, two 8- ounce (oz) jars (total 16 oz) will be filled per composite sample location to ensure that adequate sample volume is achieved. The figure also displays background locations in Area 10 where similar five-point composite samples will be collected. Based on the recommended sample density (one composite sample per 10,000 square feet), 33, 144, and 135 composite samples will be collected from Areas 2, 5 and 6, respectively.

Bioavailability Study
Soil and sediment will be collected from Areas 2, 3, 5, 6 and 9 for *in vitro* bioavailability and electron microprobe analysis for lead and arsenic. As shown in Figure 5 and detailed in Table 1, the soil and sediment will be collected as follows:

- 10 locations in upland Area 9
- 10 locations in upland Areas 2, 5, and 6
- 10 locations in intertidal zone Areas 2, 5, and 6
- 10 locations in Area 3.

The locations represent a range of different soil/sediment types and composition, a range of expected contaminant concentrations, as well as different areas for human exposure. Approximately 50 grams of material will be collected from the 0 to 24-inch interval at each location. Because this study involves the analysis of both soil and sediment, this section is duplicated in Worksheet #17d. In total, 40 samples will be collected during this study.

Soil Sample Analyses
Analyses for all soil samples are detailed by Sector and Area in Table 1.

Field Procedures for these Activities are detailed in:
- TSOP 1-2 – Sample Custody
- TSOP 1-3 – Surface Soil Sampling
- TSOP 1-4 – Subsurface Soil Sampling
- TSOP 2-1 – Packaging and Shipping Environmental Samples
- TSOP 3-1 – Geoprobe® Sampling
- TSOP 4-1 – Field Logbook Content and Control
- TSOP 4-2 – Photographic Documentation of Field Activities
- Worksheet 17j Decontamination Procedures
- Worksheet 18 Sampling Locations and Methods/ SOP Requirements
- Worksheet 21 Project Sampling SOP References
- Worksheet 28 QC Samples Table

QAPP Worksheet # 17f
Sampling Design and Rationale
Groundwater Sampling

Groundwater Sampling

Installation of up to 11 monitoring well pairs (consisting of 1 shallow and 1 deep), including one background pair, will be installed to obtain water level data to determine the groundwater flow direction and the horizontal and vertical hydraulic gradients across the seawall. The monitoring wells will also be used to collect groundwater samples to evaluate baseline groundwater quality to support development of remedial alternatives in the FS. Monitoring well installation activities will precede the activities detailed in this RI/FS QAPP and are discussed in detail in Revision 1 to the Early Actions QAPP. Figure 6 presents the proposed locations of the 11 new monitoring well pairs.

All 22 monitoring wells will be allowed to stabilize after development for at least 14 days before being sampled. Synoptic water levels and organic vapor readings at the well head will be recorded from all monitoring wells (22 new and 3 existing) prior to sampling. Additionally, the tidal stage will be recorded in the field logbooks during all field activities.

Summary of Low Stress (Low Flow) Purging and Sampling Methods

Air monitoring and water quality monitoring equipment should be calibrated in the field at the start of each day. Wells planned to be sampled on any given day should be opened at the start of the work day and left open to allow the water column to equilibrate to any changes in ambient pressure, if possible. All wells should be shut and secured at the completion of each work day. In general, the shallow monitoring well of a cluster will be purged and sampled before its respective deep counterpart.

All monitoring wells will be purged and sampled in accordance with the site-specific low-flow, minimal drawdown sample procedure, which follow the project specific low flow purging and sampling (Appendix C). In general, purging will be accomplished with a Grundfos Redi-Flo2 submersible pump and dedicated Teflon or Teflon-lined polyethylene tubing (1/4-inch but no greater than 3/8-inch), which will be lowered slowly to the approximate midpoint of the well screen. The tubing length, from the top of the well casing to the flow-through chamber, should be the shortest length manageable.

Before starting the pump, measure the water level in the well and record the measurement in the field logbook. Start purging the well at a rate between 200 and 500 milliliters per minute (mL/min), so as to prevent drawdown greater than 0.3 feet. Water levels and water quality parameters, including DO, pH, temperature, salinity, turbidity, SpC, and ORP, will be recorded in the field logbook every 5 minutes during purging until water quality parameters stabilize. Water quality parameters will be collected via a flow through cell. Stabilization is achieved when the water quality parameters remain within the following ranges of one another for three consecutive readings:

+0.1 for pH
+3% for SpC
+10mV for ORP
+10% for DO and turbidity

QAPP Worksheet # 17f
Sampling Design and Rationale
Groundwater Sampling

Turbidity will be monitored and attempts will be made to achieve a turbidity of 50 NTUs or less. If stability has not been achieved after 4 hours of continuous purging, purging will be discontinued and a groundwater sample collected. Attempts to reach stabilization will be documented in the field logbooks.

Once parameters stabilize, the flow rate will be reduced to between 100 and 250 mL/min. Groundwater samples will be collected directly from the Teflon or Teflon-lined polyethylene tubing. Care will be taken to ensure that no bubbles are present in the tubing during sampling. Worksheet #19 will be consulted to determine whether pH adjustment is necessary for the VOC samples. Sample collection time, the underscored environmental sample name (and environmental sample duplicate name), analytical parameters sampled for size, type and quantity of bottleware, and preservatives used will all be noted distinctly in the field logbook.

QC samples will be collected in addition to the surface water samples. The number and type of QC samples are detailed in Worksheet #28.

Sample Analyses
Analyses for all groundwater samples are detailed in Table 1. HACH test for ferrous iron will be performed on-site. Procedures for ferrous iron testing are included in Appendix B.

Field Procedures for these Activities are detailed in:
- TSOP 1-2 – Sample Custody
- TSOP 1-6 – Water Level Measurements
- TSOP 1-10 – Field Measurement of Organic Vapors
- TSOP 2-1 – Packaging and Shipping Environmental Samples
- TSOP 4-1 – Field Logbook Content and Control
- TSOP 4-2 – Photographic Documentation of Field Activities
- TSOP 5-1 – Control of Measurement and Test Equipment
- Worksheet 17j — Decontamination Procedures
- Worksheet 18 — Sampling Locations and Methods/ SOP Requirements
- Worksheet 21 — Project Sampling SOP References
- Worksheet 28 — QC Samples Table
- Appendix B — HACH method 8146 for Ferrous Iron
- Appendix C — Groundwater Sampling SOP for Raritan Bay Slag Site, EPA Region 2.

QAPP Worksheet # 17g
Sampling Design and Rationale
Biota Sampling

To support the HHRA, fish, clam, and crab species representative of the area and commonly consumed by humans will be collected and submitted for analysis. Dead birds will also be collected and analyzed.

Fishes

Fish will be collected from areas adjacent to the site, such as Areas 1, 2, 5, and 6, as well as the Cheesequake Creek jetty area, using common fisheries management techniques such as trawling, gill nets, or hook and line, as appropriate. Fish will be taxonomically identified and the weight and total length of representative individuals will be recorded. Following measurements, fillets from both sides of each fish will be removed and weighed. If necessary, fillets may need to be composited to ensure that analytical volume requirements are meet.

Fish targeted for collection include summer flounder (i.e., fluke), striped bass, blue fish, cunner, black sea bass, and sea robin. Legal size specimens will be retained; however, depending on catch success, individuals below the size limit may be kept in order to meet project objectives. A project goal of five individuals per species is intended where fillets from both sides of each individual will be submitted for chemical analysis. In order to fulfill analytical requirements, composite samples consisting of multiple individuals may be required. Only target species will be retained. In the event that project goals of catching five individuals of each species are not being met during sampling activities, alternative species may be selected, or additional target species may be retained if caught. In order to minimize fish mortalities by retaining everything caught, EPA will be notified of catch success problems and a discussion will be held regarding the selection of alternative species based on field observations.

During processing the length, weight, and species of each individual retained will be recorded. If still alive, fish will be euthanized via sharp blow to the head with a blunt instrument. Fish will be scaled and fillets will be removed using a decontaminated stainless steel fillet knife leaving the skin on. The remaining carcass will be disposed of in municipal trash or discarded to Raritan Bay. Fillets will then be weighed in order to ensure that the analytical mass requirement is met. One sample will consist of both fillets. The fillets will be wrapped in aluminum foil, placed into a ziplock bag on which the species and filet weights will be noted and frozen using dry ice. To the extent possible, individuals will be composited by species and area.

Clams

Clams will be collected at specified sampling locations using a clam rake. It is anticipated that these locations will consist of Areas 1, 2, 5, and 6, and the Cheesequake western jetty, within the intertidal zone. It is anticipated that the hard clam (*Mercenaria mercenaria*) will be the species submitted for chemical analyses. The hard clam is a commercially harvested and consumed clam species commonly referred to as littleneck, cherrystone, and chowder depending on their size, but all are the same species. The likelihood that this species is present at specific locations will be dictated by the habitats present. If habitats appropriate for this species are not present at a sample location, an alternate species such as the ribbed mussel (*Geukensia demissa*) may be collected. Samples will consist of the soft portions (i.e., meat) of the clam; shells will be discarded. Due to analytical volume requirements it will be necessary to composite several individuals by species into one representative sample. To the extent possible, individuals will be composited by Area.

Blue Crabs

Blue crabs will be collected from select locations within Areas 1, 2, 5, 6, and the western jetty. Crabs will be collected using standard recreational or commercial baited crab traps; however, long-handled dip nets may also be used where appropriate such as along the western jetty or if crabs are

QAPP Worksheet # 17g
Sampling Design and Rationale
Biota Sampling

visually located. An additional option, if field logistics allow, is to deploy traps from a boat. An anchor or weight such as a brick is attached to the trap, along with a buoy affixed to a length of rope to allow for retrieval. This option will only be utilized if boat-based fish sampling activities are being conducted within the same time frame as crab sampling.

If analytical mass requirements are not met with five individuals, additional crabs may be needed. An attempt will be made to ensure that a uniform number of crabs will be included in each sample; however, this is dependent on catch success as some areas may produce more crabs than others.

Once caught, individual crabs will be placed into ziplock bags, double bagged, identifying the area of collection, and held on dry ice in a cooler for transport to the lab for dissection and processing.

Dead Birds
Rubber, vinyl, or nitrile gloves shall be used when picking up dead birds. Alternately, a plastic bag shall be used. Specimens that are representative of all species affected and geographic areas will be collected. Only fresh dead specimens will be collected. Decomposed or scavenged carcasses will not be collected. The collected carcasses should be immediately stored in a cooler containing ice. The sample shall be sent to US Fish & Wildlife Services for processing.

A leg tag will be attached with the following information in pencil or waterproof ink:
Date collected, Species, Location (specific site, town, country, state), Found dead, Collector, Your reference number

Each sample shall be placed in a plastic bag and sealed. The zipper bag closure will be covered with strapping or duct tape after sealing zipper. Twist non-zipper bags closed, fold over on itself, and secure with package strapping or duct tape. Place 1st bag inside a 2nd bag, close and seal. More than one individually bagged birds can be placed in the 2nd bag. This prevents cross-contamination of individual specimens and leaking shipping containers. Tag the outside of 2nd bag and the number and species of birds, date collected, location, and name of collector. Reminder order: TAG, BAG, BAG, TAG.

Sample Analyses
Analyses for biota samples are detailed in Table 1.

Field Procedures for these Activities are detailed in:
- TSOP 1-2 Sample Custody
- TSOP 2-1 Packaging and Shipping Environmental Samples
- TSOP 2-2 Guide to Handling Investigation Derived Waste
- TSOP 4-1 Field Logbook Content and Control, see Worksheet #21 for modification
- Worksheet 17j Decontamination Procedures
- Worksheet 18 Sampling Locations and Methods/ SOP Requirements

QAPP Worksheet # 17h
Sampling Design and Rationale
Investigation Derived Waste

Investigation derived wastes (IDW) generated during sampling and drilling activities will be containerized in drums, roll-off containers, tanks, or other appropriate vessels to be provided by the designated subcontractor and disposed of off-site, if they cannot be released to the ground surface. IDW may be released to the ground surface only if the conditions outlined in the NJDEP *Field Sampling Procedures Manual* (NJDEP 2005) Chapter 2A, Sections 2.4.5.6 and 2.4.5.7, and the April 30, 2009 updates to these sections are met. In general, the disposal of IDW must be carried out in a manner such as not to contribute further environmental degradation or pose a threat to public health or safety. Additionally, water generated that is deemed not contaminated may be re-applied directly to the ground surface and allowed to percolate back into the ground water system.

Containerized IDW will be staged at a secured location agreed upon by the USACE, EPA, and CDM. IDW containers will be stored on-site until wastes are characterized and can be removed by a licensed waste hauler. Mobilization of filled drums to staging location will be accomplished with a drum dolly or cart or by a subcontractor with appropriate drum-mobilization equipment. Ground surface across the site is predominantly sand. Plywood sheets may be necessary to facilitate staging activities.

Wastes expected to be generated during site investigation activities may include heavy metals-contaminated soil, sediment, surface water, groundwater, aquatic specimen tissues, equipment decontamination water, and miscellaneous solids (i.e. personal protective equipment (PPE), absorbents, plastics, etc.).

An IDW log will be maintained in the field logbook by the Site Manager describing the drum number and contents of each drum, including gross physical characteristics, sample information, and drum labeling information. Field oversight and health and safety monitoring will be conducted during all waste disposal field activities. CDM will sign non-hazardous bills of lading on behalf of USACE. Manifests for hazardous material disposal will be signed by an on-site USACE representative.

Personal Protective Equipment
- Cut-resistant outer gloves
- Nitrile glove liners/undergloves
- Steel-toed and stell-shanked work boots
- Safety glasses or goggles

Field Procedures for these Activities are detailed in:
- TSOP 2-2 (rev 5, March 2007) Guide to Handling Investigation – Derived Waste

QAPP Worksheet # 17i
Sampling Design and Rationale
Field Blank Collection

Field equipment blanks and collection frequency are detailed on Worksheet #28. Equipment to be used during RI activities includes but is not necessarily limited to pre-cleaned and individually-wrapped soil scoops, decontaminated Grundfos Redi-Flo2 pumps, disposable hydrosleeves, and fillet knives. A field equipment blank should be representative of the quality of the equipment decontamination process for the associated samples. Collection of the field equipment blanks will occur following decontamination events and will be collected at a frequency of up to one per day. However, if a field decontamination event provides sufficient equipment for multiple days, only one field equipment decontamination blank will be collected for the decontamination event.

The field equipment blank should be collected at the beginning of the day, prior to the sampling event and after decontamination, and that blank must accompany samples collected on that day. Volume requirements are outlined on Worksheet # 19. Reagent grade, analyte-free water is required. Collection procedures are as follows:

Collection of field equipment blanks for VOC samples:

- Pour blank water over the surface of the sampling equipment into three 40-ml pre-preserved vials to form a meniscus above the rim of the vial. Seal the vials so that no air bubbles form in the vials. Note in the logbook the sample identification number, water lot number, type of water, and associated piece of equipment.

Collection of field equipment blanks for non-VOC samples:

- Pour blank water in a manner such that it touches the same contact points as the sample.
- Slowly pour blank water from the sampling equipment into the appropriate sample bottles (preserved or non-preserved as per analysis).
- Document and ship QC samples in accordance with TSOPs 2-1 and 4-1 as clarified by Worksheet #21.

QAPP Worksheet # 17j
Sampling Design and Rationale
Decontamination Procedures

Field decontamination will be performed on all personnel and equipment that enters the exclusion zone. Personnel decontamination procedures will be implemented to prevent worker exposure to site contaminants. Equipment decontamination procedures will be implemented to prevent cross-contamination of environmental samples and prevent off-site migration of contaminants as a result of site investigation activities.

Personal Protective Equipment

- Non-residual detergent (Alconox) and tap water rinse
- Respirator sanitizer (for respirator or self contained breathing apparatus [SCBA] face piece)
- Thorough rinse with potable water
- Air dry

Field Monitoring Equipment

Instruments should be cleaned per manufacturer's instructions. The electronic water level indicators and water quality parameter probes cannot be rinsed with solvents or acids. The electronic water level indicators will be decontaminated with a non-phosphate detergent, tap water rinse, and a final distilled/deionized water rinse prior to use at each well. The water quality parameter probes will be rinsed prior to and after each use with deionized/distilled water only.

Drilling Equipment and Other Large Pieces of Equipment

Soil samples collected using direct push technology (DPT) will be collected in dedicated plastic sleeves. DPT rods and samplers probes will be decontaminated as follows:

1. Physical removal of soil
2. Scrub with Alconox detergent in potable water
3. Rinse with potable water
4. Rinse in distilled/ deionized water
5. Air dry

Sediment samples collected using a vibracore sampler will be collected in dedicated plastic sleeves using dedicated core catchers. The shoe of the vibracore sampler will be decontaminated as follows:

1. Physical removal of soil
2. Scrub with Alconox detergent in potable water
3. Rinse with potable water
4. Rinse in distilled/ deionized water

Decontamination of vibracore and DPT equipment will take place at the sampling locations. All decontamination water will be collected and containerized.

QAPP Worksheet # 17j
Sampling Design and Rationale
Decontamination Procedures

Sampling Apparatus, General Considerations
All sampling apparatus must be properly decontaminated prior to its use in the field to prevent cross-contamination. Equipment should be decontaminated after usage (once a day or on an as needed basis). Decontamination will be performed in an area outside the contamination zone. Enough equipment will be available to be dedicated to the sampling points planned each day.

Decontamination Procedure:
The required decontamination procedure for sampling equipment including trowels, bowls, spoons, and hand-held sampling devices is:

*	a.	wash and scrub with low phosphate detergent
	b.	tap water rinse
**	c.	10 percent nitric acid rinse (for metals analysis only), laboratory grade (one percent solution will be used when carbon steel equipments, such as split-spoons, are used)
	d.	demonstrated analyte-free water
***	e.	isopropanol rinse (all solvents must be pesticide-grade or better)
****	f.	demonstrated analyte-free water rinse (amount of water must be at least five times that of the solvents used)
	g.	air dry
	h.	wrap in aluminum foil, shiny side out, for transport

* Tap water must be from a municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute.
** Nitric acid rinse will only be used when samples are collected for inorganics
*** Solvent rinse required only when sampling for organics.
**** A sample of the demonstrated analyte-free water will be collected and submitted for chemical analysis. Analytical results will be kept on-site. Determination of analyte-free water will be demonstrated by analyzing each lot of water used.

While performing decontamination activities, phthalate-free gloves should be used to prevent phthalate contamination of the sampling equipment that could result from the interaction of the gloves with the organic solvents.

Decontamination Equipment
- Distilled/deionized water
- Potable water
- Deep basins
- Brush
- Acetone or isopropanol (pesticide-grade)
- Personnel protective equipment
- 10 percent nitric acid (one percent when needed), ultra pure grade
- Demonstrated analyte-free water
- Polyethylene sheeting
- Utility knife
- Non-phosphate detergent (i.e. Alconox)
- Aluminum foil
- Air monitoring equipment and calibration gas

QAPP Worksheet # 17j
Sampling Design and Rationale
Decontamination Procedures

Field Procedures for these Activities are detailed in:	
▪ TSOP 4-5 (rev 7, March 2007)	Field Equipment Decontamination at Nonradioactive Sites.

QAPP Worksheet # 17k
Sampling Design and Rationale
Treatability Study

Treatability Study
Approved treatability studies of the source material (slag) and contaminated soils and sediments will be conducted in accordance with the approved addenda to the work plan, Contractor Quality Control Plan (CQCP), QAPP, and APP, as necessary, to either select or develop a remediation technology or vendor that can achieve the performance standards. A separate QAPP will be prepared for the treatability study.

QAPP Worksheet # 17l
Sampling Design and Rationale
Water Level Measurements

Staff gauges will be installed by hand, using a fence post driver, at the time of the surface water and sediment sampling. A seven foot length of 2-inch diameter galvanized steel pipe will be driven into the stream bed so that at least a four foot section of riser protrudes above the sediment surface. A four foot stream gauge will be secured to the riser with steel bolts through holes drilled in the riser such that the base of the gauge will be approximately six inches above the stream bed. Three holes drilled at the top of the staff gauge riser will be used to secure three guide ropes. Each guide rope will be tied to steel pegs driven into the ground/sediment. The pegs should be of sufficient length to allow for solid anchoring of the gauge to prevent disturbance of the gauge during elevated stream flow events.

Six rounds of synoptic water level elevation measurements will be collected at 22 new monitoring wells, 3 existing monitoring wells, a staff gauge adjacent to the seawall and a marker on the Route 35 Bridge to evaluate the vertical and horizontal groundwater gradients and the groundwater-surface water interaction.

The six rounds of measurements will be collected at one-month intervals.

Water levels will be measured manually with a calibrated m-scope. The data will be used to assess the feasibility of controlling groundwater, if necessary, as part of any remedial action. During each event measurements will be collected at high tide and at low tide as defined by the closest tidal gauge or at Cheesequake inlet.

The location and elevation of each monitoring well, the staff gauge and the marker on the Route 35 Bridge will be surveyed by a New Jersey licensed land surveyor. Elevation measurements will be made at marked water level measuring points on the inner casing, the top of the outer protective casing, and the adjacent ground surface.

Field Procedures for these Activities are detailed in:

- TSOP 1-6 Water Level Measurement, Section 5.2 Water Level Measurement Using Electronic Water Level Indicators (and manufacturer's instructions)
- TSOP 1-10 Field Measurement of Organic Vapors, Section 5.1 Direct Reading Measurement, if required by Health and Safety Plan
- TSOP 4-1 Field Logbook Content and Control, with the modifications noted on Worksheet #21.
- Worksheet 17j Decontamination Procedures

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Sampling Location ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Soil Investigation Samples Areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 [1]	Surface and Subsurface Soil	Refer to Table 1	TCL VOCs, SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, pH, TOC, grain size [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	TSOPs 1-3, 1-4	Worksheet #17e & Table 1
Surface Water Investigation Samples Areas 1, 2, 5, 6, 7, 8, 9, 10, 11 [1]	Surface Water	Refer to Table 1	TCL VOCs, SVOCs, Pesticides and PCBs, Total and Dissolved Metals, mercury, hexavalent chromium, TSS, pH, chloride, hardness, alkalinity [4]	Trace VOC Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	TSOP 1-1 / Project Specific SOP described in Worksheet #17c	Worksheet #17c & Table 1
Groundwater Investigation Samples See Figure 9 [1,2]	Groundwater	Mid-screen	TCL VOCs, SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, TSS, pH, chloride, hardness, alkalinity, ammonia, sulfate, sulfide, TKN, ferrous iron [4]	Trace VOC Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	Appendix C – EPA Region 2 Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling	Worksheet 17f & Table 1
Sediment Investigation Samples Areas 1, 2, 5, 6, 7, 8, 9, 10, 11 [1,2]	Sediment	Refer to Table 1	TCL VOCs, SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, pH, TOC, grain size, Be-7 [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	TSOP 1-11	Worksheet 17d & Table 1

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Sampling Location ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
TRW Samples Areas 2, 3, 5, 6 See Figure 3	Soil	Refer to Table 1	Pb [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	TSOP 1-3	Worksheet 17e & Table 1
Geochronology[3] Samples Area 9 [1]	Sediment	Refer to Table 1	TAL Metals, including Hg, hexavalent chromium, Cs-137 [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	TSOP 1-11	Worksheet 17d & Table 1
Biota Samples Jetty sector intertidal zones, Seawall sector intertidal zones [1]	Tissue - clams or mussels	Refer to Table 1	TCL SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, Lipids [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	Project Specific SOP described in Worksheet 17g	Worksheet 17g & Table 1
Biota Samples Seawall and jetty sectors – Raritan Bay and intertidal zones [1]	Tissue - commonly consumed fish species	Refer to Table 1	TCL SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, Lipids [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	Project Specific SOP described in Worksheet 17g	Worksheet 17g & Table 1

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Sampling Location ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Biota Samples Seawall and jetty sectors – Raritan Bay and intertidal zones [1]	Tissues - blue claw crab muscle and hepatopancreas	Refer to Table 1	TCL SVOCs, Pesticides and PCBs, TAL Metals, including Hg, hexavalent chromium, Lipids [4]	Low/Medium	Refer to Table 1, Duplicates will be collected at a rate of 1 per 20 samples	Project Specific SOP described in Worksheet 17g	Worksheet 17g & Table 1
Bioavailability and Electron Microprobe Samples Areas 2, 3, 5, 6, 9 [1,2] See Figure 8	Sediment and Soil	0-24 inches	Bioavailability in vitro test for As and Pb, Electron microprobe for As and Pb [4]	Low/Medium	40 samples	TSOP 1-3 and 1-4	Worksheet 17d and 17e & Table 1

Notes:
[1] Figure depicting surface water, sediment, and soil sampling locations will be generated upon completion of and based on the results and findings of the bathymetric survey, current and sediment transport profiles, and groundwater-surface water interactions studies.
[2] See Table 1
[3] A geochronology study is only proposed if results of environmental sampling indicate that contamination may warrant remedial action, depositional zones in the wetlands are identified, and evidence of filling activities or disturbance in the core sample location has not been found or suspected.
[4] Refer to Table 1 for percentages of locations submitted for selected analyses.

Acronyms:

VOCs – volatile organic compounds
TCL – total compound list
PCB –polychlorinated biphenyls
VOC – volatile organic compounds
Pb – lead
Cs – cesium
Be-beryllium
SVOCs – semi-volatile organic compounds
TAL – target analyte list
N/A – not available
TSOP – technical standard operating procedure
As – arsenic
DOC – dissolved organic carbon
Hg - mercury
CN – cyanide
TBD – To be determined
ID – identification
TOC – total organic carbon
TSS – total suspended solids

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Soil or Sediment for DESA or CLP	TCL VOC	Low	5035A/SOM01.2	15 grams total	(3) 40 mL glass vials with magnetic stir bars and PTFE lined septa/open top screw caps	Cool to 4°C	10 days VTSR; Technical-14 days (Technical is from time of sample collection if frozen) for closed system vials (if cooled).
	TCL SVOCs	Low + SIM	SOM01.2	100 grams	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	10 days extract-VTSR; 40 days analyze
	TCL Pesticide	Low	SOM01.2	30 grams	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	10 days extract-VTSR; 40 days analyze Technical 14/40
	TCL PCB	Low	SOM01.2	30 grams	(1) 8 oz. glass jar w/Teflon lined cap	Cool to 4°C	
	TAL Metals and Mercury	Low	ILM05.4	250 grams	(1) 8 oz. glass jar w/Teflon lined cap (fill to capacity) (extra may be needed for modified analysis)	Cool to 4°C	Technical-180 days VTSR - Subtract 2 days – this allowance for sample receipt by laboratory
Sediment (Geochronology)	Cs-137 and Be-7	**Awaiting information from the laboratory.**					
Soil (Bioavailability)	Pb & As	**Awaiting information from the laboratory.**					
Soil or sediment for DESA or CDM Subcontract laboratory	TOC	Low	Lloyd Kahn or Walkley Black	10 g	(1) 8-oz glass jar	Cool to 4°C	14 days
	Grain size	Low	ASTM D421-85 ASTM D422-63	500 g	(1) 8-oz glass jar	Cool to 4°C	None
	pH	Low	SW-846, 9045D	10 g	(1) 8-oz glass jar	Cool to 4°C	48 hours
	Hexavalent Chromium	Low	SW-846 3060A/7196A	Fill to capacity	(1) 8 oz glass jar	Cool to 4°C	30 days: extraction; 7 days: analysis

Technical holding time is referenced unless otherwise noted.
MS/MSD is not required for TCL VOC and SVOC.

QAPP Worksheet #19
Analytical SOP Requirements Table

The field team is encouraged to consolidate the sample volumes in consultation with DESA, RSCC and the subcontract laboratories as appropriate. Additional sample volumes may be required when more than one option of a method is requested, for example Low level plus SIM SVOC analysis. DESA QAPP Worksheets are provided in Appendix D for reference.
Soil VOC vials must be shipped on the day of collection.
Soil VOC vials must have recorded sample weights or a log of the vial weights and vial plus sample and spin bar weights must accompany the cooler.
Soil PCBs and Pesticides- no additional volume is required for MS/MSD analyses. The sampler shall designate a sample for the laboratory to perform the MS/MSD analysis at a frequency of one per twenty samples. MS/MSD samples should be submitted with the first (preferable) or second shipment to facilitate the CLP laboratory meeting its contractual obligation to perform the MS/MSD analyses with each SDG.

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Aqueous	TCL VOCs	Trace plus SIM	SOM01.2	200 mL	(5) 40 ml VOA vials w/Teflon lined *septum*	1:1 HCl to pH<2; no headspace; *no bubbles*. Do not preserve if effervescence occurs. Note occurrence on COC. Cool to 4°C	Technical 14 days 10 days VTSR Preserved; Unpreserved 7 days
	TCL VOCs	Trace or Low	SOM01.2	120 mL	(3) 40 ml VOA vials w/Teflon lined *septum*		
	TCL SVOCs	Low or Low plus SIM	SOM01.2	1000 mL	(2) 1L amber glass bottles w/Teflon lined cap. No additional volume required for SIM (see notes)	Cool to 4°C	5 days extract, 40 days analyze for VTSR; 7/40 Technical
	TCL Pesticide Compounds	Low	SOM01.2	1000 mL	(2) 1L amber glass bottle w/Teflon lined cap	Cool to 4°C	5 days extract, 40 days analyze; 7/40 Technical
	TCL PCBs	Low	SOM01.2	1000 mL	(2) 1L amber glass bottle w/Teflon lined cap	Cool to 4°C	5 days extract, 40 days analyze; 7/40 Technical
	TAL Metals, Mercury	Low (AES)	ILM05.4	250 mL each	(2) 1 L high density polyethylene bottle (HDPE)	HNO_3 to pH<2; Cool to 4°C	6 months (Hg-26 days VTSR or 28 days Technical)
	TAL Metals	Trace (MS)		250 mL	(1) 1 L HDPE		
	Dissolved Metals and mercury	Low		250 mL	(1) 1 L HDPE		
	Alkalinity	Low	EPA 310.2	100 mL	(1) 250 mL HDPE	Cool to 4°C	14 days
	Chloride	Low	EPA 300	50 mL	(1) 125 mL HDPE	Cool to 4°C	28 days

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Aqueous	Hardness	Low	ILM05.4 + calculation	100 mL	(1) 250 mL HDPE	HNO_3 to pH<2; Cool to 4°C	6 months
	Ferrous Iron (field test)	Low	HACH 8146	25 mL	1 HDPE	Cool to 4°C	Analyze on day collected
	Hexavalent Chromium	Low	SW-846 7196A	100mL	(1) 500 mL HDPE	Cool to 4°C	24 hours
	Nitrate	Low	EPA 300, 352.1	100 mL	(1) 250 mL HDPE	Cool to 4°C	48 hours
	TKN	Low	EPA 351.1/351.2	500 mL	(1) 1 L HDPE	H_2SO_4 to pH <2; Cool to 4°C	28 days
	Sulfate	Low	SM4500-SO4-C or D	50-100 mL	(1) 250 mL HDPE	Cool to 4°C	28 days
	Sulfide	Low	SM 4500-S-2 D, F or G	200 mL	(1) 1 L HDPE	Sodium acetate and NaOH to pH>9; Cool to 4°C	7 days; Unpreserved 48 hours
	TSS (Non-filterable residue)	Low	SM2540 D	100 mL	(1) 250 mL HDPE	Cool to 4°C	7 days

Technical holding time is referenced unless otherwise noted.
MS/MSD is not required for TCL VOC and SVOC.
The field team is encouraged to consolidate the sample volumes in consultation with DESA, RSCC and the subcontract laboratories as appropriate. Additional sample volumes may be required when more than one option of a method is requested, for example Low plus SIM SVOC analysis. Use four drops of 2N acetate solution per 100ml of sample.
Aqueous PCBs and Pesticides-For MS/MSD analyses, at least four additional bottles are required. For MS/MSD SIM another four additional bottles are required i.e. if both full scan and SIM are requested then eight additional 1L amber bottles will be needed. MS/MSD samples should be submitted with the first (preferable) or second shipment to facilitate the CLP laboratory meeting its contractual obligation to perform the MS/MSD analyses with each SDG

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix[1]	Analytical Group	Concentration Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Tissues	Percent Lipids	TBD	SM 2540B or equivalent	Minimum mass = 10 gram	2- 2 oz glass jar	Freeze sample: 0^0C to -20 ^{0}C	Solid multiphase samples - 1 year If stored at less than -10^0 C
	TAL Metals including Mercury	Low	ILM05.4	Minimum mass = 10 g	1- 8 oz glass jar	Freeze sample: 0^0C to -20 ^{0}C	6 months (12 months if frozen)

1: Tissue matrix refers to split tissue sample analyzed for chemical concentration.

2: The actual jar size may vary depending on the need of the assigned laboratory. The samplers should confirm sample volumes with the laboratory prior to mobilizing to the field.

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Aqueous (Equipment Blanks)	Trace VOCs	Trace	SOM01.2	120 ml	(3) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; cool to 4°C	10 days
	TCL SVOCs	Low	SOM01.2	1000 ml	(2) 1L amber glass bottles w/Teflon lined cap	Cool to 4°C	5 days extract, 40 days analyze
	TCL Pesticides	Low	SOM01.2	1000 ml	(2) 1L amber glass bottle w/Teflon lined cap	Cool to 4°C	5 days extract, 40 days analyze
	TCL Aroclors/PCBs	Low	SOM01.2	1000 ml	(2) 1L amber glass bottle w/Teflon lined cap	Cool to 4°C	5 days extract, 40 days analyze
	TAL Metals + Hg	Low	ILM05.4	250 ml	(1) 1 L polyethylene	HNO_3 to pH<2; cool to 4°C	6 months (Hg-26 days)
	Hexavalent Chromium	Low	SW-846-7196A	100 ml	(1) 500 mL HDPE	Cool to4 °C	24 hours
Aqueous (Trip Blanks)	Trace VOCs	Trace	SOM01.2	120 ml	(5) 40 ml VOA vials w/Teflon lined septum	1:1 HCl to pH<2; cool to 4°C	10 days

Verified time of sample receipt (VTSR) holding time is referenced above.
MS/MSD is not required for QC samples.
The field team is encouraged to consolidate the sample volumes in consultation with DESA, RSCC and the subcontract laboratories as appropriate.

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Samples	No. of Field Duplicates	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples	No. of Equipment Blanks	No. of Trip. Blanks	No of PE Samples
Soil	TCL VOCs	Low	SOM01.2	386	20	NA	1 per decontamination event	NA	TBD
	TCL SVOCs	Low	SOM01.2	386	20	NA	1 per decontamination event not to exceed 1 per day	NA	TBD
	TCL Pesticides	Low	SOM01.2	386	20	20		NA	TBD
	TCL Aroclors (PCB) Compounds	Low	SOM01.2	386	20			NA	TBD
	TAL Metals, Mercury	Low/ Medium	ILM05.4	542	28	28		NA	TBD
	Hexavalent Chromium	Low	SW-846 3060A/7196A	542	28	28		NA	TBD
	Lead (TRW)	Low/Medium	ILM05.4	295	14	14		NA	TBD
	TOC	Low	Lloyd Kahn or Walkey Black	183	10	As required by laboratory	NA	NA	TBD
	pH		SW-846, 9045D						
	Grain Size	NA	ASTM D421-85 ASTM D422-63	183	10	NA	NA	NA	NA
	Bioavailability in vitro test for Pb and As	**Awaiting information from the laboratory**		40	**Awaiting information from the laboratory**				
	Electronmicroprobe Test for Pb and As			40					
Sediment	TCL VOC	Low	SOM01.2	309	16	NA	1 per decontamination event	NA	TBD
	TCL SVOC	Low	SOM01.2	309	16	NA	1 per decontamination	NA	TBD
	TCL Pesticides	Low	SOM01.2	309	16	16		NA	TBD

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Samples	No. of Field Duplicates	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples	No. of Equipment Blanks	No. of Trip. Blanks	No of PE Samples
	TCL Aroclors (PCB) Compounds	Low	SOM01.2	309	16		event not to exceed 1 per day	NA	TBD
	TAL Metals, Mercury	Low/ Medium	ILM05.4	648	33	Triple volume		NA	TBD
	Hexavalent Chromium		SW-846 3060A/7196A						
	TOC	Low	Lloyd Kahn or Walkey Black	166	9	Double volume	NA	NA	TBD
	pH		SW-846, 9045D						
	Grain size	NA	ASTM D421-85 ASTM D422-63	166	9	NA	NA	NA	NA
	Cs-137	**Awaiting information from the laboratory.**		200	**Awaiting information from the laboratory.**				
	Be-7			22					
Tissues	TAL Metals, Mercury	Low/Medium	ILM05.4	50	3	NA	1 per decontamination event not to exceed 1 per day	NA	NA
	Hexavalent Chromium	Low/Medium	SW-846 3060A/ 7196A *modification*	50	3	NA		NA	NA
	Lipids	TBD	SM 2540B or equivalent	50	3	NA		NA	NA
Surface Water	Trace Concentration Volatile Organics	Trace	SOM01.2	49	3	NA	1 per decontamination event not to exceed 1 per day	1 per cooler	TBD
	Semi-Volatile Organics	Low	SOM01.2	49	3	NA		NA	
	Pesticide Compounds	Low	SOM01.2	49	3	Triple volume		NA	
	PCB Compounds	Low	SOM01.2	49	3			NA	

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Samples	No. of Field Duplicates	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples	No. of Equipment Blanks	No. of Trip. Blanks	No of PE Samples
Surface Water	TAL Metals, Mercury	Low	ILM05.4	122	7	7		NA	
	Hexavalent Chromium	Low/Medium	SW-846 7196A	122	7	7	1 per decontamination event not to exceed 1 per day	NA	
	Alkalinity	Low	EPA 310.2	122	7	As required by laboratory	NA	NA	
	Chloride		EPA 300						
	Hardness		ILM05.4 + calculation						
	TSS		SM 2540 D						
Groundwater	Trace Concentration Volatile Organics	Low	SOM01.2	25	2	NA	1 per *decontamination* event not to exceed 1 per day	1 per cooler	
	Semi-Volatile Organics	Low	SOM01.2	25	2	NA		NA	
	Pesticide Compounds	Low	SOM01.2	25	2	2		NA	
	PCB Compounds	Low	SOM01.2	25	2			NA	
	TAL Metals, Mercury	Low/Medium	ILM05.4	25	2	2		NA	
	Hexavalent Chromium	Low/Medium	SW-846 7196A	25	2	2		NA	
	Alkalinity		EPA 310.2	25	2	As required by laboratory	NA	NA	
	Chloride		EPA 300						

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Samples	No. of Field Duplicates	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples	No. of Equipment Blanks	No. of Trip. Blanks	No of PE Samples
	Hardness	Low	ILM05.4 + calculation						
	TSS		EPA 160.2						
	TKN		EPA 351.1/351.2						
	Ammonia		EPA 350.1						
	Sulfide		SM 4500-S2 D, F or G						
	Sulfate		SM4500-SO4-C or D						
	Nitrate		EPA 300,352.1						
	Ferrous Iron		Hach 8146						
Aqueous	pH; conductivity; dissolved oxygen; turbidity; temperature	NA	See equipment manual	25	NA	NA	NA	NA	NA

Project-specific information. PE will be used if requested by EPA Region 2.

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type*	Modified for Project Work? (Y/N)*	Comments
1-1	Surface Water Sampling, Rev. 7, 3/31/07	CDM	*TSOP, Section 5.2*	N	
1-2	Sample Custody, Rev. 5, 3/31/07	CDM	*TSOP, Section 4.2 and 5.3*	Y	-Sample tags are not required. -Forms II Lite generated COCs will be used. -Use waterproof ink for any handwritten labels.
1-3	*Surface Soil Sampling*, Rev. 6, 3/31/07	CDM	*TSOP*	N	*See notes 1 and 2* Section 5.2.1
1-4	Subsurface Sampling, Rev. 6, 3/31/07	CDM	*TSOP*	Y	Sections 4.5 and 5.2.3 of the TSOP
1-6	Water Level Measurement, Rev. 6, 3/31/07	CDM	*TSOP*	N	
1-10	Field Measurement of Organic Vapors, Rev. 4, 3/31/07	CDM	*TSOP/ Mini-RAE/Multi-RAE*	N	
1-11	Sediment/Sludge Sampling, Rev. 7, 3/31/07	CDM	*TSOP/ Mini-RAE/Multi-RAE, Section 5.3*	Y	Sediment will be collected by vibracore by a subcontractor.
2-1	Packaging and Shipping Environmental Samples, Rev. 3, 3/31/07	CDM	*TSOP*	Y	-Methanol will not be used. -Vermiculite shall not be used. -Metal cans may need to be used to collect medium level soil samples.
2-2	Guide to Handling of Investigation-Derived Waste, Rev. 5, 3/31/07	CDM	*NA*	N	
3-1	Geoprobe® Sampling, Rev. 5 03/31/07	CDM	*TSOP*	N	
4-1	Field Logbook Content and Control, Rev. 6, 3/31/07	CDM	*NA*	Y	Logbook notes should include decon procedures used, descriptions of photos taken, problems encountered and notes of conversations with project staff. Details of *samples collected including* CLP numbers and visual observations.
4-2	Photographic Documentation of Field Activities; Rev. 7, 3/31/07	CDM	*Camera*	N	
4-5	Field Equipment Decontamination at Nonradioactive Sites, Rev. 7, 3/31/07	CDM	*TSOP*	Y	See Worksheet #17i -Use phthalate-free gloves

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type*	Modified for Project Work? (Y/N)*	Comments
4-9	Aquifer Performance Tests, Rev. 0, 5/06/05	CDM	*TSOP, Section 4*	N	
5-1	Control of Measurement and Test Equipment, Rev. 8, 3/31/07	CDM	*NA*	Y	Leased or rented equipment only to be used.
Appendix C	Groundwater Sampling SOP for Raritan Bay Slag Site	EPA Region 2	*SOP, Redi-flo pump*	Y	Elaborated upon in QAPP Worksheet #17f text to be site specific and in compliance with NJDEP Low Flow Purging and Sampling Guidance to the extent possible.

Notes:

1. Homogenization – The process of mixing individual grab samples in order to minimize the bias in sample representativeness induced by the natural stratification of constituents within the sample.

Homogenization of soil is accomplished by thoroughly mixing the collected soil with a stainless steel spoon or spatula in the following manner. The soil should be scraped from the stainless steel container sides, corners, and bottom, then rolled into the middle and initially mixed. The soil is then quartered and moved to the four quarters of the container. Each quarter of the sample should be mixed individually, then rolled to the center of the stainless steel container and mixed again.

2. **Method for Collecting Surface Soil Samples for VOC Analysis in Closed-System Vials**
   1. Use the appropriate decontaminated stainless steel or Teflon sampling device to collect the sample
   2. Retrieve the sampling device and slowly decant off any liquid phase
   3. Complete the sample label by filling in the appropriate information. Do not cover the label with tape.
   4. Place the tared or pre-weighed, pre-labeled 40-ml VOA vial and cap on the scale.
   5. With the aid of a clean stainless steel spatula, quickly add 5 grams of soil to the vial.
   6. Immediately secure the Teflon-lined cap on the sample container.
   7. Repeat the procedure for the remaining two vials.
   8. Collect percent moisture sample in a 40-ml VOA vial of 60-ml jar with Teflon sealed cap. Fill the entire sample container with soil, no headspace.
   9. Store samples at 4 degrees Celsius, and ship the sample to the analytical laboratory. The sample must be received by the laboratory with 48 hours of sample collection.

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
YSI-600XL Flow through cell	Calibrate: beginning of day and check calibration at the end of the day	Performed before shipment and as needed	Measure with known National Institute for Standards and Technology (NIST) traceable buffers and conductivity calibration solutions	Upon receipt, Successful operation	Daily, before each use	pH: ± 0.05 Specific Conductivity:±5 micro Siemens (µS) DO ± 0.02 ppm Temp.: ±0.3°C	Recalibrate or service as necessary	FTL	Manufacturers specifications
Mini RAE plus Classic (PGM-76) Toxic Gas Monitor - 11.7 electron volt (eV) lamp	Calibration checked at the beginning and end of day	As needed in field; semi-annually by supplier	Measure Isobutylene 100 parts per million (ppm) (calibration gas)	Upon receipt, Successful operation	Calibrate am, check pm	± 10% of the calibrated value	Manually zero meter or service as necessary and recalibrate	FTL	Manufacturers specifications
Water Level Meter	N/A	None	Check daily, before each use	Check instruments are working	Check daily before each use	Pass/Fail	Return to rental company for replacement	Sub-contractor	Manufacturers specifications
VibeCore-D	N/A	None	Check daily, before each use	Check instruments are working	Check daily before each use	Pass/Fail	Return to rental company for replacement	Sub-contractor	Manufacturers specifications
LaMotte Turbidity Meter Model 2020	Accuracy/calibration check at the beginning and end of the day	Return for replacement	Measure with standard solution	Upon receipt, Successful operation	Calibrate before use and whenever anomaly suspected	Pass /fail	Replace battery or bulb or return for replacement	FTL	Manufacturers specifications
Ferrous Iron HACH (Colorimeter or Spectrophotometer model DR/890, 850 or 820)	Accuracy check at the beginning of the day and check calibration at the end of the day	Return to instrument rental for replacement	Measure with standard solution	Upon receipt, Successful operation	Check daily before each use	Pass/ Fail	Return to rental company for replacement	FTL	Accuracy check at the beginning of the day and check calibration at the end of the day
Multi-RAE plus photoionization detector (PID) Toxic Gas Monitor - 11.7 eV lamp	Calibration checked at the beginning and end of day	As needed in field; semi-annually by supplier	Measure known concentration of Isobutylene 100 ppm (calibration gas); plus O_2, CO, H_2S, LEL	Upon receipt, Successful operation	Calibrate am, check pm	± 10% of the calibrated value	Manually zero meter or service as necessary and recalibrate	FTL	Manufacturers specifications

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)*
SOM01.2	*EPA Contract Laboratory Program* (CLP) Statement of Work (SOW) for Multi-Media, Multi-Concentration Organic Analysis; April 2007 amendment	Definitive	TCL VOCs	GC/MS	DESA or CLP Laboratory	Y
SOM01.2	CLP SOW for Multi-Media, Multi-Concentration Organic Analysis; April 2007 amendment	Definitive	Trace SVOCs	GC/MS	DESA or CLP Laboratory	Y
SOM01.2	CLP SOW for Multi-Media, Multi-Concentration Organic Analysis; April 2007 amendment	Definitive	TCL SVOCs	GC/MS	DESA or CLP Laboratory	Y
SOM01.2	CLP SOW for Multi-Media, Multi-Concentration Organic Analysis; April 2007 amendment	Definitive	TCL Pesticides	GC/ECD	DESA or CLP Laboratory	Y
SOM01.2	CLP SOW for Multi-Media, Multi-Concentration Organic Analysis; April 2007 amendment	Definitive	TCL Aroclors (PCBs)	GC/ECD	DESA or CLP Laboratory	Y

[* *EPA has prepared modified analysis SOWs to obtain reporting limits below the CRQLs, as described in Worksheet #15s.*]

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)*
ILM05.4	CLP SOW for Multi-Media, Multi-Concentration Inorganic Analysis; December 2006	Definitive	TAL Metals	ICP-AES / ICP-MS	DESA or CLP Laboratory	N
		Definitive	Mercury	Cold Vapor Atomic Absorption	DESA or CLP Laboratory	N
		Definitive	Cyanide	Distiller - Colorimeter	DESA or CLP Laboratory	N
SW-846 7196A	Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition (SW-846).	Definitive	Hexavalent Chromium	Colorimeter/ photometer	DESA or subcontract laboratory	N
EPA 130.1or ILM05.4 + calculation	Methods for Chemical Analysis of Water and Wastes (MCAWW): EPA-600/4-79-029, revised March 1983.	Definitive	Hardness	Colorimeter, automated or titrator	DESA or subcontract laboratory	N
SM2540D	MCAWW. Revised 1983	Definitive	TSS	Balance, oven	DESA or subcontract laboratory	N
310.2	MCAWW. Revised 1983	Definitive	Alkalinity	pH meter or electronic titrator	DESA or subcontract laboratory	N
300	MCAWW. Revised 1983	Definitive	Chloride	1-Colorimetric, 2-Titrimetric	DESA or subcontract laboratory	N
1-350.1	MCAWW. Revised 1983	Definitive	Ammonia	Colorimeter-automated		N
352.1 or 300	MCAWW. Revised 1983	Definitive	Nitrate	Colorimeter Ion Chromatography		N
SM4500-SO4-C or D	Standard Method for examination of water and wastewater	Definitive	Sulfate	Gravimetric (balance/oven)		N
SM 4500-S-2 D, E or G	Standard Method for examination of water and wastewater	Definitive	Sulfide	1-Titrimetry 2-Photometric 3-Gas Dialysis 4-Potentiometric		N
1-351.1, 351.2	MCAWW. Revised 1983	Definitive	TKN	1- Colorimeter		N
Lloyd Kahn	Determination of TOC in Sediment, July 1998 and Attachment B, Supplemental Technical Direction and Additional QC Procedures.	Definitive	TOC - soil	Carbon analyzer	DESA or subcontract laboratory	N

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)*
SW-846 3060A/7196A	Alkaline digestion for Hexavalent Chromium; Determination of Dissolved Hexavalent Chromium, July 1992, Revision 1	Definitive	Hexavalent Chromium – soil	Extraction by alkaline digestion; colorimeter	DESA or subcontract laboratory	N
ASTM D421-85	Standard Practice for Dry Preparation of Soil Samples. 2002	Definitive	Grain Size	Sieves, hydrometer	DESA or CDM subcontract laboratory	N
ASTM D422-63	Standard Test Method for Particle-Size Analysis of Soils. 2002	Definitive	Grain Size	Sieves, hydrometer	DESA or CDM subcontract laboratory	N
HACH 8146	HACH Test Kit - Phenanthroline Method[4]	Screening	Ferrous Iron	Colorimeter or Spectrophotometer model DR/890, 850 or 820	CDM field staff;	N
ASTM D421-85	Standard Practice for Dry Preparation of Soil Samples. 2002	Definitive	Grain Size	Sieves, hydrometer	DESA or CDM subcontract laboratory	
SM2540B	*Standard Methods for the Examination of Water and Wastewater, 19th or current edition*	Definitive	Lipid	Balance	DESA or CDM subcontract laboratory	Y
NA	Manufacturer's Manual	Screening	Water Quality Parameters	YSI Water quality Checker, Model 600XL or current version as defined by project-specific QAPP	CDM field personnel	N
Cs-137 and Be-7 Method	**Awaiting information from the laboratory.**					
Pb & As method	**Awaiting information from the laboratory.**					

1. CLP laboratories SOPs are reviewed through EPA. DESA laboratory specific SOPs will apply and not these generic SOPs whenever the DESA laboratory is able to perform the analyses. CDM subcontract laboratory specific SOPs are available upon request. The Region II Field and Analytical Services Teaming Advisory Committee (FASTAC) Policy was implemented to procure laboratory services. A CDM master services agreement (MSA) subcontractor laboratory will be used for pH, TOC, hexavalent chromium and grain size.
2. The ASC will submit the electronic "Analytical Services Tracking System (ANSETS) Data Requirement" form to the Regional Sample Control Coordinator (RSCC) by the first day of each month for the previous month's sampling for subcontracted analyses.
3. Tissue analyses will need modification to extraction procedures. Laboratories are TBD.

4. Adapted from Standard Method for Water and Wastewater
MCAWW = Method for chemical analysis for water and waste

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS See SOM01.2	Initial calibration: 5 points *standards*	Upon award of the contract, whenever the laboratory takes *corrective action which may* change or affect the initial calibration criteria (e.g., ion source cleaning or repair, column replacement, etc.), or if the continuing calibration acceptance criteria have not been met.	relative response factor (RRF) ≥ minimum acceptable RRF listed *in Table 5 of procedure;* All target compounds, initial relative standard deviation (RSD) ≤ 10% or 20% and correlation coefficient > 0.995. %RSD ≤ value listed in Table 5 of procedure.	Inspect system for problems (e.g., clean ion *source, change the* column, service the purge and trap device), correct problem, re-calibrate.	EPA CLP Laboratory GC/MS Technician	SOM01.2
GC/MS	Continuing calibration (CCV)	Once every 12 hours	%D ≤15% or <30% as required	Inspect system; correct problem; recalibrate the instrument, reanalyze samples and standards.		
GC/MS	Calibration Standards Verification	Each lot of standards	As per lab established control limits	Inspect system; correct problem; re-run standard *and affected samples*		
GC/MS	Tuning	Daily: every 12 hours	Response factors and RRF as method specified	Inspect system; correct problem; re-run standard and affected samples		
GC/ECD See SOM01.2	Initial calibration	Upon award of the contract, whenever major instrument maintenance or modification is *performed or if the calibration* verification technical acceptance criteria have not been met.	Initial calibration/ Calibration verification: resolution between two adjacent peaks ≥60.0%, *single components* ≥90.0% resolved, RTs within the RT window,	Inspect the system (e.g., change the column, bake out the detector, clean the *injection port); correct* problem, re-calibrate.	EPA CLP Laboratory GC/ECD Technician	SOM01.2
	Calibration verification	Once every 12 hours	%D must be greater than or equal to -25 percent and less than or equal to 25 percent, %RSD must be less than or equal to 20.0 percent.	Inspect system, recalibrate the instrument, and reanalyze samples.		

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP-AES / ICP-MS	See ILM05.4; as per instrument manufacturer's recommended procedures	Initial calibration: daily or once every 24 hours and each time the instrument is set up.	ICP-AES: As per instrument manufacturer's recommended procedures, with at least 2 standards.	Inspect the system, correct problem, re-calibrate, and re-analyze samples.	TBD EPA CLP Laboratory ICP-AES / ICP-MS Technician or DESA Laboratory analyst / QA officer -	ILM05.4
	Initial calibration	Daily; after tuning and optimizing instrument	Correlation coefficient >0.995 with a minimum of 3 standards and a blank	Repeat analysis; re-prepare calibration standards and reanalyze		
	Initial calibration verification (ICV)	Before sample analysis	90-110% recovery; source of standard separate from calibration standards	Re-calibrate instrument; prepare fresh ICV standards; do not analyze samples until problem is corrected		
	Reporting Limit Standard	*After initial calibration* verification standard	*80-120% recovery or* concentration ≤ 30% difference (from true value)	*Re-analyze failed standard*		
	Continuing Calibration Verification (CCV)	Every 10 samples and at end of analytical sequence	90-110% recovery; source of standard separate from calibration standards	Re-check; re-calibrate and rerun all samples analyzed after last valid CCV		
ICP-MS	Continuing calibration	Beginning and end of run; 10% frequency or every 2 hours during an analysis run	As per instrument manufacturer's recommended procedures, with at least 2 standards. A minimum of three replicate integrations are required for data acquisition.			ILM05.4
CV-GAS	Calibration; 3 point standards	After instrument set up	$R^3 \geq 0.995$	Inspect system; correct problem	Laboratory analyst / QA officer - TBD	TBD
	ICV	Before sample analysis	80-120% recovery; source of standard separate from calibration standards	Do not analyze samples until problem is corrected	Laboratory analyst / QA officer - TBD	TBD
	CCV	10% or every 2 hours, whichever is more frequent	80-120% recovery	Inspect system, re-calibrate and rerun associated samples	Laboratory analyst / QA officer - TBD	TBD

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Total Organic Carbon Analyzer (soil)	Calibration and corrective action as per Manufacturer's instruction. No samples shall be analyzed if instrument calibration exceeds the acceptance criteria.				Lab analyst / QA officer - TBD	TBD
Colorimeter[4]	Initial Calibration; 4 - 9 point standards	Every 3 months; every 6 months for method 300. or as per lab SOP	90-110 % recovery	Re-check; re-calibrate	Lab analyst / QA officer - TBD	TBD
	Calibration check (Cal Check)	Every 10 samples and at end of analytical run	80-120 % recovery	Re-check; re-calibrate and rerun all samples analyzed after last valid Cal Check	Lab analyst / QA officer - TBD	TBD
Infra red or Ultraviolet Spectrophotometer	Initial Calibration; 5 point standards	Every 3 months or when other unresolved QC failure occurs	90-110 % recovery	Re-check; re-calibrate	Lab analyst / QA officer - TBD	TBD
	Calibration check	Every 10 samples and at end of analytical run	80-120 % recovery	Re-check; re-calibrate and rerun all samples analyzed after last valid cal check		
Ion Chromatography	Initial Calibration; 5 point standards	Every 12 hours of operation	90-110 % recovery	Find the problem and re-calibrate	Lab analyst / QA officer - TBD	TBD
Ion Chromatography	Calibration check	Every 10 samples and at end of analytical run	90-110 % recovery	Re-check; re-calibrate and rerun all samples analyzed after last valid cal check	Lab analyst / QA officer - TBD	TBD
Spectrophotometer	1 point standard	Daily	All target compounds, initial relative standard deviation (RSD) ≤ 20%	Inspect system; correct problem; re-run standard and affected samples	Lab analyst / QA officer - TBD	TBD
Balance	Calibration verification	Daily - before use	See instrument manual	Troubleshoot as per equipment manual/call for repair	Lab analyst / QA officer - TBD	TBD
	Mass check	Daily - before use	See instrument manual			
	Temperature check	Annually	± 2°C			
Oven	Serviced annually as per Manufacturer's instruction				Lab analyst / QA officer - TBD	TBD

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
pH meter	Daily buffer checks (2 point bracketing sample pH)	Before use/per batch; other checks as per rental company and manufacturer's recommendations	± 0.1 pH units or ± 0.05 pH units	Recheck; replace buffer solutions and recheck. If still fails perform instrument check or place out of service	CDM – FTL Lab analyst / QA officer - TBD	TBD
YSI	Calibrate with standard solutions; as per instrument manufacturer's recommended procedures	Prior to day's activities; end of day's activities; anytime anomaly suspected	+/- 0.1 units	Clean probe, replace battery, replace membrane, replace probe	CDM FTL	Manufacturer's Instructions

1. The FASTAC decision process will be used for procuring laboratory services. CLP, DESA and CDM subcontract laboratory's calibration and/or method SOPs will be utilized to meet calibration criteria. Specific instrument information (Manufacturer and model) is not available at this time.
2. To be determined (TBD) - Reference SOP depends on the laboratory assignment. EPA maintains the CLP laboratory SOP information. If a subcontract laboratory is needed, CDM will submit their SOP as a field change request.
3. R represents the correlation coefficient
4. For field screening use the HACH test kit SOPs 8023 for hexavalent chromium and 8146 for ferrous iron supplied with the instrument. Field instrument are calibrated by the supplier.

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

Instrument/ Equipment	Maintenance Activity	Testing/Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Analytical instrument maintenance, testing and inspection information and availability of spare parts are not available since the FASTAC decision process will be utilized for analytical services.							
Information is provided in CDM MSA subcontract laboratories' QA Manuals. MSA laboratory to be utilized (if DESA is not available) not determined at this time. Maintenance, testing and inspection frequencies are documented in the MSA laboratories SOPs.							
GC/MS	See SOM01.2; as per instrument *manufacturer's* recommendations	See SOM01.2; as per instrument *manufacturer's* recommendations	See SOM01.2; as per instrument *manufacturer's* recommendations	Acceptable re-calibration; see SOM01.2	Inspect the system, correct problem, *re-calibrate and/or* reanalyze samples.	EPA CLP Laboratory GC/MS Technician	SOM01.2
GC/ECD	See SOM01.2; as per instrument manufacturer's recommendations	See SOM01.2; as per instrument manufacturer's recommendations	See SOM01.2; as per instrument manufacturer's recommendations	Acceptable re-calibration; see SOM01.2	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP Laboratory GC/ECD Technician	SOM01.2
ICP-AES / ICP-MS	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations; check connections	As per instrument manufacturer's recommendations	Acceptable re-calibration; see ILM05.4	Inspect the system, correct problem, re-calibrate and/or reanalyze samples.	EPA CLP Laboratory ICP-AES / ICP-MS Technician	ILM05.4
YSI Multi-parameter meter	Check/replace battery	Visual inspection	Prior to day's activities; anytime anomaly suspected	No visual defects; +/- 0.1 units	Replace battery; replace probe	CDM FTL	Manufacturer's Instructions

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection: The CDM staff will collect all samples. Sample numbers will be assigned as described below. A coding system will be used to identify each sample collected during the duration of the project. This coding system will provide a tracking record to allow retrieval of information about a particular sample and ensure that each sample is uniquely identified. Each sample is identified by a unique code which indicates the sample type, sample number, and, in some cases, sample depth. A sample numbering system is described below which provides a unique identifier for all samples that will be collected during the site field investigation. The total number and types of samples collected are detailed in Worksheet #18.

Soil Samples:

Soil samples will be collected from Areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. Total number of samples include all HHRA, ERA and RI sampling (see Worksheet #20).
The surface and subsurface soil samples will be named using the following methodology:
- Soil Location ID – Depth of Sample (two digits per depth, therefore 3 inches would be 03)
- The prefix SS will be designated for surface and subsurface soil samples

For example a soil sample collected from Area 7 at location XX from 0 to 6 inches will be labeled SS07-XX-00-06

Sediment Samples:

Sediment samples will be collected from Areas 1, 2, 5, 6, 7, 8, 9, 10 and 11 and wetland locations (TBD). Total number of samples include all HHRA, ERA and RI sampling (see Worksheet #20).
The sediment samples will be named using the following methodology:
- Sediment Location ID – Depth of Sample (two digits per depth, therefore 3 inches would be 03)
- The prefix SD will be designated for sediment samples

For example a sediment sample collected from Area 7 at location XX from 0 to 6 inches will be labeled SD07-XX-00-06

Surface Water Samples:

Surface water samples will be collected from Areas 1, 2, 5, 6, 7, 8, 9, 10, and 11. The total number of samples include all HHRA, ERA and RI sampling (see Worksheet #20).
The surface water samples will be named using the following methodology:
- Sample Location ID – sample location
- The prefix SW will be designated for surface water samples

For example a surface water from Area 7 and sample location "01" will be labeled SW-07-01

Groundwater Samples:

There are a total of 25 groundwater samples to be collected, in one round, from 22 new monitoring wells and 3 existing wells for baseline groundwater quality.
The groundwater samples will be named using the following methodology:
- Well ID # - Round #
- The prefix MW will be designated for samples

For example a groundwater sample from monitoring well MW-01 will be labeled MW-01-R1

QAPP Worksheet #26
Sample Handling System

Biota Samples:
Biota samples will be collected, in one round to support the RI, ERA and HHRA (See Worksheet #20). Samples will be collected for fish, clams and blue crabs. The biota samples will be named using the following methodology:

Sample type (FISH, CLAM, or CRAB) – sample area – sample date

For example a fish sample from Area 6 collected on September 30, 2010 will be labeled FISH-A6-093010

QC Samples:
Each duplicate sample will be submitted "blind" to the laboratory by using a different sample number than the associated environmental sample. The actual collection time will be recorded for both the environmental sample and the duplicate.

Trip blanks will be numbered by using the prefix "TB" in front of the date as follows: TB093010 for September 30, 2010. If multiple trip blanks are collected on one day, a suffix will be added to indicate the media associated with the trip blank, for example TB093010-SW would be for the surface water trip blank for September 30, 2010.

Field blanks will be numbered by using the prefix "FB" in front of the date as follows: FB093010 for September 30, 2010. If multiple trip blanks are collected on one day, a suffix will be added to indicate the media associated with the field blank, for example FB093010-SW would be for the surface water field blank for September 30, 2010.

Sample Packaging: (CDM FTL and field crew): Qualified CDM personnel will perform the sample packaging. Sample packaging will follow TSOP 1-2 and TSOP 2-1; and the CLP Guidance for Field Samplers, January 2007, with the exception that: sample tags and vermiculite will not be used. Forms II Lite is mandatory and will be assigned to experienced field personnel.

Coordination of Shipment (Personnel/Organization): FTL, CDM ASC CLP coordinator

Type of Shipment/Carrier: Priority Overnight Shipping/TBD. Samples for Saturday delivery will have the airbills checked for Saturday delivery.

SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Laboratory Sample Custodian - TBD as per FASTAC. The CLP Laboratory assignment sheet will indicate the laboratory sample custodian. The laboratory project officer will notify the field team of the laboratory sample custodian.
Sample Custody and Storage (Personnel/Organization): TBD as per FASTAC
Sample Preparation (Personnel/Organization): TBD as per FASTAC
Sample Determinative Analysis (Personnel/Organization): TBD as per FASTAC

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): All samples will be shipped to a CLP laboratory, DESA or the CDM subcontract laboratories on the day of collection via priority overnight (FedEx). Samples may be hand delivered/courier depending on laboratory location.

QAPP Worksheet #26
Sample Handling System

Sample Extract/ Digestate Storage (No. of days from extraction/digestion): *Refer to Worksheet #19 for holding time requirements.*

SAMPLE DISPOSAL

Personnel/Organization: The laboratory responsible for analysis will dispose of samples in accordance with the applicable regulations.

Number of Days from Analysis: 90 days*.

*Tissue samples will be maintained frozen for up to 6 months after analysis

QAPP Worksheet #27
Sample Custody Requirements

Sample Identification Procedures: Each sample will be labeled with the sample type letter code described on Worksheet #26 and number that identifies a specific location. Each sample will also be labeled with a CLP or Non- CLP assigned number.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):
Packaging for all shipments will be performed according to the EPA Contract Laboratory Program Guidance for Field Samplers, Final (EPA 2007) and TSOP 2-1. To maintain a record of sample collection transfer between field personnel, shipment, and receipt by the laboratory, the applicable sample chain-of-custody paperwork (TSOP 1-2) is completed for each shipment (i.e., cooler) of packed sample bottles. The team member actually performing the sampling is personally responsible for the care and custody of the samples collected until they are transferred properly. The field technician will review all field sampling activities to confirm that proper custody procedures were followed during the field work. CDM personnel relinquishing the sample to the courier will sign the chain of custody record.

All courier receipts and/or paperwork associated with the shipment of samples will serve as a custody record for the samples while they are in transit from the field to the laboratory. Custody seals should remain intact during this transfer.

Coolers are secured with nylon fiber tape and at least two custody seals are placed across cooler openings. Since custody forms are sealed inside the sample cooler and custody seals remain intact, commercial carriers are not required to sign the chain-of-custody form. Examples of custody seals are included in TSOP 1-2.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): A sample custodian at the laboratory will accept custody of shipped samples, and check them for discrepancies, proper preservation, integrity, etc. If noted, issues will be forwarded to the laboratory manager for corrective action. The sample custodian will relinquish custody to the appropriate department for analysis. Disposal of the samples will occur only after analyses and QA/QC checks are completed. This will complete sample transfer.

It will be each laboratory's responsibility to maintain internal logbooks and records that provide a custody record throughout sample preparation and analysis. To track field samples through data handling, the subcontractors responsible for sampling will maintain photocopies of all chain-of-custody forms.

QAPP Worksheet #28
QC Samples Table

Duplicates: Field duplicate samples are collected and analyzed to assess the overall precision of the field sampling technique. Duplicate samples, of a similar matrix, will be collected at a rate of five percent or at least one per every 20 samples and bioavailability duplicate samples will be collected at one per 10 samples. These duplicates will be submitted "blind" to the laboratories by using sample numbers that differ from their associated environmental samples.

Duplicate samples will be collected by alternately filling bottles for the same analysis. Duplicate biota samples will be collected from the same suite of individuals, to the extent possible.

Trip Blanks A trip blank will be prepared at the start of each day on which aqueous samples will be collected for analysis of VOCs and ethane/ethene. Trip blanks are used to determine whether on site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of sample containers. A trip blank consists of demonstrated analyte-free water sealed in 40-ml Teflon septum vials with no headspace (including bubbles) in the vials. Trip blank water will be considered analyte-free when analysis results for VOC analysis are below CRQL. Certification of blank water quality will be kept on site and will be filed in the project files once field work is completed. A sample of the blank water lot used in the field will be submitted for confirmatory analysis.

Trip blanks are to be kept in close proximity to the samples being collected and will be maintained at 4 degrees Celsius (°C) and handled in the same manner as the other VOC or ethane/ethene aqueous samples. Preservation of trip blanks is presented on Worksheet # 19. One trip blank will be included with each daily shipment that contains aqueous samples collected for VOC analysis and one trip blank will be included with each daily shipment that contains aqueous samples collected for ethane/ethene analysis. Trip blanks will be analyzed by the same VOC method as the associated set of samples.

Field Blanks: One field blank will be collected for each equipment type per decontamination event and will be analyzed for the same constituents as the environmental samples. Field blanks, also known as "rinsate blanks" or "equipment blanks," are used to assess the effectiveness of equipment decontamination. Field blanks will be collected before the use of the decontaminated equipment for sampling. The frequency for field blanks is one per decontamination event, not to exceed one per day, for each equipment type and for each sample matrix. Field blanks are generated by pouring demonstrated analyte-free water over or through the decontaminated sampling tool. The definition of demonstrated analyte-free water is discussed in the previous section. Field blanks will be collected in a way that will minimize potential contamination from the ambient air. The use of the same aliquot of water on all equipment associated with a particular matrix for the required analyses is permissible. However, a separate field rinse blank must be collected for each piece of equipment associated with a particular sample matrix that will be analyzed for VOCs. Preservation of field blanks is specified on Worksheet # 19. Field blanks will accompany the set of samples collected by the decontaminated sampling equipment and will be kept at 4°C.

QAPP Worksheet #28
QC Samples Table

Cooler Temperature Indicators
One cooler temperature indicator or "temperature blank" will be placed in each cooler containing samples (solid and aqueous) being sent to the laboratory for analysis. The temperature blank will consist of a sample container filled with non-preserved water (potable or distilled). The container will be labeled "COOLER TEMPERATURE INDICATOR" and dated.

Matrix Spikes
Matrix spikes (MS) are laboratory QC samples drawn from excess volumes of existing samples to demonstrate the accuracy of laboratory analysis. In accordance with EPA Region 2, matrix spikes will be designated on environmental samples at a rate of one per sample delivery group (SDG). This designation will be noted on the sample container labels and the sample paperwork. An SDG is defined as one of the following:

1. All samples of an analytical case if the sample number is less than 20 (including environmental duplicates and QC blanks) and if sampling is completed within 7 calendar days.
2. Each group of 20 samples within an analytical case (including environmental duplicates, but excluding QC blanks) if the number is greater than 20.
3. Each 7-day calendar day period during which samples within an analytical case are received. This period begins with the receipt of the first sample in the SDG.

Triple volume is required for aqueous pesticide and PCB MS/MSDs. MS/MSDs are not required for VOCs and SVOCs for CLP method SOM01.2. The water quality parameters do not require extra volume unless identified on Worksheet #19 and confirmed with a non-CLP laboratory.

QAPP Worksheet #28a
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL Trace Concentration VOCs
Concentration Level	Trace (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Trip Blank	1 per cooler	≤ CRQL		Verify results; re-analyze. Flag outliers	Laboratory analyst	Accuracy / Contamination	≤ CRQL	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 every 12 hours	No analyte > CRQL*		Suspend analysis unit source recertified	DESA or EPA CLP Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*	
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d3	65-131 %R	Check calculations and instruments, reanalyze affected samples		Accuracy	Vinyl chloride-d3	65-131 %R
		Chloroethane-d5	71-131 %R				Chloroethane-d5	71-131 %R

*with the exception of methylene chloride, 2-butanone and acetone which can be up to 2 times the CRQL, or in some situations may require these compounds be up to 4 times the CRQL.

QAPP Worksheet #28a (contd.)
QC Samples Table

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
TCL Trace Concentration VOCs Continued								
Deuterated Monitoring Compounds [cont'd]	all samples	1,1-Dichloroethene-d2	55-104 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet recovery limits	DESA or EPA CLP Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene-d2	55-104 %R
		2-Butanone-d5	49-155 %R				2-Butanone-d5	49-155 %R
		Chloroform-d	78-121 %R				Chloroform-d	78-121 %R
		1,2-Dichloroethane-d4	78-129 %R				1,2-Dichloroethane-d4	78-129 %R
		Benzene-d6	77-124 %R				Benzene-d6	77-124 %R
		1,2-Dichloropropane-d6	79-124 %R				1,2-Dichloropropane-d6	79-124 %R
		Toluene-d8	77-121 %R				Toluene-d8	77-121 %R
		trans-1,3-Dichloropropene-d4	73-121 %R				trans-1,3-Dichloropropene-d4	73-121 %R
		2-Hexanone-d5	28-135 %R				2-Hexanone-d5	28-135 %R
		1,4-Dioxane-d8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d2	73-125 %R				1,1,2,2-Tetrachloroethane-d2	73-125 %R
		1,2-Dichlorobenzene-d4	80-131 %R				1,2-Dichlorobenzene-d4	80-131 %R
Internal Standards	all samples	60-140%		Check calculations and instruments, reanalyze affected samples		Accuracy	± 40 % of response area, ± 20 sec retention time shift	

QAPP Worksheet #28b
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL VOCs
Concentration Level	Low (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Trip Blank	1 per cooler	≤ CRQL		Verify results; re-analyze. Flag outliers	Laboratory analyst	Accuracy / Contamination	≤ CRQL	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 every 12 hours	No analyte > CRQL*		Suspend analysis unit source recertified	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*	
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d3	65-131 %R	Check calculations and instruments, reanalyze affected samples; see asterisk below	EPA CLP RAS Laboratory GC/MS Technician	Accuracy	Vinyl chloride-d3	65-131 %R
		Chloroethane-d5	71-131 %R				Chloroethane-d5	71-131 %R

*with the exception of methylene chloride, 2-butanone and acetone which can be up to 2 times the CRQL.

QAPP Worksheet #28b (contd.)
QC Samples Table

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
TCL VOCs (Low) Continued								
Deuterated Monitoring Compounds [cont'd]	all samples	1,1-Dichloroethene-d2	55-104 %R	Check calculations and instruments, reanalyze affected samples; *up to 3 DMCs per sample may fail to meet recovery limits	DESA or EPA CLP Laboratory GC/MS Technician	Accuracy	1,1-Dichloroethene-d2	55-104 %R
		2-Butanone-d5	49-155 %R				2-Butanone-d5	49-155 %R
		Chloroform-d	78-121 %R				Chloroform-d	78-121 %R
		1,2-Dichloroethane-d4	78-129 %R				1,2-Dichloroethane-d4	78-129 %R
		Benzene-d6	77-124 %R				Benzene-d6	77-124 %R
		1,2-Dichloropropane-d6	79-124 %R				1,2-Dichloropropane-d6	79-124 %R
		Toluene-d8	77-121 %R				Toluene-d8	77-121 %R
		trans-1,3-Dichloropropene-d4	73-121 %R				trans-1,3-Dichloropropene-d4	73-121 %R
		2-Hexanone-d5	28-135 %R				2-Hexanone-d5	28-135 %R
		1,4-Dioxane-d8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d2	73-125 %R				1,1,2,2-Tetrachloroethane-d2	73-125 %R
		1,2-Dichlorobenzene-d4	80-131 %R				1,2-Dichlorobenzene-d4	80-131 %R
Internal Standards	all samples	60-140%		Check calculations and instruments, reanalyze affected samples	DESA or EPA CLP Laboratory GC/MS Technician	Accuracy	± 40 % of response area, ± 20 sec retention time shift	

QAPP Worksheet #28c
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL SVOCs
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Method Blank	1 per 20 samples or batch	No analyte > CRQL*	Stop analysis unit source recertified	DESA or CLP Laboratory GC/MS Technician	Accuracy	≤ CRQL

*with the exception of bis (2-Ethylhexyl) phthalate which can be up to 5 times the CRQL. (EPA CLP National Functional Guidelines, Final, July 2007)

QAPP Worksheet #28c (contd.)
QC Samples Table

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
TCL SVOCs [cont'd]								
Deuterated Monitoring Compounds	all samples	Phenol-d5	39-106 %R	Check calculations and instruments, reanalyze affected samples; up to 4 DMCs may fail to meet recovery limits	DESA or CLP Laboratory GC/MS Technician	Accuracy	Phenol-d5	39-106 %R
		Bis(2-chloroethyl)ether-d8	40-105 %R				Bis(2-chloroethyl)ether-d8	40-105 %R
		2-Chlorophenol-d4	41-106 %R				2-Chlorophenol-d4	41-106 %R
		4-Methylphenol-d8	25-111 %R			Accuracy	4-Methylphenol-d8	25-111 %R
		Nitrobenzene-d5	43-108 %R				Nitrobenzene-d5	43-108 %R
		2-Nitrophenol-d4	40-108 %R				2-Nitrophenol-d4	40-108 %R
		2,4-Dichlorophenol-d3	37-105 %R				2,4-Dichlorophenol-d3	37-105 %R
		4-Chloroaniline-d4	1-145 %R				4-Chloroaniline-d4	1-145 %R
		Dimethylphthalate-d6	47-114 %R				Dimethylphthalate-d6	47-114 %R
		Acenaphthylene-d8	41-107 %R				Acenaphthylene-d8	41-107 %R
		4-Nitrophenol-d4	33-116 %R				4-Nitrophenol-d4	33-116 %R
		Fluorene-d10	42-111 %R				Fluorene-d10	42-111 %R
		4,6-Dinitro-2-methylphenol-d2	22-104 %R				4,6-Dinitro-2-methylphenol-d2	22-104 %R
		Anthracene-d10	44-110 %R				Anthracene-d10	44-110 %R
		Pyrene-d10	52-119 %R				Pyrene-d10	52-119 %R
		Benzo(a)pyrene-d12	32-121 %R			Accuracy	Benzo(a)pyrene-d12	32-121 %R
Internal Standards	all samples	50-100% of area, ± 20 second retention time shift		Check calculations/instruments reanalyze affected samples	DESA or CLP Laboratory GC/MS Technician	Accuracy	50-100% of area, ± 20 second retention time shift	

QAPP Worksheet #28d
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL Pesticides
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 per 20 samples or whenever samples extracted	No analyte > CRQL		Suspend analysis unit source recertified	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Analyte ≤ CRQL	
Matrix Spike	1 per 20 samples; if requested	gamma-BHC (Lindane)	56-123 %R	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Accuracy	gamma-BHC (Lindane)	56-123 %R
		Heptachlor	40-131 %R				Heptachlor	40-131 %R
		Aldrin	40-120 %R				Aldrin	40-120 %R
		Dieldrin	52-126 %R				Dieldrin	52-126 %R
		Endrin	56-121 %R				Endrin	56-121 %R
		4,4'-DDT	38-127 %R				4,4'-DDT	38-127 %R
Matrix Spike Duplicate	1 per 20 samples; if requested	gamma-BHC	0-15 %RPD	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Precision	gamma-BHC	0-15 %RPD
		Heptachlor	0-20 %RPD				Helptachlor	0-20 %RPD
		Aldrin	0-22 %RPD				Aldrin	0-22 %RPD
		Dieldrin	0-18 %RPD				Dieldrin	0-18 %RPD
		Endrin	0-21 %RPD				Endrin	0-21 %RPD
		4,4'-DDT	0-27 %RPD				4,4'-DDT	0-27 %RPD
Laboratory Control Sample	1 per 20 samples	gamma-BHC	50-120 %R	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	gamma-BHC	50-120 %R

QAPP Worksheet #28d (contd.)
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL Pesticides [cont'd]
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Laboratory Control Sample [cont'd]	1 per 20 samples	Heptachlor epoxide	50-150 %R	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Helpachlor epoxide	50-150 %R
		Dieldrin	30-130 %R				Dieldrin	30-130 %R
		4,4'-DDE	50-150 %R				4,4'-DDE	50-150 %R
		Endrin	50-120 %R				Endrin	50-120 %R
		Endosulfan sulfate	50-120 %R				Endosulfan sulfate	50-120 %R
		gamma-Chlordane	30-130 %R				gamma-Chlordane	30-130 %R
Surrogate	all samples	30-150 %R		Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	30-150 %R	

QAPP Worksheet #28e
QC Samples Table

Matrix	Aqueous
Analytical Group	TCL PCBs
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 per 20 samples or whenever samples extracted	No analyte > CRQL		Suspend analysis unit source recertified	DESA or CLP Laboratory GC/ECD Technician	Accuracy	No analyte > CRQL	
Matrix Spike	1 per 20 samples; if requested	Aroclor-1016	29-135 %R	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Aroclor-1016	29-135 %R
		Aroclor-1260	29-135 %R				Aroclor-1260	29-135 %R
Matrix Spike Duplicate	1 per 20 samples; if requested	Aroclor-1016	0-15 %RPD	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Precision	Aroclor-1016	0-15 %RPD
		Aroclor-1260	0-20 %RPD				Aroclor-1260	0-20 %RPD
Laboratory Control Sample	1 per 20 samples	Aroclor-1016	50-150 %R	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Aroclor-1016	50-150 %R
		Aroclor-1260	50-150 %R				Aroclor-1260	50-150 %R
Surrogate	all samples	30-150 %R		Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	30-150 %R	

QAPP Worksheet #28f
QC Samples Table

Matrix	Aqueous
Analytical Group	TAL inorganic Metals
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	ILM05.4
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank	1 per 20 samples	No constituent > CRQL	Suspend analysis rectify source; redigest and reanalyze affected samples	DESA or CLP Laboratory ICP Technician	Accuracy	No constituent > CRQL
Spike	1 per 20 samples	75-125%R*	Flag outliers	DESA or CLP Laboratory ICP Technician	Accuracy	75-125%R*
Laboratory Duplicate	1 per 20 samples	± 20% RPD**	Flag outliers	DESA or CLP Laboratory ICP Technician	Precision	± 20% RPD**
Post-Digestion Spike	after any analyte (except Ag and Hg) fails spike %R	75-125%R	Flag outliers	DESA or CLP Laboratory ICP Technician	Accuracy	75-125%R
Interference Check Sample [ICP Analysis Only]	beginning, end and periodically (not less than 1 per 20 samples)	± 2 x CRQL of true value or ± 20% of true value, whichever is greater	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory ICP Technician	Sensitivity	± 2 times CRQL of true value or ± 20% of true value, whichever is greater
Laboratory Control Sample	1 per 20 samples	80-120%R (except Ag and Sb)	Suspend analysis until source rectified; redigest and reanalyze affected samples	DESA or CLP Laboratory ICP Technician	Accuracy	80-120%R (except Ag and Sb)

QAPP Worksheet #28f
QC Samples Table

*except when the sample concentration is greater than 4 times the spike concentration, then disregrard the recoveries; no data validation action taken
**Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria)
**except when the sample and/or duplicate concentration is less than 5 times the CRQL, then ± CRQL.

QAPP Worksheet #28g
QC Samples Table

Matrix	Aqueous
Analytical Group	TAL – Total Mercury
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	ILM05.4 – Cold Vapor Atomic Absorption (CVAA)
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank (PB)	1 per 20 samples	No analyte > CRQL	Suspend analysis; redigest and reanalyze	DESA or CLP Laboratory Technician	Accuracy	No analyte > CRQL
Laboratory Duplicate	1 per 20 samples	± 20% RPD*	Flag outliers	DESA or CLP Laboratory Technician	Precision	± 20% RPD
Spike Sample	1 per 20 samples	75 – 125 %R	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	75 – 125 %R

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria)

QAPP Worksheet #28h
QC Samples Table

Matrix	Aqueous
Analytical Group	*TAL - Total Cyanide*
Concentration Level	Low/Medium (µg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	ILM05.4 – Colorimeter or Spectrophotometer
Sampler's Name	TBD
Field Sampling Organization	*CDM*
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	25% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank (PB)	1 per ≤ 20 samples	No analyte > CRQL	Suspend analysis; redistill and reanalyze	DESA or CLP Laboratory Technician	Accuracy	No analyte > CRQL
Laboratory Duplicate	1 per ≤ 20 samples	± 20% RPD*	Flag outliers	DESA or CLP Laboratory Technician	Precision	± 20% RPD
Spike Sample	1 per ≤ 20 samples	75 – 125 %R	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	75 – 125 %R

*Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria)

QAPP Worksheet #28i
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL VOCs
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Method Blank	1 every 12 hours	No analyte > CRQL*	Suspend analysis unit source recertified	DESA/ CLP Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*

*with the exception of methylene chloride, 2-butanone & acetone which can be up to 2 times the CRQL. (EPA CLP National Functional Guidelines, Final, July 2007)

QAPP Worksheet #28i (contd.)
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL VOCs [cont'd]
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Deuterated Monitoring Compounds	all samples	Vinyl chloride-d3	68-122 %R	Check calculations and instruments, reanalyze affected samples; up to 3 DMCs per sample may fail to meet necessary limits (Section 11.3.4, Page D45 of SOM01.2)	DESA/ CLP Laboratory GC/MS Technician	Accuracy	Vinyl chloride-d3	68-122 %R
		Chloroethane-d5	61-130 %R				Chloroethane-d5	61-130 %R
		1,1-Dichloroethene-d2	45-132 %R				1,1-Dichloroethene-d2	45-132 %R
		2-Butanone-d5	20-182 %R				2-Butanone-d5	20-182 %R
		Chloroform-d	72-123 %R				Chloroform-d	72-123 %R
		1,2-Dichloroethane-d4	79-122 %R				1,2-Dichloroethane-d4	79-122 %R
		Benzene-d6	80-121 %R				Benzene-d6	80-121 %R
		1,2-Dichloropropane-d6	74-124 %R				1,2-Dichloropropane-d6	74-124 %R
		Toluene-d8	78-121 %R				Toluene-d8	78-121 %R
		trans-1,3-Dichloropropene-d4	72-130 %R				trans-1,3-Dichloropropene-d4	72-130 %R
		2-Hexanone-d5	17-184 %R				2-Hexanone-d5	17-184 %R
		1,4-Dioxane-d8	50-150 %R				1,4-Dioxane-d8	50-150 %R
		1,1,2,2-Tetrachloroethane-d2	56-161 %R				1,1,2,2-Tetrachloroethane-d2	56-161 %R
		1,2-Dichlorobenzene-d4	70-131 %R				1,2-Dichlorobenzene-d4	70-131 %R
Internal Standards	all samples	50-200% of area, ± 30 second retention time shift		Check calculations/ instruments reanalyze affected samples	DESA or CLP Laboratory GC/MS Technician	Accuracy	50-100% of area, ± 30 second retention time shift	

QAPP Worksheet #28j
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL SVOCs
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Method Blank	1 per 20 samples or batch	No analyte > CRQL*	Suspend analysis unit source recertified	DESA or CLP Laboratory GC/MS Technician	Accuracy	No analyte > CRQL*

*with the exception of bis (2-Ethylhexyl) phthalate which can be up to 5 times the CRQL. (EPA CLP National Functional Guidelines, Final, July 2007)

QAPP Worksheet #28j (contd.)
QC Samples Table

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
TCL SVOCs – Soil/Sediment/Tissues Continued								
Deuterated Monitoring Compounds	all samples	Phenol-d5	17-103 %R	Check calculations and instruments, reanalyze affected samples; up to 4 DMCs may fail to meet recovery limits (Section 11.3.4, Page D48/SVOC of SOM01.2)	DESA or CLP Laboratory GC/MS Technician	Accuracy	Phenol-d5	17-103 %R
		Bis(2-chloroethyl)ether-d8	12-98 %R				Bis(2-chloroethyl)ether-d8	12-98 %R
		2-Chlorophenol-d4	13-101 %R				2-Chlorophenol-d4	13-101 %R
		4-Methylphenol-d8	8-100 %R				4-Methylphenol-d8	8-100 %R
		Nitrobenzene-d5	16-103 %R				Nitrobenzene-d5	16-103 %R
		2-Nitrophenol-d4	16-104 %R				2-Nitrophenol-d4	16-104 %R
		2,4-Dichlorophenol-d3	23-104 %R				2,4-Dichlorophenol-d3	23-104 %R
		4-Chloroaniline-d4	1-145 %R				4-Chloroaniline-d4	1-145 %R
		Dimethylphthalate-d6	43-111 %R				Dimethylphthalate-d6	43-111 %R
		Acenaphthylene-d8	20-97 %R				Acenaphthylene-d8	20-97 %R
		4-Nitrophenol-d4	16-166 %R				4-Nitrophenol-d4	16-166 %R
		Fluorene-d10	40-108 %R				Fluorene-d10	40-108 %R
		4,6-Dinitro-2-methylphenol-d2	1-121 %R				4,6-Dinitro-2-methylphenol-d2	1-121 %R
		Anthracene-d10	22-98 %R				Anthracene-d10	22-98 %R
		Pyrene-d10	51-120 %R				Pyrene-d10	51-120 %R
		Benzo(a)pyrene-d12	43-111 %R				Benzo(a)pyrene-d12	43-111 %R
Internal Standards	all samples	50-200% of area, ± 30 second retention time shift		Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/MS Technician	Accuracy	50-200% of area, ± 30 second retention time shift	

QAPP Worksheet #28k
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL Pesticides
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 per 20 samples or whenever samples extracted	No analyte > CRQL		Suspend analysis unit source recertified	DESA or CLP Laboratory GC/ECD Technician	Accuracy	No analyte > CRQL	
Matrix Spike	1 per 20 samples	gamma-BHC (Lindane)	46-127 %R	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Accuracy	gamma-BHC (Lindane)	46-127 %R
		Heptachlor	35-130 %R				Heptachlor	35-130 %R
		Aldrin	34-132 %R				Aldrin	34-132 %R
		Dieldrin	31-134 %R				Dieldrin	31-134 %R
		Endrin	42-139 %R				Endrin	42-139 %R
		4,4-DDT	23-134 %R				4,4-DDT	23-134 %R
Matrix Spike Duplicate	1 per 20 samples	gamma-BHC	0-50 %RPD	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Precision	gamma-BHC	0-50 %RPD
		Heptachlor	0-31 %RPD				Heptachlor	0-31 %RPD
		Aldrin	0-43 %RPD				Aldrin	0-43 %RPD
		Dieldrin	0-38 %RPD				Dieldrin	0-38 %RPD
		Endrin	0-45 %RPD				Endrin	0-45 %RPD
		4,4-DDT	0-50 %RPD				4,4-DDT	0-50 %RPD

QAPP Worksheet #28k (contd.)
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL Pesticides [cont'd]
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Laboratory Control Sample	all samples	gamma-BHC	50-120 %R	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	gamma-BHC	50-120 %R
		Heptachlor epoxide	50-150 %R				Heptachlor epoxide	50-150 %R
		Dieldrin	30-130 %R				Dieldrin	30-130 %R
		4,4'-DDE	50-150 %R				4,4'-DDE	50-150 %R
		Endrin	50-120 %R				Endrin	50-120 %R
		Endosulfan sulfate	50-120 %R				*Endosulfan sulfate*	50-120 %R
		gamma-Chlordane	30-130 %R				gamma-Chlordane	30-130 %R
Surrogate	all samples	30–150 %R		Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	30-150 %R	

QAPP Worksheet #28I
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TCL PCBs
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	SOM01.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits		Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria	
Field Duplicate	1 per 20 samples	None		Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius		Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius	
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL		Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL	
Method Blank	1 per 20 samples or whenever samples extracted	No analyte > CRQL		Suspend analysis unit source recertified	DESA or CLP Laboratory GC/ECD Technician	Accuracy	No analyte > CRQL	
Matrix Spike	1 per 20 samples	Aroclor-1016	29-135 %R	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Aroclor-1016	29-135 %R
		Aroclor-1260	29-135 %R				Aroclor-1260	29-135 %R
Matrix Spike Duplicate	1 per 20 samples	Aroclor-1016	0-15 %RPD	Flag outliers	DESA or CLP Laboratory GC/ECD Technician	Precision	Aroclor-1016	0-15 %RPD
		Aroclor-1260	0-20 %RPD				Aroclor-1260	0-20 %RPD
Laboratory Control Sample	all samples	Aroclor-1016	50-150 %R	Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	Aroclor-1016	50-150 %R
		Aroclor-1260	50-150 %R				Aroclor-1260	50-150 %R
Surrogate	all samples	30-150%R		Check calculations and instruments, reanalyze affected samples	DESA or CLP Laboratory GC/ECD Technician	Accuracy	30-150%R	

QAPP Worksheet #28m
QC Samples Table

Matrix	Soil/ Sediment/Tissues
Analytical Group	TAL – Metals
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See Worksheet #21
Analytical Method/SOP Reference	ILM05.4
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See Worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag *duplicate results*	CDM ASC and FTL	Precision	40% RPD lipid and 75% metals
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank	1 per 20 samples	No constituent > CRQL	Suspend analysis until source rectified; re-digest and reanalyze affected samples	DESA or CLP Laboratory ICP-AES/ICP-MS Technician	Accuracy	No constituent > CRQL
Spike	1 per 20 samples	75-125%R*	Flag outliers		Accuracy	75-125%R*
Laboratory Duplicate	1 per 20 samples	± 20% RPD**	Flag outliers		Precision	± 20% RPD**
Post-Digestion Spike	after any analyte (except Ag and Hg) fails spike %R	75-125%R	Flag outliers		Accuracy	75-125%R
Interference Check Sample [ICP Analysis Only]	beginning, end and periodically during run (2 times every 8 hours)	Within ± 2 times CRQL of true value or ± 20% of true value, whichever is greater	Check calculations and instruments, reanalyze affected samples		Sensitivity	Within ± 2 times CRQL of true value or ± 20% of true value, whichever is greater
Laboratory Control Sample	1 per 20 samples	Control limits established by EPA*	Suspend analysis rectify source; re-digest and reanalyze affected samples		Accuracy	Control limits established by EPA*

QAPP Worksheet #28m (contd.)
QC Samples Table

*except when the sample concentration is greater than 4 times the spike concentration, then disregrard the recoveries; no data validation action taken
**Reference EPA Region 2 SOP No. HW-2, Revision 13/Evaluation of Metals Data for CLP - (include absolute difference criteria)
**except when the sample and/or duplicate concentration is less than 5 times the CRQL.
* If the EPA LCS is unavailable, other EPA QC samples or other certified materials may be used. In such cases, control limits for the LCS must be documnetd and provided.

QAPP Worksheet #28n
QC Samples Table

Matrix	Soil/ Sediment/ Tissues
Analytical Group	TAL –Total Mercury
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	ILM05.4 – Cold Vapor Atomic Absorption (CVAA)
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank (PB)	1 per 20 samples	No analyte > CRQL	Suspend analysis; redigest and reanalyze	DESA or CLP Laboratory Technician	Accuracy	No analyte > CRQL
Laboratory Duplicate	1 per 20 samples	± 20% RPD	Flag outliers	DESA or CLP Laboratory Technician	Precision	± 20% RPD
Spike Sample	1 per 20 samples	75 – 125 %R	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	75 – 125 %R
Laboratory Control Sample	1 20 samples	Control limits established by EPA*	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	Control limits established by EPA*

* If the EPA LCS is unavailable, other EPA QC samples or other certified materials may be used. In such cases, control limits for the LCS must be documnetd and provided.

QAPP Worksheet #28o
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	TAL – Total Cyanide
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	ILM05.4 – Colorimeter or Spectrophotometer
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 samples	None	Notify TOM and flag duplicate results	CDM ASC and FTL	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Blank	1 per decontamination event not to exceed 1 per day	≤ CRQL	Verify results; re-analyze. Flag outliers. Check decontamination procedures.	Laboratory analyst / CDM TOM	Accuracy / Contamination	≤ CRQL
Preparation Blank (PB)	1 per 20 samples	No analyte > CRQL	Suspend analysis; redigest and reanalyze	DESA or CLP Laboratory Technician	Accuracy	No analyte > CRQL
Laboratory Duplicate	1 per 20 samples	± 20% RPD	Flag outliers	DESA or CLP Laboratory Technician	Precision	± 20% RPD
Spike Sample	1 per 20 samples	75 – 125 %R	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	75 – 125 %R
Laboratory Control Sample	1 per 20 samples	Control limits established by EPA*	Flag outliers	DESA or CLP Laboratory Technician	Accuracy	Control limits established by EPA*

* If the EPA LCS is unavailable, other EPA QC samples or other certified materials may be used. In such cases, control limits for the LCS must be documented and provided.

QAPP Worksheet #28p
QC Samples Table

Matrix	Aqueous
Analytical Group	*Wet Chemistry Anions by Ion Chromatography - Chloride*
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	EPA 300
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)	1 per 20 samples	Result ≤ 1/2QL No analyte > QL	Suspend analysis; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Laboratory Duplicate	1 per 20 samples	± 20% RPD	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	40% RPD
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	25% RPD
Spike Samples	1 per 20 samples	80-120%R-Method A of 300 75 – 125 %R-Method B of 300. [Perchlorate results can exceed 80-120% if other QC acceptable.]	Flag outliers	DESA or subcontract Laboratory Analyst	Accuracy	75 – 125 %R
Quality Control Sample	Quarterly	90-110%R	Identify source of problem, correct and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	90-110%R
Laboratory Fortified Blank	1 per 10 samples-method 300 1 per 20 samples	85 – 115 %R-perchlorate 90-110%R-method 300	Flag outliers	DESA or subcontract Laboratory Analyst	Accuracy	80-120%R

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28q
QC Samples Table

Matrix	Aqueous (GW)
Analytical Group	Wet Chemistry Anions by Colorimetry -see worksheet #12r for list
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	7196A
Analytical Method/SOP Reference	MCAWW Methods
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Laboratory will inform RSCC/CDM and note in data narrative. CDM will check packing procedure and increase coolant	Laboratory Analyst and CDM FTL	Accuracy	≤ 10 degrees Celsius
Field Duplicate	1 per 20 samples	None	Data assessor to inform PM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	25% RPD
Laboratory Duplicate	1 per 20 samples	None	Flag outliers	DESA or Subcontract Laboratory Analyst	Precision	40% RPD
Spike Samples	1 per 20 samples	None	Flag outliers	DESA or subcontract Laboratory Analyst	Accuracy	75 – 125 %R
Laboratory Control Sample	After calibration, every 20 samples and at end of day	None	Identify source of problem, correct and reanalyze	DESA or Subcontract Laboratory Analyst	Accuracy	80-120%R
Carbonate-bicarbonate standard-Alkalinity	1 per batch	± 10% of true value	Re-prep and re-analyze; recalibrate if still outlying	DESA or Subcontract Laboratory Analyst	Contamination – Accuracy/bias	± 20% of true value

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28r
QC Samples Table

Matrix	Aqueous
Analytical Group	Hexavalent Chromium
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	SW-846, 7196A
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)/	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	25% RPD
Laboratory Duplicate	1 per 20 samples	None	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	25% RPD
Spike Samples	1 per 20 samples	None	Flag outliers	DESA or subcontract Laboratory Analyst	Accuracy	75 – 125 %R
Laboratory Control Sample	After calibration, every 20 samples and at end of day	None	Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	80-120%R
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ 10 degrees Celsius for data validation

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28s
QC Samples Table

Matrix	Aqueous
Analytical Group	Wet Chemistry by Titrimetric or Potentiometric procedures - Alkalinity
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	MCAWW Methods – 301.2
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)/	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	25% RPD
Laboratory Duplicate	1 per 20 samples	None	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	40% RPD
Laboratory Control Sample	After calibration, every 20 samples and at end of day	None	Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	80-120%R
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ 10 degrees Celsius for data validation

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28t
QC Samples Table

Matrix	Aqueous
Analytical Group	Wet Chemistry by Gravimetric procedures - TSS
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	SM2540D
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Preparation Blank (PB)/	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	25% RPD
Laboratory Duplicate	1 per 20 samples	None	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	40% RPD
Laboratory Control Sample	After calibration, every 20 samples and at end of day	None	Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	80-120%R
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ 10 degrees Celsius for data validation

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28u
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	Wet Chemistry – Total Organic Carbon using Carbon analyzer + IR or FID detector
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	Lloyd Kahn with Additional QC requirements
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Preparation Blank	1 per 20 samples	≤ 100 mg/kg	Verify results; reanalyze; recalibrate if still outlying	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ QL
Laboratory Duplicate	Every sample	≤ 20% RPD	Re-run sample; flag outliers	DESA or subcontract Laboratory Analyst	Precision	≤ 75% RPD
Quadruplicate analysis	Per batch	<3xStandard deviation	Identify error and re-analyze	Laboratory analyst	Precision	<3S
Detection Limit Verification Standard	1 per sample run	± 25% of true value	Identify error and re-analyze	Laboratory analyst	Accuracy/bias	± 25% of true value
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ 10 degrees Celsius for data validation

QAPP Worksheet #28v
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	pH
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	SW-846, 9045D
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Buffer standard solution check – pH only	Daily	± 0.05 pH units (of true value)	Verify results; check probe for coating and clean if needed; check buffer solutions; reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	± 0.05 pH units (of true value)
Laboratory Duplicate - pH	Every sample	≤ 20% RPD	Re-run sample; flag outliers	DESA or subcontract Laboratory Analyst	Precision	± 0.05 pH units
Duplicate Sample	Every sample	Laboratory per SOP	Re-run sample; flag outliers	DESA or subcontract Laboratory Analyst	Precision	75% RPD

QAPP Worksheet #28w
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	Grain Size
Concentration Level	Low/Medium (percent particle sizes)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	ASTM D421-85 and ASTM D422-63
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or CLP]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Laboratory Duplicate / Field Duplicate	1 per sample	None	Flag outliers. Data assessor will inform project manager of variability. Data validator will recommend which results set is to be used.	DESA or subcontract Laboratory Analyst	Homogeneity/ Precision	75% RPD

QAPP Worksheet #28x
QC Samples Table

Matrix	Soil/ Sediment
Analytical Group	Hexavalent chromium
Concentration Level	Low/Medium (mg/kg)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	SW-846, 7196A; extraction by 3060A
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	75% RPD
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	≤ 10 degrees Celsius for data validation
Method Blank	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	No analyte > QL
Laboratory Duplicate	1 per 20 samples	≤ 20% RPD	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	75% RPD
Matrix Spike	1 per 20 samples	75 – 125 %R	Per method - typically Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	75 – 125 %R
Laboratory Control Sample	After calibration, every 20 samples and at end of day	80-120%R		DESA or subcontract Laboratory Analyst	Accuracy	80-120%R

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28y
QC Samples Table

Matrix	Aqueous
Analytical Group	Field Test Kits (Ferrous iron)
Concentration Level	Low/Medium (mg/L)
Sampling SOP(s)	See worksheet #21
Analytical Method/SOP Reference	HACH 8146
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	As per FASTAC [DESA or Subcontract Laboratory]
No. of Sample Locations	See worksheet #20

Lab QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Blank Check	Daily or 1 per 20 samples	No analyte > QL	Suspend analysis; re-prep and reanalyze	Field analyst	Accuracy/Sensitivity	No analyte > QL
Replicate	1 per 20 samples	None	Reanalyze. Re-perform calibration check if still outlying.	Field analyst	Precision	± 50% RPD

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28z
QC Samples Table

Matrix	Sediment
Analytical Group	Cs-137 and Be-7
Concentration Level	**Awaiting information from the laboratory.**
Sampling SOP(s)	
Analytical Method/SOP Reference	
Sampler's Name	
Field Sampling Organization	
Analytical Organization	
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	
Method Blank	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	
Laboratory Duplicate	1 per 20 samples	≤ 20% RPD	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	
Matrix Spike	1 per 20 samples	75 – 125 %R	Per method - typically Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	
Laboratory Control Sample	After calibration, every 20 samples and at end of day	80-120%R		DESA or subcontract Laboratory Analyst	Accuracy	

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28aa
QC Samples Table

Matrix	Soil
Analytical Group	Pb and As
Concentration Level	**Awaiting information from the laboratory.**
Sampling SOP(s)	
Analytical Method/SOP Reference	
Sampler's Name	
Field Sampling Organization	
Analytical Organization	
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria (Project-specific)
Field Duplicate	1 per 20 samples	None	Data assessor to inform TOM if MPC is exceeded; flag duplicate results	CDM ASC	Precision	
Temperature Blank	1 per cooler	≤ 6 degrees Celsius	Inform field crew of failure and need for additional coolant; check packing procedure	DESA or subcontract Laboratory Analyst	Accuracy/bias	
Method Blank	1 per 20 samples	None	Suspend analysis; check; redigest and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy/Sensitivity	
Laboratory Duplicate	1 per 20 samples	≤ 20% RPD	Flag outliers	DESA or subcontract Laboratory Analyst	Precision	
Matrix Spike	1 per 20 samples	75 – 125 %R	Per method - typically Identify source of problem, recalibrate if needed/ make other adjustments and reanalyze	DESA or subcontract Laboratory Analyst	Accuracy	
Laboratory Control Sample	After calibration, every 20 samples and at end of day	80-120%R		DESA or subcontract Laboratory Analyst	Accuracy	

Control limits for the LCS must be documented and provided.

QAPP Worksheet #28ab
QC Samples Table

Matrix	Tissue
Analytical Group	Moisture/lipid
Concentration Level	Low
Sampling SOP(s)	See worksheet #17g
Analytical Method/SOP Reference	SM2540B
Sampler's Name	TBD
Field Sampling Organization	CDM
Analytical Organization	CLP
No. of Sample Locations	See worksheet #18 & 20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory duplicate	*1 per 20 samples*	≤ 20% RPD	Investigate and correct; reanalyze affected samples. Flag outliers Document in case narrative	Laboratory Analyst	Precision	≤ 20% RPD

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
FORMS II Lite Traffic Reports/ COC Records	Equipment Calibration and Maintenance Log	Sample Receipt, Custody and Tracking Logs	Field Sampling Audit Plans, Reports and Checklists	M&TE (measurement and testing equipment) Forms
Airbills	Field Data Collection Logs	Standards Tracking Logs	Office Audit Plans, Reports and Checklist	Technical/QA Review Forms
Sample Tracking Log/Sheets	PID Logs, if applicable	Sample Disposal and Waste Manifests	Corrective Action Reports	Purchase Requisition Forms
Field logs/logbooks	Particulate Monitoring Data Logs, if applicable	Sample Preparation Logs	Analytical sample results	Telephone Logs
Chain of Custody Forms	Photographs	Corrective Action Reports	Subcontract Laboratory certifications	Electronic Data Deliverables
Field Change Request Forms	Inspection and maintenance records	Corrective Action Forms	Subcontract Laboratory QA Plan (on file with EPA and CDM)	Non-Conformance Reports
Custody Seals	Spill incident reports	Data Packages (Case Narratives, Sample Results, QC Summaries and Raw Data (detailed in CLP SOPs).	QC Audit Reports Data Validation SOPs Data Validation Reports	Subcontract Documents (Contract, Scopes of Work, Bid Sheet), Subcontract Documents and Review Forms
ANSETS Forms	Well installation log	Trip Reports	Data Package Completeness Checklist Validated Data Reports	NA
Boring Logs	Treatability study records	Sample analysis run logs	Self Assessment Checklist	NA
Biota sampling records	NA	Daily Status Report to USACE-KC	Data Quality Assessments	NA

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentra-tion Level	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Aqueous	Trace VOCs	Trace	SOM01.2	14 days for analysis, 14 days for data validation	EPA Primary contact: RSCC Adly Michael/Bob Toth 732-906-6161/6171 DESA contact: John Birri 732-906-6886	CLP
	TCL VOCs	Low/Medium	SOM01.2			
	SVOCs		SOM01.2			
	PCBs		SOM01.2			
	Pesticides		SOM01.2			
	TAL Metals/Cyanide including Hg		ILM05.4 -ICP-AES/MS			
Soil/ Sediment - RAS	TCL VOCs		SOM01.2		EPA Primary contact: RSCC Adly Michael/Bob Toth 732-906-6161/6171 DESA contact: John Birri 732-906-6886	CLP
	TCL SVOCs		SOM01.2			
	TCL PCBs		SOM01.2			
	TCL Pesticides		SOM01.2			
	TAL Total Metals including Hg		ILM05.4 -ICP-AES/MS			
	Cs-137 and Be-7				**Awaiting response from the laboratory.**	
	Pb				**Awaiting response from the laboratory.**	
Soil/ Sediment – non-RAS	TOC		See Worksheet #19	14 days for lab data/14 days for validation	EPA Primary contact: RSCC Adly Michael/Bob Toth 732-906-6161/6171 DESA contact: John Birri 732-906-6886	CDM MSA Subcontract Laboratory (TBD)
	Grain size					
	pH					
	Hexavalent Chromium					

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Aqueous	Alkalinity	Low/Medium	EPA and Standard Methods See Worksheet # 19	14 days for analysis, 14 days for data validation	FASTAC Tier 1: DESA All Laboratory Services: EPA Primary contact: RSCC Adly Michael/Bob Toth 732-906-6161/6171 DESA contact: John Birri 732-906-6886	CDM MSA Subcontract Laboratory (TBD)
	Ammonia					
	Chloride					
	Hexavalent Chromium		SW-846 7196A	14 days for lab data, 14 days for validation		
	Nitrate		EPA and Standard Methods See Worksheet # 19	14 days for analysis, 14 days for data validation		
	Sulfate					
	Sulfide					
	TKN					
	TSS					
Tissue	TAL Metals + mercury	Low/Medium	ILM05.4	14 days for analysis, 14 days for data validation	EPA Primary contact: RSCC Adly Michael/Bob Toth 732-906-6161/6171 DESA contact: John Birri 732-906-6886	CLP
	Percent Lipids		SM 2540B			

For non-RAS analyses, the EPA DESA laboratory will provide analytical services for aqueous wet chemistry (TSS, Alkalinity, hezvalent chromium); where the DESA laboratory is not available or does not provide a particular analytical service, the CDM subcontract MSA will be used to provide soil, pH, TOC, grain size and hexavalent chromium analyses.

Ferrous Iron (field test) Hexavalent chromium (field test)

QAPP Worksheet #31
Planned Project Assessments Table

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 Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions (Title and Organizational Affiliation)
Sample Collection and Documentation	Once	External	EPA and USACE-KCD	Amy Darpinian, Chemist, USACE-KCD	TOM, CDM	TOM, CDM	Jeniffer Oxford (RQAC) or field auditor, CDM
Health and Safety	Once if warranted	Internal/ External	EPA	TBD	TOM, CDM	TOM, CDM	Shawn Oliveira, Health & Safety Manager or designee, SSHO, CDM
Field Audit	Once	Internal	CDM	Approved field auditor	TOM, CDM	CDM Project Geologist and field staff	Field Auditor, CDM
Office Audit	Once	Internal	CDM	Approved CDM QA Staff	TOM, CDM	TOM, CDM	Jeniffer Oxford (RQAC) or designee, TOM, CDM
Data Review	Once	Internal	CDM	Scott Kirchner (ASC) or designee, CDM	TOM, CDM	TOM, CDM & Laboratory manager(s) (TBD)	Scott Kirchner (ASC), TOM, CDM

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Project Readiness Review	Checklist or logbook entry	Field Team Leader	Immediately to within 24 hours of review	Checklist or logbook entry	Field Team Leader	Immediately to within 24 hours of review
Field Observations/ Deviations from Work Plan	Logbook	Field Team Leader and EPA RPM	Immediately to within 24 hours of deviation	Logbook	Field Team Leader and EPA RPM	Immediately to within 24 hours of deviation
On-Site Field Inspection	Written Report	Field Team Leader	7 calendar days after completion of the audit	Letter/Internal Memorandum	Field Team Leader and/or EPA RPM	To be identified in the cover letter of the report
Health and Safety	Audit checklist	TOM, CDM	Notify by phone immediately Report 1 week after audit	Memorandum and checklist	Shawn Oliveira, CDM Health and Safety Manager	Immediate CA required where possible; otherwise as specified on the CA Notice, typically 15 to 30 days from date of CA Notice
Field Audit	Field Audit Report	RI Task Leader, CDM TOM, CDM	Provide summary of findings to field team on day of audit; Draft Report due within 10-15 days	Corrective Action Plan	Jeniffer Oxford, CDM RQAC; Douglas Updike, CDM QA Manager	
Office Audit	Office Audit Report	TOM, CDM	Provide summary of findings to TOM on day of audit; Draft Report due within 10-15 days	Memorandum	Jeniffer Oxford, CDM RQAC, Douglas Updike, CDM QA Manager	
Data Review	Memorandum	Scott Kirchner (ASC), CDM	Notify by phone -24 hours	Memorandum	TOM, CDM	

QAPP Worksheet #33
QA Management Reports Table

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)
Field Change Notification	As required per field change	Three days after identification of need for field change	Field Team Leader	EPA RPM
Final Project Report	Once	TBD	Field Team Leader	EPA RPM, CDM QAC
QAPP Addendums	As needed by project changes	TBD	Project Task Leader, CDM	EPA RPM, EPA Project Officer, EPA QA Officer, CDM Program Manager, CDM Site manager
Field Audit Report	Once	30 calendar days after completion of the inspection	FTL, Field Auditor, CDM	
Office Audit Report	Once	30 calendar days after completion of the inspection	FTL, Jeniffer Oxford, (QAC) or designee, CDM	
Corrective Action Reports	As required on CA request	As required on CA request	QA Auditor, CDM	
Data Usability Assessments	With each Measurement Report	With final report	Scott Kirchner (ASC), CDM	
RI/ or RD Report (Draft and Final)	Once	TBD	TOM, CDM	

QAPP Worksheet #34
Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field logbooks	Field notes will be prepared daily by the FTL and will be complete, appropriate to the project tasks, and legible. The FTL will review logbooks for accuracy and completeness. Upon completion of field work, logbooks will be placed in the project files. Field reports will be verified with field log books to ensure correct reporting of information. Review will be conducted prior to completion of each report.	Internal	Field team leader
Chains of custody	COC forms will be reviewed against the samples packed in the each cooler prior to shipment. COCs will be sent with the samples to the laboratory, while copies are retained for the Sampling Trip Report and the project files. They will be internally reviewed upon completion of activities and verified against field logs, and laboratory report. Review will be conducted with completion of each data usability assessment/measurement report.	Internal	Field team leader, ASC, data assessor
Sampling Trip Reports	They will be prepared for each case of field sampling for which samples are sent to a CLP laboratory. Information will be reviewed against the COC forms, and potential discrepancies will be discussed with field personnel to verify locations, dates, etc.	Internal	Field team leader or designee; Laboratory coordinator
QAPP	All planning documents will be available to reviewers to allow reconciliation with planned activities and objectives.	Internal	All data users
Laboratory analytical data package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All laboratory data will be verified by the laboratory performing the analysis for completeness and technical accuracy prior to submittal to EPA. Data packages will be reviewed as to content and sample information upon receipt by EPA. EPA or its contractor will evaluate the data packages for completeness and compliance. Table 9 of the IDQTF UFP-QAPP shows items for compliance review.	Internal	Laboratory analyst and QA officer; EPA DV contractor-data validator; CDM data validator, data assessor
Final Sample Report	The project data results will be compiled in a sample report for the project. Entries will be reviewed/verified against hardcopy information. Data validation reports, QAPP, FCRs and outputs of the EQuiS database will be used to prepare the project data quality and usability assessment report. The data will be evaluated against project DQOs and measurement performance criteria, such as completeness.	Internal	CDM Project task leader, data validator or field team leader
	Evaluate whether field sampling procedures were followed with respect to equipment and proper sampling support using audit and sampling reports, field change request forms and field logbooks.	Internal	CDM data assessor
Electronic Data Deliverables (EDDs)	Determine whether required fields and format were provided compatible with EQuIS.	Internal	CDM Data Manager

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

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved. Determine potential impacts from noted/approved deviations, in regard to PQOs.	CDM Task Leader or ASC
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.). Examine traceability of data from sample collection to generation of project reported data. Provides sampling dates and time; verification of sample ID; and QC sample information.	ESAT Data Validation Personnel, EPA Region 2 or CDM ASC
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.). Determine potential impacts from noted/approved deviations, in regard to PQOs.	ESAT Data Validation Personnel, EPA Region 2 or CDM ASC
IIb	Laboratory data package	Used to perform data validation on 100% of all CLP data. Any subcontractor analyzed data will be validated by CDM. A report shall be prepared within 30 days of data receipt. Ensure that all analytical procedures were followed. Corrective actions will be taken and documented when applicable per specific methods. Deviations will be documented. Data will be qualified in accordance with specific methods.	ESAT Data Validation Personnel, or CDM ASC
IIb	Field duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	CDM ASC, data validator
IIa	Methods	Records support implementation of the SOP - sampling and analysis	
IIb	Data Narrative	Determine deviations from methods and contract and the impact.	
IIb	Audit Report	Reports used to validate compliance of field sampling, handling and analysis activities with the QAPP.	
IIb	Project Quantitation Limit	PQLG achieved as established in the QAPP and that the laboratory successfully analyzed a standard at the QL.	
IIb	Field and Lab data and QC report	A summary of all QC samples and results will be verified for measurement performance criteria, completeness and 10 percent verified to field and laboratory data reports from vendors. A report on the meeting the established criteria shall be prepared within 30 days of receipt.	

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
Organics: Data Validation SOP for Region II - Data Validation Guidelines					
IIa / IIb	Soil/Sediment	TCL VOCs	Trace	SOP HW-34, rev 0	ESAT DV Personnel, or EPA Region 2 - DESA
IIa / IIb	Soil/Sediment/Aqueous	TCL VOCs	Low and Medium	SOP HW-33, rev 0	ESAT DV Personnel, or EPA Region 2 - DESA
IIa / IIb	Soil/Sediment/Aqueous	TCL SVOCs	Low and Medium	SOP HW-35, rev 1	ESAT DV Personnel, or EPA Region 2 - DESA
IIb	Soil/Sediment/Aqueous	TCL Pesticides	Low and Medium	SOP HW-36, rev 1	ESAT DV Personnel, or EPA Region 2 - DESA
IIa / IIb	Soil/Sediment/Aqueous	TCL Aroclors (PCBs)	Low and Medium	SOP HW-37, rev 1	ESAT DV Personnel, or EPA Region 2 - DESA
Inorganics: Data Validation SOP for Region II - Data Validation Guidelines					
IIa / IIb	Soil/Sediment/Aqueous/Tissues	TAL Metals, and mercury	Low and Medium	Evaluation of Metals Data for the CLP Program based on SOW ILM05.4, September 2006, SOP HW-2, rev 13	ESAT DV Personnel, or EPA Region 2 – DESA or CDM if analysis is subcontracted
IIa / IIb	Aqueous	Wet Chemistry	Low	DESA SOP or CDM 029A SOP	ESAT DV Personnel, or EPA Region 2 – DESA or CDM if analysis is subcontracted

DV – data validation

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa / IIb	Soil/Sediment/Aqueous	Inorganics (Hexavalent chromium)	Low and Medium	DESA SOP or CDM 029A SOP	ESAT DV Personnel, EPA Region 2 DV Personnel, or CDM ASC/ designee
IIb	Soil/Sediment	pH	Low and Medium	DESA SOP or CDM 029A SOP	ESAT DV Personnel, EPA Region 2 DV Personnel, or CDM ASC/ designee
IIa / IIb	Sediment (TRW samples)	Pb	Low and Medium	DESA SOP	ESAT DV Personnel, EPA Region 2 DV Personnel

Grain size will not be validated.
Method requirements will also be used to evaluate the data during data validation.
Geochronology data will not be validated.
Bioavailability data will not be validated.

QAPP Worksheet #37
Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

The Data Usability Assessment will be performed by a team of personnel at CDM. The TOM will be responsible for information in the Usability Assessment and will also be responsible for assigning task work to the individual task members who will be supporting the Data Usability Assessment. Note that the Data Usability Assessment will be conducted on validated data. After the Data Usability Assessment has been performed, data deemed appropriate for use will then be used in the RI Report, HHRA, SLERA, and FS. The results of the Data Usability Assessment will be presented in the project-specific report. The following items will be assessed and conclusions drawn based on their results.

Precision – Results of laboratory duplicates will be assessed during data validation and data will be qualified according to the data validation procedures cited on Worksheet #36. Field duplicates will be assessed by matrix using the RPD for each pair of results reported above CRQL for organic and inorganic analyses respectively. RPD acceptance criteria, presented in Worksheet #12, will be used to access field sampling precision. Absolute difference will be used for low results as described in worksheets 12 and 28. A discussion summarizing the results of laboratory and field precision and any limitations on the use of the data will be described.

Field duplicates - The TOM will review the extent of exceedance of the field duplicate criteria. For groundwater and surface water, the sample results will be flagged according to the data validation protocol. For soils/sediment, the exceedances will be compared with the field lithological logs and grain size results, if available. Based on this review, the site manager will determine whether the exceedance is due to inherent soil heterogeneity or the result of sample handling in the field or laboratory. This information will be included in the data assessment report. As an added measure, the FTL will be asked to inspect the soil coning and quartering procedures and re-train staff if needed. The data assessor will review the data validation report. If the field duplicate comparison is not included, it will be performed by the assessor.

Accuracy/Bias Contamination –Laboratory blank results will be assessed as part of data validation. During the data validation process the validator will qualify the data following the procedures listed on Worksheet #36. A discussion summarizing the results of laboratory accuracy and bias based on contamination will be presented and limitations on the use of the data will be described.

Overall Accuracy/Bias – The results of instrument calibration and matrix spike recoveries will be reviewed and data will be qualified according to the data validation procedures cited on Worksheet #36. A discussion summarizing the results of laboratory accuracy and any limitations on the use of the data will be described.

Sensitivity – Data results will be compared to criteria provided on Worksheet #15. A discussion summarizing any conclusions about sensitivity of the analyses will be presented and any limitations on the use of the data will be described.

QAPP Worksheet #37
Usability Assessment

Representativeness – A review of adherence to the sampling plan, field procedures and of project QA audits will be performed in order to assess the representativeness of the sampling program. Data validation narratives will also be reviewed and any conclusions about the representativeness of the data set will be discussed.

Comparability – Study results will be used in conjunction with existing data to make qualitative and quantitative assessments of the data to be used to produce the Site reports.

Reconciliation – The DQIs presented in Worksheet #12 will be examined to determine if the MPC were met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of major impacts observed from data validation, data quality indicators and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the DQIs were met and whether project goals were achieved. As part of the reconciliation of each objective, conclusions will be drawn and any limitations on the usability of any of the data will be described.

Completeness - The Environmental Quality Information Systems (EQuIS) database will be queried to summarize the number of samples in each analytical fraction that are estimated and rejected. This data will be used along with the planned samples indicated in the QAPP to calculate the completeness of the obtained data set.

Data validation reports will be reviewed to determine the quality of the data and potential impacts on data usability. Field duplicates will be evaluated against the MPCs outlined in worksheet #12. Non-compliant data will be discussed in the usability report. The following equations will be used :

1. To calculate field duplicate precision: $RPD = 100 \times 2 |X1 - X2| / (X1 + X2)$ where X1 and X2 are the reported concentrations for each duplicate or replicate

2. To calculate completeness: % Completeness = V/n x 100

where V= number of measurements judged valid; n = total number of measurements made and % Completeness = C/x x 100

where C= number of samples collected; x = total number of measurements planned

QAPP Worksheet #37
Usability Assessment

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

CDM will determine if quality control data is within specifications (MPC) through the data assessment and data validation process IIb.

3. Identify the personnel responsible for performing the usability assessment: Scott Kirchner, ASC or designee

4. 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:

A usability report will describe the rationale for the data used and present any data limitations. The report will include a discussion of the accuracy, precision, representativeness, completeness and comparability of the data set and deviations from planned procedures and analysis and the impact on the project objectives. Tables will be prepared, including: a summary of planned samples, collected samples and parameters analyzed; detections in field and trip blanks; comparison of field duplicates; and a comparison of planned and actual detection limits.

5. Discuss the impacts of any qualified data, any deviations from original plan or sampling procedures, whether the project objectives were met, etc.

The following procedures will be followed for using data in preparing the RI/FS Report.

- Defining the nature and extent of contamination – CDM will evaluate individual sample results for the RI/FS Report. The sample results will be compared to the site specific screening criteria defined as project action limits on worksheet #15. In addition, as part of the RI/FS Report, figures will be generated in order to further refine the understanding of the nature and extent of contamination. Figures will include geological profiles and cross-sections, water table maps, contaminant iso-concentration maps, and longitudinal and cross-sectional profiles of groundwater contamination.
- Identifying data gaps - Data gaps will be identified while writing the RI/FS Report. As soon as data gaps are identified, CDM will discuss them with EPA. To identify data gaps, CDM will evaluate the analytical results by media and determine if results indicate levels or locations of contamination that need to be further delineated.
- Using qualified data - CDM utilizes all data not rejected during validation to determine the nature and extent of contamination.

QAPP Worksheet #37
Usability Assessment

- Deciding if high results are legitimate or outliers - CDM will assume that all data not rejected during validation will be considered in defining the nature and extent of contamination at the site. CDM will work with EPA if there is a concern about the statistical validity of the sample results. In particular, high "outlier" results that have no surrounding comparable results as confirmation will be discussed with EPA.

Tables

Tables

Table 1
Proposed Sampling and Analysis
Raritan Bay Slag Site
Old Bridge and Sayreville, New Jersey

Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples: Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
Soil, Sediment, Groundwater, Surface Water Samples																
Area 1 Laurence Harbor Seawall	Sediment	18 surface, 24 subsurface, 1 extended depth	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. * 30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"; Extended depth sample: 48 - 72"	Vertical and horizontal delineation; risk assessment	79	32	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	10	*100% Total and dissolved TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	10	4	N/A	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	9 surface, 10 subsurface [2]	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; Subsurface sample: 24 - 48"	Vertical and horizontal delineation; risk assessment	37	15	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	3 shallow monitoring wells, 3 deep monitoring wells	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	6	6	N/A	6	6	N/A	N/A	N/A	N/A	N/A	N/A
Area 2 Laurence Harbor Beach	Sediment	6 surface, 12 subsurface, 1 extended depth	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"; Extended depth sample: 48 - 72"	Vertical and horizontal delineation; risk assessment	31	13	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Surface Water	5	*100% Total and dissolved TAL metals, mercury, Cr (VI) *30% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, hardness, chloride, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	5	2	N/A	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	2 surface, 16 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; Subsurface sample: 24 - 48"	Vertical delineation; risk assessment	22	8	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 4 Old Bridge Waterfront Park [2]	Soil	15 surface, 15 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; Subsurface sample: 24 - 48"	Vertical and horizontal delineation; risk assessment	60	24	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	3 shallow monitoring wells, 3 deep monitoring wells	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	6	6	N/A	6	6	N/A	N/A	N/A	N/A	N/A	N/A

Table 1
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Raritan Bay Slag Site
Old Bridge and Sayreville, New Jersey

Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples									
						Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb.	Electron microprobe test for As and Pb	Cs-137	Be-7
Area 5 Laurence Harbor Beach	Sediment	4 surface, 6 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"	Vertical and horizontal delineation; risk assessment	18	8	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	1 shallow monitoring well, 1 deep monitoring well	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	2	2	N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	3	*100% Total and dissolved TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	3	1	N/A	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	7 surface, 16 subsurface (2)	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; Subsurface sample: 24 - 48"	Vertical and horizontal delineation; risk assessment	37	15	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 6 Laurence Harbor Beach	Sediment	0 surface, 2 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"	Vertical delineation; risk assessment	2	1	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	1 shallow monitoring well, 1 deep monitoring well	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	2	2	N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	1	*100% Total and dissolved TAL metals, mercury, Cr(VI) *40% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	1	1	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 7 Cheesequake Creek Inlet	Sediment	7 surface, 10 subsurface, 1 extended depth	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"; Extended depth sample: 48 - 72"	Vertical and horizontal delineation; risk assessment	32	13	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	5, plus 1 location near Rt 35 bridge for exchange study	*100% Total and dissolved TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface. Exchange study samples will be taken at three depths in the water column.	Fate & transport, contaminant distribution, CSM	41	2	N/A	41	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	6 surface, 6 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; subsurface samples 24 - 48"	Vertical and horizontal delineation; risk assessment	24	10	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 1
Proposed Sampling and Analysis
Raritan Bay Slag Site
Old Bridge and Sayreville, New Jersey

Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples									
						Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfide, sulfide, TKN, nitrate/ ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
Area 8 Cheesequake Creek Inlet Western Jetty	Sediment	3 surface, 13 subsurface, 2 extended depth	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"; Extended depth sample: 48 - 72"	Vertical and horizontal delineation; risk assessment	24	10	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	1 shallow monitoring well, 1 deep monitoring well	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	2	2	N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	8	*100% Total and dissolved TAL metals, mercury, Cr (VI) *20% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	8	2	N/A	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	7 surface, 7 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; subsurface samples 24 - 48"	Vertical and horizontal delineation; risk assessment	28	11	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 9 [3] Margaret's Creek	Sediment	43 surface,43 subsurface	*100% Total TAL metals, Mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH *50% (of locations) beryllium-7 isotope analysis	Surface sample: 0 - 2" (Be-7), 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"	Vertical and horizontal delineation; risk assessment; identification of areas receiving recent (<6 mos.) deposition for potential subsequent geochronology study.	172	172	52	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22
	Surface water	23, plus 1 location at pedestrian bridge for exchange study	*100% Total and dissolved TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	35	23	N/A	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Soil	63 surface, 63 subsurface	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; subsurface samples 24 - 48"	Vertical and horizontal delineation; risk assessment	252	252	76	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 11 Depositional Areas	Sediment	10 surface, 20 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface sample: 0 - 6" (ERA/HHRA - sediment), 0 - 24" (HHRA - soil) , 6 - 24"; Subsurface samples: 24 - 48"	Vertical and horizontal delineation; risk assessment	50	20	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Surface water	9	*100% Total and dissolved TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Fate & transport, contaminant distribution, CSM	9	4	N/A	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Groundwater	1 shallow monitoring well, 1 deep monitoring well, 3 existing wells.	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Baseline groundwater quality	5	5	N/A	5	5	N/A	N/A	N/A	N/A	N/A	N/A

Table 1
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Old Bridge and Sayreville, New Jersey

Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples									
						Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
	Soil	13 surface, 13 subsurface	*100% Total TAL metals, mercury, Cr (VI) *40% VOCs, SVOCs, Pesticides, PCBs. *30% TOC, GS, pH	Surface samples: 0 - 12" (ERA), 0 - 24" (HHRA), 12 - 24"; subsurface samples 24 - 48"	Vertical and horizontal delineation; risk assessment	52	21	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Geochronology [4]																
Area 9 Margaret's Creek	Sediment	2	*100% Total TAL metals, mercury, Cr(VI) *100% Cs-137	1 meter cores at each location, divided into 1 cm slices for analysis.	Determination of sediment and contaminant deposition rates.	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	200	N/A
TRW Samples																
Area 2 Laurence Harbor Beach	Soil	33	*100% Pb	Equal volumes of soil from the 0 - 2 inch interval will be collected and composited from five separate points located within 50 feet of the centerpoint.	Human health risk assessment.	N/A	N/A	N/A	N/A	N/A	33	N/A	N/A	N/A	N/A	N/A
Area 3 Laurence Harbor Playground	Soil	3	*100% Pb	Equal volumes of soil from the 0 - 2 inch interval will be collected and composited from five separate points located within 50 feet of the centerpoint.	Human health risk assessment.	N/A	N/A	N/A	N/A	N/A	3	N/A	N/A	N/A	N/A	
Area 5 Laurence Harbor Beach	Soil	114	*100% Pb	Equal volumes of soil from the 0 - 2 inch interval will be collected and composited from five separate points located within 50 feet of the centerpoint.	Human health risk assessment.	N/A	N/A	N/A	N/A	N/A	114	N/A	N/A	N/A	N/A	N/A
Area 6 Laurence Harbor Beach	Soil	135	*100% Pb	Equal volumes of soil from the 0 - 2 inch interval will be collected and composited from five separate points located within 50 feet of the centerpoint.	Human health risk assessment.	N/A	N/A	N/A	N/A	N/A	135	N/A	N/A	N/A	N/A	N/A
Tissue Samples																
Jetty sector - intertidal zones	Biota: clams or mussels	N/A - sufficient biota will be collected to ensure analytical volume requirements are met	*100% Total TAL metals, mercury; *100% Lipids	Clams or mussels: soft portions of multiple individuals will be composited to ensure analytical volume requirements are met.	Human health risk assessment.	10	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A
Seawall sector - intertidal zones	Biota: clams or mussels	N/A - sufficient biota will be collected to ensure analytical volume requirements are met	*100% Total TAL metals, mercury; *100% Lipids	Clams or mussels: soft portions of multiple individuals will be composited to ensure analytical volume requirements are met.	Human health risk assessment.	10	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A

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Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples									
						Total and dissolved TAL metals, mercury, Cr(VI);[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
Seawall and jetty sectors - Raritan Bay and intertidal zones	Biota: blue crab muscle	N/A - sufficient biota will be collected to ensure analytical volume requirements are met	*100% Total TAL metals, mercury; *100% Lipids	Muscle tissue from at least five individuals will be composited to ensure analytical volume requirements are met.	Human health risk assessment.	10	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A
Seawall and jetty sectors - Raritan Bay and intertidal zones	Biota: blue crab hepatopancreas	N/A - sufficient biota will be collected to ensure analytical volume requirements are met	*100% Total TAL metals, mercury; *100% Lipids	Hepatopancreas from at least five individuals will be composited to ensure analytical volume requirements are met.	Human health risk assessment.	10	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A
Seawall and jetty sectors - Raritan Bay and intertidal zones	Biota: commonly consumed fish species	N/A - sufficient biota will be collected to ensure analytical volume requirements are met	*100% Total TAL metals, mercury; *100% Lipids	Fish: fillets from six species (five individuals each) will be collected.	Human health risk assessment.	10	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A
Bioavailability and Electron Microprobe Samples																
Upland sections of Areas 2, 5, and 6	Soil/Sediment	10	*100% Bioavailability in vitro test for As and Pb *100% Electron microprobe for As and Pb	0 - 24"	Bioavailability tests will be conducted to adjust toxicity critera used in risk assessment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	10	N/A	N/A
Intertidal sections of Areas 2, 5, and 6	Soil/Sediment	10	*100% Bioavailability in vitro test for As and Pb *100% Electron microprobe for As and Pb	0 - 24"	Bioavailability tests will be conducted to adjust toxicity critera used in risk assessment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	10	N/A	N/A
Area 3	Soil/Sediment	10	*100% Bioavailability in vitro test for As and Pb *100% Electron microprobe for As and Pb	0 - 24"	Bioavailability tests will be conducted to adjust toxicity critera used in risk assessment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	10	N/A	N/A
Upland section of Area 9	Soil/Sediment	10	*100% Bioavailability in vitro test for As and Pb *100% Electron microprobe for As and Pb	0 - 24"	Bioavailability tests will be conducted to adjust toxicity critera used in risk assessment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	10	N/A	N/A

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Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples										
						Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
Background Samples [5]																
Area 10, locations above the mean high tide line	Soil	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	0 - 12" (ERA), 0 - 24" (HHRA)	Determination of contaminant background concentrations for: (1) contaminant delineation in upland soil in Areas 1 -9 & 11 ; (2) evaluation of 0 - 12" interval soil samples collected for ERA in Areas 1 -9 & 11 (3) evaluation of 0 - 24" interval soil samples collected for HHRA in Areas 1 -9 & 11	20	20	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 10, locations in the intertidal zone above spring low tide line and below mean high tide line	Sediment	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	0 - 6" (ERA)	Determination of contaminant background concentrations for: (1) contaminant delineation in sediment in intertidal Areas 1, 2, 5 - 9, 11; (2) evaluation of 0 - 6" interval sediment samples collected for ERA in intertidal Areas 1, 2, 5 - 9, 11	10	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 10, locations in the intertidal zone above spring low tide line and below mean high tide line	Soil	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	0 - 24" (HHRA)	Determination of contaminant background concentrations for: (1) contaminant delineation in sediment in intertidal Areas 1, 2, 5 - 9, 11; (2) evaluation of 0 - 24" interval soil samples collected for HHRA in intertidal Areas 1, 2, 5 - 9, 11	10	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 10, locations above spring low tide line	Soil	10	*100% Pb	Equal volumes of soil from the 0 - 2 inch interval will be collected and composited from five separate points located within 50 feet of the centerpoint.	Determination of contaminant background concentrations for TRW lead human health risk assessment.	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A	N/A	N/A	N/A
Area 10, locations below spring low tide line	Sediment	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	0 - 6" (will serve for both ERA and HHRA)	Determination of contaminant background concentrations for: (1) contaminant delineation in sediment in Raritan Bay Areas 1, 2, 5 - 9, 11; (2) evaluation of 0 - 6" interval sediment samples collected for ERA and HHRA in Raritan Bay Areas 1, 2, 5 - 9, 11;	10	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Area 10 surface waters	Surface water	10	*100% Total and dissolved TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TSS, chloride, hardness, alkalinity	Grab sample collected just below the water's surface.	Determination of contaminant background concentrations for evaluation of surface water samples collected for ERA and HHRA in Areas 1, 2, 5 - 9, 11	10	10	N/A	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Site Area or Sector	Media	Number of Locations	% of Locations Submitted for Listed Analyses [1]	Sampling Intervals at each Location	Rationale	Number of Samples									
						Total and dissolved TAL metals, mercury, Cr(VI)[6]	VOCs, SVOCs, Pesticides, PCBs	TOC, GS, pH	Water Quality (TSS, chloride, hardness, alkalinity)	Ground Water Quality (sulfate, sulfide, TKN, nitrate, ammonia, ferrous iron)	Pb only	Lipids	Bioavailability in vitro test for As and Pb	Electron microprobe test for As and Pb	Cs-137	Be-7
Wetland location TBD.	Sediment	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	Estimated interval is 0 - 6", although depth will need to be evaluated in the field.	Determination of contaminant background concentrations for: (1) contaminant delineation in organic sediment in Margaret's Creek wetlands (Area 9); (2) evaluation of 0 - 6" interval sediment samples collected for ERA and HHRA in Margaret's Creek wetlands (Area 9)	10	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wetland location TBD.	Sediment	10	*100% Total TAL metals, mercury, Cr(VI) *100% VOCs, SVOCs, Pesticides, PCBs. *100% TOC, GS, pH	Depth will need to be evaluated in the field.	Determination of contaminant background concentrations for contaminant delineation in inorganic sediment in Margaret's Creek wetlands (Area 9)	10	10	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upgradient groundwater well, location TBD.	Groundwater	1 shallow monitoring wells, 1 deep monitoring well	*100% Total TAL metals, mercury, Cr (VI) *100% VOCs, SVOCs, Pesticides, PCBs *100% TSS, chloride, hardness, alkalinity	N/A	Determination of contaminant background concentrations for evaluation of groundwater data.	2	2	N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A

NOTES

1 - All aqueous samples will include field measurments for temperature, ph, DO, turbidity, Eh, and conductivity.

2 - Locations to be determined following review of May 2010 beach re-sampling and test trench sampling results

3 - Groundwater sampling program for Area 9 will be determined after soil, sediment, and surface water samples are collected.

4 - A geochronology study is only proposed if the environmental sampling results warrant a remedial action.

5 - For an illustration of sampling intervals for risk assessment in ralation to tidal zones, Refer to Figure 4-4 Proposed Risk Assessment Intervals

6 - Tissue samples will not be submitted for hexavalent chromium

As - Arsenic
Be-7 - The radioisotope beryllium-7
Cs-137 - The radioisotope cesium-137
Cr (VI) - Hexavalent chromium
DO - Dissolved oxygen
DOC - Dissolved organic carbon
Eh- Oxidation/reduction potential
ERA - Ecological risk assessment
FS - Feasibility study
GS - Grain size distribution
HHRA - Human health risk assessment
N/A - Not applicable
Pb - Lead
PCBs - Polychlorinated biphenyls
RI - Remedial investigation
SVOCs - semivolatile organic compounds
TBD - To be determined
TOC - Total organic carbon
TRW - EPA Technical Review Workgroup for Metals and Asbestos
TSS - Total suspended solids
VOC - volatile organic compound

Table 2a Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #1 Define the nature and extent of soil, surface water and sediment contamination
State the Problem	The nature and extent of soil, surface water and sediment contamination have not been fully characterized.
Identify the Decision	• Determine the horizontal and vertical extent of the area where contaminant concentrations exceed ARARs. • Determine if there is a human health risk from the contamination at the site • Determine if there is an ecological risk from the contamination at the site.
Identify Inputs to the Decision	• ARARs • Existing soil, surface water and sediment data • New soil, surface water and sediment data from depths not covered by existing data • TRW sample results
Define the Study Boundaries	• Lead, arsenic, antimony, chromium and copper are the primary contaminants. • Contamination is expected to be limited to the upper 72 inches of sediment and soil. • The data will be collected from Areas 1 through 11. • The site is generally bounded by Margaret's Creek to the east, Raritan Bay to the north, and Route 35 to the south. Area 8 extends approximately 500 feet to the west of Cheesequake Creek Inlet. • Sample collection will be scheduled for tidal fluctuations.
Develop a Decision Rule	• If concentrations of lead, arsenic, chromium and copper exceed applicable ARARs or acceptable risk levels, then further assessment and response will be required.
Specify limits on Decision Errors	• CRQL/QL for all analyses • The remedial investigation will be conducted in accordance with the approved RI/FS Work Plan, Contractor Quality Control Plan (QCP), quality assurance project plan (QAPP), and Accident Prevention Plan (APP).
Optimize the Design for Obtaining Data	• The existing data was reviewed and a data gap memorandum was produced to identify areas requiring additional characterization. • Remedial alternatives were considered to ensure sufficient data would be collected to support the feasibility assessment.

Table 2b Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #2 Characterize surface water flow patterns and sediment transport dynamics using current meters and geochronology samples.
State the Problem	The surface water flow patterns and sediment transport dynamics are not well understood. These processes need to be understood to characterize the fate and transport of contamination at the site.
Identify the Decision	• Determine the areas of the site where sediment deposition is occurring. • Determine the areas of the site where sediment erosion is occurring. • Assess the impact of predictable and non-predictable (storm) currents on the distribution of contaminated sediments and surface water.
Identify Inputs to the Decision	• Topography • Bathymetry • Current study (Area 6, 7, 8 and 11) • New and existing sediment analytical results • Geochronology (Area 9)
Define the Study Boundaries	• Lead, arsenic, antimony, chromium and copper are the primary contaminants. • Sediment samples • The data will be collected from Areas 6, 7, 8, 9 and 11. • Tidal fluctuations will be considered in sample collection • Areas of sediment deposition will be targeted for sampling.
Develop a Decision Rule	• If sediment deposition areas are identified, then sediment samples will be collected in that area. • If the data refines the understanding of sediment transport dynamics, then the site conceptual model will be updated to include the data. • If geochronology samples indicate an influx of clean sediment into Area 9, then non-active remedies may be considered.
Specify limits on Decision Errors	• The bathymetric and topographic survey will be recorded with 1-foot elevation contour intervals for the beach areas and adjacent areas of Raritan Bay and 5-foot elevation contour intervals for the surrounding area • The remedial investigation will be conducted in accordance with the approved RI/FS Work Plan, QCP, QAPP, and APP.
Optimize the Design for Obtaining Data	• The current studies will be conducted in areas where the greatest current impact is expected, like Cheesequake Inlet. • Areas of sediment deposition will be targeted for sediment sampling

Table 2c Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #3: Characterize groundwater-surface water interactions, vertical and horizontal groundwater flow, and provide a groundwater quality baseline.
State the Problem	There are currently no data on groundwater quality and the surface water-groundwater interactions and flow. These data are required to assess remedial alternatives.
Identify the Decision	• Determine if the groundwater at the site is impacted by the site-related contaminants. • Determine the tidal impacts on the groundwater across the seawall.
Identify Inputs to the Decision	• ARARs • Topographic survey • Groundwater analytical results • Long term groundwater elevations at selected monitoring wells • Synoptic water levels at monitoring wells and staff gauges
Define the Study Boundaries	• Lead, arsenic, antimony, chromium and copper are the primary contaminants of concern. • Shallow and deep groundwater samples • The data will be collected from Areas 1 through 11. • Long term water levels will be collected at 10 minute intervals for 1 month • Synoptic water levels will be collected at monthly intervals for 6 months. • Sample collection will be scheduled for tidal fluctuations.
Develop a Decision Rule	• If groundwater concentrations of site-related contaminants exceed ARARs, then additional investigation will be required • If groundwater concentrations exceed ARARs, then groundwater treatment may be required as part of the remedial action. • If groundwater/surface water interaction is anticipated to affect potential remedies, then management of groundwater will be incorporated into the development of remedial alternatives.
Specify limits on Decision Errors	• The water level readings and topographic survey will be recorded to 0.010 foot. • CRQL/QL for all analyses • The remedial investigation will be conducted in accordance with the approved RI/FS Work Plan, QCP, QAPP, and APP.
Optimize the Design for Obtaining Data	• Monitoring wells were located to evaluate the groundwater and tidally influenced flow across the seawall. • Pressure transducers are located in wells across the site and on both sides of the seawall.

Table 2d Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #4: Identify and quantify potential human health and ecological risks posed by exposure to contaminated soil, surface water, sediment, groundwater and biota.
State the Problem	The potential human health and ecological risks for the site have not been fully characterized.
Identify the Decision	• Determine if there is a human health risk from the contamination at the site • Determine if there is an ecological risk from the contamination at the site.
Identify Inputs to the Decision	• ARARs and risk assessment guidance • Existing soil, surface water and sediment data • New soil, surface water and sediment data from depths not covered by existing data • TRW sample results • Bioavailability data for lead and arsenic
Define the Study Boundaries	• Lead, arsenic, antimony, chromium and copper are the primary contaminants. • Contamination is expected to be limited to the upper 72 inches of sediment and soil. • The data will be collected from Areas 1 through 11. • The site is generally bounded by Margaret's Creek to the east, Raritan Bay to the north, and Route 35 to the south. Area 8 extends approximately 500 feet to the west of Cheesequake Creek Inlet. • Sample collection will be scheduled for tidal fluctuations. • Biota samples will be collected for species consumed by humans. • Biota samples will be collected during appropriate seasons to obtain species consumed by humans.
Develop a Decision Rule	• If the site risk is determined to exceed acceptable levels, risk management decisions will have to be made.
Specify limits on Decision Errors	• CRQL/QL for all analyses • The risk assessments will be conducted in accordance with the approved RI/FS Work Plan, QCP, and the QAPP.
Optimize the Design for Obtaining Data	• Local residents and non-profit organizations were contacted for input on species to sample and sampling locations.

Table 2e Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #5 Conduct treatability studies of the source material (slag) and contaminated soils and sediments in order to develop remedial alternatives.
State the Problem	Conduct treatability study to determine the suitability of stabilization/solidification as a remedial technology to address site conditions and problems.
Identify the Decision	What technologies and designs can allow on-site stabilization of the contaminants in the slag and sediment and mitigate the release of contaminants into the environment?
Identify Inputs to the Decision	• **Early Actions RI findings and results** • **Analytical results** • **Bench-Scale Testing** – Formulation of stabilization mix designs, and chemical and geotechnical testing of the cured formulations.
Define the Study Boundaries	Slag samples will be collected from the seawall and the western jetty for use in the treatability study.
Develop a Decision Rule	IF treatability study conclusions clearly indicate the performance of a technology compared with the performance standards established for the site, THEN the technology will be evaluated for: • Effectiveness, implementability, and cost • The potential for full-scale application.
Specify limits on Decision Errors	Treatability studies will be conducted in accordance with the approved Treatability Study Work Plan (TSWP) addendum to the RI/FS Work Plan, QCP, QAPP, and APP.
Optimize the Design for Obtaining Data	There are four levels of a treatability study that will be conducted: • **Laboratory chemical characterization** – Conducted to characterize the chemistry of the slag and sediment to be stabilized. • **Development and formulation of mix designs** – that are appropriate for the material's chemistry and site conditions and will mitigate the mass transfer of contaminants from the slag and sediment into the environment. • **Bench-scale testing** – to identify the performance of the mix design under expected field conditions. • **Identification of site-specific stabilization approaches using the mix designs tested** – evaluation of cost, effectiveness, and implementability at full-scale.

Table 2f Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #6 Develop and screen remedial alternatives.
State the Problem	A Feasibility Study needs to be conducted to develop and initially screen remedial alternatives to achieve remedial action objectives (RAOs) for contamination associated with the slag seawall, slag jetty, contaminated soils, and contaminated sediments at the site. The alternatives need to be screened qualitatively against three criteria: effectiveness, implementability, and relative cost.
Identify the Decision	• **Effectiveness** – How well might a technology perform at the site? How might the technology impact human health and the environment? • **Implementability** – How technically and administratively feasible is the technology? • **Relative Cost** – Are the costs of the technology high, moderate, or low compared to other technologies being considered?
Identify Inputs to the Decision	• Remedial action goals, findings from human health and ecological risk assessments, nature and extent of contamination at the site, general site conditions. • Treatment requirements, waste management considerations, relative ease or difficulty to achieve the operation and maintenance requirements. • Engineering judgment, costs of other options being evaluated.
Define the Study Boundaries	• The screening evaluation will generally focus upon the effectiveness criterion, with less emphasis on implementability and relative cost. • Technologies passing the initial screening process are those that are expected to achieve the RAOs for the site, either alone or in combination with other technologies. • The process of identifying and screening potential alternatives will be ongoing throughout the RI, as new technological and/or site-specific data emerge.
Develop a Decision Rule	IF a remedial alternative passes the initial screening process, THEN it will be presented to the USACE and EPA, incorporated into the Feasibility Study Report, and subjected to a detailed evaluation.
Specify limits on Decision Errors	How to determine whether a remedial alternative passes or fails the initial screening process is outlined in the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988).
Optimize the Design for Obtaining Data	Once existing and new data collected during the remedial investigation (RI) are evaluated, preliminary RAOs either will be refined and developed or eliminated. Based on the established RAOs and the results of the risk assessment, the general response actions will be established and remedial technologies will be identified and screened in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). Based on the results of the initial screening process, a range of both standard and innovative remedial alternatives will be compiled.

Table 2g Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

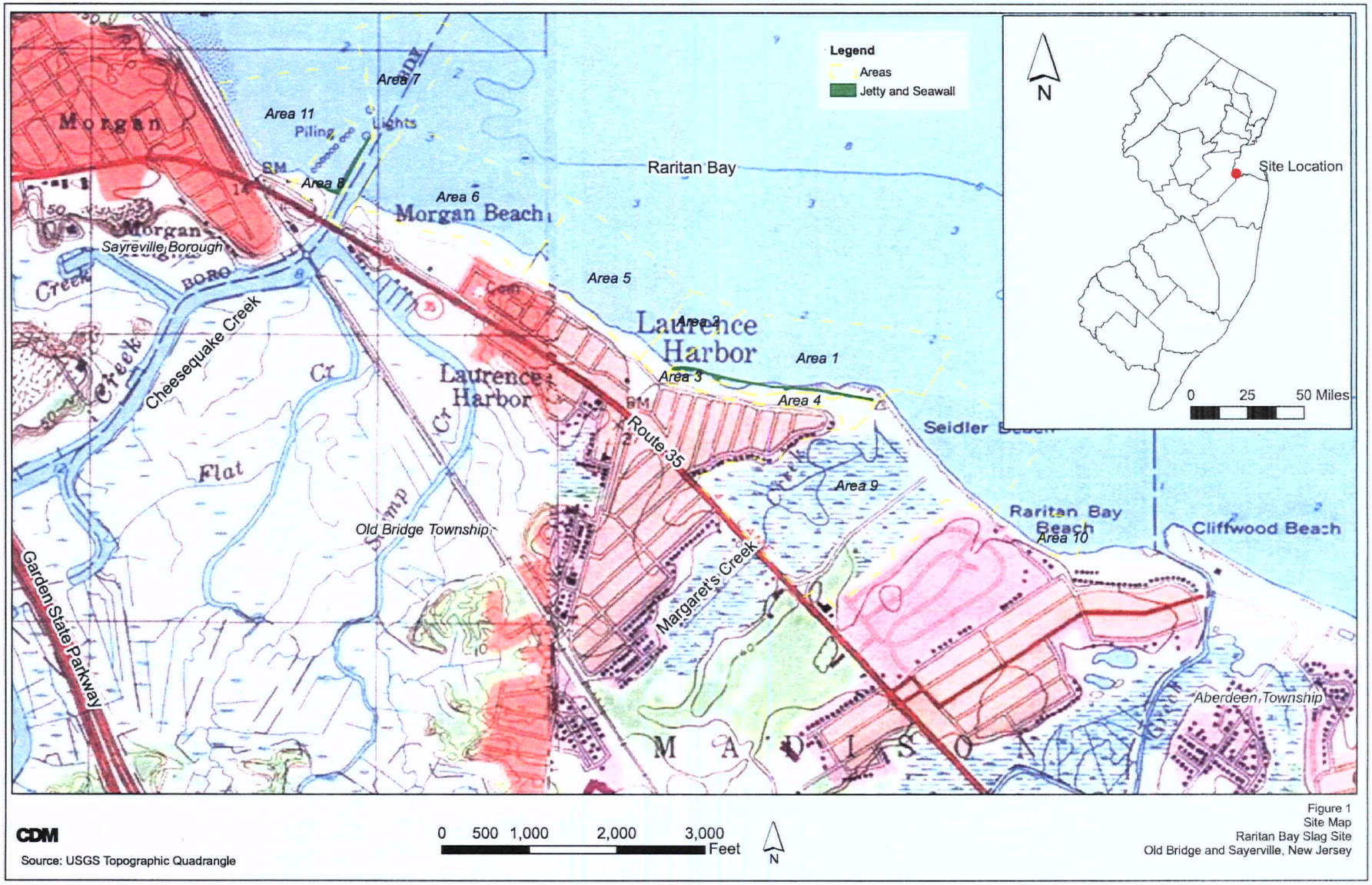
Step	RI/FS Objective #7 Conduct detailed analysis of appropriate remedial alternatives for sources of contamination and associated contaminated areas.
State the Problem	Remedial alternatives passing the initial remedial alternatives screening process will need to be subjected to a detailed evaluation in order to determine the most appropriate and effective remedy for the site. Nine criteria, detailed below, will be applied in the evaluation of each remedial alternative.
Identify the Decision	• **Overall Protection of Human Health and the Environment** - Do alternatives meets the requirement that it is protective of human health and the environment? • **Compliance with ARARs** - How do alternatives comply with applicable or relevant and appropriate federal and state requirements? • **Long-Term Effectiveness** – How extensive and effective are the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes? • **Reduction of Toxicity, Mobility, or Volume** – Which remedial action(s) employs treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contaminants? • **Short-Term Effectiveness** – What are the potential effects of the alternative during construction and implementation of the remedial actions? • **Implementability** – How feasible is it to implement each alternative? What activities will be required to implement the remedial action? • **Cost** – What are the estimated capital costs, annual operation and maintenance costs, and present worth analysis, within +50 to -30 percent? • **State Acceptance** – What technical and administrative issues and concerns might the state have regarding each alternative • **Community Acceptance** – What public concerns need to be incorporated into the evaluation of the remedial alternatives?
Identify Inputs to the Decision	• ARARs. • Magnitude of remaining risk (measured by numerical standards such as cancer risk levels), adequacy, suitability, and long-term reliability of management controls to provide continued protection from residuals (i.e., assessment of potential failure of the technical components). • Treatment process employed, amount of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility, or volume, and the type and quantity of treatment residuals.

Table 2g Data Quality Objectives
Remedial Investigation/Feasibility Study Work Plan
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Step	RI/FS Objective #7 Conduct detailed analysis of appropriate remedial alternatives for sources of contamination and associated contaminated areas.
	• Effects on community and onsite workers during the remedial action, environmental impacts resulting from implementation, and amount of time until protection is achieved • Technical feasibility - construction and operational difficulties, reliability, ease of undertaking additional remedial action, and the ability to monitor its effectiveness. Administrative feasibility - activities needed to coordinate with local and state agencies to obtain permits or approvals to implement remedial actions. • Capital costs - direct (construction) and indirect (non-construction and overhead) costs. Direct costs - expenditures for the equipment, labor, and material necessary to perform remedial actions. Indirect costs - expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs - post-construction costs necessary to ensure the continued effectiveness of a remedial action. • State Acceptance • Community Acceptance
Define the Study Boundaries	• Each remedial alternative will be subject to detailed analysis according to the nine evaluation criteria. • Ultimately, a comparative analysis of all alternatives will be performed to evaluate the relative benefits and drawbacks of each alternative according to the nine criteria.
Develop a Decision Rule	IF a remedial alternative passes the detailed evaluation, THEN it will be presented in the Feasibility Study Report as a potential remedial alternative to be considered for implementation at the site.
Specify limits on Decision Errors	How to determine whether a remedial alternative passes or fails the detailed evaluation is outlined in the following: • *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). • National Contingency Plan
Optimize the Design for Obtaining Data	• Procedures for conducting the detailed evaluation are provided in *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* and the NCP. • Recommendations for remedial alternatives will be made in consultation with USACE and EPA.

Figures

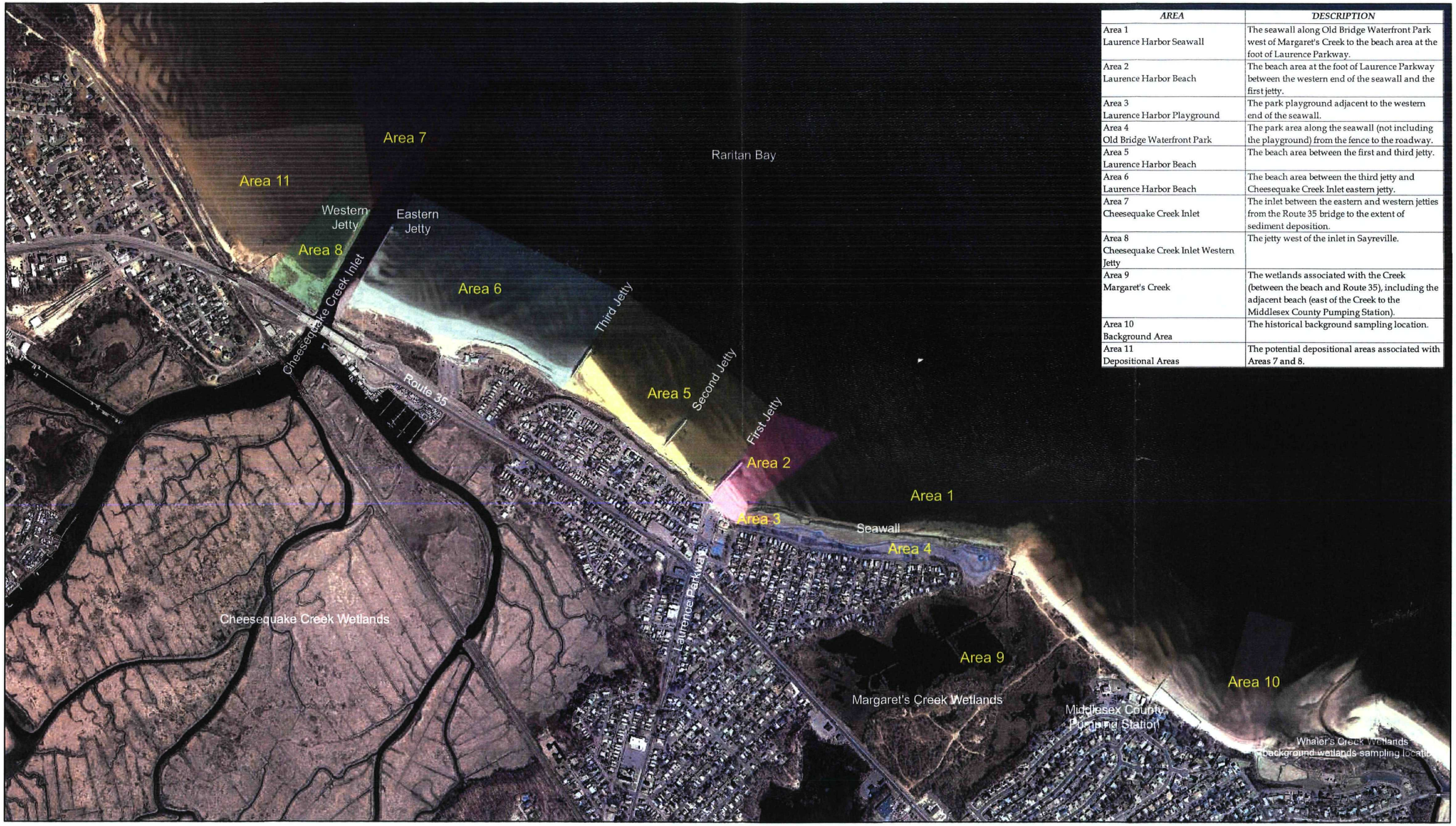
Figures



CDM

Source: USGS Topographic Quadrangle

Figure 1
Site Map
Raritan Bay Slag Site
Old Bridge and Sayerville, New Jersey



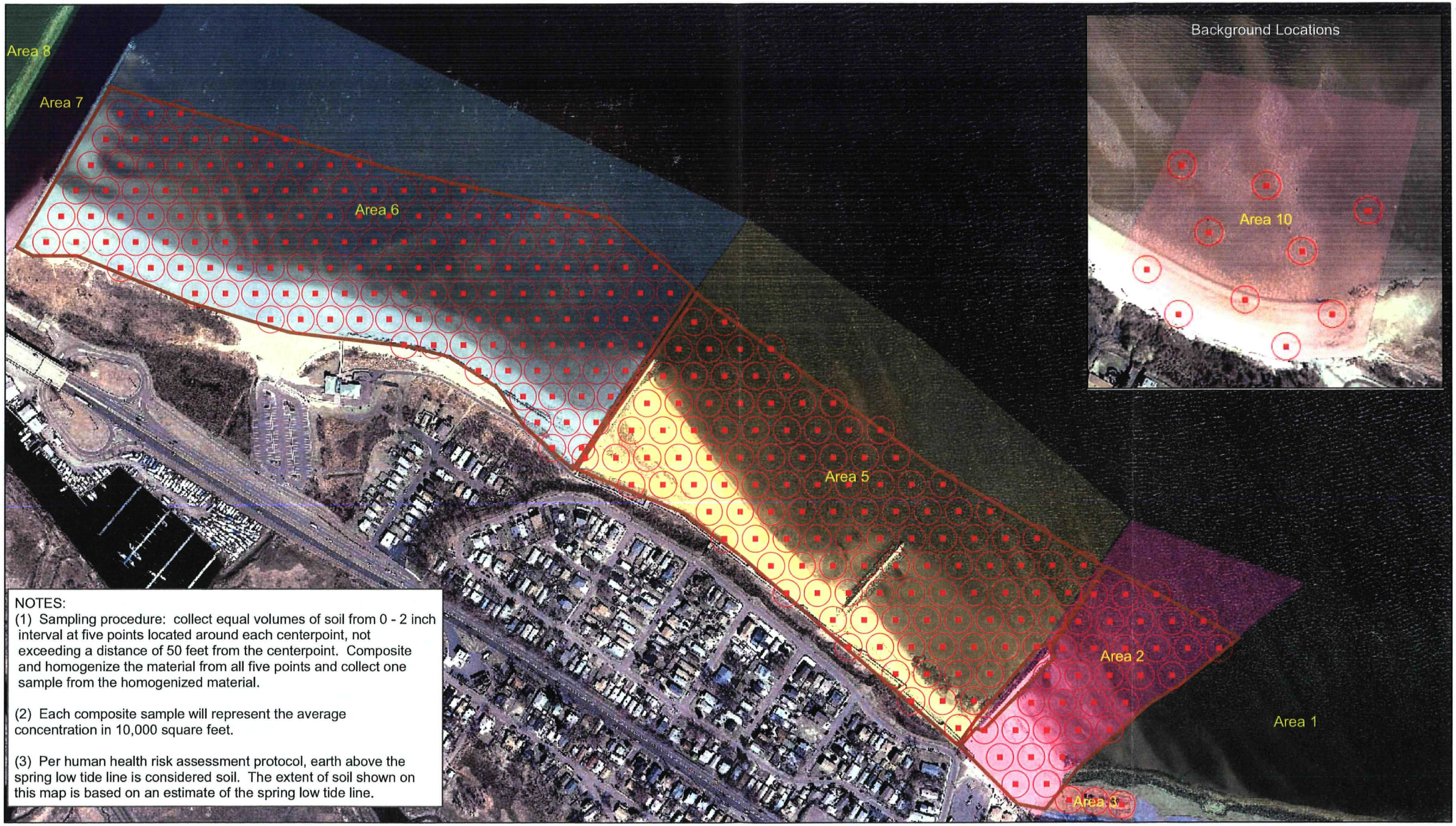
AREA	*DESCRIPTION*
Area 1 Laurence Harbor Seawall	The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
Area 2 Laurence Harbor Beach	The beach area at the foot of Laurence Parkway between the western end of the seawall and the first jetty.
Area 3 Laurence Harbor Playground	The park playground adjacent to the western end of the seawall.
Area 4 Old Bridge Waterfront Park	The park area along the seawall (not including the playground) from the fence to the roadway.
Area 5 Laurence Harbor Beach	The beach area between the first and third jetty.
Area 6 Laurence Harbor Beach	The beach area between the third jetty and Cheesequake Creek Inlet eastern jetty.
Area 7 Cheesequake Creek Inlet	The inlet between the eastern and western jetties from the Route 35 bridge to the extent of sediment deposition.
Area 8 Cheesequake Creek Inlet Western Jetty	The jetty west of the inlet in Sayreville.
Area 9 Margaret's Creek	The wetlands associated with the Creek (between the beach and Route 35), including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
Area 10 Background Area	The historical background sampling location.
Area 11 Depositional Areas	The potential depositional areas associated with Areas 7 and 8.

CDM

0 1,000 2,000 4,000 Feet

N W E S

Figure 2
Investigation Areas
Raritan Bay Slag Site



Centerpoints

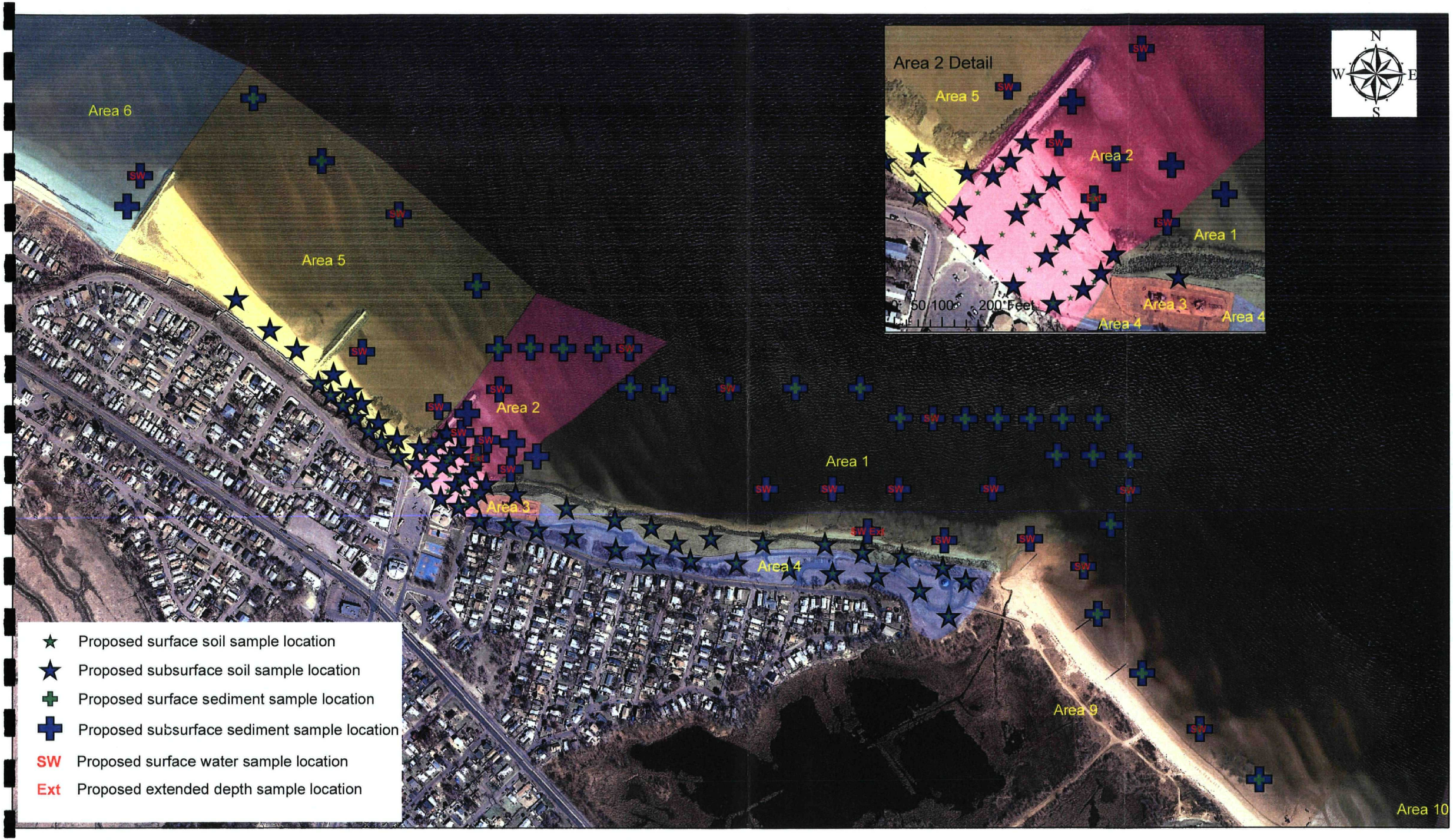
Estimated extent of soil

CDM

0 100 200 400 Feet

N
W E
S

Figure 3
TRW Lead Composite Sampling Locations
Raritan Bay Slag Site

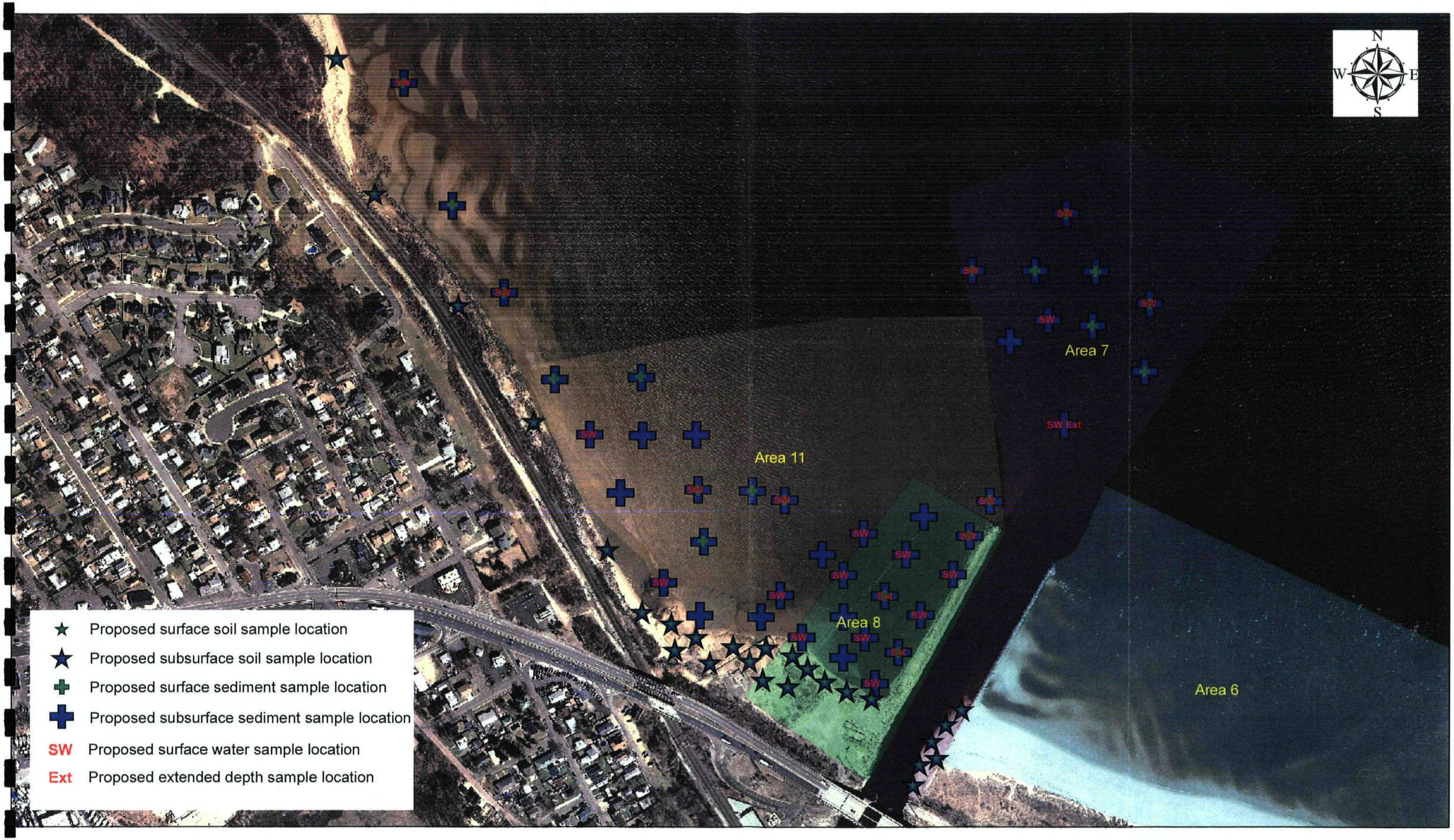


Note:
"Surface" includes all intervals between 0 and 24"
"Subsurface" includes all intervals between 24 - 48"
"Extended depth" includes intervals greater than 48"

0 485 970 1,940 Feet

CDM

Figure 4
Seawall Sector
Proposed Sample Locations
Raritan Bay Slag Site



Note:
"Surface" includes all intervals between 0 and 24"
"Subsurface" includes all intervals between 24 - 48"
"Extended depth" includes intervals greater than 48"

0 362.5 725 1,450 Feet

CDM

Figure 5
Jetty Sector
Proposed Sample Locations
Raritan Bay Slag Site

Note:
"Surface" includes all intervals between 0 and 24"
"Subsurface" includes all intervals between 24 - 48"
"Extended depth" includes intervals greater than 48"

0 500 1,000 2,000 Feet

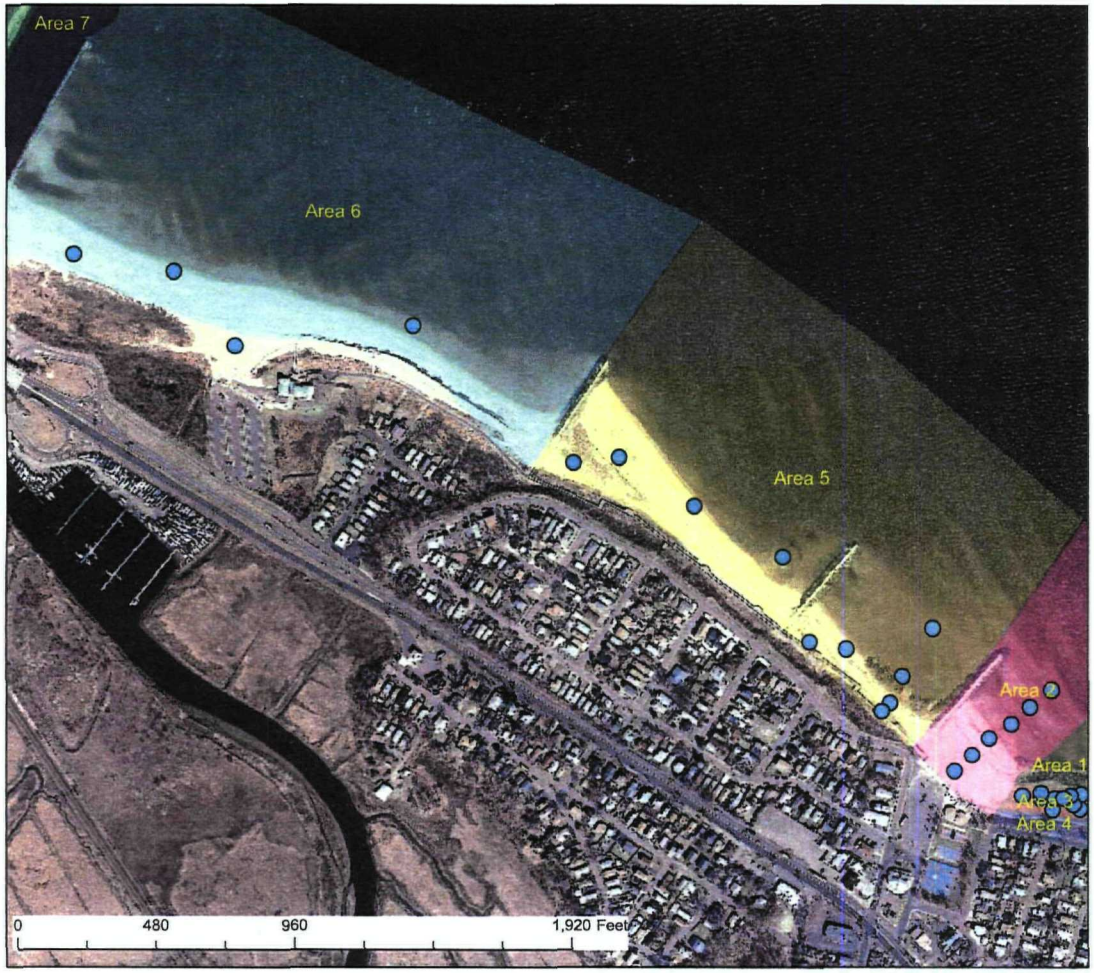
CDM

Figure 6
Margaret's Creek Sector
Proposed Sample Locations
Raritan Bay Slag Site

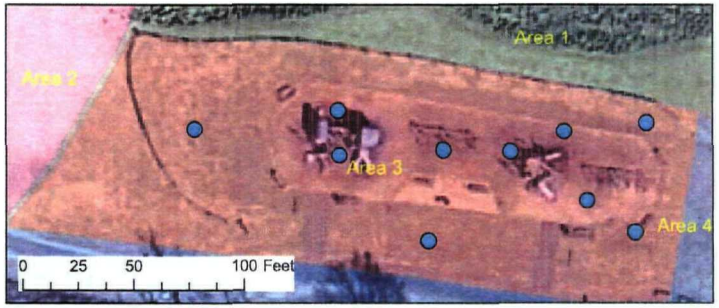
Notes:
(1) Sample locations may be adjusted after delineation of the upland and intertidal zones.
(2) Background monitoring well locations for groundwater will be determined during site reconnaissance

CDM

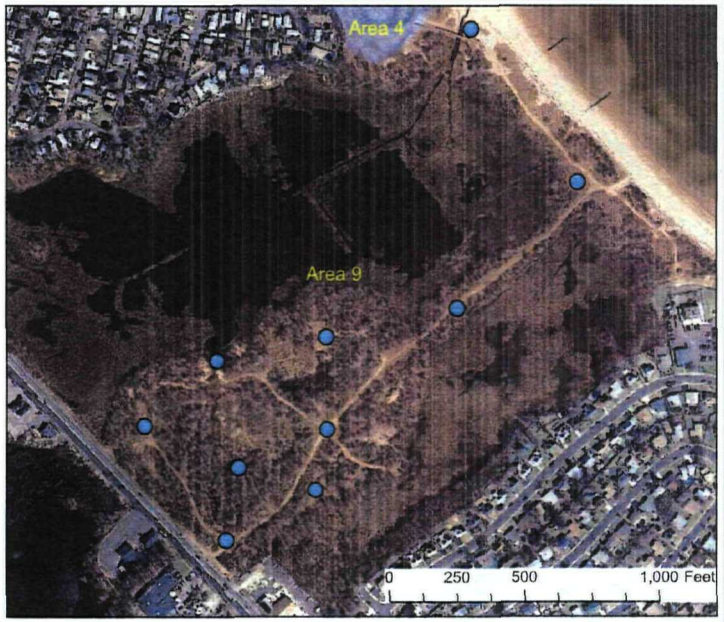
Figure 7
Background
Proposed Sample Locations
Raritan Bay Slag Site



Locations in Areas 2, 3, 5, 6



Area 3 Detail



Locations in Area 9

Media Collection Locations

CDM

N
W
E
S

Figure 8
Locations for Collection of Media for Bioavailability Study
Raritan Bay Slag Site

Note: Monitoring wells will be installed in pairs consisting of a shallow well and a deep well.

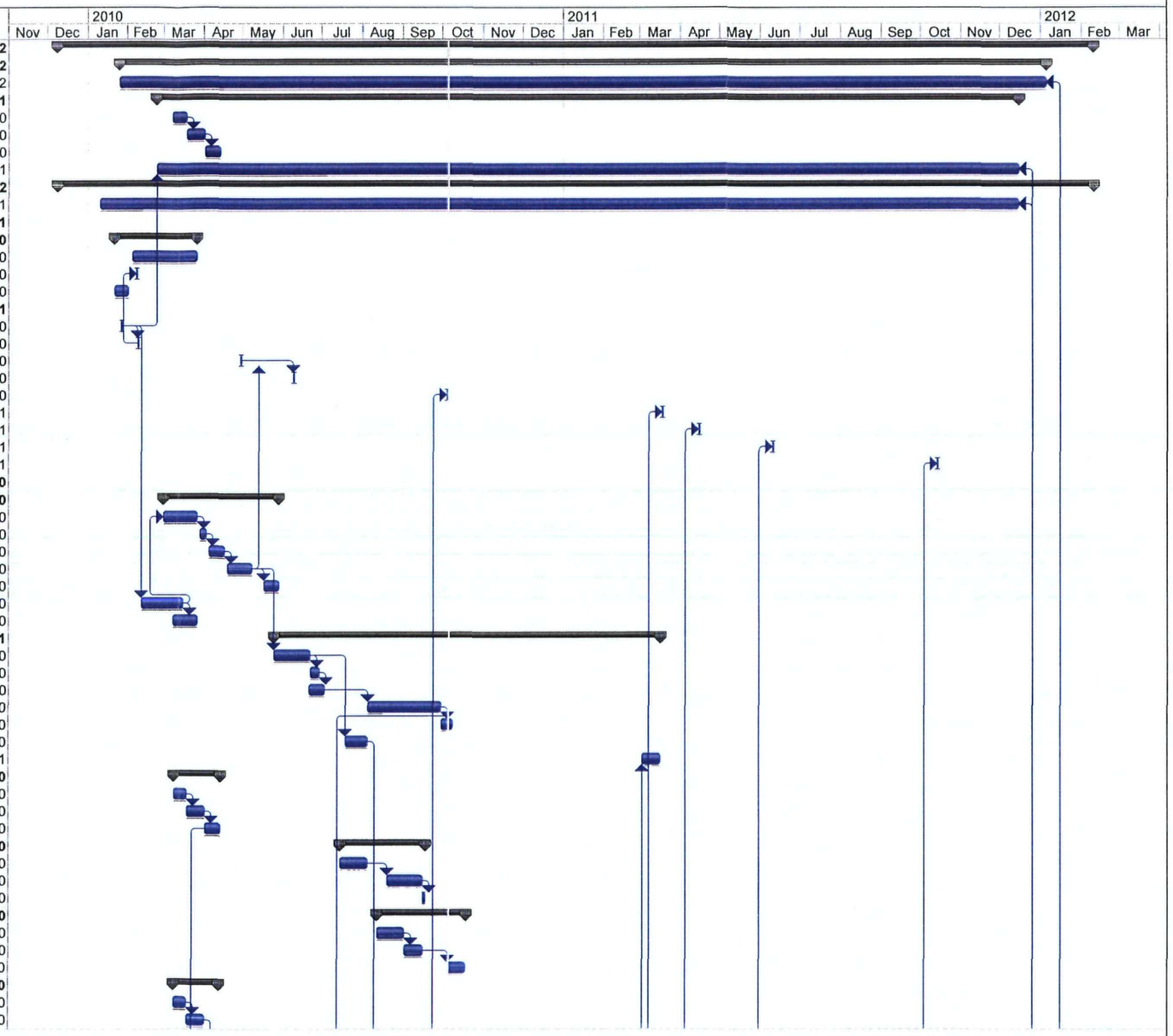
0 625 1,250 2,500 Feet

Figure 9
Proposed Monitoring Well, Stratigraphic Boring, and Staff Gauge Locations
Raritan Bay Slag Site

CDM

Figure 10
Project Schedule
Raritan Bay Slag Superfund Site

ID	Task Name	Duration	Start	Finish
1	**Raritan Bay Slag Site**	**568 days**	**Wed 12/9/09**	**Fri 2/10/12**
2	**Task 1 - Project Planning and Support**	**508 days**	**Tue 1/26/10**	**Thu 1/5/12**
3	Project Management	508 days	Tue 1/26/10	Thu 1/5/12
4	**Contractor Quality Control Plan (CQCP)**	**472 days**	**Wed 2/24/10**	**Thu 12/15/11**
5	Prepare/Submit Draft CQCP	9 days	Mon 3/8/10	Thu 3/18/10
6	USACE Review of Draft CQCP	10 days	Fri 3/19/10	Thu 4/1/10
7	Prepare/Submit Final CQCP	8 days	Fri 4/2/10	Tue 4/13/10
8	Site Security and Maintenance	472 days	Wed 2/24/10	Thu 12/15/11
9	**Task 2 Community Involvement**	**568 days**	**Wed 12/9/09**	**Fri 2/10/12**
21	Community Involvement Activities	504 days	Mon 1/11/10	Thu 12/15/11
22	**Task 3 RI/FS Planning Activities**	**451 days**	**Fri 1/22/10**	**Fri 10/14/11**
23	**Project Scoping and Planning**	**46 days**	**Fri 1/22/10**	**Fri 3/26/10**
24	Review Existing Documents	36 days	Fri 2/5/10	Fri 3/26/10
25	Site Visit	1 day	Mon 2/8/10	Mon 2/8/10
26	Early Scoping Activities	7 days	Fri 1/22/10	Mon 2/1/10
27	**Meetings**	**448 days**	**Wed 1/27/10**	**Fri 10/14/11**
28	Status Call	1 day	Wed 1/27/10	Wed 1/27/10
29	Project Meeting	1 day	Tue 2/9/10	Tue 2/9/10
30	Scoping Meeting	1 day	Thu 4/29/10	Thu 4/29/10
31	Next Steps and Streamlining Meeting	1 day	Wed 6/9/10	Wed 6/9/10
32	RI Field Investigation	1 day	Mon 10/4/10	Mon 10/4/10
33	RI Report	1 day	Fri 3/18/11	Fri 3/18/11
34	Risk Assessment Report	1 day	Fri 4/15/11	Fri 4/15/11
35	Feasibility Study	1 day	Fri 6/10/11	Fri 6/10/11
36	Final Feasibility Study	1 day	Fri 10/14/11	Fri 10/14/11
37	**Data Gap evaluation**	**76 days**	**Fri 2/12/10**	**Fri 5/28/10**
38	**Technical Memorandum [TM]**	**65 days**	**Mon 3/1/10**	**Fri 5/28/10**
39	Prepare/Submit Draft TM	20 days	Mon 3/1/10	Fri 3/26/10
40	USACE Review Draft TM	5 days	Mon 3/29/10	Fri 4/2/10
41	Prepare/Submit Draft Final TM	10 days	Mon 4/5/10	Fri 4/16/10
42	EPA Review of Draft Final TM	15 days	Mon 4/19/10	Fri 5/7/10
43	Prepare/Submit Final TM	10 days	Mon 5/17/10	Fri 5/28/10
44	EQUIS Database and Summary tables	22 days	Fri 2/12/10	Mon 3/15/10
45	GIS Database and Figures	15 days	Mon 3/8/10	Fri 3/26/10
46	**Work Plan**	**212 days**	**Tue 5/25/10**	**Wed 3/16/11**
47	Prepare/Submit Draft Work Plan	20 days	Tue 5/25/10	Mon 6/21/10
48	USACE Review of Draft Work Plan	5 days	Tue 6/22/10	Mon 6/28/10
49	Prepare/Submit Draft Final Work Plan	10 days	Mon 6/21/10	Fri 7/2/10
50	EPA Review of Review Draft Work Plan	40 days	Thu 8/5/10	Wed 9/29/10
51	Prepare/Submit Final Work Plan	7 days	Thu 9/30/10	Fri 10/8/10
52	Cost Proposal	13 days	Mon 7/19/10	Wed 8/4/10
53	Update Preliminary CSM	10 days	Thu 3/3/11	Wed 3/16/11
54	**Early Actions Quality Assurance Project Plan (QAPP)**	**26 days**	**Tue 3/9/10**	**Tue 4/13/10**
55	Prepare/Submit Early Actions Draft QAPP	8 days	Tue 3/9/10	Thu 3/18/10
56	USACE Review of Early Actions Draft QAPP	10 days	Fri 3/19/10	Thu 4/1/10
57	Prepare/Submit Early Actions Final QAPP	8 days	Fri 4/2/10	Tue 4/13/10
58	**Early RI Activities Quality Assurance Project Plan (QAPP)**	**47 days**	**Thu 7/15/10**	**Fri 9/17/10**
59	Prepare/Submit Early RI Activities Draft QAPP, revision 1	15 days	Thu 7/15/10	Wed 8/4/10
60	EPA/USACE Review of Early RI Activities Draft QAPP, revision 1	19 days	Fri 8/20/10	Wed 9/15/10
61	Prepare/Submit Early RI Activities Final QAPP, revision 1	2 days	Thu 9/16/10	Fri 9/17/10
62	**Remedial Investigation Quality Assurance Project Plan (QAPP)**	**48 days**	**Thu 8/12/10**	**Mon 10/18/10**
63	Prepare/Submit RI Draft QAPP	15 days	Thu 8/12/10	Wed 9/1/10
64	EPA/USACE Review of RI Draft QAPP	10 days	Thu 9/2/10	Wed 9/15/10
65	Prepare/Submit RI Final QAPP	10 days	Tue 10/5/10	Mon 10/18/10
66	**Site Specific Health and Safety Plan - Early Action**	**25 days**	**Tue 3/9/10**	**Mon 4/12/10**
67	Prepare/Submit Draft SSHP	8 days	Tue 3/9/10	Thu 3/18/10
68	USACE/EPA Review of Draft SSHP	10 days	Fri 3/19/10	Thu 4/1/10



Project: Figure_5-1_Schedule_100510
Date: Tue 10/5/10

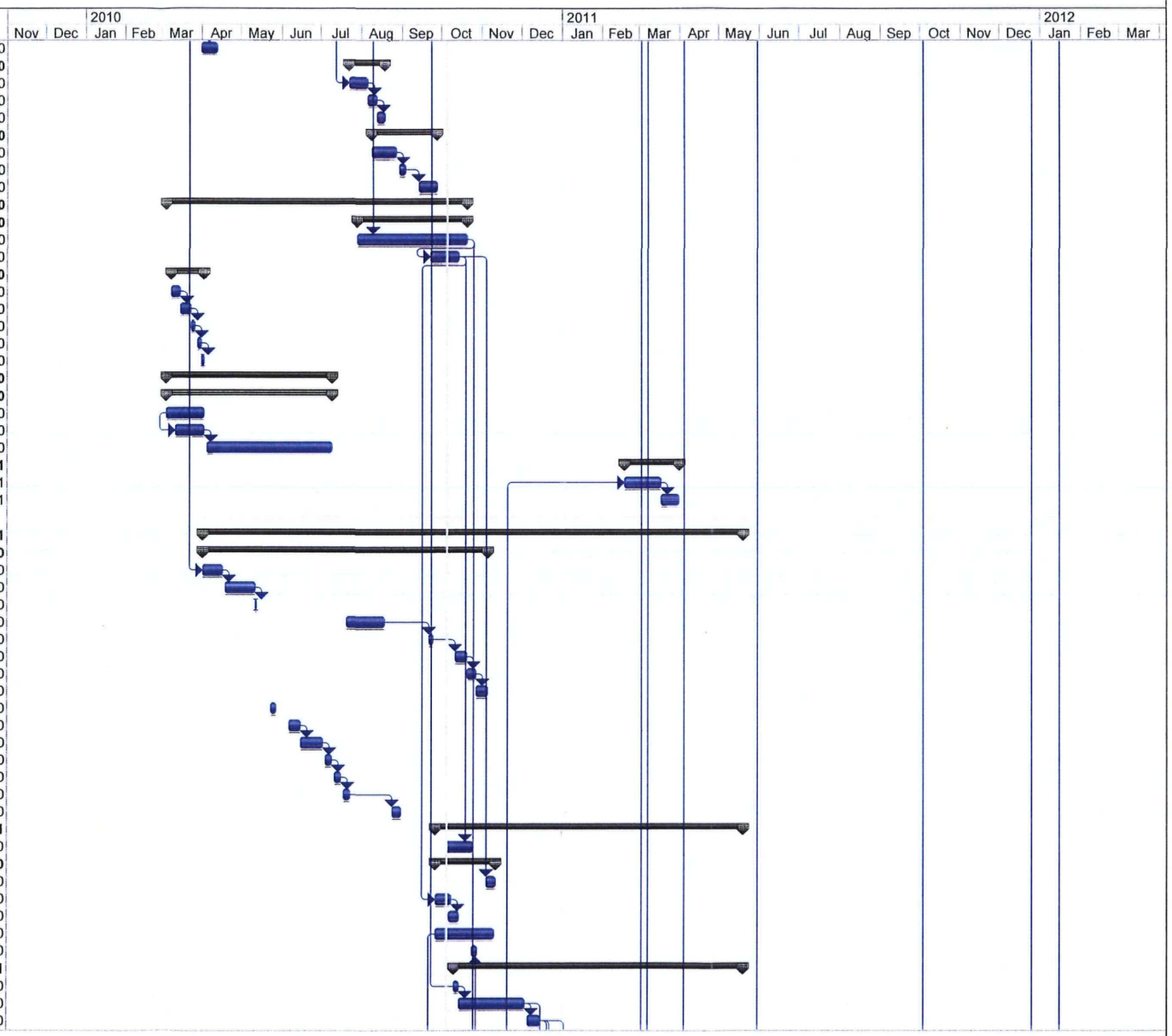
Task

Task Summary

Days in schedule are working days

Figure 10
Project Schedule
Raritan Bay Slag Superfund Site

ID	Task Name	Duration	Start	Finish
69	Prepare/Submit Final SSHP	8 days	Thu 4/1/10	Mon 4/12/10
70	**Early RI Activities Site Specific Health And Safety Plan**	**19 days**	**Fri 7/23/10**	**Wed 8/18/10**
71	Prepare/Submit Draft SSHP	10 days	Fri 7/23/10	Thu 8/5/10
72	USACE/EPA Review of Draft SSHP	5 days	Fri 8/6/10	Thu 8/12/10
73	Prepare/Submit Final SSHP	4 days	Fri 8/13/10	Wed 8/18/10
74	**RI Site Specific Health And Safety Plan**	**36 days**	**Mon 8/9/10**	**Mon 9/27/10**
75	Prepare/Submit Draft SSHP	15 days	Mon 8/9/10	Fri 8/27/10
76	USACE/EPA Review of Draft SSHP	5 days	Mon 8/30/10	Fri 9/3/10
77	Prepare/Submit Final SSHP	10 days	Tue 9/14/10	Mon 9/27/10
78	**Procurement**	**164 days**	**Fri 3/5/10**	**Wed 10/20/10**
79	**RI Procurement**	**60 days**	**Thu 7/29/10**	**Wed 10/20/10**
80	Procurement for RI Subcontracts	60 days	Thu 7/29/10	Wed 10/20/10
81	USACE Advance Notice/Consent	16 days	Thu 9/23/10	Thu 10/14/10
82	**Early Actions**	**19 days**	**Tue 3/9/10**	**Fri 4/2/10**
83	Prepare SOW for Test Excavations	5 days	Tue 3/9/10	Mon 3/15/10
84	Prepare Bid Packages and Solicit bids	6 days	Tue 3/16/10	Tue 3/23/10
85	Review Bid packages and select subcontractor	3 days	Wed 3/24/10	Fri 3/26/10
86	USACE Advance Notice	3 days	Mon 3/29/10	Wed 3/31/10
87	Award Subcontract	2 days	Thu 4/1/10	Fri 4/2/10
88	**Screening**	**91 days**	**Fri 3/5/10**	**Fri 7/9/10**
89	**Vendors for slag Reuse/Recycling**	**91 days**	**Fri 3/5/10**	**Fri 7/9/10**
90	Process and Vendor Research	21 days	Fri 3/5/10	Fri 4/2/10
91	Contact Potential Vendors	16 days	Fri 3/12/10	Fri 4/2/10
92	Vendor Meetings/Presentations	70 days	Mon 4/5/10	Fri 7/9/10
93	**Pathway Analysis Report (PAR)**	**30 days**	**Fri 2/18/11**	**Thu 3/31/11**
94	Draft Pathway Analysis Report	20 days	Fri 2/18/11	Thu 3/17/11
95	USACE/EPA Review of PAR	10 days	Fri 3/18/11	Thu 3/31/11
96	**Task 4 Field Investigation & Data Management- TBD**			
97	**Field Investigation**	**295 days**	**Fri 4/2/10**	**Thu 5/19/11**
98	**Early Actions**	**156 days**	**Fri 4/2/10**	**Fri 11/5/10**
99	Mobilization	11 days	Fri 4/2/10	Fri 4/16/10
100	Test Excavations	17 days	Mon 4/19/10	Tue 5/11/10
101	Demobilization	1 day	Wed 5/12/10	Wed 5/12/10
102	Submit Draft Test Pit Report	21 days	Wed 7/21/10	Wed 8/18/10
103	USACE Review of Draft Test Pit Report	3 days	Wed 9/22/10	Fri 9/24/10
104	Prepare/Submit Draft Final Test Pit Report	7 days	Tue 10/12/10	Wed 10/20/10
105	EPA Review of Draft Final Test Pit Report	5 days	Thu 10/21/10	Wed 10/27/10
106	Submit Final Test Pit Report	7 days	Thu 10/28/10	Fri 11/5/10
107	Debris Removal	4 days	Mon 5/24/10	Thu 5/27/10
108	Timber Removal	7 days	Mon 6/7/10	Tue 6/15/10
109	Prepare/Submit Draft Debris/Timber Report	13 days	Wed 6/16/10	Fri 7/2/10
110	USACE Review of Draft Debris/Timber Report	5 days	Mon 7/5/10	Fri 7/9/10
111	Prepare/Submit Draft Final Debris/Timber Report	5 days	Mon 7/12/10	Fri 7/16/10
112	EPA Review of Draft Final Debris/Timber Report	5 days	Mon 7/19/10	Fri 7/23/10
113	Final Debris/Timber Report	5 days	Wed 8/25/10	Tue 8/31/10
114	**RI Field Investigation**	**169 days**	**Mon 9/27/10**	**Thu 5/19/11**
115	Mobilization	15 days	Tue 10/5/10	Mon 10/25/10
116	**Site Reconnaissance/Early RI Activities**	**34 days**	**Mon 9/27/10**	**Thu 11/11/10**
117	Cultural Resources Survey	5 days	Fri 11/5/10	Thu 11/11/10
118	Topographic and Bathymetric Surveys	10 days	Mon 9/27/10	Fri 10/8/10
119	Slag Survey	6 days	Thu 10/7/10	Thu 10/14/10
120	RI Field/Sample Location Survey	33 days	Mon 9/27/10	Wed 11/10/10
121	**Ecological Characterization**	4 days	Mon 10/25/10	Thu 10/28/10
122	**Hydrogeological Assessment**	**159 days**	**Mon 10/11/10**	**Thu 5/19/11**
123	Stratigraphic Borings	4 days	Mon 10/11/10	Thu 10/14/10
124	Monitoring Well Installation	36 days	Fri 10/15/10	Fri 12/3/10
125	Develop New Wells	8 days	Mon 12/6/10	Wed 12/15/10



Project: Figure_5-1_Schedule_100510
Date: Tue 10/5/10

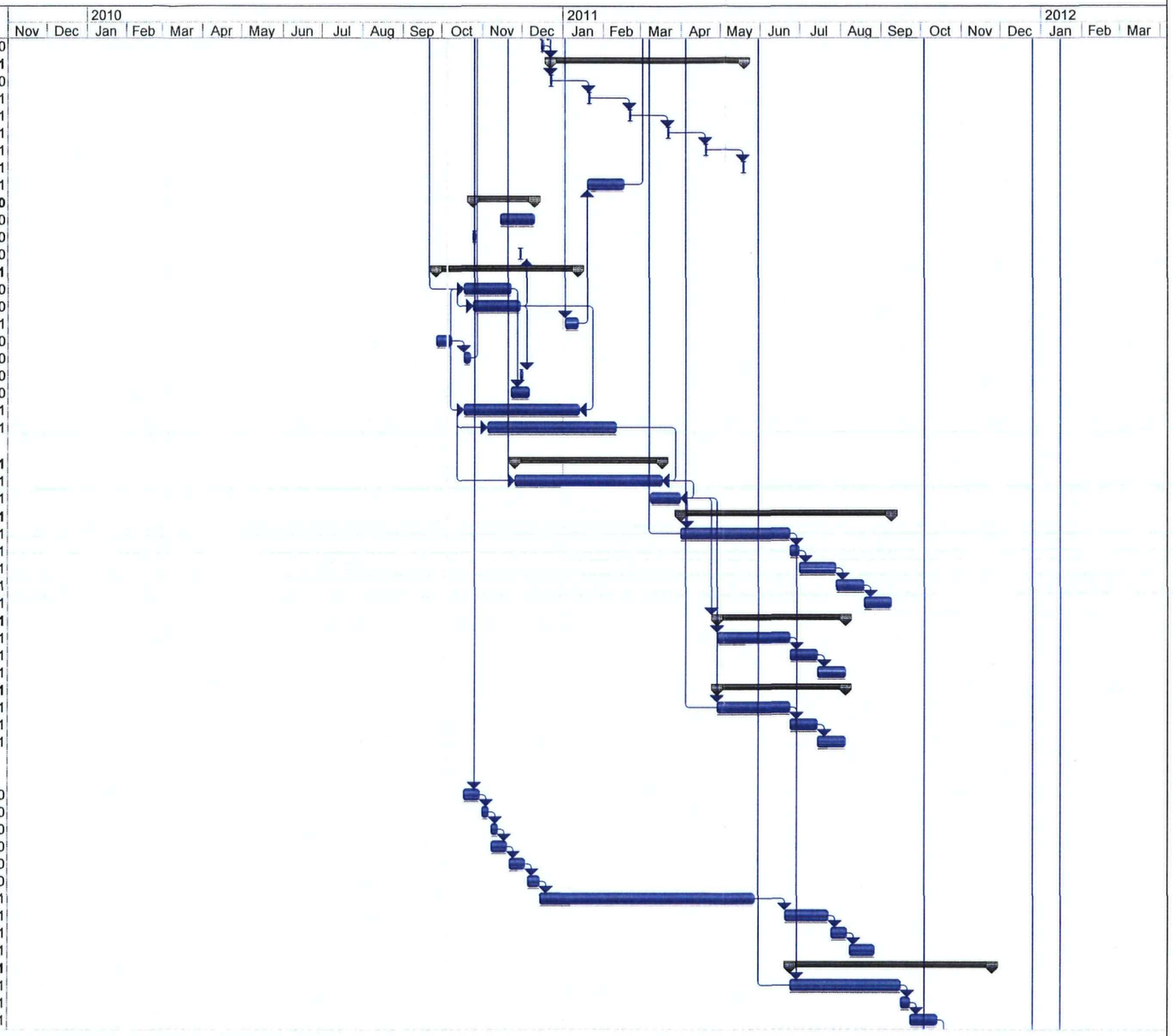
Task

Task Summary

Days in schedule are working days

Figure 10
Project Schedule
Raritan Bay Slag Superfund Site

ID	Task Name	Duration	Start	Finish
126	Redevelop Existing Wells	2 days	Thu 12/16/10	Fri 12/17/10
127	Synoptic Water Levels	**106 days**	**Thu 12/23/10**	**Thu 5/19/11**
128	Round 1	1 day	Thu 12/23/10	Thu 12/23/10
129	Round 2	1 day	Fri 1/21/11	Fri 1/21/11
130	Round 3	1 day	Mon 2/21/11	Mon 2/21/11
131	Round 4	1 day	Tue 3/22/11	Tue 3/22/11
132	Round 5	1 day	Wed 4/20/11	Wed 4/20/11
133	Round 6	1 day	Thu 5/19/11	Thu 5/19/11
134	Continuous Water Level Monitoring	20 days	Thu 1/20/11	Wed 2/16/11
135	**Sediment Dynamics**	**35 days**	**Mon 10/25/10**	**Fri 12/10/10**
136	Current and Sediment transport profiles	20 days	Mon 11/15/10	Fri 12/10/10
137	Geochronology - Be7	2 days	Mon 10/25/10	Tue 10/26/10
138	Geochronology - Cs137	1 day	Tue 11/30/10	Tue 11/30/10
139	**Environmental Sampling**	**78 days**	**Mon 9/27/10**	**Wed 1/12/11**
140	Surface water and sediment sampling	26 days	Mon 10/18/10	Mon 11/22/10
141	Soil sampling	26 days	Mon 10/25/10	Mon 11/29/10
142	Groundwater sampling	8 days	Mon 1/3/11	Wed 1/12/11
143	Biota sampling - Crabs and clams	10 days	Mon 9/27/10	Fri 10/8/10
144	Biota Sampling - Fish	5 days	Mon 10/18/10	Fri 10/22/10
145	Background Sampling - Beach	2 days	Tue 11/30/10	Wed 12/1/10
146	Background Sampling - Whaler's Creek	10 days	Tue 11/23/10	Mon 12/6/10
147	**Sample Analysis**	64 days	Mon 10/18/10	Thu 1/13/11
148	**Data Validation**	70 days	Fri 11/5/10	Thu 2/10/11
149	**Task 5 RI & BLRA Reports**			
150	**Data Evaluation/Reduction/Tabulation**	**80 days**	**Fri 11/26/10**	**Thu 3/17/11**
151	Upload and Evaluate RI Data	80 days	Fri 11/26/10	Thu 3/17/11
152	**Technical Memorandum (meeting)**	17 days	Wed 3/9/11	Thu 3/31/11
153	**RI Report**	**115 days**	**Fri 4/1/11**	**Thu 9/8/11**
154	Prepare/Submit Draft RI Report	60 days	Fri 4/1/11	Thu 6/23/11
155	USACE Review of Draft RI Report	5 days	Fri 6/24/11	Thu 6/30/11
156	Prepare/Submit Draft Final RI Report	20 days	Fri 7/1/11	Thu 7/28/11
157	EPA Review of Final Draft RI Report	15 days	Fri 7/29/11	Thu 8/18/11
158	Prepare/Submit Final RI Report	15 days	Fri 8/19/11	Thu 9/8/11
159	**Human Health Risk Assessment**	**70 days**	**Fri 4/29/11**	**Thu 8/4/11**
160	Prepare/Submit Draft HHRA Report	40 days	Fri 4/29/11	Thu 6/23/11
161	USACE/EPA Review of Draft HHRA Report	15 days	Fri 6/24/11	Thu 7/14/11
162	Prepare/Submit Final HHRA Report	15 days	Fri 7/15/11	Thu 8/4/11
163	**Ecological Risk Assessment (if needed)**	**70 days**	**Fri 4/29/11**	**Thu 8/4/11**
164	Prepare/Submit Draft ERA Report	40 days	Fri 4/29/11	Thu 6/23/11
165	USACE/EPA Review of Draft ERA Report	15 days	Fri 6/24/11	Thu 7/14/11
166	Submit Final ERA Report	15 days	Fri 7/15/11	Thu 8/4/11
167	**Task 6 Feasibility Study**			
168	**Treatability Study**			
169	Subcontractor Draft Treatability Study Work Plan	10 days	Mon 10/18/10	Fri 10/29/10
170	Review of Subcontractor Treatability Study Work Plan	5 days	Mon 11/1/10	Fri 11/5/10
171	Final Subcontractor Treatability Study Work	5 days	Mon 11/8/10	Fri 11/12/10
172	CDM Draft Treatability Study Work Plan/QAPP	10 days	Mon 11/8/10	Fri 11/19/10
173	EPA/USACE Review of CDM Treatability Study Work Plan/QAPP	10 days	Mon 11/22/10	Fri 12/3/10
174	CDM Final Treatability Study Work Plan/QAPP	7 days	Mon 12/6/10	Tue 12/14/10
175	Treatability Study	118 days	Wed 12/15/10	Fri 5/27/11
176	Prepare/Submit Draft Subcontractor Treatability Study Report	25 days	Mon 6/20/11	Fri 7/22/11
177	USACE/USACE Review of Draft Subcontractor Treatability Study Rep	10 days	Mon 7/25/11	Fri 8/5/11
178	Final Treatability Subcontractor Study Report	15 days	Mon 8/8/11	Fri 8/26/11
179	**FS Report**	**110 days**	**Fri 6/24/11**	**Thu 11/24/11**
180	Prepare/Submit Draft FS Report	60 days	Fri 6/24/11	Thu 9/15/11
181	USACE Review of Draft FS Report	5 days	Fri 9/16/11	Thu 9/22/11
182	Prepare/Submit Draft Final FS Report	15 days	Fri 9/23/11	Thu 10/13/11



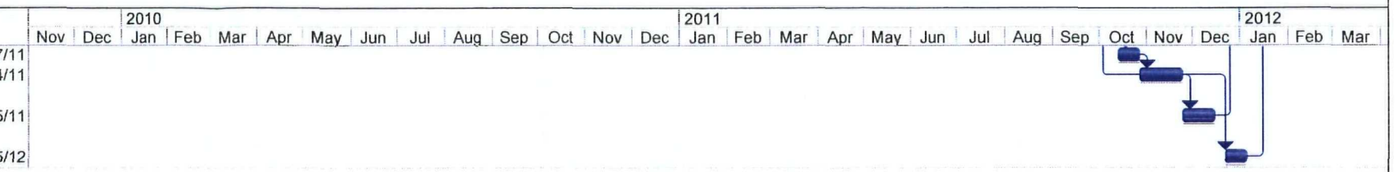
Project: Figure_5-1_Schedule_100510
Date: Tue 10/5/10

Task Task Summary

Days in schedule are working days

Figure 10
Project Schedule
Raritan Bay Slag Superfund Site

ID	Task Name	Duration	Start	Finish
183	EPA Review Final Draft FS Report	10 days	Fri 10/14/11	Thu 10/27/11
184	Prepare/Submit Final FS Report	20 days	Fri 10/28/11	Thu 11/24/11
185	**Task Post RI/FS Support TBD**			
186	Negotiations Support/Administrative Record	15 days	Fri 11/25/11	Thu 12/15/11
187	**Task 8 Work Assignment Closeout**			
188	*Project Closeout Activities*	10 days	Fri 12/23/11	Thu 1/5/12

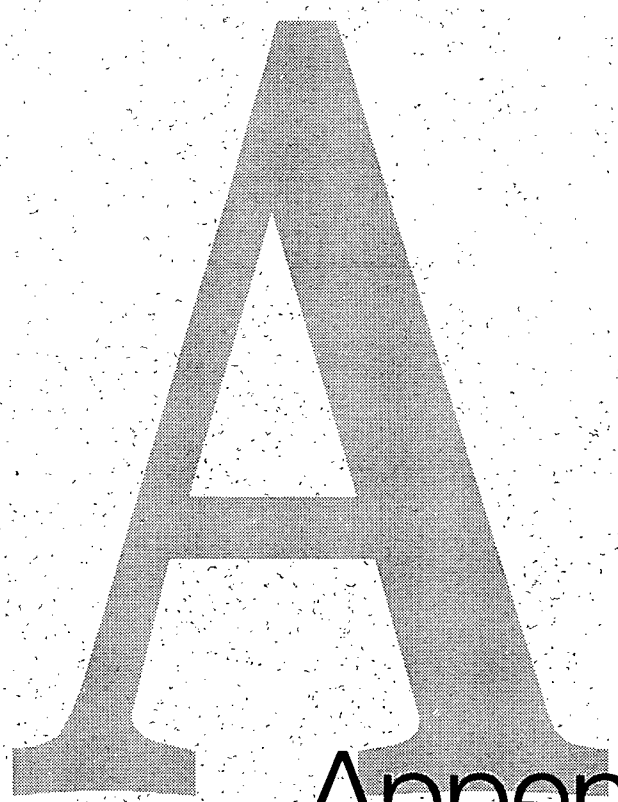


Project: Figure_5-1_Schedule_100510
Date: Tue 10/5/10

Task

Task Summary

Days in schedule are working days



Appendix A

Appendix A

Field Forms

United States Environmental Protection Agency

ANSETS Data Requirement

Date:		Sampling Start Date: Sampling End Date:	
Project Numbers			
Project Number:	Regional Account Number:	DAS Number:	Assoc. CLP Case No:
Site Information			
Site Name:		City:	State:
CERCLIS ID:	Operable Unit:	Action:	Funding Lead: EPA/Superfund
Responsible EPA Project Individual:		Sampling Organization:	

Analytical Services Information

If field analytical services are used during this project write "field analysis" in the Laboratory Name Column. If fixed laboratory is used write the name of the laboratory in the Laboratory Name Column. Please specify in this box all field analytical techniques used.	COST:

Laboratory Name (include location if multiple lab locations)	No. Samples	Matrix	Analysis	Requested Turnaround (Days)
Completed by:		Organization: CDM		

Please use this FedEx airbill to return **all coolers** sent to your laboratory(ies) under this case number. It should be sent FedEx Express Saver (Third Business day) and addressed:

CDM Federal Warehouse
115 Newfield Ave.
Edison, NJ 08837
Attn: Equipment Return

Thanks,

CDM Federal Programs Corporation

Please use this FedEx airbill to return **all coolers** sent to your laboratory(ies) under this case number. It should be sent FedEx Express Saver (Third Business day) and addressed:

CDM Federal Warehouse
115 Newfield Ave.
Edison, NJ 08837
Attn: Equipment Return

Thanks,

CDM Federal Programs Corporation

DAILY SIGN-IN SHEET
RARITAN BAY SLAG SITE

Date	Print Name	Signature	Affiliation	Time On-Site	Time Off-Site

REV 5/01

DAILY STATUS REPORT

RARITAN BAY SLAG SITE

DATE: _____ WEATHER: _____

Personnel Onsite: _____

_____

_____

_____

_____

Samples Collected (List locations): _____

_____

_____

_____

_____

Borings Completed (Include total footage drilled for each boring): _____

_____

_____

_____

_____

Number of Drums Generated (Names): _____

_____

_____

_____

_____

Miscellaneous (Equipment needs, health and safety issues, visitors onsite, etc.): _____

_____

_____

_____

SIGNATURE: _____ DATE: _____

GENERAL EQUIPMENT CALIBRATION LOG
RARITAN BAY SLAG SITE

Instrument (make/model/serial #): _____ Manufacturer: _____ Rental Company: _____

Upon receipt, all parts are included and this instrument is in working order: _____
(signature/date)

Calibration Date	Initial Setting	Standard/ Gas Used (Concentration)	Lot Control No. Expiration Date	Adjustments Made	Final Reading	Comments Pass/Fail	Signature

RARITAN BAY SLAG SITE
FIELD CHANGE NOTIFICATION (FCN) FORM

USACE Contract No.: W912DQ-08-D-0018

REQUEST NO: _____ DATE: _____

FCR TITLE: _____

DESCRIPTION: _____

_____

_____

_____

REASON FOR DEVIATION: _____

_____

_____

_____

RECOMMENDED MODIFICATION: _____

_____

_____

_____

IMPACT ON PROJECT OBJECTIVES: _____

_____

_____

_____

Dated Signatures: _____
Field Team Leader (FTL)

_____
CDM Task Order Manager (TOM)

Distribution:
EPA Remedial Project Manager
RI Task Leader
Field Team
USACE PM
Regional Quality Assurance Coordinator
Project File

Instrument Calibration Log
RAE Systems
MultiRAE + (4 gas + PID)
RARITAN BAY SLAG SITE

Calibration Completed By	Date	Rental Company	Rental Company Number	Instrument Serial Number	Time Instrument On[1]	Warm Up 5 to 10 Minutes[2]

Calibration Gas	Manufacturer	Lot No./Expiration Date	Concentration(s)
			CO: H_2S: LEL: O_2:
			Isobutylene:

Fresh Air Calibration	Carbon Monoxide (CO) Reading	VOC[3] Reading (zero)	H_2S Reading (zero)	LEL Reading (zero)	Oxygen (O_2)
Expected Reading[4]	Zero	Zero	Zero	Zero	20.9%
Actual Reading					

Multiple Sensor Calibration	CO Reading	H_2S Reading	LEL Reading	O_2 Reading	VOC Sensor Calibration	VOC Reading
Expected Reading[5]					Expected Reading	
Actual Reading					Actual Reading	

Instrument OK? YES (Calibration Completed) NO (Problem with instrument, detail in comments)

Calibration Check[6]	Completed (Circle one): YES NO		
Time:	Date:	Calibration Completed By:	
Calibration Gas	Same as Above (Circle one)? YES NO (IF NO COMPLETE INFORMATION BELOW)		
	Manufacturer	Lot No./Expiration Date	Concentration(s)
			CO: H_2S: LEL: O_2:

[1] Note time instrument is turned on for initial warm up
[2] While instrument is warming up, make sure inlet tubing is connected to a hydrophobic filter and fill one Tedlar bag with isobutylene and one with four gas mix
[3] VOC – volatile organic compounds, H_2S – hydrogen sulfide, LEL – lower explosive limit
[4] Instruments should read zero after fresh air calibration is complete, write down actual readings below headings
[5] Write concentration from calibration gas on this line
[6] Complete at the end of the day

Instrument Calibration Log
RAE Systems
MultiRAE + (4 gas + PID)
RARITAN BAY SLAG SITE

			Isobutylene:	
Calibration Check Readings:				
CO:	H_2S:	LEL:	O_2:	VOC:

Comments/Corrective Action: _____

PHOTOLOG

SITE NAME: RARITAN BAY SLAG SITE

CAMERA # _____

Photograph #	Description	Date/Time	Photographer

REV 5/01

SAMPLE TRACKING LOG

LDL VOC LAB: _____ INORGANIC CLP LAB: _____

CLP CASE NO: _____ ORGANIC CLP LAB: _____ SUBCONTRACT LAB: _____

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DEPTH (feet)	TCL VOC CLP NO.	ORGANIC CLP NO.	INORGANIC CLP NO.	pH, TOC & Grain Size	QA/QC

ANALYSIS SUMMARY: _____

_____

REV 5/01

LOW FLOW GROUNDWATER SAMPLING PURGE RECORD
Raritan Bay Slag Site

DATE: **WELL #:**

SAMPLERS: **DEPTH OF PUMP INTAKE:** **ft TIC or ft BGS (circle one)**

WEATHER CONDITIONS: **SCREENED/OPEN BOREHOLE INTERVAL:** **ft TIC or ft BGS (circle one)**

SAMPLE ID: **SAMPLE TIME:** **SAMPLE FLOW RATE:** **ml/minute**
CLP ID:

Instrument Type/Model: **YSI Model #_____/ Horiba U-22 (circle one)** **Instrument:**
Complete and/or Circle at right **Other (specify)_____**

CURRENT TIME	VOLUME PURGED	DEPTH TO WATER	FLOW RATE	DRAWDOWN (± 0.3 FT)	pH (± 0.1 SU)	SPECIFIC CONDUCTIVITY (± 3%)	DISSOLVED OXYGEN (± 10%)	TEMP. (± 10%)	REDOX POTENTIAL (± 10 mV)	TURBIDITY (± 10%)
24-Hour	gallons / liters (circle one)	ft TIC / ft BGS (circle one) Units: ft bgs or	Units:	ft TIC / ft BGS (circle one)	SU	S/cm, mS/cm^c/ or µS/cm (circle one)	mg/L **(not %)**	Units: °C	mV	NTUs

Drawdown is not to exceed 0.3 feet. Flow rate should not exceed 500 ml/min during purging or 250 ml/min during sampling. Readings should be taken every three to five minutes. The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis.
Typical values: DO = 0.3 - 10 mg/L Redox Potential = -100 - +600 mV Turbidity = 0 - >500 NTUs
Spec. Conductivity (µS/cm) = 0.01 - 5,000; up to 10,000 in industrial, ~55,000 in high salt content water. Note: 1,000 µS/cm = 1 mS/cm

TIC = Top of Inner Casing BGS = Below Ground Surface

CDM

Raritan Plaza I
110 Fieldcrest Ave, 6th Floor
Edison, New Jersey 08837

Page of

Boring Name:

Client:
Project Location:

Project Name:
Project Number:

Drilling Contractor:
Drilling Method:
Sample Method:
Drilling Date:
North:
East:

Surface Elevation (ft amsl):
Total Depth:
Depth to Initial Water Level (ft bgs):
Field Screening Instrument:
Logged by:

Depth (ft. bgs)	Sample Number	Blows per 6 inches	Sample Interval (ft)	Recovery (ft)	OVM Reading (ppm)	Graphic Log	Material Description

Remarks:

RARITAN BAY SLAG SITE
FERROUS IRON HACH TEST RESULTS

HACH Model No.:_____ MDL: _____

Analyst Name:_____ Instrument Range/unit: _____

Date	Time of Run	Sample ID	Sample Collection Time	Sample Volume (V1)	Sample Volume (V2)	Dilution (V2/V1)	Instrument Reading	Result (mg/L)	Second Reading (mg/L)

QA/QC Requirement = 1 duplicate per 20 samples analyzed

Notes:

1. Record all note on this form and in the Site log book. You should be recording them throughout the day as you do them - not just a summary at the end of the day.

2. Note if samples are turbid.

3. Second reading does not need to be done on all samples - just every 5^{th} or 6^{th} sample. Used to make sure the machine is functioning correctly.

4. Duplicate samples will be collected and ran independently (i.e. NJDEP-MW10-R3 is the dup. of NJDEP-MW1-R3), record as separate samples.

5. 3.30 mg/L is the limit. If you receive this reading record it with the word LIMIT and you will need to perform a dilution.

6. You should run a sample of the reagent grade water that you will use for dilutions, try to use the same bottle through the sampling event.

Do not forget - a 10% dilution result needs to get multiplied by 10, and a 25% dilution result gets multiplied by 4.
Write out the reading from the machine and then show the math on the sheet.
You will also need to record this in your logbook.

Appendix B

Appendix B

CDM Technical Standard Operating Procedures

CDM

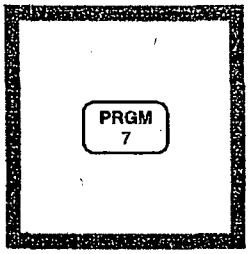
FERROUS IRON

IRON, FERROUS (0 to 3.00 mg/L)

For water, wastewater, and seawater

1,10 Phenanthroline Method* (Powder Pillows or AccuVac Ampuls)

Using Powder Pillows



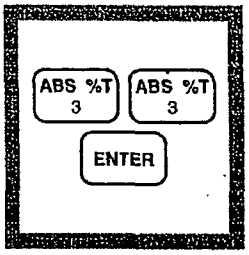
1. Enter the stored program number for Ferrous iron (Fe^{2+})-powder pillows.

Press: **PRGM**

The display will show:

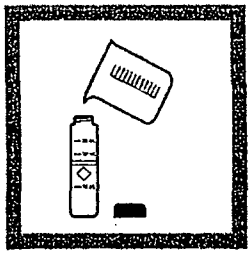
PRGM ?

Note: Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric iron, which is not determined.

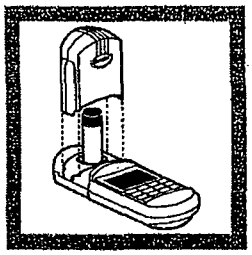


2. Press: **33 ENTER**

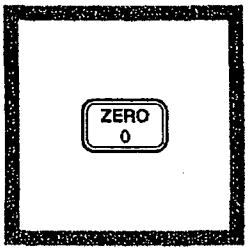
The display will show **mg/L, Fe** and the **ZERO** icon.



3. Fill a sample cell with 25 mL of sample (the blank).



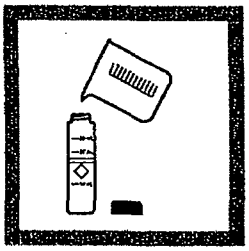
4. Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.



5. Press: **ZERO**

The cursor will move to the right, then the display will show:

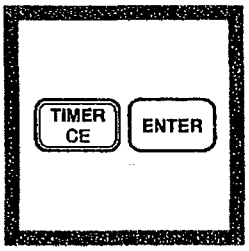
0.00 mg/L Fe



6. Fill another sample cell with 25 mL of sample.

7. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Cap and invert to mix.

Note: Undissolved powder does not affect accuracy.



8. Press:

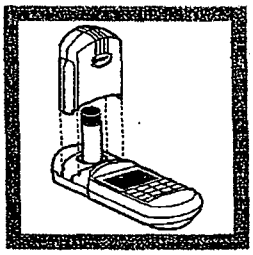
TIMER ENTER

A three-minute reaction period will begin.

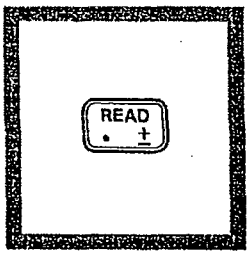
Note: An orange color will form if ferrous iron is present.

---

* Adapted from *Standard Methods for the Examination of Water and Wastewater.*



9. Place the prepared sample into the cell holder. Tightly cover the sample cell with the instrument cap.

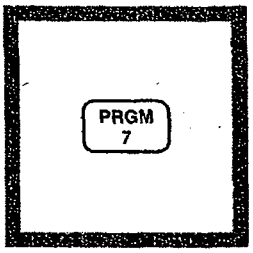


10. Press: **READ**

The cursor will move to the right, then the result in mg/L ferrous iron will be displayed.

Note: Standard Adjust may be performed using a prepared standard (see Section 1).

Using AccuVac Ampuls



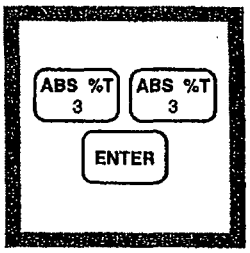
1. Enter the stored program number for ferrous iron (Fe^{2+}) AccuVac ampuls.

Press: **PRGM**

The display will show:

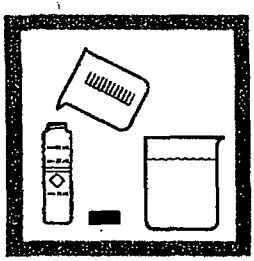
PRGM ?

Note: Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric, which is not determined.

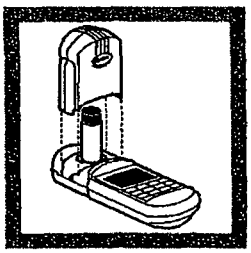


2. Press: **33 ENTER**

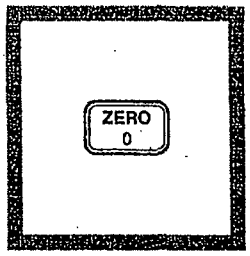
The display will show **mg/L, Fe** and the **ZERO** icon.



3. Fill a sample cell with at least 10 mL of sample (the blank). Collect at least 40 mL of sample in a 50-mL beaker.



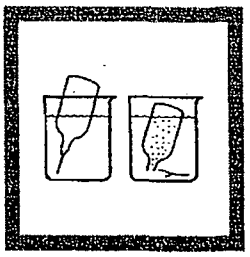
4. Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.



5. Press: **ZERO**

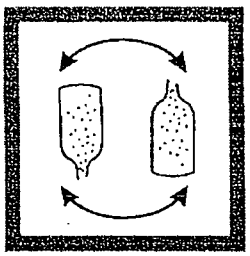
The cursor will move to the right, then the display will show:

0.00 mg/L Fe



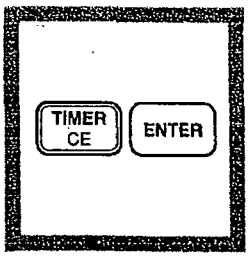
6. Fill a Ferrous Iron AccuVac Ampul with sample.

Note: Keep the tip immersed while the ampul fills completely.



7. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: Undissolved powder does not affect accuracy.

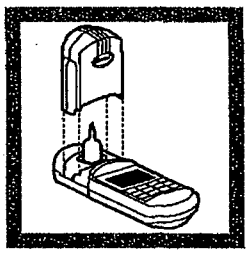


8. Press:

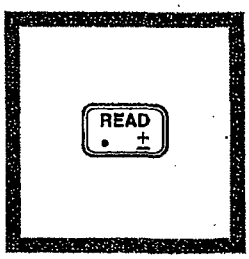
TIMER ENTER

A three-minute reaction period will begin.

Note: An orange color will form if ferrous iron is present.



9. Place the AccuVac ampul into the cell holder. Tightly cover the sample cell with the instrument cap.



10. Press: **READ**

The cursor will move to the right, then the result in mg/L ferrous iron will be displayed.

Note: Standard Adjust may be performed using a prepared standard (see Standard Adjust in Section 1).

Sampling and Storage

Ferrous iron must be analyzed immediately and cannot be stored. Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric iron, which is not measured.

Accuracy Check

Standard Solution Method

Prepare a ferrous iron stock solution (100 mg/L Fe^{2+}) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate, in deionized water. Dilute to 1 liter. Prepare immediately before use. Dilute 1.00 mL of this solution to 100 mL with deionized water to make a 1.00 mg/L standard solution. Prepare immediately before use.

Run the test using the 1.00 mg/L Fe^{2+} Standard Solution by following either the powder pillow or AccuVac procedure. Results should be between 0.90 mg/L and 1.10 mg/L Fe^{2+}.

Method Performance

Precision

In a single laboratory using an iron standard solution of 2.00 mg/L Fe^{2+} and two representative lots of powder pillow reagents with the instrument, a single operator obtained a standard deviation of ±0.017 mg/L Fe^{2+}.

In a single laboratory using a standard solution of 2.00 mg/L Fe^{2+} and two representative lots of AccuVac ampuls with the instrument, a single operator obtained a standard deviation of ±0.009 mg/L Fe^{2+}.

Estimated Detection Limit

The estimated detection limit for program 33 (powder pillows and AccuVac Ampuls) is 0.03 mg/L Fe. For more information on the estimated detection limit, see *Section 1*.

Summary of Method

The 1,10-phenanthroline indicator in Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

IRON, FERROUS, continued

REQUIRED REAGENTS & APPARATUS (USING POWDER PILLOWS)

Description	Quantity Required Per Test	Units	Cat. No.
Ferrous Iron Reagent Powder Pillows	1 pillow	100/pkg	1037-69
Sample Cell, 10-20-25 mL, w/ cap	2	6/pkg	24019-06

REQUIRED REAGENTS & APPARATUS (USING ACCUVAC AMPULS)

Ferrous Iron Reagent AccuVac Ampuls	1 ampul	25/pkg	25140-25
Beaker, 50 mL	1	each	500-41H

OPTIONAL REAGENTS

Ferrous Ammonium Sulfate, hexahydrate, ACS		113 g	11256-14
Water, deionized		4 L	272-56

OPTIONAL APPARATUS

AccuVac Snapper Kit		each	24052-00
Balance, analytical, 115 V, 0.1 mg		each	28014-01
Balance, analytical, 230 V, 0.1 mg		each	28014-02
Clippers, for opening powder pillows		each	968-00
Flask, volumetric, 100 mL, Class A		each	14574-42
Flask, volumetric, 1000 mL, Class A		each	14574-53
Pipet, volumetric, Class A, 1.00 mL		each	14515-35
Pipet Filler, safety bulb		each	14651-00
Weighing Boat, 67/46 mm, 8.9 cm square		500/pkg	21790-00

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Outside the U.S.A.—Contact the Hach office or distributor serving you.

TSOP 1-1

SURFACE WATER SAMPLING

Surface Water Sampling

SOP: 1-1
Revision: 7
Date: March 2007

Prepared: Del Baird

Technical Review: Curt Coover

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

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E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

The purpose of this standard operating procedure (SOP) is to define requirements for collection and containment of surface water samples.

2.0 Background

Surface water samples are collected to determine the type(s) and level(s) of contamination in a particular surface water body and/or its biological disposition.

2.1 Definitions

Surface Water - Water that flows over or rests on the land and is open to the atmosphere. This includes ditches, streams, rivers, lakes, pools, ponds, and basins.

Shallow Surface Water - Water within 1 to 3.3 feet (0.3 to 1 meter) of the surface of a body of water.

Deep Surface Water - Water deeper than 3.3 feet (1 meter) of the surface of a body of water.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Simple Composite - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, and then a single average sample is taken from the mixture.

Temporal Composite - Two or more subsamples taken from a specific media and site over a period of time. The subsamples are collected and mixed, and then a single average sample is taken from the mixture.

Churn Splitter - Large vessel for compositing subsamples. Includes a mechanism to agitate the water to keep solids suspended.

2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 4-2, *Photographic Documentation of Field Activities*
- CDM Federal SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that field personnel are trained in the use of this SOP, related SOPs, and the required equipment.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling. The FTL also must ensure that the quantity and location of surface water samples collected meet the requirements of the site-specific plans.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

All or part of the equipment listed under the "as needed" category may be required at any specific site, depending on the plan(s) for that site.

- Site-specific plans
- Field logbook
- Indelible black-ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Ice bags or "blue ice"
- Plastic zip-top bags
- Clear waterproof tape
- Personal protective clothing and equipment
- Latex or appropriate gloves
- Rubber boots and/or rubberized waders
- Life jacket
- Kimwipe or paper towels
- Clean plastic sheeting
- Tap and deionized water
- Appropriate photographic equipment and supplies
- Appropriate decontamination equipment and supplies

As needed:

- Pond sampler with 1-liter (L) beaker (preferably Teflon®), clamp, and heavy-duty telescoping pole
- Weighted bottle sampler, 1-L capacity (preferably Teflon) and handle; see USGS Open File Report 2005-1087 for selection of sampler; a Kemmerer or Van Dorn sampler may be used if Teflon is not required
- Churn splitter
- Peristaltic pump or suitable replacement
- Temperature, pH, and conductivity meter(s), dissolved oxygen meter, redox potential meter (as required by project plan)
- Boat with depth finder for deep water or inaccessible shorelines
- Global positioning system (GPS) unit
- Tape measure
- Any personal protective equipment specified in the site-specific health and safety plan
- Spare parts for all equipment

5.0 Procedures

5.1 Preparation

The following steps should be taken when preparing for sampling surface water:

1. Review site-specific health and safety plan and project plans before initiating sampling activity.

2. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.

3. Select wadeable stream/river sampling locations that exhibit cross-sectional homogeneity and are well-mixed. Avoid areas where the channel is constricted or bends where scouring may have occurred. For lake samples, the investigator should consider the lake stratification caused by seasonal temperature differences. If possible, select a location that can be described precisely, such as xx feet upstream of xx bridge. Use caution when wading streams more than 1 to 2 feet deep. Flowing water can be a safety hazard.

4. Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.

5. Make field measurements as required by the project plans in physical, chemical, and biological characteristics of the water (e.g., discharge, gage height, temperature, dissolved oxygen, conductivity, pH).

6. The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in 1 day, always collect from downstream to upstream.

7. The sampler should be facing upstream when sampling, both for proper sample collection and for safety (ability to observe floating objects).

8. Document the sampling events, recording all information in the designated field logbook and take photographs if required or if possible. Document any and all deviations from this SOP and include rationale for changes.

9. The collection points shall be located on a site map and described in the field logbook. Use GPS if required or if possible.

10. Label each sample container with the appropriate information. Secure the label by covering it with a piece of waterproof clear tape.

11. Decontaminate reusable sampling equipment after sample collection according to CDM Federal SOP 4 5.

12. Processes for verifying depth of samples must be included in site-specific project plans.

13. Check that a trip blank/temperature blank, when necessary, is included in the chilled cooler. Quality assurance/quality control sample requirements vary from project to project. Consult the project-specific work plan for quality requirements.

5.2 Shallow Surface Water Sample Collection for Wadeable Streams

5.2.1 Method for Collecting Samples for Volatile Organic Compound Analysis

All volatile organic compound (VOC) samples should be discrete samples. The following steps must be taken when collecting shallow surface water VOC samples:

If the volatile organic analysis (VOA) vials do not require a preservative:

1. Approach the sample location from downstream; do not enter the sample area. Slowly submerge VOA vials completely into an area of gently flowing water and fill. Do not disturb bottom sediments. The open end of the vials should be pointed upstream

Note: When collecting samples for VOC analysis, avoid collecting from a surface water point where water is cascading and aerating.

2. Cap the VOA vial while it is underwater. Be sure to dislodge all air bubbles from the cap before sealing the vial.

3. Turn the capped vial upside down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.

4. Proceed to Step 5 below.

If the VOA vials require a preservative:

1. Collect a sufficient sample in a clean glass jar as in Steps 1 and 2 above for unpreserved vials. Specific sampling devices to be used must be specified in site-specific plans.

2. Decant the sample immediately into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Tip vials slightly while filling to reduce turbulence until nearly filled. Then straighten vial to vertical for final filling. Ensure that a meniscus is raised above the lip of the vial before capping.

3. Cap each vial once the meniscus has formed.

4. Turn the capped vial upside down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.

5. Wipe the outside of sample vials with a Kimwipe or clean paper towel. Affix a completed sample label.

6. Place sample vial(s) in a zip-top plastic bag and seal the bag.

7. Immediately pack all samples into a chilled cooler.

5.2.2 Method for Collecting Discrete Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

The following steps must be followed when collecting discrete shallow surface water samples for nonvolatile organic or inorganic compound analysis:

1. Directly dip the sample container, with the opening facing upstream, into the surface water and fill. If wading is necessary, approach the sample location from downstream; do not enter the actual sample area. Do not disturb underlying sediments.

2. Filter samples if required by the site-specific plan.

3. Add appropriate preservatives to the sample containers if required and check pH.

Note: Use a separate container when field testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

4. Cap the sample containers and wipe the outer surfaces of the sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

5. Place sample container(s) in individual zip-top plastic bags, if possible, and seal the bags.

6. Immediately pack all samples into a chilled cooler.

5.2.3 Method for Collecting Simple Composite Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

If the QAPP requires the use of simple composite samples, then a sampler capable of collecting composite samples is required. For width and depth integrated (WDI) composite samples, a DH-48 or DH-81 are recommended, but the QAPP may specify an alternative. The following steps must be followed when collecting simple composite shallow surface water samples for nonvolatile organic or inorganic compound analysis:

1. Record the gage height, if any, before and after sampling.

2. Select the number of width increments based on the requirements of the QAPP. Generally, small well mixed streams require few increments while large or poorly mixed streams require more increments.

3. For fewer than six width increments, subsample locations can be visually estimated. For more than five width increments, string a tape measure across the stream above the water surface to be able to accurately identify the subsample locations. Increments should be evenly spaced across the stream for equal width-integrated (EWI) sampling.

4. If depth-integrated sampling is required, collect a subsample at each width increment by submerging the sampler, orifice facing upstream, from the surface to near the bottom and back up to the surface again in an even steady motion. Do not disturb the sediment at the bottom. The sampler should be retrieved less than full. If the sampler is full, empty it and repeat the subsample collection.

5. If depth-integrated sampling is not required, submerge the sampler with the orifice facing upstream into the surface water and fill.

6. Empty the sampler into a churn splitter or temporary container for later splitting.

7. Repeat Steps 4 to 6 for each width increment.

8. If temporary containers were used, empty into churn splitter. Operate the churn splitter by moving the churn up and down in a steady motion fast enough to homogenize the sample without causing aeration. While the churn is in motion, fill the sample bottles from the tap on the churn.

9. Follow Steps 2 though 6 in Section 5.2.2.

5.2.4 Method for Collecting Temporal Composite Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Compound Analysis

If the QAPP requires the use of temporal composite samples, this can be accomplished using a series of discrete samples collected by hand or an automated sampler, or using a series of simple composite samples. Refer to the preceding sections for collecting the subsamples. The compositing scheme can be time-based (e.g., once per hour for 4 hours) or time-discharge (or time gage height) based (e.g., once per hour until the gage height exceeds xx feet, then change to once per 15 minutes).

Because of the project-specific nature of temporal composite sampling, the specific requirements should be identified in the QAPP. The following are general steps to be followed to collect temporal composite samples:

1. Provide for a method of measuring discharge or gage height before, during, and after sample collection as required in the QAPP.

2. Select the number of time increments based on the requirements of the QAPP. If the time increments change based on a change in flow or water quality, specify the trigger, the new time increment, and any additional trigger to return to the previous increment.

3. Calculate the storage volume for the subsamples and provide a churn splitter of adequate size to contain the entire sample to be composited.

4. Collect the samples according to a method described in this SOP or alternate specified in the QAPP.

5. Provide for cold storage of subsamples, if possible. Do not process any subsamples by filtering or preserving unless specified in the QAPP.

6. Following collection of all subsamples, empty the containers into a churn splitter. If discrete data are required including laboratory or field analysis, retain a portion of the subsample.

7. Operate the churn splitter by moving the churn up and down in a steady motion fast enough to homogenize the sample without causing aeration. While the churn is in motion, fill the sample bottles from the tap on the churn.

8. Follow Steps 2 though 6 in Section 5.2.2.

9. Field parameters should be measured in the surface water at the time of collection. Some field parameters can be measured on the subsamples at the time of compositing, but the temperature and temperature-dependant parameters will not be representative.

5.3 Deep Surface Water Sample Collection

5.3.1 Method for Collecting Samples at Specified Depth Using a Weighted Bottle Sampler

The following steps must be followed when collecting surface water samples at specific depths using a weighted bottle sampler:

1. Lower the weighted bottle sampler to the depth specified in the site-specific plan.
2. Remove the stopper by pulling on the sampler line; allow the sampler to fill with water.
3. Release the sampler line to reseat the stopper and retrieve the sampler to the surface.
4. Wipe the weighted bottle sampler dry with a Kimwipe or clean paper towel.
5. Remove the stopper slowly. Fill the specified number of sample containers by slightly tipping the sampler against each sample bottle. Samples to be used for VOC analysis should be decanted directly from the sampler first into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Add appropriate preservatives to the other sample containers and check pH. Samples may be pooled in stainless steel, glass, or Teflon containers to obtain the necessary volumes. Filter samples if required. Collect sample in separate container for pH, conductivity, temperature, and other measurements if necessary.
6. Close each sample container with the Teflon-lined cap once it is filled. Check for air bubbles in the VOC sample containers. If bubbles are present, discard and resample.
7. Wipe the outside of the sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.
8. Place sample container(s), if possible, in individual zip-top plastic bags, and seal the bags.
9. Immediately pack all samples into a chilled cooler.

5.3.2 Method for Deep Surface Water Sample Collection Using a Peristaltic Pump

The following steps must be followed when collecting deep surface water samples using a peristaltic pump:

1. Install clean medical-grade silicon or Teflon tubing on the pump head. Leave sufficient tubing on the discharge side for convenient dispensing of liquid directly into sample containers.
2. Select the appropriate length of Teflon intake tubing necessary to reach the specified sampling depth. Attach the intake sampling tube to the intake pump tube.
3. Lower the intake tube into the surface water at the specified sampling location to the specified depth; make sure the end of the intake tube does not touch underlying sediments.
4. Start the pump and allow at least three tubing volumes of liquid to flow through and rinse the system before collecting any samples. Do not immediately dispense the purged liquid back to the surface water body. Instead, collect the purged liquid and return it to the source after sample collection is complete.
5. Fill the specified number of sample containers directly from the discharge line. Filter samples if required by the site-specific plan. While filling, allow the liquid to flow gently down the inside of the sample bottle to minimize turbulence.

For VOC samples, fill prepreserved VOA vials and allow a meniscus to form above the top of the container before capping. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Check VOA vials to ensure that there are no air bubbles. Add appropriate preservatives to the other samples and check pH.

Note: Use a separate container when field-testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

6. Cap the sample container(s). Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

7. Place sample container(s) in individual zip-top plastic bags and seal the bags.

8. Immediately pack all samples into a chilled cooler.

9. Drain the pump system, rinse it with deionized water, and wipe it dry. Replace all tubing with new tubing before sampling at another sampling location. Place all used tubing in plastic bags to be discarded or decontaminated according to the site-specific plans.

6.0 Restrictions/Limitations

Peristaltic pumps are generally not capable of lifting water distances greater than 20 to 25 feet (6 to 7.5 meters) above the normal hydrostatic level.

Grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point and has been disturbed.

7.0 References

U. S. Department of Energy. Hazardous Waste Remedial Actions Program. *Quality Control Requirements for Field Methods,* DOE/HWP-69/R1. July 1990 or current revision.

_____. Hazardous Waste Remedial Actions Program. *Standard Operating Procedures for Site Characterizations*, DOE/HWP-100/R2. September 1996 or current revision.

U. S. Environmental Protection Agency, Region 2. *CERCLA Quality Assurance Manual.* March 1988 or current revision.

_____, Region 4. *Environmental Investigations, Standard Operating Procedures and Quality Assurance Manual.* May 1996 or current revision.

U. S. Geological Survey. *National Field Manual for the Collection of Water-Quality Data, Chapter A4.* September 1999.

_____. A guide to the Proper Selection and Use of Federally Approved Sediment and Water Quality Samplers. Open-File Report 2005-1087. 2005.

TSOP 1-2

SAMPLE CUSTODY

Sample Custody

SOP 1-2
Revision 5
Date: March 2007

Prepared: David O. Johnson

Technical Review: S. Budney

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

Because of the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements shall be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample - A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record - A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label - A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 General Responsibilities

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to

ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork.

Field Sample Custodian - The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the *field plan or site/quality assurance project plan* (QAPP).

4.0 Required Supplies

- Chain-of-custody records (applicable client or CDM forms)
- Sample labels and/or tags
- EPA Field Operations Records Management System II Lite™ (FORMS II Lite™) software (if required)
- Printer paper
- Custody seals
- Clear tape
- Computer
- Printer

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations before the actual fieldwork. As few people as possible shall handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

    - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.

    - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.

    - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.

3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record and field logbook in accordance with TSOP 4-1, *Field Logbook Content and Control.*

Procedure for Completing CDM Example Chain-of-Custody Record

The following procedure is to be used to fill out the CDM chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA Contract Laboratory Program (CLP) or a subcontract laboratory or generated by FORMS II Lite™) is used to track the custody of samples, the custody record shall be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the "Remarks" box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier's airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter appropriate designation for laboratory quality control (e.g., matrix spike/matrix spike duplicate [MS/MSD], matrix spike/duplicate [MS/D]), or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number or EPA CLP identification number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.

- Place a check to indicate composite or grab sample.
- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to "yes" or "no" to indicate if a preservative was added.
- Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number."
- Place or write additional relevant information under "Remarks."

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring-style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted, and relooped around the neck until the slack in the string is removed.

4. Double-check that the information recorded on the sample tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) before shipment. The seals shall be signed and dated by the shipper.

Custody seals may also be required to be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples* defines the requirements for packaging and shipping environmental samples.

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure shall be followed.

For EPA CLP sampling events, combined chain-of-custody/traffic report forms generated with EPA FORMS II Lite™ or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ software may be used to customize sample labels and custody records when directed by the client or the CDM project manager.

7.0 References

U. S. Army Corps of Engineers. 2001. *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. Revised March 1992. *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p.85.

_____. Region IV. 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.* Section 3.3. May.

_____. 2002. *FORMS II Lite™ User's Guide, Version 5.1.*

_____. 2002. *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/240/R-02/009. Section 2.2.3. December.

_____. 2004. *Contract Laboratory Program (CLP), Guidance for Field Samplers,* EPA-540-R-00-003. Final. Section 3.2. August.

Figure 1
Example CDM Chain-of-Custody Record

CDM

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123
Fax: (212) 785-6114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE
1. Surface Water
2. Groundwater
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other _____

PRESERVATIVES
1. HCl, pH <2
2. HNO3, pH <2
3. NaOH, pH >12
4. H2SO4, pH <2
5. Zinc Acetate, pH >9
6. Ice Only
7. Not Preserved
8. Other _____

SAMPLE TYPE
G = Grab
C = Composite

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESERVATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	20__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

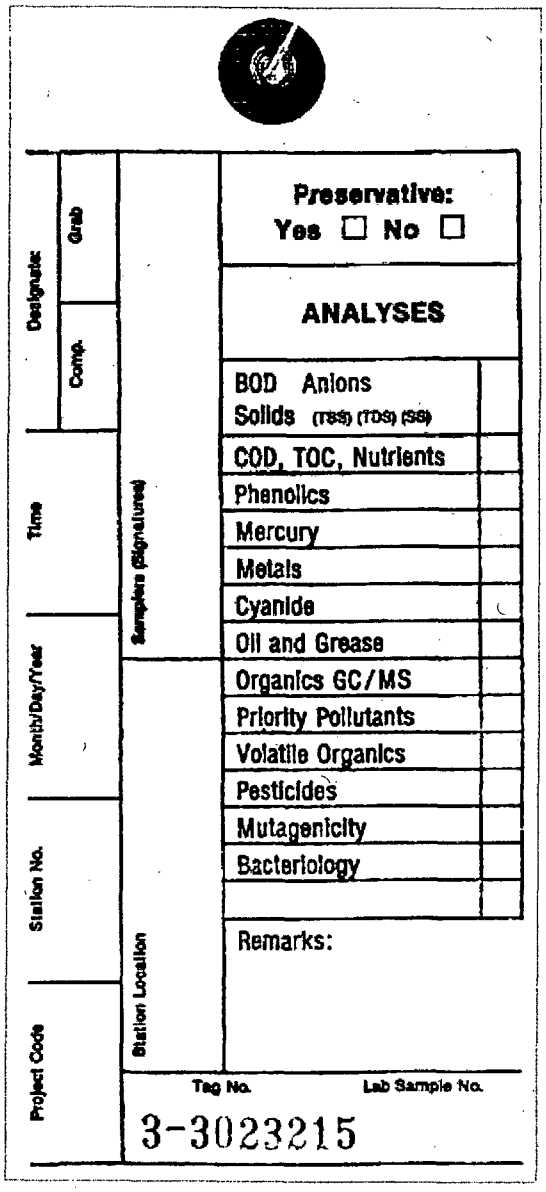
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy retained by laboratory; Pink copy retained by samplers. 1/98

Note: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.

Figure 2
Example Sample Tag



Note: Equivalent sample labels or tags may be used.

TSOP 1-3

SURFACE SOIL SAMPLING

Surface Soil Sampling

SOP 1-3
Revision: 6
Date: March 2007

Prepared: Del R. Baird

Technical Review: Mark Caldwell

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

The purpose of this standard operating procedure (SOP) is to define the techniques and requirements for the collection of surface soil samples.

2.0 Background

The techniques and protocols described herein may be used to collect other surface media, including sediment and sludge.

2.1 Definitions

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Spoon/Scoop - A small stainless steel or Teflon® utensil approximately 15 cm (6 inches) in length with a stem-like handle.

Surface Soil - Soils generally defined as the soils extending from ground surface to approximately 30 centimeters (cm) (1 foot) below ground surface (bgs). Surface soil samples are frequently collected from 0 to 15 cm (0 to 6 inches) bgs. Depending on application, the soil interval to be sampled will vary.

Trowel - A small stainless steel or Teflon shovel approximately 15 to 20 cm (6 to 8 inches) in length with a slight (approximately 140°) curve across the length. The trowel has a stem-like handle (for hand operation). Samples are collected with a spooning action.

2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

2.3 Discussion

Surface soil samples are collected to determine the type(s) and level(s) of contamination and are often important to risk assessment. These samples may be collected as part of an investigative plan, site-specific sampling plan, and/or as a screen for "hot spots," which may require more extensive sampling.

Sediment(s) and sludge(s) that have been exposed by evaporation, stream rerouting, or any other means are collected by the same methods as those for surface soil(s). Typically the top 1 to 2 cm of material are carefully removed before collection of the sample. If a thick, matted root zone is encountered at or near the surface, it shall be removed before collecting the sample.

Surface soil, exposed sediment, or sludge is collected using stainless steel and/or Teflon-lined trowels or scoops.

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling. The site manager must also ensure that the quantity and location of surface soil samples collected meet the requirements of the site-specific plans.

Field Team Leader - The field team leader is responsible for ensuring that field personnel collect surface soil samples in accordance with this procedure and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

- Insulated cooler and clear waterproof sealing tape
- Ice bags or "blue ice"
- Latex or appropriate gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Stainless steel and/or Teflon-lined spatulas and pans, trays, or bowls
- Stainless steel and/or Teflon-lined trowels or spoons (or equipment as specified in the site-specific plans)
- Plastic sheeting
- Project plans (work plan/health and safety plan)
- Appropriate sample containers
- Field logbook
- Indelible black ink pen and/or marker
- Sample chain-of-custody forms
- Custody seals
- Decontamination supplies

Additional equipment is discussed in Section 5.2.2, VOC Field Sampling/Preservation Methods.

5.0 Procedures

5.1 Preparation

The following steps must be followed when preparing for sample collection:

1. Review site-specific health and safety plan and project plans before initiating sampling activity.

2. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.

3. Locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the appropriate field logbook. When possible, reference locations back to existing site features such as buildings, roads, intersections, etc.

4. Processes for verifying depth of sampling must be specified in the site-specific plans.

5. Place clean plastic sheeting on a flat, level surface near the sampling area, if possible, and place equipment to be used on the plastic; place the insulated cooler(s) on separate plastic sheeting.

6. A clean, decontaminated trowel, scoop, or spoon will be used for each sample collected. Other equipment may be used (e.g., shovels) if constructed of stainless steel.

5.2 Collection

The following general steps must be followed when collecting surface soil samples:

1. Wear clean gloves during handling of all sample containers and sampling devices.

2. Surface soil samples are normally collected from the least contaminated to the most contaminated areas, if known.

3. Document the sampling events, recording the information in the designated field logbook. Document any and all deviations from SOPs in the field logbook and include rationale for changes. See CDM Federal SOP 4-1.

4. Carefully remove stones, vegetation, snow, etc. from the ground surface in the immediate vicinity of the sampling location.

5. First collect required sample aliquot for volatile analyses, as well as any other samples that would be degraded by aeration. Follow with collection of samples for other analyses.

6. Decontaminate sampling equipment between sample locations. See CDM Federal SOP 4-5.

5.2.1 Method for Collecting Samples for Volatile Organic Compound Analysis
The requirements for collecting grab samples of surface soil for volatile organic compounds (VOCs) or other samples degraded by aeration are as follows:

1. VOC samples shall be collected with the least disturbance possible.

2. VOC samples shall be collected as grab samples; however, the method of collection will vary from site to site, based on data quality objectives and the degree of known or suspected contamination.

3. Complete sample label by filling in the appropriate information and securing the label to the container. Cover the sample label with a piece of clear tape.

4. Use a clean stainless steel or Teflon-lined trowel or spoon (or tube) to collect sufficient material in one grab to fill the sample containers.

5. With the aid of a clean stainless steel spatula, quickly fill the sample containers directly from the sampling device, removing stones, twigs, grass, etc., from the sample. Fill the containers as full and compact as possible to minimize headspace.

6. Immediately secure the Teflon-lined cap(s) on the sample container(s).

7. Wipe the containers with a clean Kimwipe or paper towel to remove any residual soil from the exterior of the container.

8. Place the containers in individual zip-top plastic bag(s) and seal the bag(s).

9. Pack all samples as required. Include properly completed documentation and affix signed and dated custody seals to the cooler lid. See CDM Federal SOPs 1-2 and 2-1.

Note: A trip blank shall be included with sample coolers containing VOC samples. QC sample requirements vary from project to project. Consult the project-specific work plan for requirements.

5.2.2 VOC Field Sampling/Preservation Methods
The following four sections contain SW-846 test methods for sampling and field preservation. These methods include EnCore™ Sampler Method for low-level analyses, EnCore Sampler Method for high-level analyses, acid preservation for low-level analyses, and methanol preservation for high-level analyses. These methods are very detailed and contain equipment requirements at the beginning of each section.

When collecting soil samples using the EnCore Sampler Method, collection of soil for moisture content analysis is required. Results of this analysis are used to adjust "wet" concentration results to "dry" concentrations to meet analytical method requirements.

Note: Some variations from these methods (e.g., sample volume) may be required depending on the contracted analytical laboratory.

5.2.2.1 EnCore Sampling Equipment and Collection for Low Level Analyses (<200 µg/kg)
The following equipment is required for low-level analysis:

- Three 5-gram (g) samplers

Note: The sample volume requirements are general requirements. Actual sample volumes, sizes, and quantities may vary depending on client or laboratory requirements.

- One 110-milliliter (mL) (4-ounce) wide-mouth glass jar or applicable container for moisture analysis
- One T-handle
- Paper towels

The requirements for collecting low level analysis (<200 µg/kg) by the EnCore Sampler Method are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.
2. Remove sampler and cap from package and attach T-handle to sampler body.
3. Quickly push the sampler into a freshly exposed surface of soil until the O-ring is visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
4. Extract the sampler and wipe the sampler head with a paper towel so that the cap can be tightly attached.
5. Push cap on with a twisting motion to secure to the sampler body.
6. Rotate the sampler stem counterclockwise until stem locks in place to retain sample within the sampler body.
7. Fill out sample label and attach to sampler.
8. Repeat procedure for the remaining two samplers.
9. Collect moisture sample in 110-mL (4-ounce) wide-mouth jar using a clean stainless steel spoon or trowel.
10. Store samples at 4° Celsius (C), (±2°C). Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

Note: Verify requirements for extraction/holding times.

5.2.2.2 Acid Preservation Equipment and Sampling Requirements for Low Level Analyses (<200 µg/kg)
Note: Determine specific field acid preservation procedure based on the requirements specified in the analytical method to be employed. Variations between analytical methods exist with respect to field acid preservation.

The following equipment and supplies are required if field acid preservation is required:

- One 40-mL VOA vial with acid preservation (for field testing of soil pH)
- Two preweighed 40-mL VOA vials with acid preservative and stir bar (for lab analysis)
- Two preweighed 40-mL VOA vials with water and stir bar (in case samples cannot be pre-preserved)
- One preweighed jar that contains methanol or a preweighed empty jar accompanied with a preweighed vial that contains methanol (for screening sample and/or high level analysis)
- One 110-mL (4-oz) wide-mouth glass jar or applicable container for moisture analysis
- One 55-mL (2-oz) jar with acid preservative (if additional acid is needed because of high soil pH)
- One appropriately sized scoop capable of delivering 1 g of solid sodium bisulfate
- pH paper
- Weighing scale capable of reading to 0.01 g

- Set of balance weights used in daily balance calibration
- Gloves for working with preweighed sample vials
- Paper towels
- Sodium bisulfate acid solution ($NaHS0_4$)
- A cutoff plastic syringe or other coring device capable of collecting sufficient sample volume (5 g)

Testing Effervescing Capacity of Soils
Soils must be tested with acid to determine the amount of effervescing that will occur when preserved with acid. Effervescing will drive off VOCs as well as create a high pressure in a sealed vial that could result in the explosion of the sample container. The following steps provide information on the effervescing capacity of the soil.

1. Wear clean gloves during handling of all sample containers and sampling devices.

2. Place approximately 5 g of soil into a vial that contains acid preservative and no stir bar.

3. Do not cap this vial as it may EXPLODE upon interaction with the soil.

4. Observe the sample for gas formation (due to carbonates in the soil).

5. If vigorous or sustained gas emissions are observed, then acid preservation is not acceptable to preserve the sample.
   - In this case the samples need to be collected in the VOA vials with only water and a stir bar. The vials with acid preservative CANNOT be used.

6. If a small amount or no gas formation occurs, then acid preservation is acceptable to preserve the sample. Keep this testing vial for use in the buffering test detailed below.
   - In this case the samples need to be collected in the VOA vials with the acid preservative and a stir bar.

Testing Buffering Capacity of Soils
The soils must be tested to determine the quantity of acid that is required to achieve a pH reading of ≤2 standard units (SUs). The following steps will assist in determining this quantity.

1. If acid preservation is acceptable for sampling soils, then the sample vial that was used to test the effervescing capacity of the soils can be used to test the buffering capacity.

2. Wear clean gloves during handling of all sample containers and sampling devices.

3. Cap the vial that contains 5 g of soil, acid preservative, and no stir bar from Step 1 in the effervescing test.

4. Shake the vial gently to homogenize the contents.

5. Open the vial and check the pH of the acid solution with pH paper.
   - If the pH paper reads below 2, then the sampling can be done in the two preweighed 40-mL VOA vials with the acid preservative and stir bar. Since the pH was below 2, it is not necessary to add additional acid to the vials.
   - If the pH paper reads above 2, then additional acid needs to be added to the sample vial.

6. Use the jar with the solid sodium bisulfate acid and add another 1 g of acid to the sample.

7. Cap the vial and shake thoroughly again.

8. Repeat Step 4.
   - If the pH paper reads below 2, then the sampling can be done in the two preweighed 40-mL VOA vials with the acid preservative and stir bar and 1 g extra of acid.

- Make a note of the extra gram of acid needed so the same amount of acid can be added to the vials the lab will analyze.
- If the pH paper reads above 2, repeat Steps 5 through 7 until the sample pH ≤2 SUs.

Now that the soil chemistry has been determined, the actual sampling can occur. The procedure stated below assumes the correct vials are used based on the guidance discussed.

Sample Preservation Steps

1. Wear clean gloves during all handling of preweighed vials.
2. Add more acid if necessary (based on the buffering capacity testing discussed in the previous section).
3. Quickly collect a 5-g sample using a cutoff plastic syringe or other coring device designed to deliver 5 g of soil from a freshly exposed surface of soil.
4. Carefully wipe exterior of sample collection device with a clean paper towel.
5. Quickly transfer the sample to the appropriate VOA vial, using caution when extruding the sample to prevent splashing of the acid within the vial.
6. Remove any soil from the threads of the sample vial using a clean paper towel.
7. Cap vial and weigh the jar to the nearest 0.01 g.
8. Record exact weight on sample label.
9. Repeat sampling procedure for the duplicate VOA vial.
10. Weigh the vial containing methanol preservative to the nearest 0.01 g. If the weight of the vial with methanol varies by *more than 0.01 g from the original weight recorded on the vial, discard the vial. If the weight is within tolerance, it can* be used for soil preservation below.
11. Take the empty jar or the jar that contains the methanol preservative and quickly collect a 5-g or 25-g sample using a cutoff plastic syringe or other coring device designed to deliver 5 g or 25 g of soil from a freshly exposed surface of soil. The 5-g or 25-g size is dependent on who is doing the sampling and requirements specified by the client or analytical laboratory.
12. Carefully wipe the exterior of the collection device with a clean paper towel.
13. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol, be careful not to splash the methanol outside of the vial.
14. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided, using only one vial of methanol preservative per sample jar.
15. Remove any soil from the threads of the sample vial using a clean paper towel and cap the jar.
16. Weigh the jar with sample to the nearest 0.01 g and record the weight on the sample label.
17. Collect dry weight sample using a clean stainless steel spoon or trowel.
18. Store samples at 4°C, ±2°C.
19. Ship sample containers to the analytical laboratory with plenty of ice and in accordance with Department of Transportation (DOT) regulations (CORROSIVE. FLAMMABLE LIQUID. POISON).

5.2.2.3 EnCore Sampling Equipment and Sampling Requirements for High Level Analysis (≥200 µg/kg)
The following equipment is required for high-level analysis:

- One 5-g sampler or one 25-g sampler

Note: The volume requirements specified are general requirements. Actual sample volumes, container sizes, and quantities may vary depending on client or laboratory requirements.

- One 110-mL (4-oz) wide-mouth glass jar or applicable container specified for moisture analysis
- One T-handle
- Paper towels

The requirements for collecting high level analysis by the EnCore Sampler Method are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.
2. Remove sample and cap from package and attach T-handle to sampler body.
3. Quickly push the sampler into freshly exposed surface of soil until the O-ring is visible within the hole/window on the side of the T-handle. If the O-ring is not visible within the window/hole, then the sampler is not full.
4. Use a clean paper towel to quickly wipe the sampler head so that the cap can be tightly attached.
5. Push cap on with a twisting motion to secure to the sampler body.
6. Fill out sample label and attach to sampler.
7. Rotate sampler stem counterclockwise until the stem locks in place to retain the sample within the sampler body.
8. Collect moisture sample in 110-mL (4-oz) wide-mouth glass jar or designated container using a clean stainless steel spoon or trowel.
9. Store samplers at 4°C, ±2°C. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

Note: Verify requirements for extraction/holding times.

5.2.2.4 Methanol Preservation Equipment and Sampling Requirements for High Level Analyses (≥200 µg/kg)
The following equipment is required for high-level analysis:

- One preweighed jar that contains methanol or a preweighed empty jar accompanied with a preweighed vial that contains methanol (laboratory grade)
- One dry weight cup
- Weighing balance that accurately weighs to 0.01 g
- Set of balance weights used in daily balance calibration
- Latex gloves
- Paper towels
- Cutoff plastic syringe or other coring device to deliver 5 g or 25 g of soil

The requirements for sampling and preservation are as follows:

1. Wear clean gloves during all handling of preweighed vials.
2. Weigh the vial containing methanol preservative to the nearest 0.01 g. If the weight of the vial with methanol varies by more than 0.01 g from the original weight recorded on the vial, discard the vial. If the weight is within tolerance, it can be used for soil preservation/collection below.

3. Quickly collect a 5-g or 25-g sample using a cutoff plastic syringe or other coring device designed to deliver 5 g or 25 g of soil from a freshly exposed surface of soil.

4. Carefully wipe the exterior of the collection device with a clean paper towel.

5. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol, be careful not to splash the methanol outside of the vial. Again, the type of jar used is dependent on the client or laboratory requirements.

6. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided, using only one vial of methanol preservative per sample jar.

7. Remove any soil from the exterior of the vial using a clean paper towel and cap the sample jar.

8. Weigh the jar with the soil in it to the nearest 0.01 g and record the weight on the sample label.

9. Collect a dry weight sample using a clean stainless steel spoon or trowel.

10. Store samples at 4°C, ±2°C.

11. Ship sample containers with plenty of ice to the analytical laboratory in accordance with DOT regulations (CORROSIVE. FLAMMABLE LIQUID. POISON).

5.2.3 Method for Collecting Samples for Nonvolatile Organic or Inorganic Compound Analysis
The requirements for collecting samples of surface soil for nonvolatile organic or inorganic analyses are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.

2. Label each sample container with the appropriate information. Secure the label by covering it with a piece of clear tape.

3. Use a decontaminated stainless steel or Teflon-lined trowel or spoon to obtain sufficient sample from the required interval and subsampling points, if necessary, to fill the specified sample containers.

4. Empty the contents of the sampling device directly into a clean stainless steel or Teflon-lined tray or bowl.

5. Homogenize the sample by mixing with a spoon, spatula, or trowel.

6. Use the spoon, spatula, or trowel to distribute the uniform mixture into the labeled sample containers. Fill organic sample containers first, then inorganics.

7. Secure the appropriate cap on each container immediately after filling it.

8. Wipe the sample containers with a clean Kimwipe or paper towel to remove any residual soil.

9. Place sample containers in individual zip-top plastic bags and seal the bags.

10. Pack all samples as required. Include properly completed documentation and affix custody seals to the cooler lid.

11. Decontaminate sampling equipment according to CDM Federal SOP 4-5.

6.0 Restrictions/Limitations

When grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, it is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

7.0 References

U. S. Department of Energy. 1996. Hazardous Waste Remedial Actions Program. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R2. September.

_____. Hazardous Waste Remedial Actions Program. *Standard Operating Procedures for Site Characterizations*, DOE/HWP-100/R1. September 1996 or current revision.

U. S. Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001. December 1987 or current revision.

_____. *Test Methods for Evaluating Solid Waste*, Physical/Chemical Methods (SW-846). Third Edition, November 1986, (as amended by Update III, June 1997). Method 5035: Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

_____. Region 4. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. November.

TSOP 1-4

SUBSURFACE SOIL SAMPLING

Subsurface Soil Sampling

SOP 1-4
Revision: 6
Date: March 2007

Prepared: Del R. Baird

Technical Review: Mark Caldwell

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to define the techniques and requirements for collecting soil samples from the unconsolidated zone. Techniques include use of hand augers, split-barrel samplers, Shelby tubes, direct-push rig samplers, and backhoes.

2.0 Background

2.1 Definitions

Auger Flight - A steel section length attached to the auger length to extend the augers and remove additional unconsolidated material as drilling depth increases.

Backhoe - An excavator whose shovel bucket is attached to a hinged boom and is drawn backward to move earth.

Direct Push Rig Sampler - A sampler with a locking tip that keeps the device closed during the sampling push. The tip is released at the desired depth, and the push is continued. During the push, the soil moves into the sampler.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Hand Auger - A stainless steel cylinder (bucket) approximately 7 to 10 centimeters (cm) (3 to 4 inches) in diameter and 30 cm (1 foot) in length, open at both ends with the bottom edge designed to twist into the unconsolidated material and obtain a soil core. The auger has a T-shaped handle (used for manual operation) attached to the top of the bucket by extendable stainless steel rods.

Liner - A cylindrical sleeve generally made of brass, stainless steel, or Teflon® that is placed inside a split-barrel sampler, direct-push rig sampler, or hand auger bucket to collect samples for VOC analysis or prevent cross-contamination of the sample.

Shelby Tube - A cylindrical sampling device, generally made of steel, that is driven into the subsurface soil through a hollow-stem auger using a drill rig. The tube, once retrieved, may be capped and the undisturbed soil sample extruded in the laboratory before analysis.

Slide Hammer - A device consisting of a drive weight (hammer) and a drive weight fall guide.

Split-Barrel Sampler - A cylindrical sampling device generally made of carbon steel that fits into a hollow-stem auger. The sampler is opened lengthwise, which allows the sample to be retrieved by "splitting" the barrel sampler. Also referred to as a split-spoon.

Subsurface Soil - The unconsolidated material that exists deeper than approximately 30 cm (1 foot) below the ground surface.

Unconsolidated Zone - A layer of nonlithified earth material (soil) that has no mineral cement or matrix binding its grains.

2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 3-5, *Lithologic Logging*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

2.3 Discussion

Shallow subsurface soil samples (to depths between 0.15 cm to 3 meters (m) [6 inches and 10 feet]) may be collected using hand augers. However, soil samples collected with a hand auger are commonly of poorer quality than those collected by split-barrel or Shelby tube samplers because the soil sample is disturbed in the augering process. Split-barrel and Shelby tube samplers are generally used during collection of soil samples using hollow-stem auger drill methods. Barrel-type samplers may also be used to collect soil samples from hand auger borings using a slide hammer device. Liners are used to minimize the loss of volatile organic compounds (VOCs) and to prevent cross-contamination from the sampler to the sample. The size and material of sampling devices shall be selected based on project and analytical objectives and defined in site-specific plans. Collecting samples using backhoes enables the collector to correlate the precise vertical and horizontal interval with adjacent materials (cross section).

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that field personnel are trained in the use of this procedure and the required equipment, and for ensuring that subsurface soil samples are collected in accordance with this procedure and any other SOPs pertaining to specific media sampling. The site manager must also ensure that the quantity and location of subsurface soil samples collected meet the requirements of the site-specific plans.

Field Team Leader - The field team leader is responsible for ensuring that field personnel collect subsurface soil samples in accordance with this SOP and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.0 Required Equipment

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens and markers
- Clear, waterproof tape
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler(s) and waterproof sealing tape
- Ice bags or "blue ice"
- Latex or appropriate gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Plastic sheeting
- Stainless steel and/or Teflon-lined spatulas and pans, trays, bowls, trowels, or spoons
- Decontamination supplies
- Sample chain-of-custody forms
- Custody seals

Additional equipment is discussed in Section 5.2.7, Field Sampling/Preservation Methods.

4.2 Manual (Hand) Augering

- T-handle
- Hand auger: flighted-, bucket-, or tube-type auger as required by the site-specific plans
- Extension rods
- Wrench(es), pliers
- Slide hammer with extension rods

4.3 Split-Barrel and Shelby Tube Sampling

- Drill rig equipped with a 63-kilogram (kg) (140-lb) drop hammer and sufficient hollow-stem auger flights to drill to the depths required by the site-specific plans.
- Sufficient numbers of split-barrel samplers so that at least one is always decontaminated and available for sampling. Three split-barrel samplers are generally the minimum necessary (Shelby tubes are used only once).
- Split-barrel liners (as appropriate).
- Wrench(es), hammer.

4.4 Direct Push Rig Sampling

- Direct push rig with sufficient probe rods to extend to sample depths required by the site-specific plans
- Sufficient number of samplers (in case of malfunction) and appropriate liners to collect adequate number of samples
- Extension rods
- Wrench(es), pliers, other specific tools

4.5 Backhoe Sampling

- Backhoe with a sufficient length boom to extend to planned depths
- Sufficient number of trowels or scoops
- Extension rods
- Tape, utility knife, other specific tools as needed

5.0 Procedures

5.1 Preparation

1. Review site-specific health and safety plan and project plans before initiating sampling activity.

2. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.

3. Locate sampling location(s) in accordance with project documents (e.g., work plan) and document pertinent information in the appropriate field logbook. When possible, reference locations back to existing site features such as buildings, roads, intersections, etc.

4. Processes for verifying depth of sampling must be specified in the site-specific plans.

5. Clear away vegetation and debris from the ground surface at the boring location.

6. Prepare an area next to the sample collection location for laying out cuttings by placing plastic sheeting on the ground to cover the immediate area surrounding the borehole.

7. Set up a decontamination line, if decontamination is required, in accordance with CDM Federal SOP 4-5.

5.2 Collection

The following general steps must be followed when collecting all subsurface soil samples:

1. Wear clean gloves during handling of all sample containers and sampling devices.

2. VOC samples or samples that may be degraded by aeration shall be collected first and with the least disturbance possible.

3. Sampling information shall be recorded in the field logbook and on any associated forms. Describe lithology, according to CDM Federal SOP 3-5, in the field logbook or on the lithologic log form.

4. Specific sampling devices to be used shall be identified in the site-specific plans and recorded in the field logbook.

5. Care must be taken to prevent cross-contamination and misidentification of samples.

6. Sample containers containing samples for VOC analysis shall be filled completely to minimize headspace.

5.2.1 Manual (Hand) Augering

The following steps must be followed when collecting hand-augered samples:

1. Auger to the depth required for sampling. Place cuttings on plastic sheeting or as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.

2. Throughout the augering, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.

3. Cease augering when the top of the specified sampling depth has been reached. If required, remove the auger from the hole and decontaminate the auger or use a separate decontaminated auger, then obtain the sample.

4. Collect a grab sample for VOC analyses (or samples that may be degraded by aeration) immediately and place in sample container. Sample bottles shall be filled completely to minimize headspace.

5. Remaining sample shall be homogenized for other analyses before placing samples in the appropriate containers. Label containers as required.

6. Wipe containers with a clean Kimwipe or paper towel to remove residual soil from the exterior of the container(s).

7. Label the sample container with the appropriate information. Secure the label by covering it with a piece of clear tape.

8. Place the containers in zip-top plastic bags and seal the bags. Pack samples in a cooler with ice.

9. Proceed with further sampling, as required by the site-specific plans.

10. When all sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.

11. Complete the field logbook entry and other appropriate forms, being sure to record all relevant information before leaving the site.

12. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-1 or site-specific plans.

5.2.2 Manual (Hand) Augering Using a Tube Sampler with Liner or Slide Hammer

The following steps must be followed when collecting hand-augered samples using a tube sampler with liner or slide hammer:

1. Auger to the depth required for sampling. Place cuttings on the plastic sheeting as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.

2. Throughout augering, make detailed notes in the field logbook concerning the geologic features of the soil or sediments.

3. Cease augering when the top of the specified sampling depth has been reached. Remove the auger from the hole and decontaminate.

4. Prepare a decontaminated tube sampler by installing a decontaminated liner in the auger tube.

5. Obtain the sample by driving the sample tube through the sample interval with the slide hammer. Remove the liner from the tube and immediately cover the ends with Teflon tape and cap the ends of the tube. Seal the caps with waterproof tape.

6. Wipe sealed liners with a clean Kimwipe or paper towel.

7. Label the sealed liners as required in the site-specific plans. Mark the top and bottom of the sample on the outside of the liner.

8. Place sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

9. Proceed with further sampling, as required by the site-specific plans.

10. When sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.

11. Decontaminate all equipment according to CDM Federal SOP 4-5 between each sample.

12. Complete the field logbook entry and other forms, being sure to record all relevant information before leaving the site.

13. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-1 or site-specific plans.

5.2.3 Split-Barrel Sampling

Note: Steps 1 through 12 describe activities to be performed by a licensed drilling contractor, not CDM personnel.

The following steps must be followed when collecting split-barrel samples:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.

2. The drilling rig will be decontaminated at a separate location before drilling, per CDM Federal SOP 4-5 or the site-specific decontamination procedures.

3. Attach the hollow-stem auger with the cutting head, plug, and center rod(s) to the drill rig.

4. Begin drilling and proceed to the first designated sample depth, adding auger flights as necessary.

5. Upon reaching the designated sample depth, slightly raise the auger(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.

6. Remove the plug and center rods, if applicable.

7. If required by the site-specific sampling plan, install decontaminated liners in the split barrel sampler.

8. Install a decontaminated split-barrel on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.

9. Mark the center rod in 15-cm (6-inch) increments from the top of the auger(s).

10. Drive the split-barrel using the hammer. Use a full 76-cm (30-inch) drop as specified by the American Society for Testing and Materials (ASTM) Method D-1586. Record the number of blows required to drive the sampler through each 15-cm (6-inch) increment.

11. Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little or no progress is made for 50 blows of the hammer. ASTM D1586-99 § 7.2.1 and 7.2.2 defines "refusal" as >50 blows per 6-inch advance or a total of 100 blows.

12. Pull the sampler free by using upswings of the hammer to loosen the sampler. Pull out the center rod and sampler.

13. Unscrew the sampler assembly from the center rod and place it on the plastic sheeting.

14. Remove the drive shoe and head assembly. If necessary, tap the sampler assembly with a hammer to loosen threaded couplings.

15. With the drive shoe and head assembly off, open (split) the sampler, being careful not to disturb the sample.

16. Label sample containers with appropriate information. Secure the label, covering it with a piece of clear tape. If liners were used, immediately install Teflon tape over the ends of the liners, cap the liners, and seal the caps over the ends of the liner with waterproof tape. Label the samples as required by the site-specific plans. Mark the top and bottom of each sample on the outside of each liner. Indicate boring/well number and depth on the outside of the liner, as required.

17. If VOC analyses are to be conducted on the soil sample and liners were not used, place that sample in its sample container immediately after opening the split-barrel, filling the sample bottle completely. Seal the container immediately, then describe it in the field logbook and/or associated forms. Record the sample identification number, depth from which the sample was taken, and the analyses to be performed on the samples in the field logbook and on the appropriate forms.

18. Remaining sample shall be homogenized before placing samples in appropriate containers.

19. Wipe containers with a clean Kimwipe or paper towel. Label containers as required when liners are not used.

20. Place containers and/or sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.

21. In the field logbook and on the boring log, describe sample lithology by observing cuttings and/or the bottom end of the liner.

22. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.

23. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.

24. Dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans. Backfill borehole as specified in project-specific plans.

25. Decontaminate samplers and other small sampling equipment according to CDM Federal SOP 4-5 before proceeding to other sampling locations.

26. Complete the field logbook entry and other forms, being sure to record all relevant information before leaving the site.

27. Properly package all samples for shipment to laboratories and complete all necessary sample shipment documentation. Remand custody of the samples to appropriate personnel. See CDM Federal SOPs 1-2 and 2-1 or site-specific plans.

5.2.4 Shelby Tube Sampling

Note: Steps 1 through 11 describe activities to be performed by a licensed drilling contractor, not CDM personnel. ASTM D1586-99 provides more details pertaining to this sampling methodology.

The following steps must be followed when collecting samples using the Shelby tube:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.

2. The drilling rig will be decontaminated at a separate location before drilling.

3. Attach the hollow-stem auger with the cutting head, plug, and center rod(s).

4. Begin drilling and proceed to the first designated sample depth, adding auger(s) as necessary.

5. Upon reaching the designated sample depth, slightly raise the auger(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.

6. Remove the plug and center rods, if applicable.

7. Attach a head assembly to a decontaminated Shelby tube. Attach the Shelby tube assembly to the center rods.

8. Lower the Shelby tube and center rods into the hollow-stem augers and seat it at the bottom. Be sure to leave 30 inches or more of center rod above the lowest point to the hydraulic piston's extension.

9. Use the rig's hydraulic drive to push the Shelby tube into undisturbed soil. The tube shall be pushed with a slow, steady force. Note the pressure used to push the Shelby tube in the field logbook.

10. When the Shelby tube has been advanced to its full length or to refusal, back off the hydraulic pistons. Attach a hoisting plug to the upper end of the center rod, slightly twist to break off the sample, and pull the apparatus out of the hole with the rig winch.

11. Retrieve the Shelby tube to the surface, detach it from the center rod, and remove the head assembly.

12. Since the typical intent of Shelby tube sampling is for engineering purposes and an undisturbed sample is required, the tube ends shall be sealed immediately. Sealing is accomplished by filling any void space in the tube with melted beeswax, then placing caps on the ends of the tube and taping caps into place. The top and bottom ends of the tube shall be marked and the tube transported to the laboratory in an upright position. ***It is extremely important that the Shelby tube samples are not disturbed in any way (dropped, rolled, subjected to extreme temperatures, etc.)***.

13. Wipe sealed tubes with a clean Kimwipe or paper towel.

14. Indicate boring/well number and depth on outside of the tube.

15. Place sealed tubes in zip-top plastic bags, seal bags, and pack samples in a chilled cooler, if applicable.

16. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.

17. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.

18. Dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.

19. Complete the field logbook entry, being sure to record all relevant information before leaving the site. These methods may be used if directed by the EPA region, client, or governing sample plan.

5.2.5 Direct Push Rig Sampling
Note: Steps 1 through 11 describe activities to be performed by a licensed drilling contractor, not CDM personnel.

The following steps must be followed when collecting samples using a direct push rig sampler:

1. Verify that the push rig has been decontaminated at a separate location before drilling.

2. Attach the properly assembled sampler with appropriate liner to the end of the probe rod.

3. Attach drive cap and probe to the first designated sample depth, adding rod(s) as necessary.
4. Upon reaching the designated sample depth, remove the drive cap to access the inside of the probe rods.
5. Insert extension rods into probe rod; turn extension rod to release tip.
6. Retrieve extension rods, replace drive cap, add additional push rod if required, and push probe rod to the planned sample interval.
7. Attach pull cap and retrieve push rods and sampler.
8. Remove the sampler from the probe rod, then remove the cutting shoe from the sampler.
9. Once the cutting shoe is removed, the liner, containing the sample, can be removed from the sampler. The sample can now be handled per site-specific plans.
10. When sample collection is complete, remove the push rig to the heavy equipment decontamination area.
11. Dispose of excess sample cuttings, plastic sheeting, etc., as specified in the site-specific plans.
12. Complete the field logbook entry, being sure to record all relevant information before leaving the site. These methods may be used if directed by the EPA region, client, or governing sample plan.

5.2.6 Backhoe Sampling

Note: Steps 1, 2, 7, and 8 describe activities to be performed by a licensed heavy equipment operator, not CDM personnel.

The following steps must be followed when collecting samples using a backhoe:

1. Verify that the backhoe has been decontaminated at a separate location before excavation.
2. Excavate to the depth required.
3. Use a stainless steel trowel or scoop.
4. Attach the trowel to an electrical conduit, steel rod, or other similar devise.
5. Remove the surface layer of soil "smeared" on the trench wall.
6. Replace the trowel with a clean trowel and collect the sample.
7. When sample collection is complete in the trench, backfill the trench with the excavated material, if allowed.
8. Once the trench has been backfilled, move the backhoe to the heavy equipment decontamination area.
9. Dispose of excess sample cuttings, plastic sheeting, etc., as specified in the site-specific plans.
10. Complete the field logbook entry, being sure to record all relevant information before leaving the site. These methods may be used if directed by the EPA region, client, or governing sample plan.

5.2.7 Field Sampling/Preservation Methods

The following three sections contain SW 846 Methods for sampling and field preservation. These methods include EnCore™ Sampler Method for low-level detection limits, EnCore Sampler Method for high-level limits/screening, and methanol preservation. These methods may be used if required by the EPA Region, client, or governing sample plan. These methods are very detailed and contain equipment requirements at the beginning of each section.

When collecting soil samples using the EnCore Sampler Method, collection of soil for moisture content analysis is required. Results of this analysis are used to adjust "wet" concentration results to "dry" concentrations to meet analytical method requirements.

Note: Some variations from these methods, (e.g., sample volume) may be required depending on the contracted analytical laboratory.

5.2.7.1 EnCore Sampler Equipment and Collection Requirements for Low-Level Analyses (<200 µg/kg)
The following equipment is required for low-level analysis:

- Three 5 grams (g) samplers

Note: The sample volume requirements specified are general requirements. Actual sample volume and/or container sizes may vary depending on client or laboratory requirements.

- One 110-milliliter (mL) (4-ounce [oz.]) wide-mouth glass jar or applicable container for moisture analysis
- One T-handle
- Paper towels

The requirements for collecting low level analysis by the EnCore Sampler Method are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.
2. Remove sampler and cap from package and attach T-handle to sampler body.
3. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full. The O-ring will be visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
4. Extract sampler and wipe the sampler head with a paper towel so that the cap can be tightly attached.
5. Push cap on with a twisting motion to secure to the sampler body.
6. Rotate the sampler stem counterclockwise until stem locks in place to retain sample within the sampler body.
7. Fill out sample label and attach to sampler.
8. Repeat procedure for the remaining two samplers.
9. Collect moisture sample in 110-mL (4-oz.) wide-mouth jar using a clean stainless steel spoon or trowel.
10. Store samplers at 4 degrees (°) Celsius (C), ±2°C. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

Note: Verify requirements for extraction/holding times.

5.2.7.2 EnCore Sampler Equipment and Collection Requirements for High-Level Analyses (≥200 µg/kg)
The following equipment is required for high-level analysis:

- One 5-g sampler or one 25-g sampler (the sampler size used will be dependent on client and laboratory requirements
- One 110-mL (4-oz.) wide-mouth glass jar or applicable container specified for moisture analysis
- One T-handle
- Paper towels

The requirements for collecting high-level analysis by the EnCore Sampler Method are as follows:

1. Wear clean gloves during handling of all sample containers and sampling devices.
2. Remove sample and cap from package and attach T-handle to sampler body.
3. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full. The O-ring will be visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
4. Use clean paper toweling to quickly wipe the sampler head so that the cap can be tightly attached.
5. Push cap on with a twisting motion to attach cap.
6. Fill out a sample label and attach to sampler.
7. Rotate sampler stem counterclockwise until the stem locks in place to retain the sample within the sampler body.
8. Collect moisture sample in 110-mL (4-oz.) wide-mouth jar or designated container using a clean stainless steel spoon or trowel.
9. Store samplers at 4°C, ±2°C. Samples must be shipped and delivered to the analytical laboratory for extraction within 48 hours.

Note: Verify requirements for extraction/holding times.

5.2.7.3 Methanol Preservation Equipment and Sampling Requirements for High-Level Analyses (≥200 µg/kg)
The following equipment is required for methanol preservation sampling:

- One preweighed jar that contains methanol or a preweighed empty jar accompanied with a preweighed vial that contains methanol (laboratory grade)
- One dry weight cup
- Weighing balance that accurately weighs to 0.01 g (with accuracy of ±0.1 g)
- Set of balance weights used in daily balance calibration
- Latex gloves
- Paper towels
- Cutoff plastic syringe or other coring device to deliver 5 g or 25 g of soil

The requirements for sampling and preservation are as follows:

1. Wear clean gloves during all handling of preweighed vials.
2. Weigh the vial containing methanol preservative to the nearest 0.01 g. If the weight of the vial with methanol varies by more than 0.01 g from the original weight recorded on the vial, discard the vial. If the weight is within tolerance, it can be used for soil preservation/collection below.
3. Quickly collect a 5-g or 25-g sample using a cutoff plastic syringe or other coring device designed to deliver 5 g or 25 g of soil from a freshly exposed surface of soil. The 5-g or 25-g size used is dependent on client and laboratory requirements.
4. Carefully wipe the exterior of the collection device with a clean paper towel.
5. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol, be careful not to splash the methanol outside of the vial. Again, the type of jar used is dependent on the client or laboratory requirements.

6. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided, using only one vial of methanol preservative per sample jar.

7. Using the paper toweling, remove any soil off of the vial threads and cap the jar.

8. Weigh the jar with the soil in it to the nearest 0.01 g and record the weight on the sample label.

9. Collect dry weight sample using a clean stainless steel spoon or trowel.

10. Store samples at 4°, ±2°C.

11. Ship sample containers with plenty of ice in accordance with DOT regulations (CORROSIVE. FLAMMABLE LIQUID. POISON) to the laboratory.

6.0 Restrictions/Limitations

Basket or spring retainers may be needed for split-barrel sampling in loose, sandy soils.

Shelby tubes may not retain the sample in loose, sandy soils.

7.0 References

American Society for Testing and Materials. 1999. *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*. Standard Method D1586-99.

_____. 2000. *Standard Test Method for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes*. Standard Method D1587-00.

U. S. Department of Energy. 1996. Hazardous Waste Remedial Actions Program. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R2. September.

_____. Hazardous Waste Remedial Actions Program. *Standard Operating Procedures for Site Characterizations*, DOE/HWP-100/R1. September 1996 or current revision.

U. S. Environmental Protection Agency. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, November 1986, (as amended by Updates I, II, IIA, IIB, III, and IIIA, June 1997). Method 5035 (***Note***: § 6.2.1.8 of this method says samples stored in EnCore™ samplers shall be analyzed within 48 hours or transferred to soil sample vials in the laboratory within 48 hours): December 1996, Revision O, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

_____. 2001. Region 4. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. November.

TSOP 1-6

WATER LEVEL MEASUREMENT

Water Level Measurement

SOP: 1-6
Revision: 6
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Prepared: Del Baird

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1.0 Objective

Water level measurements are fundamental to groundwater and solute transport studies and are conducted during groundwater sampling events to calculate the amount of groundwater to be purged from the well. This standard operating procedure (SOP) defines the techniques and requirements for obtaining groundwater level measurements.

2.0 Background

2.1 Definitions

Water Level Indicator - A portable device for measuring the depth from a fixed point (which could be below, at, or above the ground surface) to the groundwater inside a well, borehole, or other underground opening.

Measurement Point - An easily located and clearly defined mark at the top of a well from which all water level measurements from that particular well are made. The measurement point shall be as permanent as possible to provide consistency in measurements.

Electrical Tape - A graduated plastic tape onto which a water-sensitive electrode is connected that will electronically signal the presence of water (as a result of circuit closure).

Immiscible Fluids - Two or more fluid substances that will not mix and, therefore, will exist together in a layered form. The fluid with the highest density will exist as the bottom layer, the fluid with the lowest density will exist as the top layer, and any other fluid layers will be distributed relative to their respective densities.

Discharge - The removal/release of water from the zone of saturation.

Recharge - The addition of water to the zone of saturation.

Static Water Level - The level of water in a well, borehole, or other underground opening that is not influenced by discharge or recharge.

Well Riser - A steel, stainless steel, or polyvinyl chloride pipe that extends into a borehole and is connected to the well screen or sealed at the bedrock surface in open-hole wells. The upper portion (approximately 3 to 5 feet) of the well riser is normally enclosed by an outer steel protective casing.

Protective Casing - A steel cylinder or square protective sleeve extending approximately 3 to 5 feet into the ground, surrounding the well riser. In flush-mounted wells, the protective casing will extend only high enough so that the well and protective casing can be enclosed by a Christy box or equivalent vault. In above-grade wells, the protective casing will extend above the ground surface approximately 2 to 3 feet. The protective casing protects the well riser.

2.2 Associated Procedures

- CDM Federal (CDM) SOP 4-1, *Field Logbook Content and Control*
- CDM SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

2.3 Discussion

The most common uses of static water level data are to determine the elevation of groundwater, the direction of groundwater flow, to identify areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relationships. Specific uses for water level data may include:

- Determine the change in water level due to distribution or rate of regional groundwater withdrawal
- Show the relationship of groundwater to surface water
- Estimate the amount, source, and area of recharge and discharge
- Determine rate and direction of groundwater movement

Static water level measurements shall be obtained from each well before purging, sampling, or other disturbance of the water table.

3.0 General Responsibilities

Project Manager - The project manager is responsible for ensuring that measurements are conducted in accordance with this procedure and any other SOP pertaining to site activities related to obtaining groundwater level measurements.

Field Team Leader - The field team leader is responsible for ensuring that field personnel obtain water level measurements in accordance with this and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens
- Permanent felt-tip marker (e.g., Sharpie)
- Personal protective equipment
- Decontamination equipment and supplies, including rinse bottles and deionized water
- Tap water and large beaker or bucket
- Water level meter

4.2 Measuring Devices

The equipment required to obtain water level measurements is dependent on the type of procedure chosen. Measurements may be made with a number of different devices and procedures. Measurements are taken relevant to a permanent measurement point on the well riser.

Electrical tapes are preferred over other devices such as steel tape because of the electrical tape's simplicity and ability to make measurements in a short period of time. Many types of electrical instruments have been devised for measuring water levels; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Examples of electrical tapes that are frequently used include the Slope Indicator Co.® and Solinst® electronic water level indicators. These instruments are powered by batteries that shall be checked before mobilization to the field.

Electrical tapes are coiled on a hand-cranked reel unit that contains the batteries and a signaling device that indicates when the circuit is closed (i.e., when the probe reaches the water). Electrodes are generally contained in a weighted probe that keeps the tape taut in addition to providing some shielding of the electrodes against false indications as the probe is being lowered into the hole. The electrical tapes are marked with 0.01-foot increments. Caution shall be exercised when using electrical tapes when the water contains elevated amounts of dissolved solids. Under these conditions, the signaling device will remain activated after the probe is removed from the water. When the water being measured contains very low amounts of dissolved solids, it is possible for the probe to extend several inches below the water level before activating the signaling device. Both of these conditions are related to the conductivity of the water and in some cases may be compensated for by the sensitivity control, if the device has this option. In groundwater with high conductivity the sensitivity control may need to be turned down, and in groundwater with low conductivity the sensitivity control may need to be turned up to get a proper depth to groundwater measurement.

5.0 Procedures

5.1 Preparation

The following steps must be taken when preparing to obtain a water level measurement:

- Assign a designated field logbook to record all field events and measurements according to CDM SOP 4-1. Document any and all deviations from SOPs and site-specific plans in the logbook and include rationale for the changes.
- Always exercise caution to prevent inappropriate or contaminated materials from entering an environmental well.
- Standing upwind from the well, open the groundwater well. Monitor the well with a photoionization detector, flame ionization detector, or equivalent vapor analyzer as soon as the cap is opened, as dictated by the site-specific health and safety plan.

For comparability, water level measurements shall always be referenced to the same vertical (elevation) datum marker, such as a U. S. Geological Survey (USGS) vertical and horizontal control point monument. The elevations calculated from the measurement of static water levels shall be referenced to mean sea level unless otherwise specified in the site-specific plans.

The measurement point must be as permanent as possible, clearly defined, marked, and easily located. Frequently, the top of the PVC riser is designated as the measurement point. However, since the top of the riser is seldom smooth and horizontal, one particular point on the riser pipe shall be designated and clearly marked. This can be accomplished by marking a point on the top of the riser pipe with a permanent marker. To avoid spilling liquids into the well, paints or other liquid marking materials shall not be used.

5.2 Water Level Measurement Using Electrical Water Level Indicators

The following steps must be followed when taking water level measurements using electrical tapes:

- Before lowering the probe into the well, the circuitry shall be checked by dipping the probe in tap water and checking to ensure that the signaling device responds to probe submergence. The probe shall then be lowered slowly into the well until contact with the water surface is indicated. The electrical tape reading is made at the measuring point. Take a second and third check reading to verify the measurement before completely withdrawing the tape from the well.
- Independent electrical tape measurements of static water levels using the tape shall agree within 0.01 foot for depths of less than about 200 feet. At greater depths, independent measurements may not be this close. For a depth of about 500 feet, the maximum difference of independent measurement using the same tape shall be within 0.1 foot.
- Decontaminate the electrical tape according to CDM SOP 4-5 before proceeding to the next well to minimize cross contamination.

It may be necessary to check the electrical tape length with a graduated steel tape after the line has been used for a long period of time (at least annually) or after it has been pulled hard in attempting to free the line. Some electrical tapes, especially the single line wire, are subject to becoming permanently stretched.

5.3 Other Water Level Measurement Methods

Although the method cited above (electrical water level indicator) for measuring water levels predominates in the environmental sector, there are a number of other methods available that may be well suited for a particular purpose.

5.3.1 Ultrasonic Method

The ultrasonic method electronically measures the amount of time it takes a sound wave to reach and reflect off the water surface and return to the ground surface. These instruments contain electronic microprocessors, capable of performing this measurement many times each second. The actual depth to water, as calculated by the microprocessor, is an average of many individual readings.

5.3.2 Pressure Gauge Method

This method, also called the air-line submergence method, uses a pressure gauge and is the preferred method for obtaining water level measurements in pumping wells. An air line constructed of semi-rigid tubing is inserted into the well below the water table. The tube end at the surface is connected to an air tank or compressor and pressure gauge. Filtered air is then forced through the tube and the resultant pressure is read in pounds per square inch (psi). This reading is converted to feet of water in the column and subtracted from the total tube length to give depth to water. Readings are then converted to groundwater elevation. Results are plotted on a field logging form. Calibration records and the exact procedures used must be maintained.

5.3.3 Acoustic Probe Method

The acoustic probe is an electronic device containing two electrodes and a battery-powered transducer. The probe is attached to a tape. The probe is lowered into the well until a sound is detected, indicating the electrodes in the probe have contacted the water surface. This method is similar to the electrical probe method discussed in Section 5.2.

5.3.4 Continuous Recording Method

The measurement of groundwater elevations within pumping or monitoring wells can be accomplished by the use of a mechanical or digital analog computerized continuous recording system and shall be performed according to specifications given by the manufacturer of each unit. In general, when using the mechanical or digital system, the pressure or electrical transducer is lowered into the well until it intersects the water surface. The actual depth to water is then measured by one of the methods described above and used to calibrate the continuous recorder.

The necessary adjustments and preparations are then completed according to the specifications given for each type of continuous recorder. Proper maintenance of continuous recording devices during water level monitoring shall be performed such that continuous, permanent records are developed for the specified period of time. Records shall be stored on mechanical graph paper or on a microprocessor. Frequent calibrations of equipment shall also be made during monitoring periods of long duration in accordance with the manufacturers' specifications.

6.0 Restrictions/Limitations

6.1 Groundwater and Miscible Fluids

Where water is rapidly dripping or flowing into a well, either from the top of the well or from fractures, obtaining an accurate reading may not be possible.

The effect of the water flowing into the well may interfere with an electronic water level measuring device, resulting in a false water level measurement. If water levels must be recorded in wells completed in aquifers that are recharging or discharging, the electronic water level indicator is the preferred measuring device, but shall be used with the awareness of possible false measurements. To minimize the effects of "splashing," a 1-inch pipe (decontaminated for environmental wells) may be lowered into the pumping well into which the water level indicator would be inserted. This will minimize the effect of "splashing" until the probe contacts the groundwater and protect the probe from becoming tangled in pump wiring or well spacers associated with downhole equipment such as submersible pumps.

6.2 Immiscible Fluids

For wells containing immiscible contaminants, the field personnel will need to use special procedures for the measurement of fluid levels. The procedure to follow will depend on whether layers are light immiscibles that form lenses floating on the top of the water table, or dense immiscibles that sink through the aquifer and form lenses over less permeable layers.

In the case of light immiscibles, measurements of immiscible fluid and water levels cannot be accomplished by using normal techniques. A conventional electrical tape often will not respond to nonconducting immiscible fluids.

Techniques have been specially developed to measure fluid levels in wells containing immiscible fluids, particularly petroleum products. A special paste or gel applied to the end of the steel tape and submerged in the well will show the top of the oil as a wet line and the top of the water as a distinct color change, or an interface probe can be used that will detect

the presence of conducting and nonconducting fluids. Thus, if a well is contaminated with low density, nonconducting immiscible fluids such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, it will detect electrical conduction. Normally, a variation in an audible signal indicates the difference between phases.

Both of these methods have disadvantages. These methods are less effective with heavier and less refined petroleum products because the product tends to stick to the tape or probe, giving a greater product thickness measurement than it shall. Paste or gel cannot be used when sampling groundwater for the same constituents present in the paste or gel product.

Note that water levels obtained in this situation are not suitable for determining hydraulic gradients without further interpretation. To use such data for determining hydraulic gradients, the difference in density between the light immiscible phase and water has to be considered.

Measuring fluid levels in wells screened in lenses of dense immiscible fluids resting on a low permeability formation is somewhat easier, provided the immiscible fluid is nonconducting. The top of the dense layer can be identified by simply using an electrical sounder. As an electrical sounder passes from groundwater into the immiscible phase, the detection unit will deactivate because the fluid will no longer conduct electricity. A better method would be to use an interface probe as described above. The variation in the audible signal associated with the detection of differing phase liquids will also allow the user to obtain a groundwater depth and dense immiscible thickness measurement.

7.0 References

Camp Dresser & McKee Inc., et al. 1991. *Sampling and Analysis Procedures, Geophysical Survey Procedures.* May.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods.* EPA/540/P-87/001. December.

Weight, Willis D. and Sonderegger, John L., 2001. *Manual of Applied Hydrogeology.* Lewis Publishing Company. 187-190.

Westinghouse Savannah River Company. 1997. *Standard Operating Procedures Manual*, 3Q5, Chapter 13, Revision 2, Hydrogeologic Data Collection Procedures and Specifications. October.

TSOP 1-10

FIELD MEASUREMENT OF ORGANIC VAPORS

Field Measurement of Organic Vapors

SOP 1-10
Revision 4
Date: March 2007

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1.0 Objective

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for the measurement of organic vapors in the field.

2.0 Background

2.1 Definitions

Photoionization Detector (PID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the photoionization of organic vapors.

Flame Ionization Detector (FID) - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the flame ionization of organic vapors.

2.2 Associated Procedures

- CDM Federal SOP 1-4, *Subsurface Soil Sampling*
- CDM Federal SOP 1-5, *Groundwater Sampling Using Bailers*
- CDM Federal SOP 1-6, *Water Level Measurement*
- CDM Federal SOP 1-8, *Volatile Organic Compound Air Sampling Using USEPA Method TO-15 with SUMMA Canister*
- CDM Federal SOP 3-1, *Geoprobe® Sampling*
- CDM Federal SOP 3-5, *Lithologic Logging*
- CDM Federal SOP 4-3, *Well Development and Purging*

2.3 Discussion

The measurement of organic vapors is a required step during numerous field activities. The primary purpose of such measurements is health and safety monitoring to determine if the breathing zone in a work area is acceptable or if personal protective equipment such as a respirator or a supplied air device is necessary for field personnel. In addition to health and safety monitoring, organic vapor measurement is also used in conjunction with sampling activities, including screening subsurface soil samples, soil vapor and indoor air sampling, and groundwater sampling, where measurements are useful for establishing approximate contaminant levels or ranges.

The two types of instruments most commonly used to measure organic vapors are PIDs and FIDs. Both instruments first ionize the gaseous compound and then measure the response, which is proportional to the concentration.

2.3.1 PID Operation

The PID is preferred when the compound of interest is an aromatic or chlorinated volatile organic compound (VOC). The PID ionizes the sampled vapors using an ultraviolet lamp that emits light energy at a specific electron voltage (eV - labeled on the lamp). The ultraviolet lamp produces photons that are absorbed by the sampled vapor molecule. The molecule becomes excited, producing a positively charged ion and emitting an electron. The number of electrons emitted is proportional to the concentration of the sampled gases. Every organic compound has a specific ionization potential in electron volts. The energy emitted by the lamp must be higher than the ionization potential of the compound for the compound to become ionized and emit an electron. If the ionization potential of the compound is higher than the eV of the lamp, there will be no response on the instrument. Therefore, the ionization potential of the known or suspected compounds shall be checked against the energy of the ultraviolet lamp to verify that the energy provided by the lamp is

greater. Additionally, manufacturer's manuals shall be consulted to obtain the appropriate correction factors for known or suspected contaminants.

Water vapor in the vapor sample can interfere with the PID detector and cause the instrument to stop responding. This can be caused by using the PID on a rainy day or when sampling headspace samples that have been in the sun. If

moisture is suspected, the calibration gas shall be used to check the instrument response by inserting the gas as a check sample, not by recalibrating. If the response is lower than the gas level, then the probe and the ionization chamber shall be dried out before reusing the instrument.

Note: The ultraviolet lamp in the PID is sensitive to shock, especially when using the higher eV lamps. Therefore, they shall be handled and transported carefully.

The sampling probe shall not be inserted directly into soil samples or dusty areas, as the instrument vacuum will pull dirt into the ionization chamber. Under particularly dirty or dusty conditions, the lamp may become covered with a layer of dust. If dirty conditions are encountered, or if the instrument response seems to have decreased, then the lamp shall be cleaned. The instrument manual provides instructions on how to remove the instrument cover to access the lamp, and how to clean the screen in the ionization chamber and the surface of the lamp.

2.3.2 FID Operation

The FID is preferred when sampling for petroleum hydrocarbons and methane (landfill gases). It responds well to aromatic hydrocarbons but is not as convenient to use as the PID. The FID allows measurement of a wide variety of compounds, but in general its sensitivity is not as high as the PID for compounds where the PID is applicable.

The FID ionizes the vapor sample by burning it in a hydrogen/air flame, and measuring the response beyond what is caused by the hydrogen alone. This instrument requires a hydrogen supply, contained in a small tank in the instrument. This hydrogen, including the gas in the instrument tank, is considered a flammable gas and appropriate requirements must be adhered to when shipping. The instrument shall be emptied of hydrogen before shipping. Federal Express Hazardous Material shipping manifests must be completed when shipping the gas.

The hydrogen gas in the FID combustion chamber is ignited by pressing a red button on the side of the instrument, which sends electrical current to a small resistance coil igniter in the combustion chamber. This igniter is very sensitive, and if the red button is pressed for longer than 5 seconds, the coil will burn out and the instrument will be unusable unless another igniter is available. If the instrument will not light, check the electrical connections and switches for proper settings. Check that the pump is pumping, and allow fresh air to flow through the combustion chamber for several minutes before lighting. Check to see if the exhaust port of the combustion chamber is dirty.

3.0 Responsibilities

Site Manager - The site manager is responsible for ensuring that field activities are conducted in accordance with this procedure and any other SOPs pertaining to the specific activity.

Field Team Leader - The field team leader is responsible for ensuring that field personnel conduct field activities in accordance with this and other relevant procedures.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment

- Site-specific plans
- Field logbook
- Waterproof black ink pen
- Personal protective clothing and equipment
- Photoionization detector or flame ionization detector
- Calibration gases in a range appropriate for the expected use
- 0.5 liter (16-ounce) or "Mason" type glass jar
- Hydrogen Canister and fill valve and hose (if using FID for a period of more than 1 day)

5.0 Procedures

5.1 Direct Reading Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.

2. Calibrate the instrument following the applicable manufacturer's manual

3. Make sure the instrument is reading zero and all function and range switches are set appropriately.

4. Insert the end of the probe directly into the atmosphere to be measured (e.g., breathing zone, monitoring well casing, split spoon, etc.) and read the organic vapor concentration in parts per million (ppm) from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.

5. Immediately document the reading in the field logbook or on the appropriate field form.

5.2 Headspace Measurement

1. Connect the measurement probe to the instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.

2. Calibrate the instrument following the appropriate manufacturer's manual.

3. Make sure the instrument is reading zero and all function and range switches are set appropriately.

4. Fill a clean glass jar approximately half-full of the sample to be measured. Quickly cover the top of the jar with one or two sheets of clean aluminum foil and apply cap to seal the jar.

5. Allow headspace to develop for approximately 10 minutes. It is generally preferable to shake the sealed jar for 10 to 15 seconds at the beginning and end of headspace development.

Note: When the ambient temperature is below 0°C (32°F), the headspace development and subsequent measurement shall occur within a heated vehicle or building.

6. Remove the jar cap and quickly puncture the foil and insert the instrument probe to a point approximately one-half of the headspace depth. Do not let the probe contact the soil. If using a PID and there is condensation on the inside of the jar, only leave the probe in the jar long enough to obtain a reading. Remove the probe and allow fresh air to flow through the instrument to avoid excess water vapor to build up.

7. Read the organic vapor concentration in ppm from the instrument display. Apply the appropriate correction factor if necessary. Record the highest instrument response.

8. Immediately record the reading in the field logbook or on the appropriate field form.

6.0 Restrictions/Limitations

The two methods outlined above are the most commonly used for field measurement of organic vapors but do not apply to all circumstances. Consult project- or program-specific procedures and guidelines for deviations. Both the PID and FID provide quantitative measurement of organic vapors, but generally neither instrument is compound-specific. The typical reading range of the PID is 0 to 2,000 ppm, and the typical reading range of the FID is 0 to 1,000 ppm. The FID will measure methane while the PID will not. ***Note***: The presence of methane will cause erratic PID measurements. In methane rich environments, toxic organic vapors shall be monitored with an FID. If desired, a charcoal filter can be placed temporarily on the FID inlet probe, which will trap all organic vapors except methane. The filtered (methane only) reading can be subtracted from unfiltered (total organic vapors) to provide an estimate of non-methane organic vapors. The reading accuracy of both instruments can be affected by ambient temperature, barometric pressure, humidity, lithology, etc.

7.0 References

Martin Marietta Energy Systems, Inc. 1998. *Environmental Surveillance Procedures Quality Control Program*, ESH/Sub/87-21706/1.

TSOP 1-11

SEDIMENT/SLUDGE SAMPLING

Sediment/Sludge Sampling

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1.0 Objective

The purpose of this standard operating procedure (SOP) is to define requirements for collection and containment of sediment/sludge samples.

2.0 Background

2.1 Definitions

Sediment - Geologic and/or organic material underlying a body of water. The material has been transported by a fluid and deposited within the boundaries of the body of water.

Sludge - Materials ranging in type from dewatered solids to high viscosity liquids. The material may exist suspended throughout the water or settled from the water as all or part of the sediment.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Composite - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, then a single average sample is taken from the mixture.

2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 4-2, *Photographic Documentation of Field Activities*
- CDM Federal SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

2.2 Discussion

Sediment/sludge samples are collected to determine the type(s) and level(s) of contamination in a particular surface water body and/or its biological disposition. Sediment/sludge samples will provide a more historical account of contamination than will water samples because of the nature of the matrix.

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling. The FTL must also ensure that the quantity and location of sediment/sludge samples collected meet the requirements of the site-specific plans.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

All or part of the equipment listed under the "as needed" category may be required at any specific site, depending on the plan(s) for that site.

- Site-specific plans
- Field logbook
- Indelible black ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Ice bags or "blue ice"
- Plastic zip-top bags
- Clear waterproof tape
- Personal protective clothing and equipment
- Latex or appropriate gloves
- Rubber boots and/or rubberized waders
- Stainless steel or Teflon® spoons, spatulas, or scoops
- Teflon or stainless steel mixing bowls or trays
- Aluminum foil
- Kimwipe or paper towels
- ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope
- Clean plastic sheeting
- Tap and deionized water
- Water spray bottle
- Appropriate photographic equipment and supplies
- Appropriate decontamination equipment and supplies
- Eckman grab for depositional area (primarily stream) sediment sampling
- Ponar sampler for lake sampling

As needed:

- Global Positioning System (GPS) unit
- Hand or gravity corer with extensions or stainless steel hand auger
- Core liners of Teflon, stainless steel, brass, aluminum, or polybutyrate, as specified in the site-specific plan(s)
- Stainless steel push tubes
- Dredge with 15- to 20-foot (4.5- to 6.0-meter) sampling pole (hollow) and insert (e.g., Peterson, Eckman, Ponar)
- Motorized coring device
- Boat with depth finder for deep water or inaccessible shorelines
- Any personal protective equipment specified in the site-specific health and safety plan
- Spare parts for all equipment
- Tape measure

5.0 Procedures

5.1 Preparation

The following steps shall be taken when preparing for sampling sediment/sludge:

1. Review site-specific health and safety plan and project plans before initiating sampling activity.

2. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.

3. Select stream/river sampling locations that exhibit cross-sectional homogeneity. Avoid areas where the channel is constricted or bends where scouring may have occurred. For lakes, collect sediment samples away from the shoreline.

4. Prepare sampling site by laying out clean plastic sheeting on the ground or any flat, level surfaces near the sampling area and place equipment to be used on the plastic.

5. If surface water is present at the sample location, make field measurements in physical, chemical, and biological characteristics of the water (e.g., temperature, dissolved oxygen, conductivity, pH), as dictated by the project-specific plans.

6. The samples shall be collected from areas of least to greatest contamination (when known) and, when collecting several samples in 1 day, always collect from downstream to upstream.

7. When sampling sediment and surface water from the same surface water body, collect surface water samples before sediment samples.

8. Document the sampling events, recording all information in the designated field logbook and take photographs (if required). Document any and all deviations from this SOP and include rationale for changes.

9. The collection points shall be located on a site map and described in the field logbook. Use GPS if required or if possible.

10. Label each sample container with the appropriate information. Secure the label by covering it with a piece of waterproof clear tape.

11. Decontaminate reusable sampling equipment after sample collection according to CDM Federal SOP 4 5.

12. Processes for verifying depth of samples must be included in site-specific project plans.

13. Check that a trip blank/temperature blank, when necessary, is included in the chilled cooler. Quality assurance/quality control requirements vary from project to project. Consult the project-specific work plan for quality requirements.

5.2 Sediment/Sludge Sample Collection from Shallow Waters

5.2.1 Method for Collecting Samples for Volatile Organic Compound (VOC) Analysis

The following steps must be followed when collecting shallow water sediment/sludge VOC samples:

1. Use a decontaminated stainless steel or Teflon, long-handled scoop, corer, push tube, or dredge to collect the entire sample in one grab. If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area.

2. Retrieve the sampling device and slowly decant off any liquid phase.

3. Immediately fill the specified sample container(s) with the solid. Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.

Note: Samples to be analyzed for VOC or other compounds degraded by aeration shall be taken as grab samples. Do not homogenize or composite these samples.

4. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the container clean with a Kimwipe or clean paper towel. Affix a completed sample label.

5. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

6. Immediately pack all samples into a chilled cooler.

5.2.2 Method for Collecting Samples for Nonvolatile Organic and Inorganic Compound Analysis

The following steps must be taken when collecting shallow water sediment/sludge samples for analytes not degraded by aeration:

1. Collect sufficient volume to fill specified sample containers using decontaminated stainless steel or Teflon-lined equipment (scoops, corer, dredge sampler, etc.). If wading is necessary, approach the sample location from downstream. Do not enter the actual sample area.

2. Retrieve the sampling device with the sample and slowly decant off any liquid phase.

3. Pool and homogenize samples in a stainless steel, Teflon, or appropriate pan or mixing bowl, using stainless steel spatula or spoon.

4. Fill each sample container with the homogenized sample to approximately 75 to 90 percent capacity, filling sample containers for organics analyses first.

5. Once each container is filled, close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

6. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

7. Immediately pack all samples into a chilled cooler.

5.3 Subsurface Sediment/Sludge Sample Collection Using a Corer or Auger from Shallow Waters

5.3.1 Method for Collecting Samples for Volatile Organic Compound Analysis Using an Unlined Corer (also applies to augers)

The following steps must be taken when collecting subsurface sediment/sludge VOC samples that underlie shallow water:

1. At the specified sampling location, force or drive the corer to the specified depth.

2. Twist and withdraw the corer in a smooth motion.

3. Retrieve the sampling device, remove the corer nosepiece (if possible), and extrude the sample into the specified sampling container(s). Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.

4. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the sample container clean with a Kimwipe or clean paper towel. Affix a completed sample label.

5. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

6. Immediately pack all samples into a chilled cooler.

5.3.2 Method for Collecting Samples for Volatile Organic Compound Analysis Using a Lined Corer

The following steps must be followed when collecting shallow water subsurface sediment/sludge VOC samples that underlie shallow water:

1. Install decontaminated liner(s) in the corer barrel.

2. At the specified sampling location, force or drive the corer to the specified depth.

3. Twist and withdraw the corer in a smooth motion.

4. Retrieve the sampling device, remove the corer nosepiece (if possible) and remove the liner(s), cap the liner(s), and seal the caps with Teflon tape.

5. Wipe the outside of the liner clean with a Kimwipe or clean paper towel. Label the top and bottom ends of the liner(s). Affix a completed sample label.

6. Place capped and sealed liners in individual zip-top plastic bags and seal the bags.

7. Immediately pack all samples into a chilled cooler.

5.3.3 Method for Collecting Samples for Nonvolatile Organic and Inorganic Compound Analysis Using a Corer (also applies to augers)

The following steps must be followed when collecting subsurface sediment/sludge samples that underlie shallow water for analytes not degraded by aeration:

1. At the specified sampling location, force or drive the corer to the specified depth.

2. Twist and withdraw the corer in a smooth motion.

3. Retrieve the sampling device. Remove the corer nosepiece (if possible) and extrude the sample into a stainless steel or Teflon-lined pan or bowl. Collect sufficient sample volume to fill all containers.

4. Use a stainless steel or Teflon spoon or spatula to homogenize and then divide the sample material into the appropriate number of sample containers.

5. Fill each container to approximately 75 to 90 percent capacity, filling containers for organics analyses first. Close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

6. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

7. Immediately pack all samples into a chilled cooler.

5.4 Sediment/Sludge Sample Collection Using a Dredge from Deep Waters

5.4.1 Method for Collecting Samples for Volatile Organic Compound Analysis

The following steps must be followed when collecting deep-water sediment/sludge VOC samples:

1. Attach a clean piece of ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach the sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.

2. Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.

3. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediment/sludge) is felt.

4. Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler.

5. Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon-lined tray or pan. Open the sampler. Immediately collect the sample for VOC analysis, using a stainless steel or Teflon spoon or spatula. Fill each container completely to minimize headspace.

6. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

7. Place the sample container(s) in individual zip-top plastic bags and seal the bags.

8. Immediately pack all samples into a chilled cooler.

5.4.2 Method for Collecting Samples for Nonvolatile Organic and Inorganic Compounds

The following steps must be followed when collecting deep-water sediment/sludge samples for analytes not degraded by aeration:

1. Attach a clean piece of ½- to ¾-inch (12- to 19-mm) braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.

2. Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.

3. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediments/sludge) is felt.

4. Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler.

5. Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon-lined tray or pan. Open the sampler.

6. Collect sufficient volume of sample to fill the specified sampler containers. Pool the grab samples in a tray, pan, or bowl. Homogenize the pooled samples by mixing them together with a stainless steel or Teflon spoon or spatula.

7. Fill the specified sample containers to approximately 75 to 90 percent capacity with the homogenized sample using the stainless steel or Teflon spoon or spatula. Fill sample containers for organics analyses first.

8. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a completed sample label.

9. Place sample container(s) in individual zip-top plastic bags and seal the bags.

10. Immediately pack all samples into a chilled cooler.

6.0 Restrictions/Limitations

Core sampling devices may not be usable if cobbles exist in the sediment/sludge. Bumping of core sampling devices and Ponar dredge samplers may result in the loss of some of the sample.

Grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

7.0 References

U. S. Department of Energy. Hazardous Waste Remedial Actions Program. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R1. July 1990 or current revision.

_____. Hazardous Waste Remedial Actions Program. *Standard Operating Procedures for Site Characterizations*, DOE/HWP-100/R2. September 1996 or current revision.

U. S. Environmental Protection Agency. Region II. *CERCLA Quality Assurance Manual.* March 1988 or current revision.

_____. Region IV. *Environmental Investigations, Standard Operating Procedures and Quality Assurance Manual.* November 2001 or current revision.

U. S. Geological Survey. *National Field Manual for the Collection of Water-Quality Data*, Chapter A8. October 1997.

TSOP 2-1

PACKAGING AND SHIPPING ENVIRONMENTAL SAMPLES

Packaging and Shipping Environmental Samples

SOP 2-1
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1.0 Objective

The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.1 Packaging and Shipping of All Samples

This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 - Packaging and Shipping Samples Preserved with Methanol
Section 3.0 - Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 - Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 - Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 - Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 - Packaging and Shipping Limited-Quantity Radioactive Samples

1.2 Background

1.2.1 Definitions

Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

Custody Seal - A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

Inside Container - The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container - The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment - The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

Excepted Quantity - Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity - Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing - Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper - A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*

1.2.3 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples shall be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.3 Required Equipment

- Coolers with return address of the appropriate CDM office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Vermiculite (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels

*Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "environmental sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. ***Note***: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers

- The maximum volume of methanol in a sample container is limited to 30 ml.
- The sample container must not be full of methanol.

2.2 Responsibility

It is the responsibility of the qualified shipper to:

- Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of "hazardous material" as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packing may consist of glass or plastic jars
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 3 flammable liquid labels
- Orientation labels
- Consignor/consignee labels

2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Total volume of methanol per shipping container must not exceed 500 ml.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

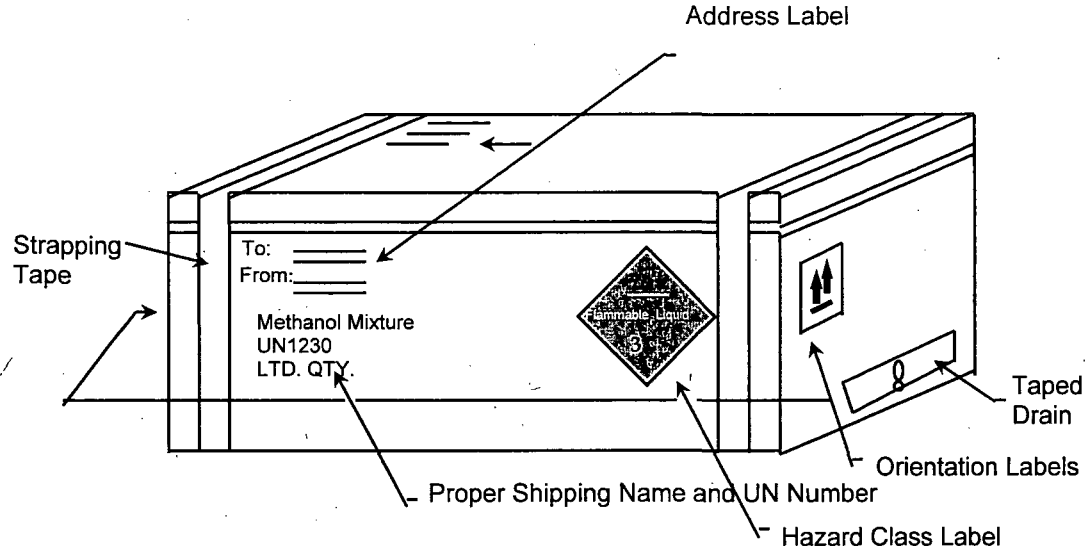
Methanol Mixture
UN1230
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Flammable Liquid label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: No marking or labeling can be obscured by strapping or duct tape.
Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

Figure 1
Example of Cooler Label/Marking Locations



3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sodium Hydroxide Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

3.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide

Samples containing NaOH as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- The total volume of sample in each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sodium Hydroxide Solution
  UN1824
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Hydrochloric Acid Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container		
		pH	Conc.	40 ml	125 ml	250 ml
HCl	2N	<1.96	0.04%	.2	.5	1

5 drops = 1 ml

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- *Survey documentation (if shipping from DOE or radiological sites)*
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)

- Total volume of sample inside each cooler must not exceed 1 liter.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Hydrochloric Acid Solution
UN1789
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

5.0 Packaging and Shipping Samples Preserved with Nitric Acid

5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Nitric Acid Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
HNO_3	6N	<1.62	0.15%		2	4	5	8

5 drops = 1 mg/L

5.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

5.4 Packaging Samples Preserved with Nitric Acid

Samples containing HNO_3 as a preservative that exceed the excepted concentration of 0.15 percent HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

Nitric Acid Solution (with less than 20 percent)
UN2031
Ltd. Qty.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples meeting the exception concentration of 0.15 percent HNO_3 by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sulfuric Acid Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
H_2SO_4	37N	<1.15	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing H_2SO_4 as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)
- Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- The maximum volume of preserved solution in the cooler must not exceed 500 ml.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

  Sulfuric Acid Solution
  UN2796
  LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

Note: Samples containing less than the exception concentration of 0.35 percent H_2SO_4 by weight will be shipped as nonregulated or nonhazardous in accordance with the procedure described in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

7.1 Containers

The inner packaging containers that may be used for these shipments include:

- Any size sample container

7.2 Description/Responsibilities

- The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials*.
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.
- If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring before shipment of the package.
- The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma). It shall be noted that these values are more conservative than the DOT requirements for removable surface contamination.
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive."
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities label
- Consignor/consignee labels

7.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipments:

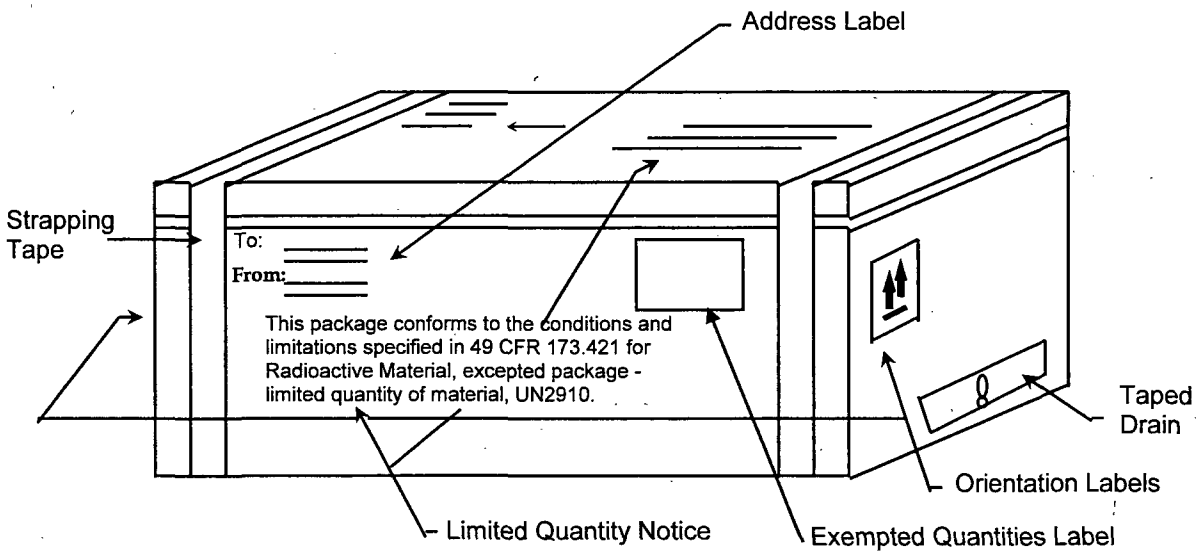
- The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape before sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place sufficient amount of vermiculite, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tieing or taping.
- Place a label marked Radioactive on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: ***"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."***
- Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.
- The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of the cooler labeling/marking is shown in Figure 2.

Note: No marking or labeling can be obscured by strapping or duct tape.

- Complete the Shipment Quality Assurance Checklist (Appendix B).

Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.
Note: A declaration of dangerous goods is not required.

Figure 2
Radioactive Material – Limited-Quantity Cooler Marking Example



8.0 References

U. S. Environmental Protection Agency. Region IV. February 1991 or current. *Standard Operating Procedures and Quality Assurance Manual.*

_____. 1996 or current. *Sampler's Guide to the Contract Laboratory Program*, EPA/540/R-96/032.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Shippers General Requirements for Shipments and Packagings*, 49 CFR 173.

Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
❑	❑	❑	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
❑	❑	❑	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
❑	❑	❑	The drain plug is taped inside and outside to ensure control of interior contents.
❑	❑	❑	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
❑	❑	❑	The cooler weighs less than the 66-pound limit for limited-quantity shipment.
❑	❑	❑	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
❑	❑	❑	The chain-of-custody has been secured to the interior of the cooler lid.
❑	❑	❑	The cooler lid and sides have been taped to ensure a seal.
❑	❑	❑	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
❑	❑	❑	Section 1 has the shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
❑	❑	❑	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
❑	❑	❑	Section 3 has the **Bill Sender** box checked.
❑	❑	❑	Section 4 has the **Standard Overnight** box checked.
❑	❑	❑	Section 5 has the **Deliver Weekday** box checked.
❑	❑	❑	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
❑	❑	❑	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
❑	❑	❑	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
❑	❑	❑	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization** have been filled out for the type of chemical being sent.
❑	❑	❑	The **Name, Place and Date, Signature, and Emergency Telephone Number** appears at the bottom of the FedEx Airbill.
❑	❑	❑	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.
❑	❑	❑	The **Emergency Contact Information** at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.

Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Sub Risk	Quantity	Packing Instruction	Authorization
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Methanol	3	UN1230	II		1 plastic box × 1 L	Y305	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
❑	❑	❑	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
❑	❑	❑	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
❑	❑	❑	The name and address of the shipper and receiver appear on the top and side of the shipping container.
❑	❑	❑	The air waybill is attached to the top of the shipping container.
❑	❑	❑	**Up Arrows** have been attached to opposite sides of the shipping container.
❑	❑	❑	Packaging tape does not obscure markings or labeling.

Appendix B
Shipment Quality Assurance Checklist

Date: _____ Shipper: _____ Destination: _____

Item(s) Description: _____

Radionuclide(s): _____

Radiological Survey Results: surface _____mrem/hr 1 meter _____

Instrument Used: Mfgr: _____ Model: _____

S/N: _____ Cal Date: _____

Limited-Quantity or Instrument and Article

Yes	No		
___	___	1.	Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2.	Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3.	Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma).
___	___	4.	Outside inner package bears the marking "Radioactive."
___	___	5.	Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6.	Notice enclosed in or on the package that includes the consignor or consignee and the statement, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
___	___	7.	Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8.	On all air shipments, the statement **Radioactive Material, excepted package-limited quantity of material** shall be noted on the air waybill.

Qualified Shipper: _____ Signature: _____

TSOP 2-2

GUIDE TO HANDLING OF INVESTIGATION DERIVED WASTE

Guide to Handling Investigation-Derived Waste

SOP 2-2
Revision: 5
Date: March 2007

Prepared: Tim Eggert

Technical Review: Matt Brookshire

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed before field activities
- Removing wastes that pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require offsite disposal or extended aboveground containerization
- Complying with federal, state, local, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW

2.0 Background

2.1 Definitions

Hazardous Waste - Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, sludge, liquid, gaseous, or multiphase materials that may be classified as hazardous or nonhazardous.

Mixed Waste - Any material that has been classified as hazardous and radioactive.

Radioactive Wastes - Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities that accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U. S. Environmental Protection Agency (EPA) and appropriate state and local agencies.

2.2 Discussion

Field investigation activities result in the generation of waste materials that may be characterized as hazardous or radioactive waste. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

Note: The client's representatives may not be aware of all potential contaminants. The management of IDW must comply with applicable regulatory requirements.

3.0 General Responsibilities

Site Manager - The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager - The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members - Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager's attention.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/project specific quality assurance plan.

4.0 Required Equipment

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required shall consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 millimeters
- Department of Transportation (DOT)-approved steel containers
- Polyethylene or steel bulk storage tanks

Containment of IDW shall be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device shall be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking shall be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are:

- Labels and markings that contain the following information: project name, generation date, location of waste origin, container identification number, sample number (if applicable), and contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers that are 5 gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported offsite must be in accordance with the requirements of 49 CFR 172.

4.3 IDW Container Movement

Staging areas for IDW containers shall be predetermined and in accordance with site-specific and/or client requirements. Arrangements shall be made before field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation offsite onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW shall be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided for liquid IDW storage and as appropriate for solid IDW storage.

5.0 Procedures

The three general options for managing IDW are (1) collection and onsite disposal, (2) collection for offsite disposal, and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected shall take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW onsite
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client shall approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Collection and Onsite Disposal

5.1.1 Soil/Sludge/Sediment

The options for handling soil/sludge/sediment IDW are as follows:

1. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

2. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).

3. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

4. Send to onsite TSDF - may require analytical analysis before treatment/disposal.

Note: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

1. Discharge to surface water, only when IDW is not contaminated.

2. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern or associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.

3. Discharge to sanitary sewer, only when IDW is not contaminated.

4. Send to onsite TSDF - may require analysis before treatment/disposal.

Note: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposable PPE

The options for handling disposable PPE are as follows:

1. Double-bag contents in nontransparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.

2. Containerize, label, and send to onsite TSDF - may require analysis before treatment/disposal.

5.2 Collection for Offsite Disposal

Before sending to an offsite TSDF, analysis may be required. Manifests are required. In some instances, a bill of lading can be used for nonhazardous solid IDW (i.e., wooden pallets, large quantities of plastic sheeting). Arrangements must be made with the client responsible for the site to sign as generator on any waste profile and all manifests or bill of ladings; it is CDM's policy not to sign manifests. The TSDF and transporter must be permitted for the respective wastes. Nonbulk containers (e.g., drums) must have a DOT-approved label adhered to the container and all required associated placard stickers before leaving for a TSDF off site. These labels must include information as required in 49 CFR 172. Bulk containers (i.e., rolloffs, tanks) do not require container specific labels for transporting off site, but must include appropriate placards as required in 49 CFR 172.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums with appropriate secondary containment) until final disposal. The management option selected shall take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires offsite treatment disposal, the IDW may be containerized and stored. The management option selected shall take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Collection and Interim Management

All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW onsite until the final action may be practical in the following situations:
   - Returning wastes (especially sludges and soils) to their onsite source area would require reexcavation for disposal in the final remediation alternative.
   - Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
   - Offsite disposal options may trigger land disposal regulations under the Resource Conservation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
   - Interim storage may be necessary to provide time for sampling and analysis.

2. Segregate and containerize all waste for future treatment and/or disposal.
   - Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.
   - Containment options for aqueous liquids may include mobile tanks or drums.
   - Containment options for PPE may include drums or roll-off boxes.

6.0 Restrictions/Limitations

Site Managers Shall Determine the Most Appropriate Disposal Option for Aqueous Liquids on a Site-Specific Basis. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **Under No Circumstances Shall These Types of Materials Be Brought Back to the Office or Warehouse**.

7.0 References

Environmental Resource Center. 1997. *Hazardous Waste Management Compliance Handbook 2nd Edition*. Karnofsky (Editor).

Academy of Certified Hazardous Materials Manager. May 1999. *Hazardous Materials Management Desk Reference*. Cox.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1.

_____. August 1990. *Low-Level Mixed Waste: A RCRA Perspective for NRC Licensees*, EPA/530-SW-90-057.

_____. May 1991. *Management of Investigation-Derived Wastes During Site Inspections*, EPA/540/G-91/009.

_____. January 1992. *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS.

_____. Region IV. November 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*.

Attachment 1
IDW Management Options

Type of IDW	Generation Processes	Management Options
Soil	■ Well/Test pit installations ■ Borehole drilling ■ Soil sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Spread around boring, pit, or source within the AOC ■ Consolidate in a pit (within the AOC) ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Sludge/Sediment	■ Sludge pit/sediment sampling	**Onsite Disposal** ■ Return to boring, pit, or source immediately after generation ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal
Aqueous Liquids (groundwater, surface water, drilling fluids, wastewaters)	■ Well installation/development ■ Well purging during sampling ■ Groundwater discharge during pump tests ■ Surface water sampling ■ Wastewater sampling	**Onsite Disposal** ■ Pour onto ground close to well (nonhazardous waste) ■ Discharge to sewer ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite commercial treatment unit ■ Client to send to publicly owned treatment works (POTW) **Interim Management** ■ Store for future treatment and/or disposal
Decontamination Fluids	■ Decontamination of PPE and equipment	**Onsite Disposal** ■ Send to onsite TSDF ■ Evaporate (for small amounts of low contamination organic fluids) ■ Discharge to ground surface **Offsite Disposal** ■ Client to send to offsite TSDF ■ Discharge to sewer **Interim Management** ■ Store for future treatment and/or disposal
Disposable PPE and Sampling Equipment	■ Sampling procedures or other onsite activities	**Onsite Disposal** ■ Place in onsite industrial dumpster ■ Send to onsite TSDF **Offsite Disposal** ■ Client to send to offsite TSDF **Interim Management** ■ Store for future treatment and/or disposal

Adapted from U. S. Environmental Protection Agency, *Guide to Management of Investigation-Derived Wastes*, 9345-03FS, January 1992.

TSOP 3-1

GEOPROBE SAMPLING

Geoprobe® Sampling

SOP 3-1
Revision: 5
Date: March 2007

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Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to define the requirements for collecting soil, soil gas, groundwater, and pneumatic slug test data using the Geoprobe® sampling system. Geoprobe is a trade name proprietary to Geoprobe Systems of Salina, Kansas.

2.0 Background

2.1 Definitions

Geoprobe - A hydraulically-operated hammer device installed on the back of a van, pickup truck, or skid used to advance a hollow-stem rod into the soil for the purpose of collecting soil, soil gas, or groundwater samples.

Probe-Drive Sampler - A sampling device, similar to a split-spoon sampler, used to collect soil samples with a Geoprobe rig. Three types of soil samplers are available: standard 25- and 60-centimeter (cm) (10- and 24-inch) length sampler, dual tube (DT), and large bore (with an acetate liner) sampler.

Extension Rod - Stainless steel rod used to remove stop-pin and drive-point assembly.

Extension Rod Coupler - Stainless steel connector used to join sections of extension rods.

Drive Point - Solid steel retractable point used to advance sample collection device to the required sample depth.

Probe Rod - Hollow, flush-threaded, steel rod similar to a drill rod.

Stop-Pin - Steel plug that threads into the top of the drive cap to hold the drive point in place during advancement of the probe rods.

Drive Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when advancing the probe rods with the hydraulic hammer.

Pull Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when retracting the probe rods.

Extruder Rack and Piston - A device used in conjunction with the Geoprobe to force soil sample volume out of the sample tube.

Screen Point Groundwater Sampler - A groundwater sampling device designed for use with the Geoprobe consisting of a well screen encased in a perforated stainless steel sleeve.

Mill-Slotted Well Rod and Point - A groundwater sampling device designed for use with the Geoprobe consisting of a Geoprobe probe rod with 15-mil slots, each 5 cm long by 0.05 cm wide (2 inches long x 0.020 inches wide).

Post-Run Tubing System (PRT) - The Geoprobe soil vapor sampling system uses disposable polyethylene or Teflon tubing (inserted into the probe rods at the desired sampling depth) and a vacuum.

Expendable Drive Point - Solid steel point attached to the end of the screen point groundwater sampler and PRT expendable point holder.

Membrane Interface Probe (MIP) - A screening tool with semi-quantitative capabilities acting as an interface between the volatile contaminates in the subsurface and gas phase detectors at the surface. The membrane is placed in a heated block attached to the probe. Heating the block accelerates diffusion of the contaminant through the membrane into the carrier gas, which flows up hole to the detectors.

2.2 Associated Procedures

- CDM Federal SOP 1-2, *Sample Custody*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 1-5, *Groundwater Sampling Using a Bailer*
- CDM Federal SOP 1-6, *Water Level Measurements*
- CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples*
- CDM Federal SOP 4-1, *Field Logbook Content and Control*
- CDM Federal SOP 4-3, *Well Development and Purging*
- CDM Federal SOP 4-5, *Field Equipment Decontamination*

2.3 Discussion

The Geoprobe unit consists of a hydraulically-operated hammer device mounted on the back of a van, a pickup truck or a skid (Figure 1). The Geoprobe system hydraulically advances small-diameter, hollow rods to the desired sampling depth. The specific type of Geoprobe sampling equipment for soil, soil gas, and groundwater collection is then employed.

The use of Geoprobe technology may be a cost-effective alternative to using conventional drilling techniques for collecting subsurface soil, soil gas, and groundwater samples depending on the site-specific geologic and hydrogeologic conditions and sample requirements. The Geoprobe system is generally used to gather screening-level data. The site-specific sampling plans must consider such factors as soil types, presence of cobbles, depth to groundwater, quantity and depth of samples, site access and topography, data quality objectives (DQOs), analytical requirements, and waste handling and disposal requirements before selecting the use of the Geoprobe.

Advantages of using the Geoprobe Systems include:

- Areas usually considered inaccessible by drill rigs because of overhead wires, steep slopes, size constraints, etc., may be accessed with a van-, pickup truck-, or skid-mounted Geoprobe.
- Investigation-derived wastes such as soil cuttings and purge water are minimized with the Geoprobe due to its small diameter rods and its displacement of soil horizontally, not vertically.
- Pneumatic slug testing is also an option when using the SP15/SP16 groundwater sampler. Analyses of these tests will yield hydraulic conductivity values for the surrounding aquifer materials.

A Geoprobe membrane interface probe (MIP) and integrated electrical conductivity (EC) dipole combination can be deployed with direct push methods to discriminate variation in grain size and volatile organic contaminants (VOCs). As a result, lithologic changes and distribution of contaminants (chlorinated and nonchlorinated) can be determined in the subsurface.

Cost savings over conventional drilling techniques may be realized. The Geoprobe is rented/leased on a daily, weekly, or monthly basis for a fixed price as opposed to drilling subcontractors who are generally compensated based on the footage drilled. For shallow probing, the Geoprobe may be hand- operated by field personnel rather than subcontractors. A cost evaluation based on project-specific requirements and site conditions shall be conducted to determine the most cost-effective method for a particular project.

Two people are required to operate the Geoprobe and conduct sampling and recordkeeping activities. Safety considerations shall be addressed when operating the Geoprobe. A safety hazard is present whenever the Geoprobe is operated. The hydraulic system operates with a fluid pressure of over 907 kilograms (kg) (2,000 pounds per square inch [psi]). A leaking hose may produce a stream of hydraulic fluid with sufficient pressure to penetrate skin. Therefore, periodic checks of the hydraulic lines and hoses shall be conducted to ensure they are in good condition and connections are tight. Do not attempt to repair or tighten hoses with the engine running and the system under pressure. Use paper or cardboard to check for leaks.

3.0 General Responsibilities

Field Team Leader (FTL) - The field team leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure, associated SOPs, and the site-specific plans.

Sampling Personnel - Field team members are responsible for conducting Geoprobe sampling events in accordance with this procedure, all associated SOPs, and requirements as described in the site-specific plans.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

General

- Site-specific plans
- Field logbook, chain-of-custody forms, other forms for documenting sample shipment
- Indelible black or blue ink pens and markers
- Sample containers with labels and preservatives
- Insulated coolers
- Bagged ice or "blue ice"
- Plastic zip-top bags
- Waterproof sealing tape
- Temperature, conductivity, pH, dissolved oxygen, and turbidity meters (with clean beakers or other appropriate containers), as required by the site-specific plans
- Monitoring/screening instruments as required by the site-specific health and safety plan or sampling plan
- Decontamination supplies, as required by SOP 4-5
- Personal protective equipment (PPE), as required by the site-specific health and safety plan (at a minimum, hard hat, steel-toed shoes, safety glasses, and hearing protection are required)
- Latex or appropriate gloves
- Geoprobe rig (van, truck, or skid-mounted) with the following:
  - Probe rods 30-, 60-, and 90-cm (1-, 2-, and 3-foot [ft]) lengths
  - Extension rods 30-, 60-, and 90-cm (1-, 2-, and 3-ft) lengths, couplers, and handle
  - Piston stop-pins (two each per rig, minimum)
  - Drive caps and pull caps (two each per rig, minimum)
  - Carbide-tipped drill bit for working in concrete- or asphalt-covered areas
  - O-rings

Geoprobe Soil Sampling Equipment

- Extruder rack and piston (i.e., if soil is to be extruded into a sample container)
- Assembled soil samplers (i.e., standard 25-cm or 60-cm [10-inch or 24-inch] sampler, Dual Tube [DT21 or 325], and large bore sampler. The stainless steel sample tubes or acetate liners from these samplers may be individually sealed and shipped directly to the laboratory, as indicated in site-specific plans)
- Refer to the Geoprobe Systems Equipment and Tools Catalog [2005] for specific parts and accessories for each sampler

Geoprobe Soil Gas Sampling Equipment
- Expendable drive points (one each per sample location, plus spares)
- Extension rod ram
- 10 millimeter (mm) (3/8-inch) polyethylene (Teflon-lined) tubing and PRT adapter
- Vacuum or sampling system
- Syringe
- PRT adapter
- PRT expendable point holder

Geoprobe Groundwater Sampling Equipment
- Expendable drive points (one each per sample location, plus spares)
- Mill-slotted well point or screen point groundwater sampler assemblies
- Extension rod ram
- 10-mm (3/8-inch) polyethylene or Teflon-lined tubing
- Check valves (if using Waterra system)
- Peristaltic pump (limited to shallow depths)
- Mini-bailer (with thin nylon line)

5.0 Procedures

Procedures common to all three sampling methods are discussed below.

Before sampling:
- Review site-specific health and safety plan and project plans before initiating sampling activity.
- Arrange utility clearance.
- Decontaminate all Geoprobe equipment according to SOP 4-5, *Field Equipment Decontamination.*
- Don the appropriate PPE as dictated by the site-specific health and safety plan.
- If the sampling site is in a concrete- or asphalt-covered area, drill a hole using the rotary function and a specially designed 3.75-cm or 5-cm (1.5-inch or 2.0-inch) diameter carbide-tipped drill bit. Otherwise, the area needs to be cleared of heavy underbrush and immediate overhead obstructions.

After sampling is completed:
- Thread the pull cap onto the top probe rod and retract the probe rods.
- Seal the borehole with sand, neat cement, or bentonite grout, if necessary.
- Record all appropriate data in the field logbook and on the chain-of-custody forms as outlined in CDM Federal SOP 4-1, *Field Logbook Content and Control* and CDM Federal SOP 2-1, *Packaging and Shipping Environmental Samples.*
- Decontaminate the sampling equipment according to CDM Federal SOP 4-5, *Field Equipment Decontamination.*

5.1 Soil Sampling

Assembly

1. Assemble the sampling device as follows:
   - Screw the cutting shoe to the bottom end of the sample tube, unless using standard probe drive sampler which has a built-in cutting edge.
   - Screw the piston tip onto the piston rod.
   - Screw the drive head onto the top end of the sample tube.
   - If using Teflon liner, insert liner into sample tube.
   - Slide the piston rod into the sample tube, leaving the piston tip sticking out of the bottom end of the sample tube.
   - Screw the piston stop-pin onto the top end of the piston rod in a counter-clockwise direction.

2. Attach the assembled sampler onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start the 60-cm (24-inch) standard and large bore samplers.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Stop-Pin Removal

5. Move the probe unit back from the top of the probe rods and remove the drive cap.

6. Lower the extension rods into the inside diameter of the probe rods using extension rod couplers to join the extension rods.

7. Attach the extension rod handle to the top extension rod and rotate the handle clockwise until the leading extension rod is screwed into the piston stop-pin. Continue to rotate the handle clockwise until the stop-pin disengages from the drive head.

8. Remove the extension rods and attached piston stop-pin from the probe rods.

Interval Sampling

9. Replace the drive cap, mark the top probe rod with a marker or tape at a distance above the ground equal to the length of the sample tube (either 30 or 60 cm [12 or 24 inches]).

10. Advance the probe rods using the hydraulic hammer the length of the sample tube (either 30 or 60 cm [12 or 24 inches]).

11. Replace the drive cap with the pull cap and retract the probe rod(s). Secure the rod(s) with a clamp or by hand during removal so they do not fall back down the resulting borehole.

12. Detach the sampler from the lead probe rod, verifying that sufficient sample volume was recovered (***Note***: The length of sample contained within the tube is approximately equal to the length of exposed piston rod).

13. Disassemble the sampler. If the sample is to be analyzed for VOCs, then the sample tube or liner shall be sealed immediately by placing a Teflon septa over the ends and covering them with plastic caps.

14. If samples do not require VOC analysis, they may be extruded from the sampler and transferred to the sample jars specified in the site-specific plans or SOP 2-1, *Packaging and Shipping Environmental Samples*. Samples can be extruded by one of two methods:

    - Using the Geoprobe rig and the extruder rack (Figure 2), position the extruder rack on the foot of the Geoprobe derrick; insert the sample tube into the extruder rack with cutting end up; and position the extruder piston, pushing the sample out of the sample tube using the "probe" function. Catch the sample as it exits beneath the extruder in a sample jar or stainless steel mixing bowl.

Note: Samples to be collected for VOCs will be collected directly from the sample tube into the sample jars.

- Lightly tap the side of the sample tube with a hammer while also lightly pushing the Piston Rod.

15. Label the sample liner or sample jars as required, securing the label by covering it with a piece of clear, waterproof tape.

16. Homogenize the sample in a stainless steel bowl with a stainless steel spoon or spatula. Transfer the sample from the bowl to the sample container.

17. Clean the outside of the sample jars and place individual samples into sealable bags and seal the closure.

18. Place samples in a cooler containing ice according to SOP 2-1, *Packaging and Shipping Environmental Samples.*

Continuous Sampling
The DT 21 is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed 54 mm (2.15-inch) O.D. probe rods. Samples are collected and retrieved within a liner that is threaded onto the leading end of a string of Geoprobe 25mm (1-inch) O.D. rods inserted to the bottom of the outer casing.

Other sizes are available (i.e., DT325) for maximum sample recovery (up to a 77-inch stroke allowing use of 60-inch probe rods and Macro-Core® [MC5] samplers) depending on the type of direct push unit.

5.2 Soil Gas Sampling

Assembly

1. Assemble the sampling device as follows (Figure 3):

   - Test fit the adapter with the PRT expendable point holder or retractable point holder to ensure that threads are compatible and fit together smoothly.
   - Attach the PRT adapter to flexible tubing equal in length to the depth of sampling, with some additional tubing for sampling activities.
   - Secure the PRT adapter with a length of electrical tape and check the condition of the O-ring attached to the end of the PRT adapter.
   - Screw the PRT expendable point holder into the bottom of the lead probe rod.
   - Attach an expendable drive point to the bottom of the PRT expendable point holder.

2. Attach the assembled sampler onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start the 60-cm (24-inch) standard and large bore samplers.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to 30 cm (1 ft) past the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

5. Connect the out-of-hole tubing to a vacuum or sampling system. A short section of inert silicon tubing may be connected to the end of the out-of-hole tubing so that a sample can be collected with a glass gas chromatograph (GC) syringe.

6. Start the vacuum or sampling system and allow the system to operate for 2 to 3 minutes to ensure that a sufficient volume of air has been run through the tubing. Document the depth, vacuum pressure, and purge duration in logbook. ***Note***: Make sure the vacuum evacuation pump is able to pull vapors from the formation. Excessive vacuum may occur in clay/clayey units resulting in insufficient sample volume.

7. Collect sample using the method specified in the site-specific plan.

8. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.

9. Remove the tubing from the probe rods. Dispose of the tubing or set it aside for decontamination.

10. Remove probe rod(s) from hole. Leave tubing in place for longer term monitoring.

5.3 Groundwater Sampling

Assembly

1. Assemble the screen point groundwater sampler as shown on Figure 4 and described below (see Geoprobe Systems Equipment and Tools Catalog, Groundwater Sampling Tools, pp. 5.1-5.12):

   - Push the screen insert and plug into the screen sleeve from the bottom. The bottom end has one drain hole.
   - Push the screen connector over the top end of the screen sleeve and push the screen connector pin into place. The pin must be held in place as it has a loose fit.
   - Insert the screen sleeve, screen connector first, into one end of the sampler sheath.
   - Slide the drive point seat over the end of the screen assembly that protrudes from the sampler sheath. Thread it in until tight using a 22-mm (7/8-inch) wrench.
   - Push the screen assembly just far enough into the sampler sheath that an expendable drive point can be pushed into place in the drive seat.
   - Screw the groundwater drive head with the O-ring end first into the open end of the sampler sheath.
   - O-rings are installed at various critical places in the sampler assembly. Ensure that all O-rings have not been worn and that the connections made at O-ring locations are tight.
   - The mill-slotted well point does not need any assembly.

2. Attach the mill-slotted well point, or screen point groundwater sampler, onto the leading probe rod. A 30-cm (12-inch) probe rod is recommended to start either groundwater sampler.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler using either the hydraulic hammer or hydraulic probe mechanism on the Geoprobe rig. Replace the 30-cm (12-inch) rod with a 90-cm (36-inch) rod as soon as the top of the sampler is driven to within 15 cm (6 inches) of the ground surface.

4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Developing and Sampling

6. Move the probe unit back from the top of the probe rods and remove the drive cap.

7. The next step varies depending on the type of sampler being used:

   - Mill-slotted well point - measure and record the water level, allowing time for the water level to reach equilibrium.
   - Screen point groundwater sampler - attach the pull cap to the top probe rod, retract the probe rods approximately 60 cm (2 ft), push the screen into the formation using extension rods fitted with a ram, remove extension rods from the probe rods, and measure and record the water level, allowing time for the water level to reach equilibrium.

8. Surging and purging shall be conducted throughout the length of the exposed screen to properly develop the well point before sampling.

9. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.

10. Collect groundwater samples using one of three methods (as outlined in site-specific plans) described below:

    - Collect sample from the inside diameter of the probe rods using a decontaminated mini-bailer. Follow CDM Federal SOP 1-5, *Groundwater Sampling Using a Bailer.*
    - Collect sample using a peristaltic pump and flexible tubing system.
    - Collect sample using a check valve (Waterra-type valve) attached to the bottom of 10-mm (3/8-inch) diameter tubing. The tubing is lowered into the probe rods below the top of the water table, check valve-end first. Water sample is collected through the tubing by rapidly oscillating the tubing up and down creating an inertial pump.

11. Clean the outside of the sample containers and place individual samples into sealable bags and seal closure.

12. Place samples in a cooler containing ice according to SOP 2-1, *Packaging and Shipping Environmental Samples.*

5.4 Pneumatic Slug Testing

Assembly

1. Assemble the screen point groundwater sampler and the pneumatic manifold assembly as shown on Figure 5 (see Geoprobe Systems Technical Bulletin No. 19344).

2. Be sure to accurately document all well construction parameters and site geologic information:
    - Effective screen length (includes sand or filter pack)
    - Height of water column in well
    - Radius of filter pack
    - Radius of transducer and cable (for wells 1-inch diameter or less)
    - Depth of transducer below static water level
    - Saturated thickness of the aquifer
    - True screen length
    - Screen radius
    - Casing radius
    - Static water level from a fixed reference point
    - Total depth of well from a fixed reference point
    - Initial head change

3. Once the pneumatic head is in place, a vented pressure transducer assembly is installed. The transducer itself is inserted through the port on top of the pneumatic head and lowered into the well about 2-feet below the static water level and off the bottom of the well.

4. Let the transducer equilibrate to ambient groundwater temperature and then zero out the transducer.

Testing

5. Set up slug test data acquisition software and select preferred options (refer to Technical Bulletin No. 19344).

6. Close inlet and release valves and close the pressure regulator on the manifold assembly.

7. Adjust zero setting on pressure gauge, if needed.

8. Operate foot pump to pressurize supply hose to approximately 30 to 40 pounds per square inch (psi).

9. Open inlet valve on pneumatic head.

10. Slowly open the pressure regulator. From the fully closed position it takes about five revolutions to begin opening the regulator. Observe the pressure gauge on the pneumatic head (scaled as inches of water). Let the pressure in the well head rise slowly to a few inches above the level desired for testing (e.g. if you want to initiate the slug test with H0 of 10 inches let the gauge rise to about 12 inches).

11. Quickly close the inlet valve and allow the pressure observed from the transducer in the well head to return to equilibrium and stabilize. Record the stabilized gauge pressure. The readings shall return to the levels noted before pressurization was started.

12. Leak test the fittings on the pneumatic head and connection to the rods with a soapy fluid. Tighten fittings if necessary and retest. It is preferable to locate and correct any slow leaks before continuing with the slug test.

13. Once the transducer readout is back to equilibrium and stable, the slug test is ready to initiate. The slug test is initiated by opening the release valve as quickly as possible.

14. A very rapid initial drop in the transducer readout (head) shall be observed as the air pressure is released. Then the rise or recovery of the water level to the pre-test equilibrium level (baseline) will occur. Once the water level has returned to the pre-test level and is stable, the slug test is complete.

15. It is strongly recommended that at least three slug tests are run using different initial head values (H_0) to verify appropriate well performance and development. If there is significant deviation between the repeat tests, additional development of the well or sampler may be necessary.

Geoprobe Systems has designed a simple user-friendly software package and data logger that allows acquisition and filing of pneumatic transducer data on a laptop computer. The data files are stored in ASCII format for easy export to spreadsheet and data analysis programs. The selection and application of the appropriate data analysis methods is beyond the scope of this SOP for field techniques.

6.0 Restrictions/Limitations

The Geoprobe sampling system is not designed for collecting large sample volumes, thereby limiting the number of analytical parameters. Soil sample recovery will be poor in soils with substantial amounts of gravel and/or cobbles. Production rates will vary substantially depending on sampling depths/intervals, subsurface conditions, and the platform used. However, a minimum of between 10 and 15 samples per day can be expected in most situations.

The most efficient sampling depth is limited by the geologic and hydrogeologic conditions. Practical, efficient sampling depths shall be limited to approximately 6 meters (20 feet) under most conditions. However, sampling depths in excess of 30 meters (100 feet) have been achieved in unconsolidated, homogeneous sandy soils using heavy duty platforms and MC5 tools. Attainable depths will be greatly reduced in more consolidated and indurated formations and in soils with gravel and cobbles.

The presence of gravel and cobbles in soils will likely damage soil sampling tubes and possibly probe rods, couplers, stop-pins, and other probing equipment. A sufficient supply of replaceable equipment shall be kept on site in the event of damage or breakdowns. Replacement may be at the project's - not the subcontractor's - expense. A copy of the Geoprobe Systems Equipment and Tools Catalog shall also be kept on site; Geoprobe Systems provides overnight deliveries.

Before conducting the Geoprobe sampling event, underground utilities and structures must be demarcated on the ground surface. The local utility companies must be notified at least 72 hours before the scheduled sampling event to allow sufficient time to locate and mark the utility lines. The selected sampling location shall be a safe distance from the demarcated utility. In some cases, records regarding utility locations may not exist. In any event, a good practice is to slowly push the probe rods the first few feet (rather than hammering) to ensure that no utilities, underground storage tanks, or other subsurface structures are present.

7.0 References

Geoprobe® Systems. 1991. *The Probe-Drive Soil Sampling System.* September.

_____. 2002. *Pneumatic Slug Test Kit*, Technical Bulletin No. 19344. February.

_____. 2002. *DT21 Dual Tube Soil Sampling System*, Technical Bulletin No. 982100. June.

_____. 2005. *Equipment and Tools Catalog.*

Figure 1
Geoprobe® Unit

BASICS

- HYDRAULICALLY POWERED PROBE OPERATES FROM HYDRAULIC SYSTEM DRIVEN FROM THE VEHICLE OR AN AUXILIARY ENGINE.
- REMOTE VEHICLE IGNITION ALLOWS OPERATORS TO START VEHICLE ENGINE FROM REAR COMPARTMENT.
- BELT DRIVEN HYDRAULIC PUMP SUPPLIES 10 GPM AT 2000 RPM, 2250 PSI OPERATING PRESSURE.
- PROBE UNIT FOLDS FOR TRANSPORT AND SETS UP AGAIN IN SECONDS.
- UTILIZES STATIC FORCE (WEIGHT OF VEHICLE) AND PERCUSSION TO ADVANCE PROBING TOOLS.
- POWERFUL 8 HP HYDRAULIC HAMMER DELIVERS OVER 1800 BLOWS PER MINUTE.
- HAMMER FEATURES 0-300 RPM LH DIRECTIONAL ROTARY FUNCTION FOR DRILLING SURFACE PAVEMENTS.
- PROBE HAS GREATER THAN 12,000 LBS. OF PULLING CAPACITY.
- DRIVES SMALL DIAMETER (1" O.D. - 1.6" O.D.) PROBING TOOLS TO DEPTHS LIMITED ONLY BY SOIL TYPE AND DEPTH TO BEDROCK, TYPICALLY TO OVER THIRTY FEET.

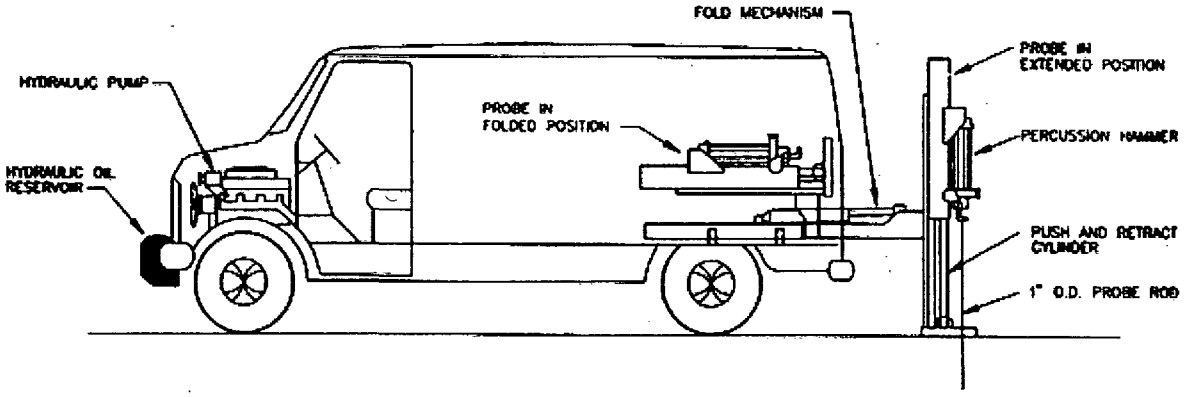


Figure 2
Sample Extruder Rack

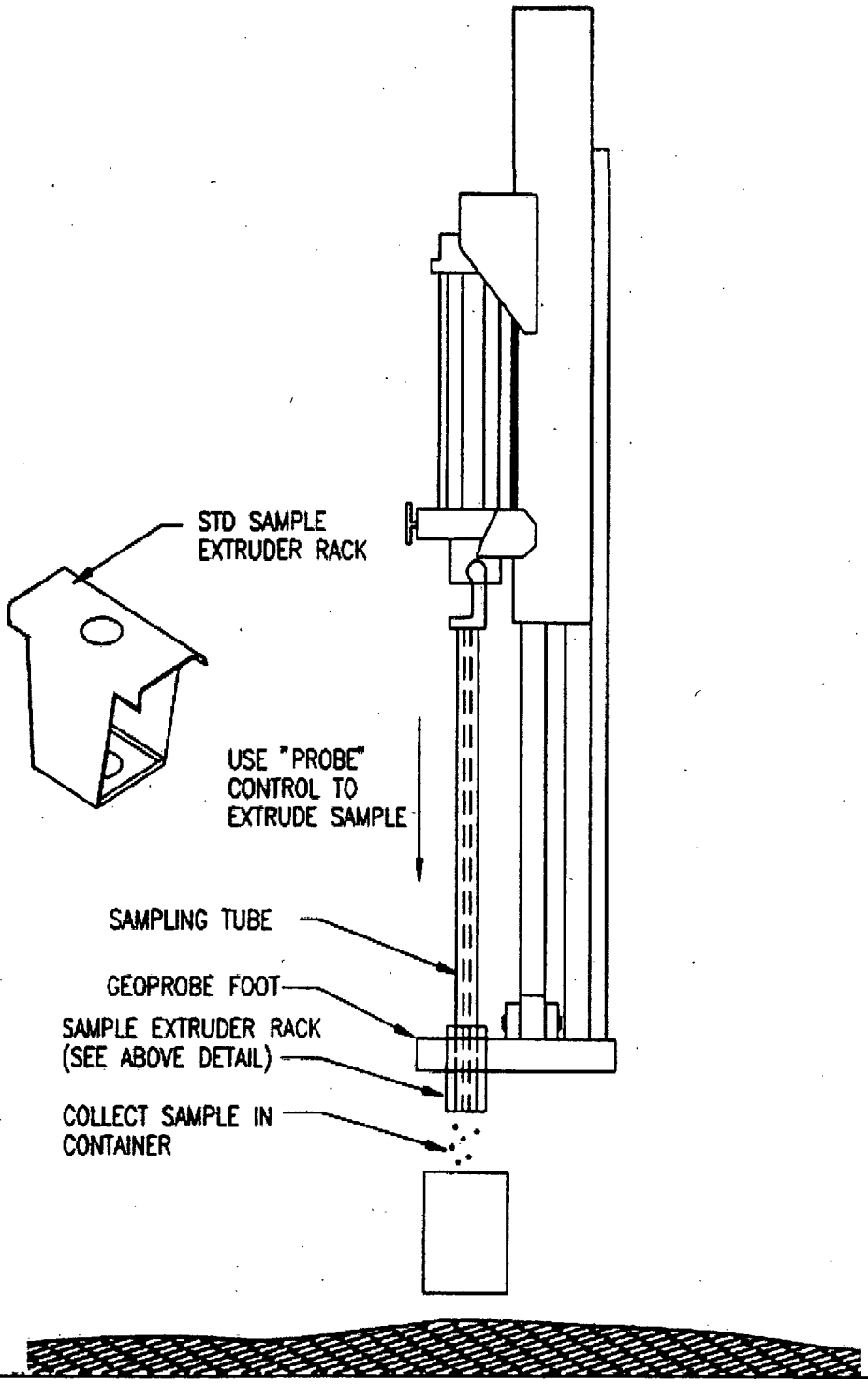


Figure 3
PRT Soil Gas Sampling System

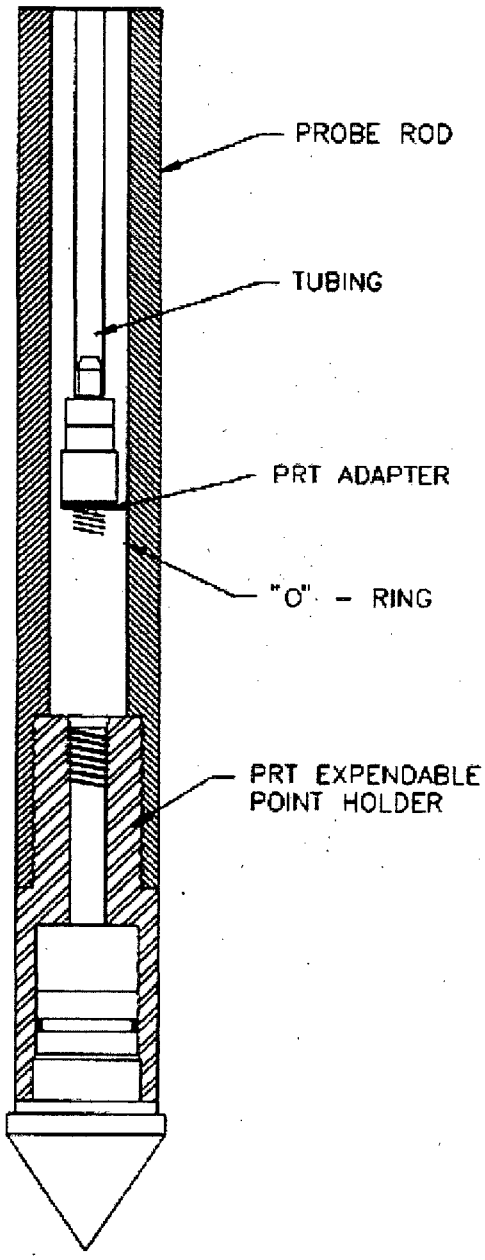


Figure 4
Groundwater Sampling

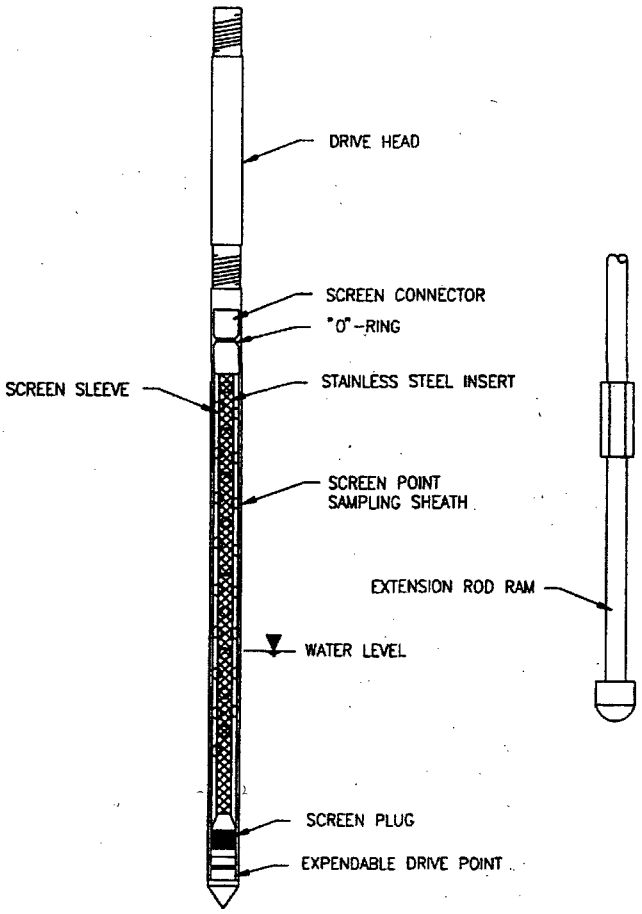
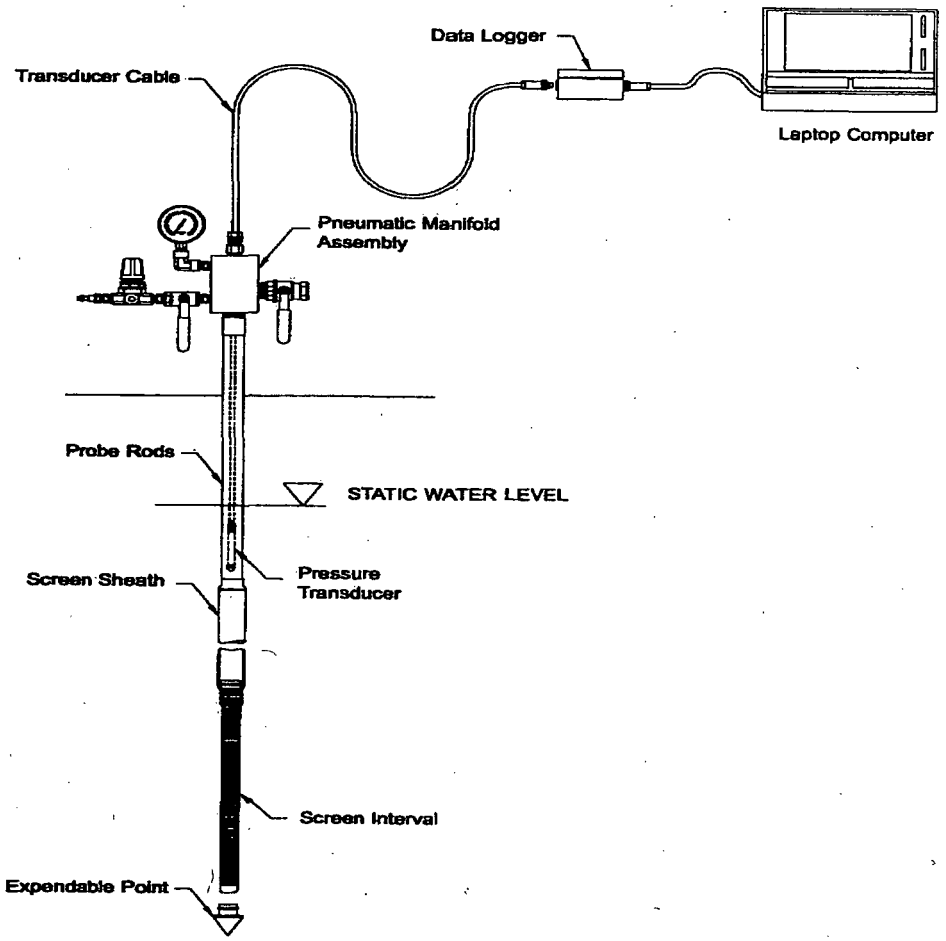


Figure 5
Pneumatic Slug Testing with an SP15/16 Groundwater Sampler



TSOP 4-1

FIELD LOGBOOK CONTENT AND CONTROL

Field Logbook Content and Control

SOP 4-1
Revision 6
Date: March 2007

Prepared: Del Baird

Technical Review: Laura Splichal

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

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Signature/Date

E-Signed by P. Michael Schwan
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Issued:

Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to set CDM Federal (CDM) criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background

2.1 Definitions

Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names; observations; data; calculations; date/time; weather; and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 General Responsibilities

Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM employees who make entries in field logbooks during onsite activities are required to read this procedure before engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities should be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment

- Site-specific plans
- Field logbook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 Procedures

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office or vehicle for easy reference.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered before initial use of the logbook. Before use in the field, each logbook will be marked with a specific document control number issued by

the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

- Field logbook document control number (if applicable).
- Activity (if the logbook is to be activity-specific), site name, and location.
- Name of CDM contact and phone number(s) (typically the project manager).
- Start date of entries.
- End date of entries.
- In specific cases, special logbooks may be required (e.g., waterproof paper for stormwater monitoring).

The first few (approximately five) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

Table of Contents

Date/Description	Pages
(Start Date)/Reserved for TOC	1-5

The remaining pages of the table of contents will be designated as such with "TOC" written on the top center of each page. The table of contents should be completed as activities are completed and before placing the logbook in the records file.

5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information does not need to be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:
  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection used
  - Serial numbers of instruments
  - Equipment calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.
- Visitors to the site.

5.3 Post-Operation

To guard against loss of data as a result of damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and nonsubjective. Field logbooks, and entries within, are not to be used for personal use.

7.0 References

Sandia National Laboratories. 1991. *Procedure for Preparing Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures,* QA-02-03. Albuquerque Environmental Program, Department 3220, Albuquerque, New Mexico.

Sandia National Laboratories. 1992. *Field Operation Procedure for Field Logbook Content and Control.* Environmental Restoration Department, Division 7723, Albuquerque, New Mexico.

TSOP 4-2

PHOTOGRAPHIC DOCUMENTATION OF FIELD ACTIVITIES

Photographic Documentation of Field Activities

SOP 4-2
Revision: 7
Date: March 2007

Prepared: David O. Johnson

Technical Review: Sharon Budney

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VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

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Issued:

Signature/Date

1.0 Objective

The purpose of this standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include still and digital photography and videotape or DVD recordings of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This document shall provide guidelines designed for use by a professional or amateur photographer. This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 Background

2.1 Definitions

Photographer - A photographer is the camera operator (professional or amateur) of still photography, including digital photography, or videotape or digital versatile discs (DVD) recording whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component - Identifier components are visual components used within a photograph such as visual slates, reference markers, and pointers.

Standard Reference Marker - A standard reference marker is a reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates - Slates are blank white index cards or paper used to present information pertaining to the subject/procedure being photographed. Letters and numbers on the slate will be bold and written with black indelible marking pens.

Arrows and Pointers - Arrows and pointers are markers/pointers used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds - Contrasting backgrounds are backdrops used to lay soil samples, cores, or other objects on for clearer viewing and to delineate features.

Data Recording Camera Back - A data recording camera back is a camera attachment or built-in feature that will record, at the very least, frame numbers and dates directly on the film.

2.2 Associated Procedures

- CDM Federal SOP 4-1, *Field Logbook Content and Control*

2.3 Discussion

Photographs and videotape or DVD recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used, and possible lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard

reference markers, and pointers. These items shall become an integral part of the "visual media" that, for the purpose of this document, shall encompass still photographs, digital photographs, videotape recordings (or video footage), and recordings on DVDs. The use of a photographic logbook and standardized entry procedures are also outlined. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the visual media and ensure the representative nature of the photographic documentation.

3.0 General Responsibilities

Field Team Leader - The field team leader (FTL) is responsible for ensuring that the format and content of photographic documentation are in accordance with this procedure. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting.

Photographer - The photographer shall seek direction from the FTL and regularly discuss the visual documentation requirements and schedule. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP. Responsibilities will be defined in the project sampling plan.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

A general list of equipment that may be used:

- 35mm camera or disposable single use camera (35mm or panoramic use)
- Digital camera
- Extra batteries for 35mm camera
- Video camera and appropriate storage media (e.g., video tapes, DVDs)
- Logbook
- Indelible black or blue ink pen
- Standard reference markers
- Slates
- Arrows or pointers
- Contrasting backgrounds
- Medium speed, or multi purpose fine-grain, color, 35mm negative film or slide film (project dependent)
- Data recording camera back (if available)
- Storage medium for digital camera

5.0 Procedures

5.1 Documentation

A commercially available, bound logbook will be used to log and document photographic activities. Review CDM Federal SOP 4-1, *Field Logbook Content and Control* and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook may be designated as the photographic log and documentation section.

Field Health and Safety Considerations

There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site-specific and dictated through requirements set by the site safety officer, site health and safety plan, and/or prescribed by the CDM Federal Corporate Health and Safety Program. The photographer should contact the site safety officer for health and safety orientation before commencing field activities. The site health and safety plan must be read before entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazards while photographing the subject (e.g., traffic, low overhead hazard, edge of excavation).

5.2 Operation

5.2.1 General Photographic Activities in the Field

The following sections provide general guidelines that should be followed to visually document field activities and site features using still/digital cameras and video equipment. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

- The photographer should be prepared to make a variety of shots, from close-up to wide-angle. Many shots will be repetitive in nature or format, especially close-up site feature photographs. Consideration should therefore be given to designing a system or technique that will provide a reliable repetition of performance.
- All still film photographs should be made using a medium speed, or multi purpose fine-grain, color negative film in the 35mm format unless otherwise directed by the FTL.
- It is suggested that Kodak brand "Ektapress Gold Deluxe" film or equivalent be used as the standard film for the still photography requirements of the field activities. This film is stable at room temperature after exposure and will better survive the time lag between exposure and processing. It is suggested that film speed ASA 100 should be used for outdoor photographs in bright sunlight, ASA 200 film should be used in cloudy conditions, and ASA 400 film should be used indoors or for very low-light outdoor photographs.
- No preference of videotape or DVD brand along with digital storage medium is specified and is left to the discretion of the photographer.
- The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. If the ambient lighting conditions are inadequate, the photographer should be prepared to augment the light (perhaps with reflectors or electronic flash) to maintain the desired visual effect.
- Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store a fewer number of photographs per digital storage medium.

5.2.2 General Guidelines for Still Photography

Slate Information

It is recommended that each new roll of film or digital storage medium shall contain on the first usable frame (for film) a slate with consecutively assigned control numbers (a consecutive, unique number that is assigned by the photographer as in sample numbers).

Caption Information

All still photographs will have a full caption permanently attached to the back or permanently attached to a photo log sheet. The caption should contain the following information (digital photographs should have a caption added after the photographs are downloaded):

- Film roll control number (if required) and photograph sequence number
- Date and time
- Photographer
- Description of activity/item shown (e.g., name of facility/site, specific project name, project number)
- Direction (if applicable)

When directed by the sampling plan, a standard reference marker should be used in all documentary visual media. While the standard reference marker will be predominantly used in close-up feature documentation, inclusion in all scenes should be considered.

Digital media should be downloaded at least once each day to a personal computer; the files should be in either "JPEG" or "TIFF" format. Files should be renamed at the time of download to correspond to the logbook. It is recommended the electronic files be copied to a compact disc for backup.

Close-Up and Feature Photography

When directed by the sampling plan, close-up photographs should include a standard reference marker of appropriate size as an indication of the feature size and contain a slate marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their in situ locations. This enables a more accurate record of their initial condition and color. When directed by the sampling plan, include a standard reference color strip (color chart such as Munsell Soil Color Chart or that available from Eastman Kodak Co.) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aid to the viewer for formal lithologic observations and interpretations.

Site Photography
Site photography, in general, will consist predominantly of medium- and wide-angle shots. A standard reference marker should be placed adjacent to the feature or, when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and caption/slate be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide-angle shots. In such a case, the film/tape control number shall be entered in the photographic logbook along with the frame number and all other information pertinent to the scene.

Panoramic
In situations where a wide-angle lens does not provide sufficient subject detail, a single-use disposable panoramic camera is recommended. If this type of camera is not available, a panoramic series of two or three photos would be appropriate. Panoramas can provide greater detail while covering a wide subject, such as an overall shot of a site.

To shoot a panoramic series using a standard 35mm or digital camera, the following procedures are recommended:

- Use a stable surface or tripod to support the camera
- Allow a 20- to 30-percent overlap while maintaining a uniform horizon
- Complete two to three photos per series

5.2.3 General Photographic Documentation Using Video Cameras
As a reminder, it is not within the scope of this document to set appropriate guidelines for presentation or "show" videotape or DVD recording. The following guidelines are set for documentary videotape or DVD recordings only and should be implemented at the discretion of the site personnel.

Documentary videotape or DVD recordings of field activities may include an audio slate for all scenes. At the beginning of each video session, an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account may include any additional information clarifying the subject matter being recorded.

A standard reference marker may be used when taking close-up shots of site features with a video camera. The scene may also include a caption/slate. It should be placed adjacent and parallel to the feature being photographed.

It is recommended that a standard reference marker and caption/slate be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original video recordings will not be edited. This will maintain the integrity of the information contained on the videotape or DVD. If editing is desired, a working copy of the original video recording can be made.

A label should be placed on the videotape or DVD with the appropriate identifying information (project name, project number, date, location, etc.).

5.2.4 Photographic Documentation
Photographic activities must be documented in a photographic logbook or in a section of the field logbook. The photographer will be responsible for making proper entries.

In addition to following the technical standards for logbook entry as referenced in CDM Federal SOP 4-1, the following information should be maintained in the appropriate logbook:

- Photographer name.
- If required, an entry shall be made for each new roll/tape/DVD control number assigned.
- Sequential tracking number for each photograph taken (for digital cameras, the camera-generated number may be used).
- Date and time (military time).
- Location.
- A description of the activity/item photographed.
- If needed, a description of the general setup, including approximate distance between the camera and the subject, may be recorded in the logbook.
- Record as much other information as possible to assist in the identification of the photographic document.

5.3 Post Operation

All film will be sent for development and printing to a photographic laboratory (to be determined by the photographer). The photographer will be responsible for arranging transport of the film from the field to the photographic laboratory. The photographer shall also be responsible for arranging delivery of the negatives and photographs, digital storage medium, or videotape or DVD to the project management representative to be placed in the project files.

5.3.1 Documentation

At the end of each day's photographic session, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in CDM Federal SOP 4-1.

5.3.2 Archive Procedures

- Photographs and the associated set of uncut negatives, digital media, and original unedited documentary video recordings will be submitted to the project files and handled according to contract records requirements. The project manager will ensure their proper distribution.
- Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

6.0 Restrictions/Limitations

This document is designed to provide a set of guidelines for the field amateur or professional photographer to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or "show" photography.

The procedures outlined herein are general by nature. The photographer is responsible for specific operational activity or procedure. Questions concerning specific procedures or requirements should be directed to the project manager or FTL.

Note: Some sites do not permit photographic documentation. Check with the site contact for any restrictions.

7.0 References

U. S. Army Corps of Engineers. 2001. *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. 1992. National Enforcement Investigations Center. *Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p. 85. Revised March.

_____. Region IV. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. Athens, Georgia. November.

TSOP 4-5

FIELD EQUIPMENT DECONTAMINATION AT NONRADIOACTIVE SITES

Field Equipment Decontamination at Nonradioactive Sites

SOP 4-5
Revision 7
Date: March 2007

Prepared: Steven Fundingsland

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1.0 Objective

The objective of this standard operating procedure (SOP) is to describe the general procedures required for decontamination of field equipment at nonradioactive sites. This SOP serves as a general guide and is applicable at most sites; however, it shall be noted that site-specific conditions (i.e., type of contamination, type of media sampled), the governing agency (e.g., EPA, DOE, USACE), and site-specific work plans, sampling and analysis plans and/or quality assurance (QA) project plans may require modifications to the decontamination procedures provided in this SOP. Decontamination of field equipment is necessary to ensure acceptable quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants offsite.

2.0 Background

2.1 Definitions

Acid Rinse - A solution of 10 percent nitric or hydrochloric acid made from reagent grade acid and analyte-free water.

Analyte-Free Water - Tap water that has been treated so that the water contains no detectable heavy metals or other inorganic compounds. Analyte-free water shall be stored only in clean glass, stainless steel, or plastic containers that can be closed when not in use.

Clean - Free of contamination and when decontamination has been completed in accordance with this SOP.

Cross Contamination - The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or noncontaminated samples or areas.

Decontamination - The process of rinsing or otherwise cleaning the surfaces of equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure of personnel.

Material Safety Data Sheets (MSDS) - These documents discuss the proper storage and physical and toxicological characteristics of a particular substance used during decontamination. These documents, generally included in site health and safety plans, shall be kept on site at all times during field operations.

Organic-Free/Analyte-Free Water - Tap water that has been treated so that the water meets the analyte-free water criteria and contains no detectable organic compounds. Organic-free/analyte-free water shall be stored only in clean glass, Teflon™, or stainless steel containers that can be closed when not in use.

Potable Water - Tap water may be obtained from any municipal system. Chemical analysis of the water source may be required before it is used.

Sampling Equipment - Equipment that comes into direct contact with the sample media. Such equipment includes split spoon samplers, well casing and screens, and spatulas or bowls used to homogenize samples.

Soap - Low-sudsing, nonphosphate detergent such as Liquinox™.

Solvent Rinse - Pesticide grade, or better, isopropanol, acetone, or methanol.

2.2 Associated Procedures

- CDM Federal SOP 1-1 - *Surface Water Sampling*
- CDM Federal SOP 1-3 - *Surface Soil Sampling*
- CDM Federal SOP 1-4 - *Subsurface Soil Sampling*
- CDM Federal SOP 1-5 - *Groundwater Sampling Using Bailers*
- CDM Federal SOP 1-7 - *Wipe Sampling*
- CDM Federal SOP 1-9 - *Tap Water Sampling*
- CDM Federal SOP 1-11 - *Sediment/Sludge Sampling*
- CDM Federal SOP 2-2 - *Guide to Handling Investigation-Derived Waste*
- CDM Federal SOP 3-1 - *Geoprobe® Sampling*

3.0 Responsibilities

The project manager or designee, generally the field team leader (FTL), ensures that field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this SOP and site-specific work plans. The FTL may also be required to collect and document rinsate samples (also known as equipment blanks) to provide quantitative verification that these procedures have been correctly implemented.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific QA plan.

4.0 Required Equipment

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Soap
- Nalgene or Teflon sprayers or wash bottles or 2- to 5-gallon, manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting, plastic bags, and/or aluminum foil to keep decontaminated equipment clean between uses
- Disposable wipes, rags, or paper towels
- Potable water*
- Analyte-free water
- Organic-free/analyte-free water
- Gloves, safety glasses, and other protective clothing as specified in the site-specific health and safety plan
- High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)
- Appropriate decontamination solutions pesticide grade or better and traceable to a source (e.g., 10 percent and/or 1 percent nitric acid [HNO_3], acetone, methanol, isopropanol, hexane)
- Tools for equipment assembly and disassembly (as required)
- 55-gallon drums or tanks for temporary storage of decontamination water (as required)
- Pallets for drums or tanks holding decontamination water (as required)

* Potable water may be required to be tested for contaminants before use. Check field plan for requirements.

5.0 Procedures

All reusable equipment (nondedicated) used to collect, handle, or measure samples shall be decontaminated before coming into contact with any sampled media or personnel using the equipment. Decontamination of equipment shall occur either at a central decontamination station or at portable decontamination stations set up at the sampling location, drill site, or monitoring well location. The centrally located decontamination station shall include an appropriately sized bermed and lined area on which equipment decontamination shall occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e., pre-remedial sampling). Equipment shall be transported to and from the decontamination station in a manner to prevent cross contamination of equipment and/or area. Precautions taken may include enclosing augers in plastic wrap while being transported on a flatbed truck.

The decontamination area shall be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the decontamination area that then drains into a collection system. Water from the collection system shall be transferred into 55-gallon drums or portable tanks for temporary storage. Typically, decontamination water shall be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition of the waste is determined (SOP 2-2, *Guide to Handling Investigation-Derived Waste*). The exact procedure for decontamination waste disposal shall be discussed in the work plan. Also, solvent and acid rinse fluids may need to be segregated from other investigation-derived wastes.

All items that shall come into contact with potentially contaminated media shall be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they shall be covered either with clean plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows:

General Guidelines

- Potable, analyte-free, and organic-free/analyte-free water shall be free of all contaminants of concern. Following the field QA sampling procedure described in the work plan, analytical data from the water source may be required.
- Sampling equipment that has come into contact with oil and grease shall be cleaned with methanol or other approved alternative to remove the oily material. This may be followed by a hexane rinse and then another methanol rinse. Regulatory or client requirements regarding solvent use shall be stated in the work plan.
- All solvents and acids shall be pesticide grade or better and traceable to a source. The corresponding lot numbers shall be recorded in the appropriate logbook.

  Note: Solvents and acids are potentially hazardous materials and must be handled, stored, and transported accordingly. Solvents shall never be used in a closed building. See the site-specific health and safety plan and/or the chemical's MSDS for specific information regarding the safe use of the chemical.
- Decontaminated equipment shall be allowed to air dry before being used.
- Documentation of all cleaning and field QA sampling shall be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment shall be used as specified in the site-specific health and safety plan.

5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs, well development rigs, and backhoes. Follow these steps when decontaminating this equipment:

- Establish a bermed decontamination area that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be used; otherwise, use one or more layers of heavy plastic sheeting to cover the ground surface and berms. All decontamination pads shall be upwind of the area under investigation.
- With the rig in place, spray areas (rear of rig or backhoe) exposed to contaminated media using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.
- Use brushes, soap, and potable water to remove dirt whenever necessary.
- Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.
- Record the equipment type, date, time, and method of decontamination in the appropriate logbook.

- After decontamination activities are completed, collect all contaminated wastewater, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination

Downhole equipment includes hollow-stem augers, drill pipes, rods, stems, etc. Follow these steps when decontaminating this equipment:

- Set up a centralized decontamination area, if possible. This area shall be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.
- Set up a "clean" area upwind of the decontamination area to receive cleaned equipment for air-drying. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads shall be upwind of any areas under investigation.
- Place the object to be cleaned on aluminum foil or plastic-covered wooden sawhorses or other supports. The objects to be cleaned shall be at least 2 feet above the ground to avoid splashback when decontaminating.
- Using soap and potable water in the hot water high-pressure sprayer (or steam unit), spray the contaminated equipment. Aim downward to avoid spraying outside the decontamination area. Be sure to spray inside corners and gaps especially well. Use a brush, if necessary, to dislodge dirt.
- If using soapy water, rinse the equipment using clean, potable water. If using hot water, the rinse step is not necessary if the hot water does not contain a detergent. If the hot water contains a detergent, this final clean water rinse is required.
- Using a suitable sprayer, rinse the equipment thoroughly with analyte-free water.
- Remove the equipment from the decontamination area and place in a clean area upwind to air dry.
- Record equipment type, date, time, and method of decontamination in the appropriate logbook.
- After decontamination activities are completed, collect all contaminated wastewaters, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal. Liquids and solids must be drummed separately.

5.3 Sampling Equipment Decontamination

Follow these steps when decontaminating sampling equipment:

- Set up a decontamination line on plastic sheeting. The decontamination line shall progress from "dirty" to "clean." A clean area shall be established upwind of the decontamination wash/rinse activities to dry the equipment. At a minimum, clean plastic sheeting must be used to cover the ground, table, or other surfaces that the decontaminated equipment is placed for drying.
- Disassemble any items that may trap contaminants internally. Do not reassemble the items until decontamination and air drying are complete.
- Wash the items with potable water and soap using a stiff brush as necessary to remove particulate matter and surface films. The items may be steam cleaned using soap and hot water as an alternative to brushing. ***Note*: Polyvinyl chloride or plastic items shall not be steam cleaned.** Items that have come into contact with concentrated and/or oily contaminants may need to be rinsed with a solvent such as hexane and allowed to air dry prior to this washing step.
- Thoroughly rinse the items with potable water.

- If sampling for metals, thoroughly rinse the items with an acid solution (e.g., 10 percent nitric acid) followed by a rinse using analyte-free water. If sampling for organic compounds, thoroughly rinse the items with solvent (e.g., isopropanol) followed by a rinse using analyte-free water. The specific chemicals used for the acid rinse and solvent rinse phases shall be specified in the work plan. The acid rinsate and solvent rinsate must each be containerized separately. Acids and solvents are potentially hazardous materials and care must be exercised when using these chemicals to prevent adverse health affects (e.g., skin burns, irritation to the eyes and respiratory system). Appropriate personal protective equipment must be worn when using these chemicals. These chemicals (including spent rinsate) must be managed and stored appropriately. Special measures such as proper labels, paperwork, notification, etc. may be required when transporting or shipping these chemicals.
- Rinse the items thoroughly using organic-free/analyte-free water.
- Allow the items to air dry completely.
- After drying, reassemble the parts as necessary and wrap the items in clean plastic wrap or in aluminum foil.
- Record equipment type, date, time, and method of decontamination in the appropriate logbook.
- After decontamination activities are completed, collect all contaminated waters, used solvents and acids, plastic sheeting, and disposable personal protective equipment. Place the contaminated items in properly labeled drums for disposal. Liquids and solids must be drummed separately. Refer to site-specific plans for labeling and waste management requirements.

5.4 Pump Decontamination

Follow the manufacturer's recommendation for specified pump decontamination procedures. At a minimum, follow these steps when decontaminating pumps:

- Set up the decontamination area and separate "clean" storage area using plastic sheeting to cover the ground, tables, and other surfaces. Set up four containers: the first container shall contain dilute (nonfoaming) soapy water, the second container shall contain potable water, the third container shall be empty to receive wastewater, and the fourth container shall contain analyte-free water.
- The pump shall be set up in the same configuration as for sampling. Submerge the pump intake (or the pump, if submersible) and all downhole-wetted parts (tubing, piping, foot valve) in the soapy water of the first container. Place the discharge outlet in the wastewater container above the level of the wastewater. Pump soapy water through the pump assembly until it discharges to the waste container. Scrub the outside of the pump and other wetted parts with a metal brush.
- Move the pump assembly to the potable water container while leaving discharge outlet in the waste container. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.
- Move the pump intake to the analyte-free water container. Pump the water through the pump assembly. Pump the volume of water through the pump specified in the field plan. Usually, three pump-and-line-assembly volumes shall be required.
- Decontaminate the discharge outlet by hand, following the steps outlined in Section 5.3.
- Remove the decontaminated pump assembly to the clean area and allow it to air dry upwind of the decontamination area. Intake and outlet orifices shall be covered with aluminum foil to prevent the entry of airborne contaminants and particles.
- Record the equipment type, serial number, date, time, and method of decontamination in the appropriate logbook.

5.5 Instrument Probe Decontamination

Instrument probes used for field measurements such as pH meters, conductivity meters, etc. shall be decontaminated between samples and after use with analyte-free, or better, water.

5.6 Waste Disposal

Refer to site-specific plans and SOP 2-2 for waste disposal requirements. The following are guidelines for disposing of wastes:

- All wash water, rinse water, and decontamination solutions that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste.
- Small quantities of decontamination solutions may be allowed to evaporate to dryness.
- If large quantities of used decontamination solutions shall be generated, each type of waste shall be contained in separate containers.
- Unless otherwise required, plastic sheeting and disposable protective clothing may be treated as solid, nonhazardous waste.
- Waste liquids shall be sampled, analyzed for contaminants of concern in accordance with disposal regulations, and disposed of accordingly.

6.0 Restrictions/Limitations

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics, respectively. These steps shall not be used, unless required, because of the potential for acid burns and ignitability hazards.

If the field equipment is not thoroughly rinsed and allowed to completely air dry before use, volatile organic residue, which interferes with the analysis, may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted. In the summer, volatilization is rapid, and in the winter, volatilization is slow. Check with your EPA region, state, and client for approved decontamination solvents.

7.0 References

American Society for Testing and Materials. 2002. *Standard Practice for Decontamination of Field Equipment at Nonradioactive Waste Sites*, ASTM D5088-02. January 10.

Department of Energy. Hazardous Waste Remedial Actions Program. 1996. *Standard Operating Procedures for Site Characterization*, DOE/HWP-100/R1. September.

_____. Hazardous Waste Remedial Actions Program. 1996. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R2. September.

U. S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1.

_____. 1992. *Standard Operating Safety Guidelines*; Publication 9285.1-03. June.

_____. *Region 2. 1989. CERCLA Quality Assurance Manual, Revision 1.*

_____. Region 4. 2001. *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*. November.

TSOP 4-9

AQUIFER PERFORMANCE TESTS

Aquifer Performance Tests

SOP 4-9
Revision 0
Date: May 6, 2005

Prepared: Aaron Frantz
Technical Review: Michael Smith
QA Review: Doug Updike
Approved: Michael C. Malloy 5/05/05 Signature/Date
Issued: 5/5/05 Signature/Date

1.0 Objective

The purpose of this standard operating procedure (SOP) is to define requirements for conducting a constant rate aquifer performance test (APT).

2.0 Background

Many different methods and techniques are performed to determine hydraulic properties of an aquifer (American Society for Testing and Materials 2004). The methods and techniques in this procedure are for a standard constant-rate withdrawal test to be conducted at a nonflowing well. APTs are commonly performed in wells that will ultimately be used to withdraw groundwater for an extended period of time. These wells are typically 6 inches or more in diameter and are used for purposes such as drinking water (a supply well), contaminated groundwater removal (a recovery well), and industrial processes (production well). However, tests can be run in other well types and sizes (e.g., a monitoring well that is 4 inches in diameter). The information collected during an APT is used for defining the hydraulic characteristics of the aquifer. Data collected during an APT can also be used to assess pump selection and water delivery piping.

2.1 Definitions

Pumping well - The well from which water is withdrawn during an APT.

Observation well - A well that is used to monitor the groundwater level at some distance from the pumping well during an APT.

Stilling pipe - A small diameter (about 1 inch) pipe that is installed in the pumping well from the top of the pump to the surface; the transducer is placed in the pipe.

2.2 Discussion

In general, APTs consist of withdrawing water from a pumping well for a specified time period and monitoring the water level in the pumping well and observation wells. The recorded time-drawdown data are then reduced and analyzed to:

- Determine the specific capacity and safe yield of the well
- Calculate the properties (transmissivity [T] and storativity [S]) of the aquifer (T may be estimated from pumping well and observation well data; S may be estimated from observation well data)
- Characterize the hydrogeologic framework at and near the investigation area

These three items, or one of the items at a minimum, are typically evaluated with APT data. However, other ancillary but useful information (e.g., water quality changes under stressed conditions) may also be obtained from the APT data. During the planning stages of the APT, the objectives of the test shall be specified so that the necessary data to reach the objectives are collected when the test is performed.

2.3 Associated SOPs

- CDM Federal (CDM) SOP 1-6, *Water Level Measurement*
- CDM SOP 1-10, *Field Measurement of Organic Vapors*
- CDM SOP 2-2, *Guide to Handling of Investigation-Derived Waste*
- CDM SOP 4-1, *Field Logbook Content and Control*
- CDM SOP 4-4, *Design and Installation of Monitoring Wells in Aquifers*
- CDM SOP 4-5, *Field Equipment Decontamination at Nonradioactive Sites*

3.0 Roles and Responsibilities

Site Manager - Translates client's requirements into technical direction of project. Sets technical criteria, reviews, and approves technical progress. Ensures that all participating personnel have proper training. ***Note***: Other titles such as project manager may be used.

Field Team Leader (FTL) - Supervises field operations. Ensures that all necessary equipment, including safety equipment, is available and functioning properly before project operations begin. Ensures that all necessary personnel are mobilized on time. Maintains daily log of activities each work day.

Field Geologist - Collects and maintains data. Coordinates and consults with site manager on decisions relative to unexpected encounters during testing and deviations from this SOP. Directs overall activities of testing procedures and support subcontractors.

4.0 Required Equipment

Water measuring and recording:

- Pressure transducers and data logger
- Personal computer for viewing and downloading data
- Water level measuring device
- Stopwatch
- Field logbook
- Decontamination equipment and supplies
- Data on construction of the pumping well (depth to screen and screen length)

Water pumping, treating, storing, and discharging:

- Pump (sufficient capacity to withdraw at the required rate) with electric wiring
- Discharge hosing/piping
- Electrical source (e.g., generator)
- Flowmeter with totalizer
- Sampling valve
- Water treatment unit (if required)
- Water storage container (if required)
- Ancillary equipment and supplies to install and/or operate the main equipment

A field service subcontractor will typically be responsible for providing and operating the equipment for pumping, treating, storing, and discharging water. However, in some cases, it may be appropriate for the pumping, treating, storing, and/or discharging equipment to be provided and operated by those that also provide and operate the water measuring and recording equipment. The project requirements and structure will need to be evaluated to determine the most suitable arrangement for providing and operating the necessary equipment.

5.0 Procedures

An APT has five main components:

- Preparation
- Continuous background monitoring
- Step-drawdown test
- Long-term constant rate test
- Discharge water management

Sometimes only the long-term constant rate test is performed and the background monitoring and the step-drawdown tests are omitted. Therefore, the long-term test is sometimes referred to as an APT.

A form that provides typical general information that should be recorded for each test is provided at the end of this SOP.

5.1 Preparation

Adequate attention to the planning and design of the APT is a significant phase of the procedure and will ensure that useful results are produced (U. S. Geological Survey 1976, U. S. Environmental Protection Agency 1993). A planning meeting shall be held to identify the objectives of the APT and then the scope of the APT shall be developed. After the objectives are identified and the scope is developed, an APT plan shall be prepared that describes the procedures to be followed. The plan shall identify and describe the details to be followed for each component of the APT.

5.2 Continuous Background Monitoring

Water levels shall be collected continuously prior to performing the long-term test. Adjacent surface water bodies should also be monitored. The water levels shall be used to reduce and analyze the data collected during the long-term test. The background data is also useful in characterizing the hydrogeologic framework.

Transducers/loggers shall be installed in the pumping well and the observation wells. Each transducer/logger shall be checked and set following the manufacturer's manual, including setting the internal clock to a common external standard. Each transducer shall be installed to a depth that does not exceed the working capacity of the transducer and where the water level will not drop below the transducer during ambient water level changes. After the selected depth is reached with the transducer:

- Securely attach the cable to the well head and mark a reference point with electrical tape to allow verification that the transducer position does not change during the test
- Read the depth of water using the transducer (note that the transducer may need to equilibrate with the water temperature following the manufacturer's specifications and recover from displacement of water caused by submersion of the transducer)
- Collect a manual water level measurement from the well's measuring point
- Begin recording water levels on a linearly rate of 1 reading per 30 minutes

Transducers shall be programmed so that water level recording begins at the same time at each well. Having water levels recorded at the same time for each well simplifies the data reduction and evaluation activity contrasted to having water levels recorded at different times for different wells.

Background water levels shall be recorded for 7 days. During the monitoring period, the transducers/loggers should be occasionally checked (e.g., check the transducers on day two and day five) to verify that the equipment is working properly. Manual water level measurements should be taken and recorded during this check. Replace any transducer that is identified to be not operating correctly.

At the end of the monitoring period, stop the test recording and download the recorded data.

Barometric pressure (BP) and precipitation shall be recorded during the background monitoring period. These two elements are commonly considered the main natural factors to impact groundwater levels. If publicly available data can be obtained from a weather station located nearby (within approximately 5 miles of the project), the data from that station may be used. BP and precipitation data shall also be recorded during the long-term test.

5.3 Step Drawdown Test

The step drawdown test (or simply, step test) is required to determine the constant pumping rate that will be used for the subsequent long-term test and to assess well efficiency. Step test data may also be used to evaluate the hydrogeologic characteristics. The step test is performed at the pumping well. In summary, the step drawdown test consists of pumping water from the well at short incrementally increased rates (steps) so that a withdrawal rate can be determined for the long-term test.

A pump capable of yielding 1.5 times the estimated yield of the pumping well shall be installed to the specified depth. A vertical check valve will be placed in the discharge line immediately above the pump or intake to prohibit water from draining into the well when the pumping ceases. A 1-inch diameter polyvinyl chloride line will be placed in the well with

the bottom end open to a depth within 1 foot from the top of the pump. Several ¼-inch diameter holes should be drilled in the bottom 5 feet of this stilling pipe. The water level transducer will be installed in the pipe. After the pumping equipment and transducer are installed, the following steps will be followed:

- Connect a flow meter/totalizer and sample tap with valve to the discharge line from the pump; direct the discharge line to the system to handle the water. Care must be taken to provide sufficient straight sections of pipe above and below the flow meter to obtain accurate measurements. Recent calibration certificates should be obtained for the flow meter.
- Record the volumetric reading on the totalizer (***Note***: Prior to pumping and increasing pumping rate and after ending pumping, the volumetric reading should be recorded).
- Measure and record the static water level in the pumping well.
- Begin logging with the transducer and then start pumping water from the pumping well at a relatively low (approximately ½ of the estimated yield) but steady rate (STEP 1); logging should be started approximately 2 to 5 seconds prior to starting pumping. Flow should be adjusted to maintain a constant rate, noting when changes are made.
- Record the time at which pumping is started, using a clock that is synchronized with the transducer clocks, and the flow rate; check operation of the transducer.
- Monitor the water level in the pumping well with the transducer and confirm periodically with manual measurements.
- After approximately 1½ hours, increase the pumping rate to approximately ¾ of the estimated yield, and continue to monitor the water level for approximately 2 hours (STEP 2).
- Record the time at which the pumping rate is increased and the new flow rate; check operation of the transducer.
- Approximately 2 hours after increasing the pumping rate for STEP 2, increase the pumping rate to approximately equal to the estimated yield, and continue to monitor the water level for approximately 2 hours (STEP 3).
- Record the time at which the pumping rate is increased and the new flow rate.
- Approximately 2 hours after increasing the pumping rate for STEP 3, increase the pumping rate to approximately 1.5 x the estimated yield, and continue to monitor the water level for approximately 2 hours (STEP 4).
- Record the time at which the pumping rate is increased and the new flow rate.
- Shut off the pump at the end of STEP 4 (maximum of 8 hours has elapsed since pumping started at the beginning of the test) and download data. The transducer should continue recording during the recovery period.

A step test is dynamic. During each step the operator will gain more information on how the well's water level responds to specified pumping rates. The estimated increases identified above for each step should only be used as a guide. Each successive increase should be based on the operator's general understanding of well hydraulics, observations made while installing and developing the well, and on the well's response during the previous step(s). The goal, in summary, is to achieve the well yield at STEP 3 and exceed the well yield at STEP 4.

During the test, water levels at the pumping well shall be recorded logarithmically following the recommended schedule in the following chart. Typical data loggers have default sample intervals except for the largest sample interval, which is set by the user (in the table below, the 10-minute sample interval is set by the user). The default sample intervals shall be equal to or similar to the table below.

Log Cycle	Elapsed Time	Sample Interval	Points/Cycle
1	0 to 20 seconds	0.2 second	101
2	20 to 60 seconds	1 second	40
3	1 to 10 minutes	10 seconds	54
4	10 to 100 minutes	2 minutes	45
5	100 to 1,000 minutes	10 minutes	90

The drawdown-time data shall be plotted semi-logarithmically. The drawdown (y-axis) shall be plotted on a linear scale and time (x-axis) shall be plotted on a logarithmic scale. The drawdown curves shall be extrapolated to the specified time of the proposed long-term test. The rate that results in the maximum drawdown without dropping the water level below the design pumping level within the time period of the long-term test shall be considered the flow rate to be used for the long-term test. The specific capacity versus pumping rate should also be plotted to determine if excessive well losses occur at the selected rate.

5.4 Long-Term Constant Rate Test

The long-term constant rate test will be performed at the pumping well. Water levels will be monitored in the pumping well and the observation wells. The same pumping equipment used for the step test will be used for the long-term test. BP and precipitation shall be recorded during the long-term test. If publicly available data can be obtained from a weather station located nearby (within approximately 5 miles of the project), the data from that station may be used. Adjacent surface water bodies should also be monitored if the surface water is potentially connected to the groundwater system.

The time interval for the long-term constant rate test shall be specific to the project. However, at a minimum, a confined aquifer should be pumped for 24 hours and an unconfined aquifer to be pumped for 72 hours (American Water Works Association 1997). The project objectives will need to be reviewed and aquifer test solution requirements considered so that the correct pumping period is selected. The following steps shall be followed to conduct the long-term test after the step test is completed.

- Install transducers in the pumping well and the observation wells (note that transducers can be installed in observation wells prior to the day the long-term test starts).
- Read the water level depths with the transducers and record the values; measure and record the static water levels with the electronic water level meter from the wells' measuring points.
- Record the volumetric reading on the totalizer.
- Begin logging water level data with the transducers and then start pumping at the predetermined rate (determined based on the step-drawdown test results).
- Periodically monitor discharge rate and transducers; maintain constant pumping rate.
- Stop pumping at the end of the specified time, record volumetric reading on the totalizer.
- Continue to record water level data with transducers until the water level in the pumping well has recovered so that sufficient data are collected to adequately analyze the recovery or a maximum of 24 hours has elapsed.

The water level data will be transferred to disk form so that it may be reduced, analyzed, and put into report format.

The water levels in the wells will be recorded logarithmically following the recommended schedule in the following chart:

Cycle	Elapsed Time	Sample Interval	# Points/Cycle
1	0 to 20 seconds	0.2 second	101
2	20 to 60 seconds	1 second	40
3	1 to 10 minutes	10 seconds	54
4	10 to 100 minutes	2 minutes	45
5	>100 minutes	10 minutes	unspecified

When the pump is shut off and recovery begins, a new logarithmic series will be started for the transducer in the pumping well. The series shall be started 1 to 5 seconds prior to ending the pumping activity. The transducers in the observation wells will continue to monitor on the first logarithmic cycle series. If the aquifer is expected to recover quickly, the observation well transducers may also be restarted on a new series. Data will be recorded until the water level in the pumping well has returned so that sufficient data are collected to adequately analyze the recovery or until a maximum of 24 hours has elapsed. A manual water level measurement shall be collected from the wells, measuring points, and a reading should be taken with the transducers during recovery.

At the conclusion of the recovery test, the data logging shall be stopped at each well and the transducers shall be removed and the data downloaded.

5.5 Discharge Water Management

The water pumped from the well shall be discharged and managed following the plan specific to the project. Several methods may be used to handle the discharge water from an APT. The water may be discharged:

- Directly to the ground surface or a water body, if permitted by the regulatory agencies. Such discharge should be at a sufficient distance from the pumping and observation wells so that the test is not impacted if water infiltrates to the aquifer.
- To a holding tank, sampled and analyzed after the test, and then released to the ground surface or water body after analytical results prove that discharge requirements are met.
- To a unit designed and constructed to treat the water to meet discharge criteria; treated and then released to the ground surface or water body.

Also, a combination of the three options above may be used. Other discharge options may also be available and followed.

In summary, several different methods are typically available to handle discharge water. The governing agency shall be contacted so that required water handling practices are followed and discharge criteria are met.

6.0 Data Reduction and Analysis

The data sets from an APT are typically very robust. The data may be reduced and analyzed to:

- Determine the specific capacity and safe yield of the well
- Calculate the properties (T and S) of the aquifer
- Characterize the hydrogeologic framework at and near the investigation area

These three items, or one of the items at a minimum, are typically evaluated with APT data. Other pumping test data may also be available and evaluated.

APT data are recommended to be analyzed with computer software; however, data may also be analyzed manually. The CDM groundwater modeling tool kit contains Aquifer^{Win32}, which is a program that may be used to assist in analyzing test data. Other programs are also available. Software packages are useful since they can be used to manage a significant amount of data in short time periods and contain many different confined and unconfined test solutions. The trained user can use these benefits to generate detailed response curve graphs, precise hydraulic values, and insights into the hydrogeologic framework near the well. Regardless of the analytical method employed or whether the data is analyzed manually or by computer, the analyst should review the original technical paper or textbook summary of the method in order to understand the mechanics and assumptions underlying the method prior to attempting any analysis and verify the method is appropriate for the site conditions.

APT data analyses and hydraulic property calculations shall be performed by an experienced professional, documented in a calculation brief, and reviewed. Data analysis and parameter calculations are beyond the scope of this SOP and, therefore, are not discussed here.

7.0 Restrictions/Limitations

This procedure describes the standard steps used to conduct a constant rate APT. Since APTs are complex and project objectives and site requirements vary, not every step or possible method was incorporated into the procedure.

A planning meeting shall be held to identify the objectives of the APT, then the scope of the APT shall be developed. After the objectives are identified and the scope is developed, an APT plan shall be prepared that describes the project-specific procedures to be followed. The plan shall describe the details to be followed for each component of the APT. The objectives of the test shall be specified so that the necessary data to reach the objectives are collected when the test is performed.

8.0 References

American Society for Testing and Materials. 2004. Standard Guide for Selection of Aquifer Test Method in Determining *Hydraulic Properties by Well Techniques. D 4043-96 (Reapproved 2004).*

_____. 2002. Standard Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems. D 4050-96 (Reapproved 2002).

American Water Works Association. 1997. AWWA Standard for Water Wells (ANSI/AWWA A 100-97).

Environmental Simulations, Inc. 2000. Guide to Using Aquifer^{Win32}.

U. S. Environmental Protection Agency. 1993. Ground Water Issue Suggested Operating Procedures for Aquifer Pumping Tests (EPA/540/S-93/503). February.

U. S. Geological Survey. 1976. Techniques of Water-Resources Investigations of the United States Geological Survey (Chapter B1 Aquifer Test Design, Observation and Data Analysis).

Aquifer Test Data

Project Name:	Date:
Pumped Well ID:	Weather:
Observation Well ID:	Personnel:
Well locations (*provide sketch or attach map*):	
Include: Scale/dimensions, north arrow, and significant features (*e.g., surface water*)	
This sheet records data for (*well ID*):	
Measuring Point:	(*e.g., notch or inner casing*)
Static Water Level:	(*feet below measuring point [ft BMP]*)
Static Water Level Date:	Time:
Interval Open/Screened to Aquifer (*ft BMP*):	
Pump Setting Depth (*ft BMP*):	
Pump Model:	Serial No.:
Flow Meter Model:	Serial No.:
Logger/Transducer Model:	Serial No.:
Totalizer Reading before Pumping:	
Date/Time Pumping Started:	
Discharge Rate (*gpm*):	

Date	*Time*	*Manual Water Level Measure (ft BMP)*	*Discharge (gpm)*	*Comments*

*Use more sheets if more rows are needed.

Date/Time pumping ended: _____

Totalizer reading at end of pumping: _____

(One sheet to be completed for each well)

TSOP 5-1

CONTROL OF MEASUREMENT AND TEST EQUIPMENT

Control of Measurement and Test Equipment

SOP 5-1
Revision 8
Date: March 2007

Prepared: Dave Johnson

Technical Review: Steve Guthrie

E-Signed by Michael C. Malloy
VERIFY authenticity with ApproveIt

QA Review: Jo Nell Mullins

Approved:

Signature/Date

E-Signed by P. Michael Schwan
VERIFY authenticity with ApproveIt

Issued:

Signature/Date

1.0 Objective

The objective of this standard operating procedure (SOP) is to establish the baseline requirements, procedures, and responsibilities inherent to the control and use of all measurement and test equipment (M&TE). Contractual obligations may require more specific or stringent requirements that must also be implemented.

2.0 Background

2.1 Definitions

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.2 Associated Procedures

- CDM Federal Technical SOP 4-1, *Field Logbook Content and Control*
- CDM Quality Procedures (QPs) 2.1 and 2.3
- Manufacturer's operating and maintenance and calibration procedures

2.3 Discussion

M&TE may be government furnished (GF), rented or leased from an outside vendor, or purchased. It is essential that measurements and tests resulting from the use of this equipment be of the highest accountability and integrity. To facilitate that, the equipment shall be used in full understanding and compliance with the instructions and specifications included in the manufacturer's operations and maintenance and calibration procedures and in accordance with any other related project-specific requirements.

3.0 Responsibilities

All staff with responsibility for the direct control and/or use of M&TE are responsible for being knowledgeable of and understanding and implementing the requirements contained herein as well as any other related project-specific requirements.

The project manager (PM) or designee (equipment coordinator, quality assurance coordinator, field team leader, etc.) is responsible for initiating and tracking the requirements contained herein.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Requirements for M&TE

- Determine and implement M&TE related project-specific requirements
- The maintenance and calibration procedures must be followed when using M&TE
- Obtain the maintenance and calibration procedures if they are missing or incomplete
- Attach or include the maintenance and calibration procedures with the M&TE
- Prepare and record maintenance and calibration in an equipment log or a field log as appropriate (Figure 1)
- Maintain M&TE records
- Label M&TE requiring routine or scheduled calibration (when required)
- Perform maintenance and calibration using the appropriate procedure and calibration standards
- Identify and take action on nonconforming M&TE

For M&TE that is rented or leased from an outside vendor:
Shipper - Inspect the item to ensure that the maintenance and calibration procedures and latest calibration and standards certification records are included prior to shipment. If any documentation is missing or incomplete, do not ship the item. Immediately contact the procurement division and request that they obtain the documentation from the vendor.

5.7 Records Maintenance

For GF M&TE:
PM or Designee - Create a file upon the initial receipt of an item of M&TE or calibration standard. Organize the files by contract origin and by M&TE item and calibration standard. Store all files in a cabinet, file drawer, or other appropriate storage media at the pertinent warehouse or office location.

Receiver - Forward the original packing slip to the procurement division and a photocopy to the PM or designee.

PM or Designee and User:
- Maintain all original documents in the equipment file except for the packing slip and field log.
- File the photocopy of the packing slip in the M&TE file.
- Record all maintenance and calibration in an equipment log or field log (as appropriate). File the completed equipment logs in the M&TE records. Forward completed field logs to the PM for inclusion in the project files.

For M&TE rented or leased from an outside vendor:
Receiver - Forward the packing slip to the procurement division.

User:
- Forward the completed field log to the PM for inclusion in the project files.
- Retain the most current maintenance and calibration record and calibration standards certifications with the M&TE item and forward previous versions to the PM for inclusion in the project files.

5.8 Traceability of Calibration Standards

For all items of M&TE:
PM or Designee and User:
- When ordering calibration standards, request nationally recognized standards as specified or required. Request commercially available standards when not otherwise specified or required. Or, request standards in accordance with other related project-specific requirements.
- Require certifications for standards that clearly state the traceability.
- Require Material Safety Data Sheets to be provided with standards.
- Note standards that are perishable and consume or dispose of them on or before the expiration date.

5.9 M&TE That Fails Calibration

For any M&TE item that cannot be calibrated or adjusted to perform accurately:
PM or Designee
- Immediately discontinue use and segregate the item from other equipment. Notify the appropriate PM and take appropriate action in accordance with the CDM QP 2.3 for nonconforming items.
- Review the current and previous maintenance and calibration records to determine if the validity of current or previous measurement and test results could have been affected and notify the appropriate PM(s) of the results of the review.

6.0 Restrictions/Limitations

On an item-by-item basis, exemptions from the requirements of this SOP may be granted by the Headquarters health and safety manager and/or Headquarters quality assurance director. All exemptions shall be documented by the grantor and included in the equipment records as appropriate.

7.0 References

CDM Federal Programs Corporation. 2007. *Quality Assurance Manual.* Rev. 11.

CDM Federal Programs Corporation. 2005. *Government Property Manual.* Rev. 3.

Figure 1

CDM
A subsidiary of Camp Dresser & McKee Inc.

Maintenance and Calibration

Date: Time: (a.m./p.m.)

Employee Name: Equipment Description:

Contract/Project: Equipment ID No.:

Activity: Equipment Serial No.:

Maintenance

Maintenance Performed:

Comments:

Signature: Date:

Calibration/Field Check

Calibration Standard: Concentration of Standard:

Lot No. of Calibration Standard: Expiration Date of Calibration Standard:

Pre-Calibration Reading: Post-Calibration Reading:

Additional Readings: Additional Readings:

Additional Readings: Additional Readings:

Pre-Field Check Reading: Post-Field Check Reading:

Adjustment(s):

Calibration: □ Passed □ Failed

Comments:

Signature: Date:

Appendix C

Appendix C

Raritan Bay Slag Site Ground Water Sampling Procedure
Low Stress (Low Flow) Purging and Sampling

CDM

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 2

GROUNDWATER SAMPLING PROCEDURE
LOW STRESS (LOW-FLOW) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region 2 preferred method for collecting groundwater samples from single screen monitoring wells at the Raritan Bay Slag Site. The procedure minimizes stress on the formation and minimizes disturbance of sediment in the well. The procedure applies to monitoring wells that have well casing with an inner diameter of 2.0 inch or greater. It is appropriate for groundwater samples that will be analyzed for volatile and semi-volatile organic compounds (VOC and SVOC), pesticides, polychlorinated biphenyls (PCB), metals, and microbiological and other contaminants in association with any EPA program.

This procedure does not address the collection of non-aqueous phase liquid (NAPL) samples and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The goal of the Low Stress Purging and Sampling procedure is to collect samples that are representative of groundwater conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that allows a maximum drawdown of 0.3 foot.

Sampling at such a low flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing a filtered sample from the same well. Second, it minimizes aeration of the groundwater during sample collection, which improves the sample quality for VOC analysis. Third, in most cases it significantly reduces the volume of groundwater purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of a key indicator parameter to stabilize; c) cascading of water and formation of air bubbles in the tubing; and d) cross-contamination.

For wells with insufficient yield (i.e., low recharge rate of the well), care should be taken to avoid loss of pressure in the tubing line, cascading through the sand pack, or pumping the well dry. Purging should be interrupted before the water level in the well drops below the top of the pump. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

If a key indicator parameter fails to stabilize after 4 hours, one of two options should be considered: a) continue purging in an attempt to achieve stabilization; or b) discontinue purging, collect samples, and document attempts to reach stabilization in the log book. The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

For cascading and air bubbles in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 inch ID) to ensure that the tubing remains filled with liquid during sampling.

An item that should be checked on a daily basis, is the water within the cooling chamber of the submersible pump. This chamber should always be filled with demonstrated analyte-free water and any leakage from this chamber should be immediately brought to the attention of the person(s) responsible for equipment maintenance so that the appropriate seals can be replaced. Operating the pump with insufficient water in this cooling chamber could result in the pump overheating and/or pump failure. The analyte-free water should be replaced on a daily basis in order to facilitate the mechanical operation of the pump.

IV. EQUIPMENT

- ☐ **Approved site-specific Quality Assurance Project Plan (QAPP).** Generally, the target depth corresponds to just above the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake.
- ☐ Well construction data, location map, field data from last sampling event.
- ☐ Polyethylene sheeting.
- ☐ Photo Ionization Detector (PID).

- ☐ Adjustable rate, positive displacement groundwater sampling pump constructed of stainless steel.
- ☐ Interface probe or equivalent device for determining the presence or absence of NAPL.
- ☐ Teflon-lined polyethylene tubing to collect samples for organic and inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- ☐ Electronic water level measuring device, 0.01 foot accuracy.
- ☐ Flow measurement supplies (e.g., graduated cylinder and stop watch).
- ☐ Power source (generator).
- ☐ Monitoring instruments for indicator parameters. Redox potential (Eh) and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Temperature, pH and specific conductance may be monitored with an in-line monitor. A nephalometer is used to measure turbidity.
- ☐ Decontamination supplies (see Section VII, below).
- ☐ Logbook (see Section VIII, below).
- ☐ Sample bottles.
- ☐ Sample preservation supplies (as required by the analytical methods).
- ☐ Sample tags or labels, chain of custody.
- ☐ Other supplies as specified in the EPA approved field sampling plan/QAPP.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check well for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID or FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one.

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. Care should be taken to minimize disturbance in the

water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment which has accumulated at the bottom of the well. Record the observations in the log book.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to a depth midway within the screen interval for that well. The pump intake must be kept at least two feet above the bottom of the well to prevent disturbance and resuspension of any sediment or DNAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well with a rate that varies from 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every three to five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every three to five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

If pH adjustment is necessary for sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 mls). Groundwater purged from the well prior to sampling can be used for this purpose.

13. Collect Samples: Collect samples at flow rates of between 100 and 250 ml/min or such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. Samples should be collected at the same flow rate at which the indicator parameters stabilized. VOC samples must be collected first, at the lower rate, and directly into pre-preserved sample containers. All sample containers should be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for re-sampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance was consulted when preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at frequency of one per sample cooler containing VOCs

- ☐ Field duplicate.
- ☐ Equipment blank (not necessary if equipment is dedicated to the well).
- ☐ Trip blank (VOCs only)

Groundwater samples should be collected systematically beginning at wells known or believed to have the lowest level of contamination and proceeding in order to wells known or believed to have the highest level of contamination.

VII. DECONTAMINATION

Sampling equipment must be decontaminated thoroughly each day before use (daily decon) and after each well is sampled (between-well decon). As noted above, wells should be sampled in order from the least contaminated to the most contaminated. Pumps should not be removed from the well between purging and sampling operations. All non-disposable equipment, including the pump (support cable and electrical wires which are in contact with the sample) will be decontaminated as described below.

17. Prior to Sampling Event Decon

Please Note: Steps D through K should only be performed once (for each pump that is to be used) before the commencement of a particular sampling event by a person qualified to disassemble pumps.

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

D) Disassemble pump.

E) Wash pump parts (inlet screen, shaft suction interconnector, motor lead assembly, stator house): Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water for five minutes.

G) Rinse the pump parts with demonstrated analyte-free water.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water for five minutes.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Thoroughly rinse impeller assembly with demonstrated analyte-free water.

18. Daily and Between-Well Decon

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and thoroughly flush other equipment with fresh detergent solution. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and thoroughly flush other equipment with potable water for five minutes.

D) Final Rinse: Operate pump in a deep basin of analyte-free water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- ☐ Well identification number and physical condition.
- ☐ Well depth, and measurement technique.
- ☐ Static water level depth, date, time, and measurement technique.
- ☐ Presence and thickness of immiscible liquid layers and detection method.
- ☐ Collection method for immiscible liquid layers.
- ☐ Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- ☐ Well sampling sequence and time of sample collection.
- ☐ Types of sample bottles used and sample identification numbers.
- ☐ Preservatives used.
- ☐ Parameters requested for analysis.
- ☐ Field observations of sampling event.
- ☐ Name of sample collector(s).
- ☐ Weather conditions.
- ☐ QA/QC data for field instruments.
- ☐ Other logbook entries as required in the EPA approved field sampling plan/QAPP.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

EPA, 1998, EPA Region 2, Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, March 16.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

Appendix D

Appendix D

DESA QAPP Worksheets

CDM

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Semi-Volatiles
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheet #28 & #23	Precision Accuracy	% RPD < 30 Compound Specific (full range: D-262%)	LCS Duplicate	A
		Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
		Accuracy	Compound Specific (full range: D-262%)	Matrix spike	A
		Accuracy	Limits 30%-120% for Base Neutrals Limits 20%-120% for Acids	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Metals/Mercury
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See #28/ #23	Precision	% RPD < 20(Aq), % RPD <25(Soil)	LCS Duplicate	A
		Accuracy	Limits: Average Recovery ± 20% aqueous, ± 25% Soil)	LCS	A
		Accuracy	± 20% aqueous, ± 25% Soil)	Matrix spike	A
		Precision	< RL Except for Al, Fe, Ca, K, Mg and Na	Interference Check Sample(ICP/AES)	A
		Accuracy	< RL	Method Blank	A
		Precision	RPD < 20 %	Serial Dilution Test(ICP/AES)	A
		Accuracy	Range of 0.60-1.87 of the original response in the calibration blank	Internal Standards(ICP-MS)	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:
Revision Date:
Page ___ of ___

Measurement Performance Criteria Table

Matrix	Aqueous/Soils
Analytical Group[1]	Microbiology
Concentration Level	N/A

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Media selectivity,sensitivity	Growth promotion	LCS(Positive Control)	A
		Precision	10% (different analyst) 5%(same analyst)	Sample Duplicates Count	A
		Contamination	No growth	Method Blank	A
		Media /containers selectivity,sensitivity Contamination	No growth	Sterility or Performance Testing	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:
Revision Date:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Pest/PCB
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 30 Average Recovery 50-150%	LCS Duplicate	A
		Accuracy	Compound Specific (full range: 30-150%)	Matrix spike	A
		Accuracy	Limits 30%-150%	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Sanitary
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision	% RPD < 20	LCS Duplicates	A
		Accuracy	90-110% or manufacturer limits	LCS	A
		Accuracy	± 20%	Matrix Spike	A
		Precision	% RPD < 20	Sample Duplicates	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	VOA
Concentration Level	Low(aq)/Medium(soil)

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 20 Average Recovery 70-130%	LCS Duplicate	A
		Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
		Accuracy	Compound Specific (full range: 17-259%)	Matrix spike	A
		Accuracy	Limits 70%-130%(Aqueous) Table 7 of C-123(low Soil)	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group[1]	VOA
Concentration Level	Trace

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 20 Average Recovery(80-120%)	LCS Duplicate	A
		Accuracy	+/- 40% from the initial/continuing calibration	Internal standards	A
		Accuracy	Limits 70%-130%	Matrix spike	A
		Accuracy	Limits 80%-120%	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Metals-ICP/AES
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/l	Achievable (DESA) Limits [2]	
				MDLs µg/l	RLs µg/l
Aluminum	7429-90-5		200	93.9	200
Antimony	7440-36-0		60	0.71	20
Arsenic	7440-38-2		10	2.26	8
Barium	7440-39-3		200	0.83	6
Beryllium	7440-41-7		5	0.24	5
Cadmium	7440-43-9		5	0.11	4
Calcium	7440-70-2		5000	68.0	1000
Chromium	7440-47-3		10	0.22	6
Cobalt	7440-48-4		50	0.18	8
Copper	7440-50-8		25	5.89	10
Iron	7439-89-6		100	35.6	100
Lead	7439-92-1		10	1.18	7
Magnesium	7439-95-4		5000	30..5	1000
Manganese	7439-96-5		15	0.07	5
Mercury	7439-97-6		0.2	.017	0.2
Nickel	7440-02-0		40	0.46	5
Potassium	7440-09-7		5000	53.3	1000
Selenium	7782-49-2		35	1.34	7
Silver	7440-22-4		10	.030	6
Sodium	7440-23-5		5000	161	1000
Thallium	7440-28-0		25	1.62	20
Vanadium	7440-62-2		50	2.14	10
Zinc	7440-66-6		60	4.84	8

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Metals-ICP/MS
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/l	Achievable (DESA) Limits[2]	
				MDLs µg/l	RLs µg/l
Aluminum	7429-90-5		-	1.19	10
Antimony	7440-36-0		2	0.022	2.0
Arsenic	7440-38-2		1	0.062	1.0
Barium	7440-39-3		10	0.031	1.0
Beryllium	7440-41-7		1	0.010	1.0
Cadmium	7440-43-9		1	0.009	1.0
Calcium	7440-70-2		-		-
Chromium	7440-47-3		2	0.314	1.0
Cobalt	7440-48-4		1	0.015	1.0
Copper	7440-50-8		2	0.315	1.0
Iron	7439-89-6		-		-
Lead	7439-92-1		1	0.011	1.0
Magnesium	7439-95-4		-		-
Manganese	7439-96-5		1	0.135	1.0
Mercury	7439-97-6		-		-
Nickel	7440-02-0		1	0.471	1.0
Potassium	7440-09-7		-		-
Selenium	7782-49-2		5	0.183	5.0
Silver	7440-22-4		1	0.007	1.0
Sodium	7440-23-5		-		-
Thallium	7440-28-0		1	0.013	1.0
Vanadium	7440-62-2		1	0.082	1.0
Zinc	7440-66-6		2	0.165	1.0

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Metals
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs mg/kg	Achievable (DESA) Limits[2]	
				MDLs - mg/kg	RLs - mg/kg
Aluminum	7429-90-5		20	*	100
Antimony	7440-36-0		6	0.22	2
Arsenic	7440-38-2		1	0.35	0.8
Barium	7440-39-3		20	0.24	10
Beryllium	7440-41-7		0.5	0.02	0.3
Cadmium	7440-43-9		0.5	0.02	0.3
Calcium	7440-70-2		500	12.57	50
Chromium	7440-47-3		1	0.34	0.5
Cobalt	7440-48-4		5	0.03	2
Copper	7440-50-8		2.5	0.26	1
Iron	7439-89-6		10	*	5
Lead	7439-92-1		1	0.23	0.8
Magnesium	7439-95-4		500	5.06	50
Manganese	7439-96-5		1.5	0.33	0.5
Mercury	7439-97-6		0.1	.0043	0.05
Nickel	7440-02-0		4	0.09	2
Potassium	7440-09-7		500	12.36	50
Selenium	7782-49-2		3.5	0.22	2
Silver	7440-22-4		1	0.06	0.5
Sodium	7440-23-5		500	22.48	100
Thallium	7440-28-0		2.5	3.14	2
Vanadium	7440-62-2		5	0.40	2
Zinc	7440-66-6		6	1.57	2

* MDL study cannot be successfully performed on these analytes because of high background levels in matrix (sand).

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: PEST/PCBs
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
alpha-BHC	319-89-6		1.7	2.15	2.5
gamma-BHC	58-89-9		1.7	1.89	2.5
beta-BHC	319-85-7		1.7	1.35	2.5
delta-BHC	319-86-8		1.7	1.51	2.5
Heptachlor	76-44-8		1.7	2.05	2.5
Aldrin	309-00-2		1.7	1.66	2.5
Heptachlor epoxide	1024-57-3		1.7	1.34	2.5
Gamma-chlordane	5103-74-2		1.7	0.96	2.5
alpha-chlordane	5103-71-9		1.7	1.01	2.5
Endosulfan I	1031-07-8		1.7	1.16	2.5
4,4'-DDE	72-55-9		3.3	1.92	5.0
Dieldrin	60-57-1		3.3	1.91	5.0
Endrin	72-20-8		3.3	1.84	5.0
4,4'-DDD	72-54-8		3.3	1.35	5.0
Endosulfan II	1031-078		3.3	1.27	5.0
4,4'-DDT	50-29-3		3.3	1.52	5.0
Endrin aldehyde	7421-93-4		3.3	2.24	5.0
Methoxychlor	72-43-5		17	8.00	25
Endosulfan sulfate	1031-07-8		3.3	1.24	2.5
Endrin ketone	53494-70-5		3.3	1.18	2.5
Toxaphene	8001-35-2		170	75.9	190
Technical chlordane				56.1	62
AROCLOR 1016	12674-11-2		33		31
AROCLOR 1221	11104-28-2		33		62
AROCLOR 1232	11141-16-5		33		31
AROCLOR 1242	53469-21-9		33	29.9	31
AROCLOR 1248	12672-29-6		33		31
AROCLOR 1254	11097-69-1		33		31
AROCLOR 1260	11096-82-5		33		31
AROCLOR 1262	37324-23-5		33		31
AROCLOR 1268	11100-14-4		33		31

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: PEST/PCB Aroclors
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/L	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs µg/L
alpha-BHC	319-89-6		0.050	0.001	0.0025
gamma-BHC	58-89-9		0.050	0.001	0.0025
beta-BHC	319-85-7		0.050	0.002	0.0025
delta-BHC	319-86-8		0.050	0.002	0.0025
Heptachlor	76-44-8		0.050	0.001	0.0025
Aldrin	309-00-2		0.050	0.001	0.0025
Heptachlor epoxide	1024-57-3		0.050	0.005	0.0025
Gamma-chlordane	5103-74-2		0.050	0.001	0.0025
Alpha-chlordane	5103-71-9		0.050	0.002	0.0025
Endosulfan I	1031-07-8		0.050	0.002	0.0025
4,4'-DDE	72-55-9		0.10	0.003	0.005
Dieldrin	60-57-1		0.10	0.004	0.005
Endrin	72-20-8		0.10	0.004	0.005
4,4'-ddd	72-54-8		0.10	0..005	0.005
Endosulfan II	1031-078		0.10	0.004	0.005
4,4'-DDT	50-29-3		0.10	0.004	0.005
Endrin aldehyde	7421-93-4		0.10	0.006	0.005
Methoxychlor	72-43-5		0.50	0.032	0.050
Endosulfan sulfate	1031-07-8		0.10	0.004	0.005
Endrin ketone	53494-70-5		0.10	0.004	0.005
Toxaphene	8001-35-2		5.0	0.049	0.1875
Technical chlordane				0.020	0.0625
AROCLOR 1016	12674-11-2		1.0		0.03125
AROCLOR 1221	11104-28-2		1.0		0.0625
AROCLOR 1232	11141-16-5		1.0		0.03125
AROCLOR 1242	53469-21-9		1.0	0.020	0.03125
AROCLOR 1248	12672-29-6		1.0		0.03125
AROCLOR 1254	11097-69-1		1.0	0.014	0.03125
AROCLOR 1260	11096-82-5		1.0		0.03125
AROCLOR 1262	37324-23-5		1.0		0.03125
AROCLOR 1268	11100-14-4		1.0		0.03125

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Sanitary Chemistry
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5]	Achievable (DESA) Limits	
				MDLs mg/L	RLs mg/l
Alkalinity	471-34-1			0.11	1.0
Ammonia	7664-41-7			0.010	0.05
Chloride	16887-00-6			0.54	1.0
COD				8.89	20
Cyanide	57-12-5		10 µg/L	1.29 µg/l	5.0 µg/l
Fluoride (IC)				0.0040o	0.10
Fluoride (ISE)	016984488			.036	1.00
Hexavalent Chromium	018540299			6.21 µg/l	10.0 µg/L
Nitrite (NO2) (as N)	014797650			0.010	0.05
Nitrite (NO2) (as N) IC				0.0030	0.10
Nitrate (NO3) (as N)	014797558			0.010	0.05
Nitrate (NO3) (as N) IC				0.050	0.10
Nitrite + Nitrate (as N)	7727-37-9			0.0020	0.05
O-PO4	14265-44-2			0.0030	0.01
0P04 (IC)				0.039	0.10
Oil and Grease(Hexane extractable Material)				1.280	5.0
TPH(Silica-Gel treated Hexane Extractable material)				4.66	5.0
TSS				N/A	10
BOD	E1640606			N/A	2.0
Total Phenols				7.13 µg/l	10.0 µg/l
Sulfate	14808-79-8			1.34	5.0
Total Phosphorus	77723-14-0			0.0060	0.05
TKN				0.070	0.10
Sulfide				0.0090	0.05
TOC	10-19-5			0.19	1.0

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semi -Volatile Organic Compounds
Concentration Level: low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5] µg/kg	Achievable (DESA) Limits [2]	
				MDLs µg/kg	RLs µg/kg
Benzaldehyde	100-52-7		170		120
Phenol	108-95-2		170		120
Bis(2-chloroethyl)ether	111-44-4		170		120
2-Chlorophenol	95-57-8		170		120
2-Methylphenol	95-48-7		170		120
Bis(2-chloroisopropyl)ether	108-60-1		170		120
Acetophenone	98-86-2		170		120
4-Methylphenol	106-44-5		170		120
N-Nitroso-di-n-propylamine	621-64-7		170		120
Hexachloroethane	67-72-1		170		120
Nitrobenzene	98-95-3		170		120
Isophorone	78-59-1		170		120
2-Nitrophenol	88-75-5		170		120
2,4-dimethylphenol	105-67-9		170		120
Bis(2-chloroethoxy)methane	111-91-1		170		120
2,4-dichlorophenol	120-83-2		170		120
Naphthalene	91-20-3		170		120
4-Chloroaniline	106-47-8		170		120
Hexachlorobutadiene	87-68-3		170		120
Caprolactam	105-60-2		170		120
4-Chloro-3-methylphenol	59-50-7		170		120
2-methyl naphthalene	91-57-6		170		120
Hexachlorocyclopentadiene	77-47-4		170		120
1,2,4,5-Tetrachlorobenzene	95-94-3		170		120
2,4,6-Trichlorophenol	88-06-2		170		120
2,4,5-Trichlorphenol	95-95-4		170		120
1,1'-Biphenyl	92-52-4		170		120
2-Chloronaphthalene	91-58-7		170		120
2-Nitroaniline	88-74-4		330		120
Dimethyl phthalate	131-11-3		170		120
Acenaphthylene	208-96-8		170		120
2,6-Dinitrotoluene	606-20-2		170		120

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5] µg/kg	Achievable (DESA) Limits [2]	
				MDLs µg/kg	RLs µg/kg
3-Nitroaniline	99-09-2		330		120
Acenaphthene	83-32-9		170		120
2,4-Dinitrophenol	51-28-5		330		800
4-Nitrophenol	100-02-7		330		400
Dibenzofuran	132-64-9		170		120
2,4-Dinitrotoluene	121-14-2		170		120
2,3,4,6-Tetrachlorophenol	58-90-2		170		120
Fluorene	86-73-7		170		120
Diethylphthalate	84-66-2		170		120
4-Chlorophenyl phenyl ether	7005-72-3		170		120
4-Nitroaniline	100-01-6		330		120
4,6-Dinitro-2-Methylphenol	534-52-1		330		400
N-Nitrosodiphenylamine	86-30-6		170		120
4-Bromophenyl phenyl ether	101-55-3		170		120
Hexachlorobenzene	118-74-1		170		120
Atrazine	1912-24-9		170		120
Pentachlorophenol	87-86-5		330		400
Phenanthrene	85-01-8		170		120
Anthracene	120-12-7		170		120
Carbazole	86-74-8		170		120
Di-n-butyl phthalate	84-74-2		170		120
Fluoranthene	206-44-0		170		120
Pyrene	129-00-0		170		120
Butylbenzylphthalate	85-68-7		170		120
3,3-Dichlorobenzidine	91-94-1		170		120
Benzo(a)anthracene	56-55-3		170		120
Chrysene	218-01-9		170		120
Bis(2-ethylhexyl)phthalate	117-81-7		170		120
Di-n-octyl phthalate	117-84-0		170		120
Benzo(b)Fluoranthene	205-99-2		170		120
Benzo(k)Fluoranthene	207-08-9		170		120
Benzo(a)pyrene	50-32-8		170		120
Indeno(1,2,3-cd)pyrene	193-39-5		170		120
Dibenzo(a,h)anthracene	53-70-6-3		170		120
Benzo(g,h,i)perylene	191-24-2		170		120
1,4-Dioxane					

Note: Based on the new CRQLs the MDL study is currently being reanalyzed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Semi -Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limits	
				MDLs µg/L	RLs
Benzaldehyde	100-52-7		5 µg/L	0.10	5 µg/L
Phenol	108-95-2		5 µg/L	1.36	5 µg/L
Bis(2-Chloroethyl)ether	111-44-4		5 µg/L	1.38	5 µg/L
2-Chlorophenol	95-57-8		5 µg/L	1.43	5 µg/L
2-Methylphenol	95-48-7		5 µg/L	0.99	5 µg/L
Bis(2-Chloroisopropyl)ether	108-60-1		5 µg/L	1.23	5 µg/L
Acetophenone	98-86-2		5 µg/L	0.9	5 µg/L
4-Methylphenol	106-44-5		5 µg/L	0.81	5 µg/L
N-Nitroso-di-n-propylamine	621-64-7		5 µg/L	0.99	5 µg/L
Hexachloroethane	67-72-1		5 µg/L	1.35	5 µg/L
Nitrobenzene	98-95-3		5 µg/L	1.13	5 µg/L
Isophorone	78-59-1		5 µg/L	0.76	5 µg/L
2-Nitrophenol	88-75-5		5 µg/L	1.08	5 µg/L
2,4-Dimethylphenol	105-67-9		5 µg/L	1.81	5 µg/L
Bis(2-Chloroethoxy)methane	111-91-1		5 µg/L	0.97	5 µg/L
2,4-Dichlorophenol	120-83-2		5 µg/L	0.94	5 µg/L
Naphthalene	91-20-3		5 µg/L	1.05	5 µg/L
4-Chloroaniline	106-47-8		5 µg/L	0.42	5 µg/L
Hexachlorobutadiene	87-68-3		5 µg/L	1.02	5 µg/L
Caprolactam	105-60-2		5 µg/L	1.0	5 µg/L
4-Chloro-3-methylphenol	59-50-7		5 µg/L	0.62	5 µg/L
2-Methyl naphthalene	91-57-6		5 µg/L	0.88	5 µg/L
Hexachlorocyclopentadiene	77-47-4		5 µg/L	0.92	5 µg/L
1,2,4,5-Tetrachlorobenzene	95-94-3		5 µg/L	0.8	5 µg/L
2,4,6-Trichlorophenol	88-06-2		5 µg/L	0.55	5 µg/L
2,4,5-Trichlorphenol	95-95-4		5 µg/L	0.76	5 µg/L
1,1'-Biphenyl	92-52-4		5 µg/L	1.0	5 µg/L
2-Chloronaphthalene	91-58-7		5 µg/L	0.80	5 µg/L
2-Nitroaniline	88-74-4		10 µg/L	0.70	5 µg/L
Dimethyl phthalate	131-11-3		5 µg/L	0.47	5 µg/L
Acenaphthylene	208-96-8		10 µg/L	0.77	5 µg/L
2,6-Dinitrotoluene	606-20-2		5 µg/L	0.79	5 µg/L
3-Nitroaniline	99-09-2		10 µg/L	0.76	5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limits	
				MDLs µg/L	RLs
Acenaphthene	83-32-9		5 µg/L	0.72	5 µg/L
2,4-Dinitrophenol	51-28-5		10 µg/L	0.33	20µg/L
4-Nitrophenol	100-02-7		10 µg/L	0.35	10µg/L
Dibenzofuran	132-64-9		5 µg/L	0.72	5 µg/L
2,4-Dinitrotoluene	121-14-2		5 µg/L	0.48	5 µg/L
2,3,4,6-Tetrachlorophenol	58-90-2		5 µg/L		5 µg/L
Fluorene	86-73-7		5 µg/L	0.61	5 µg/L
Diethylphthalate	84-66-2		5 µg/L	0.39	5 µg/L
4-Chlorophenyl Phenyl Ether	7005-72-3		5 µg/L	0.57	5 µg/L
4-Nitroaniline	100-01-6		10 µg/L	0.34	5 µg/L
4,6-Dinitro-2-Methylphenol	534-52-1		10 µg/L	0.85	10µg/L
N-Nitrosodiphenylamine	86-30-6		5 µg/L	0.61	5 µg/L
4-Bromophenyl Phenyl Ether	101-55-3		5 µg/L	0.58	5 µg/L
Hexachlorobenzene	118-74-1		5 µg/L	0.49	5 µg/L
Atrazine	1912-24-9		5 µg/L	1.5	5 µg/L
Pentachlorophenol	87-86-5		10 µg/L	0.91	10µg/L
Phenanthrene	85-01-8		5 µg/L	0.47	5 µg/L
Anthracene	120-12-7		5 µg/L	0.58	5 µg/L
Carbazole	86-74-8		5 µg/L	1.2	5 µg/L
Di-N-Butyl Phthalate	84-74-2		5 µg/L	0.48	5 µg/L
Fluoranthene	206-44-0		5 µg/L	0.51	5 µg/L
Pyrene	129-00-0		5 µg/L	0.53	5 µg/L
Butylbenzylphthalate	85-68-7		5 µg/L	0.49	5 µg/L
3,3-Dichlorobenzidine	91-94-1		5 µg/L	0.4	5 µg/L
Benzo(a)anthracene	56-55-3		5 µg/L	0.58	5 µg/L
Chrysene	218-01-9		5 µg/L	0.53	5 µg/L
Bis(2-Ethylhexyl)phthalate	117-81-7		5 µg/L	0.68	5 µg/L
Di-n-octyl phthalate	117-84-0		5 µg/L	0.57	5 µg/L
Benzo(b)fluoranthene	205-99-2		5 µg/L	0.41	5 µg/L
Benzo(k)fluoranthene	207-08-9		5 µg/L	0.60	5 µg/L
Benzo(a)pyrene	50-32-8		5 µg/L	0.55	5 µg/L
Indeno(1,2,3-cd)pyrene	193-39-5		5 µg/L	0.50	5 µg/L
Dibenzo(a,h)anthracene	53-70-6-3		5 µg/L	0.42	5 µg/L
Benzo(g,h,i)perylene	191-24-2		5 µg/L	0.35	5 µg/L
*1,4-Dioxane					2 µg/L

MDL study is being performed

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
Dichlorodifluoromethane	75-71-8		5	0.7	5
Chloromethane	74-87-3		5	2.2	5
Vinyl Chloride	75-01-4		5	*	5
Bromomethane	74-83-9		5	1.3	5
Chloroethane	75-00-3		5	0.9	5
Trichlorofluoromethane	75-69-4		5	0.4	5
1,1-Dichloroethene	75-35-4		5	0.7	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5	0.8	5
Carbon Disulfide	75-15-0		5	0.8	5
Acetone	67-64-1		10	4.0	10
Methyl Acetate	79-20-9		5	1.6	5
Methylene Chloride	75-09-2		5	0.6	5
trans-1,2-Dichloroethene	156-60-5		5	0.5	5
cis-1,2-Dichloroethene	156-59-2		5	0.6	5
Methyl tert-Butyl Ether	1634-04-4		5	0.3	5
1,1-Dichloroethane	75-34-3		5	0.7	5
2-Butanone	78-93-3		10	1.2	10
Chloroform	67-66-3		5	0.3	5
1,2-Dichloroethane	107-06-2		5	0.5	5
1,1,1-Trichloroethane	71-55-6		5	0.3	5
Cyclohexane	110-82-7		5	0.4	5
Carbon Tetrachloride	56-23-5		5	1.9	5
Benzene	71-43-2		5	0.5	5
Trichloroethene	79-01-6		5	0.6	5
Methylcyclohexane	108-87-2		5	0.8	5
1,2-Dichloropropane	78-87-5		5	0.5	5
Bromodichloromethane	75-27-4		5	0.5	5
cis-1,3-Dichloropropene	10061-01-5		5	0.6	5
trans-1,3-Dichloropropene	10061-02-6		5	0.6	5
1,1,2-Trichloroethane	79-00-5		5	0.3	5
Dibromochloromethane	124-48-1		5	0.5	5
4-Methyl-2-Pentanone	108-10-1		10	0.6	10
Toluene	108-88-3		5	1.2	5

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
1,2-Dibromoethane	106-93-4		5	0.4	5
Chlorobenzene	108-90-7		5	0.8	5
Tetrachloroethene	127-18-4		5	0.5	5
2-Hexanone	591-78-6		10	0.5	10
Ethylbenzene	100-41-4		5	0.6	5
m,p-Xylene	179601-23-1		5	1.1	5
o-Xylene	95-47-6		5	0.7	5
Styrene	100-42-5		5	0.7	5
Bromoform	75-25-2		5	0.6	5
Isopropylbenzene	98-82-8		5	0.6	5
1,1,2,2-Tetrachloroethane	79-34-5		5	0.4	5
1,3-Dichlorobenzene	541-73-1		5	1.1	5
1,4-Dichlorobenzene	106-46-7		5	1.2	5
1,2-Dichlorobenzene	95-50-1		5	1.0	5
1,2-Dibromo-3-Chloropropane	96-12-8		5	0.5	5
1,2,4-Trichlorobenzene	120-82-1		5	1.5	5
1,2,3-Trichlorobenzene	87-61-6		5	1.5	5
Bromochloromethane	74-97-5		5	0.6	5

* MDL Study will be performed

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Medium

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQL µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
Dichlorodifluoromethane	75-71-8		250		250
Chloromethane	74-87-3		250		250
Vinyl Chloride	75-01-4		250		250
Bromomethane	74-83-9		250		250
Chloroethane	75-00-3		250		250
Trichlorofluoromethane	75-69-4		250		250
1,1-Dichloroethene	75-35-4		250		250
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		250		250
Carbon Disulfide	75-15-0		250		250
Acetone	67-64-1		500		500
Methyl Acetate	79-20-9		250		250
Methylene Chloride	75-09-2		250		250
trans-1,2-Dichloroethene	156-60-5		250		250
cis-1,2-Dichloroethene	156-59-2		250		250
Methyl tert-butyl ether	1634-04-4		250		250
1,1-Dichloroethane	75-34-3		250		250
2-Butanone	78-93-3		500		500
Chloroform	67-66-3		250		250
1,2-Dichloroethane	107-06-2		250		250
1,1,1-Trichloroethane	71-55-6		250		250
Cyclohexane	110-82-7		250		250
Carbon Tetrachloride	56-23-5		250		250
Benzene	71-43-2		250		250
Trichloroethene	79-01-6		250		250
Methylcyclohexane	108-87-2		250		250
1,2-Dichloropropane	78-87-5		250		250
Bromodichloromethane	75-27-4		250		250
cis-1,3-Dichloropropene	10061-01-5		250		250
trans-1,3-Dichloropropene	10061-02-6		250		250
1,1,2-Trichloroethane	79-00-5		250		250
Dibromochloromethane	124-48-1		250		250
4-Methyl-2-pentanone	108-10-1		500		500
Toluene	108-88-3		250		250

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQL µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
1,2-Dibromoethane	106-93-4		250		250
Chlorobenzene	108-90-7		250		250
Tetrachloroethene	127-18-4		250		250
2-Hexanone	591-78-6		500		500
Ethylbenzene	100-41-4		250		250
m,p-Xylene	179601-23-1		250		250
o-Xylene	95-47-6		250		250
Styrene	100-42-5		250		250
Bromoform	75-25-2		250		250
Isopropylbenzene	98-82-8		250		250
1,1,2,2-Tetrachloroethane	79-34-5		250		250
1,3-Dichlorobenzene	541-73-1		250		250
1,4-Dichlorobenzene	106-46-7		250		250
1,2-Dichlorobenzene	95-50-1		250		250
1,2-Dibromo-3-Chloropropane	96-12-8		250		250
1,2,4-Trichlorobenzene	120-82-1		250		250
1,2,3-Trichlorobenzene	87-61-6		250		250
Bromochloromethane	74-97-5		250		250

Note: Based on the new CRQLs the MDL study is currently being reanalyzed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limit	
				MDLs	µg/L RLs
Dichlorodifluoromethane	75-71-8		5 µg/L	0.3	5 µg/L
Chloromethane	74-87-3		5 µg/L	0.54	5 µg/L
Vinyl Chloride	75-01-4		5 µg/L	1.52	5 µg/L
Bromomethane	74-83-9		5 µg/L	1.90	5 µg/L
Chloroethane	75-00-3		5 µg/L	1.01	5 µg/L
Trichlorofluoromethane	75-69-4		5 µg/L	2.18	5 µg/L
1,1-Dichloroethene	75-35-4		5 µg/L	1.12	5 µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5 µg/L	0.3	5 µg/L
Carbon Disulfide	75-15-0		5 µg/L	1.58	5 µg/L
Acetone	67-64-1		10 µg/L	0.67	10 µg/L
Methyl Acetate	79-20-9		5 µg/L	0.4	5 µg/L
Methylene Chloride	75-09-2		5 µg/L	0.52	5 µg/L
trans-1,2-Dichloroethene	156-60-5		5 µg/L	0.91	5 µg/L
cis-1,2-Dichloroethene	156-59-2		5 µg/L	0.2	5 µg/L
Methyl tert-Butyl Ether	1634-04-4		5 µg/L	0.4	5 µg/L
1,1-Dichloroethane	75-34-3		5 µg/L	0.58	5 µg/L
2-Butanone	78-93-3		10 µg/L	0.7	10 µg/L
Chloroform	67-66-3		5 µg/L	0.44	5 µg/L
1,2-Dichloroethane	107-06-2		5 µg/L	0.55	5 µg/L
1,1,1-Trichloroethane	71-55-6		5 µg/L	0.6	5 µg/L
Cyclohexane	110-82-7		5 µg/L	0.6	5 µg/L
Carbon Tetrachloride	56-23-5		5 µg/L	1.23	5 µg/L
Benzene	71-43-2		5 µg/L	0.46	5 µg/L
Trichloroethene	79-01-6		5 µg/L	0.99	5 µg/L
Methylcyclohexane	108-87-2		5 µg/L	0.7	5 µg/L
1,2-Dichloropropane	78-87-5		5 µg/L	0.44	5 µg/L
Bromodichloromethane	75-27-4		5 µg/L	0.51	5 µg/L
cis-1,3-Dichloropropene	10061-01-5		5 µg/L	0.63	5 µg/L
trans-1,3-Dichloropropene	10061-02-6		5 µg/L	0.4	5 µg/L
1,1,2-Trichloroethane	79-00-5		5 µg/L	0.3	5 µg/L
Dibromochloromethane	124-48-1		5 µg/L	0.2	5 µg/L
4-Methyl-2-Pentanone	108-10-1		10 µg/L	0.64	10 µg/L
Toluene	108-88-3		5 µg/L	0.77	5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limit	
				MDLs	µg/L RLs
1,2-Dibromoethane	106-93-4		5 µg/L	0.2	5 µg/L
Chlorobenzene	108-90-7		5 µg/L	0.59	5 µg/L
Tetrachloroethene	127-18-4		5 µg/L	1.11	5 µg/L
2-Hexanone	591-78-6		10 µg/L	0.68	10 µg/L
Ethylbenzene	100-41-4		5 µg/L	0.59	5 µg/L
m,p-Xylene	179601-23-1		5 µg/L	1.17	5 µg/L
o-Xylene	95-47-6		5 µg/L	0.56	5 µg/L
Styrene	100-42-5		5 µg/L	0.57	5 µg/L
Bromoform	75-25-2		5 µg/L	0.43	5 µg/L
Isopropylbenzene	98-82-8		5 µg/L	0.3	5 µg/L
1,1,2,2-Tetrachloroethane	79-34-5		5 µg/L	0.64	5 µg/L
1,3-Dichlorobenzene	541-73-1		5 µg/L	0.82	5 µg/L
1,4-Dichlorobenzene	106-46-7		5 µg/L	0.84	5 µg/L
1,2-Dichlorobenzene	95-50-1		5 µg/L	0.75	5 µg/L
1,2-Dibromo-3-Chloropropane	96-12-8		5 µg/L	0.7	5 µg/L
1,2,4-Trichlorobenzene	120-82-1		5 µg/L	0.4	5 µg/L
*1,2,3-Trichlorobenzene	87-61-6		5 µg/L		5 µg/L
* Bromochloromethane	74-97-5		5 µg/L		5 µg/L

* MDL study will be performed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Volatile Organic Compounds
Concentration Level: Trace

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs
Dichlorodifluoromethane	75-71-8		0.5 µg/L	0.11	0.5 µg/L
Chloromethane	74-87-3		0.5 µg/L	0.07	0.5 µg/L
Vinyl Chloride	75-01-4		0.5 µg/L	0.12	0.5 µg/L
Bromomethane	74-83-9		0.5 µg/L	0.14	0.5 µg/L
Chloroethane	75-00-3		0.5 µg/L	0.14	0.5 µg/L
Trichlorofluoromethane	75-69-4		0.5 µg/L	0.11	0.5 µg/L
1,1-Dichloroethene	75-35-4		0.5 µg/L	0.10	0.5 µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		0.5 µg/L		0.5 µg/L
Carbon Disulfide	75-15-0		0.5 µg/L	0.10	0.5 µg/L
Acetone	67-64-1		5.0µg/L	0.36	0.5 µg/L
Methyl Acetate	79-20-9		0.5 µg/L		0.5 µg/L
Methylene Chloride	75-09-2		0.5 µg/L	0.18	0.5 µg/L
trans-1,2-Dichloroethene	156-60-5		0.5 µg/L	0.09	0.5 µg/L
cis-1,2-Dichloroethene	156-59-2		0.5 µg/L	0.06	0.5 µg/L
Methyl tert-butyl ether	1634-04-4		0.5 µg/L	0.03	0.5 µg/L
1,1-Dichloroethane	75-34-3		0.5 µg/L	0.08	0.5 µg/L
2-Butanone	78-93-3		5.0µg/L	0.21	0.5 µg/L
Chloroform	67-66-3		0.5 µg/L	0.07	0.5 µg/L
1,2-Dichloroethane	107-06-2		0.5 µg/L	0.09	0.5 µg/L
1,1,1-Trichloroethane	71-55-6		0.5 µg/L	0.09	0.5 µg/L
Cyclohexane	110-82-7		0.5 µg/L		0.5 µg/L
Carbon Tetrachloride	56-23-5		0.5 µg/L	0.10	0.5 µg/L
Benzene	71-43-2		0.5 µg/L	0.07	0.5 µg/L
Trichloroethene	79-01-6		0.5 µg/L	0.08	0.5 µg/L
Methylcyclohexane	108-87-2		0.5 µg/L		0.5 µg/L
1,2-Dichloropropane	78-87-5		0.5 µg/L	0.04	0.5 µg/L
Bromodichloromethane	75-27-4		0.5 µg/L	0.06	0.5 µg/L
cis-1,3-Dichloropropene	10061-01-5		0.5 µg/L	0.05	0.5 µg/L
trans-1,3-Dichloropropene	10061-02-6		0.5 µg/L	0.04	0.5 µg/L
1,1,2-Trichloroethane	79-00-5		0.5 µg/L	0.08	0.5 µg/L
Dibromochloromethane	124-48-1		0.5 µg/L	0.03	0.5 µg/L
4-Methyl-2-pentanone	108-10-1		0.5 µg/L	0.10	0.5 µg/L
Toluene	108-88-3		0.5 µg/L	0.08	0.5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs
1,2-Dibromoethane	106-93-4		0.5 µg/L	0.04	0.5 µg/L
Chlorobenzene	108-90-7		0.5 µg/L	0.06	0.5 µg/L
Tetrachloroethene	127-18-4		0.5 µg/L	0.09	0.5 µg/L
2-Hexanone	591-78-6		5.0µg/L	0.11	0.5 µg/L
Ethylbenzene	100-41-4		0.5 µg/L	0.06	0.5 µg/L
m,p-Xylene	179601-23-1		0.5 µg/L	0.13	0.5 µg/L
o-Xylene	95-47-6		0.5 µg/L	0.05	0.5 µg/L
Styrene	100-42-5		0.5 µg/L	0.03	0.5 µg/L
Bromoform	75-25-2		0.5 µg/L	0.07	0.5 µg/L
Isopropylbenzene	98-82-8		0.5 µg/L	0.06	0.5 µg/L
1,1,2,2-Tetrachloroethane	79-34-5		0.5 µg/L	0.05	0.5 µg/L
1,3-Dichlorobenzene	541-73-1		0.5 µg/L	0.05	0.5 µg/L
1,4-Dichlorobenzene	106-46-7		0.5 µg/L	0.03	0.5 µg/L
1,2-Dichlorobenzene	95-50-1		0.5 µg/L	0.04	0.5 µg/L
1,2-Dibromo-3-Chloropropane	96-12-8		0.5 µg/L	0.18	0.5 µg/L
1,2,4-Trichlorobenzene	120-82-1		0.5 µg/L	0.06	0.5 µg/L
1,2,3-Trichlorobenzene	87-61-6		0.5 µg/L	0.05	0.5 µg/L
Bromochloromethane	74-97-5		0.5 µg/L	0.10	0.5 µg/L

QAPP Worksheet #19
(UFP-QAPP Manual Section 3.1.1)
For each matrix, analytical group, and concentration level, list the analytical and preparation method/SOP and associated sample volume, container specifications, preservation requirements, and maximum holding time.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	TCL Volatiles	Low Medium	DW-1 *(Ref: EPA 524.2)* C-89 *(Ref: EPA 624)*	3 X40ml 6 X 40ml (QC)	VOA vial with Teflon-lined septum	Cool, 4°C ; HCL to pH < 2 $Na_2S_2O_3$, if Res CL present	Preserved w/HCL: 14 days: Unpreserved: 7 days
Soil	TCL Volatiles	Low- Medium	C-123 *(Ref:* SOM01.1)	1 x 100g or 4 X Encore Same(QC)	Glass, wide mouth or Encore samplers	Cool, 4°C or Frozen (-10 to -14)	14 days
Aqueous	TCL Semi-Volatiles	Low	C-90 *(Ref: EPA 625)*	2 X 1000ml 2 X1000 ml(QC)	Amber Glass	Cool, 4°C ; $Na_2S_2O_3$, if Res CL present	To extraction: 7 days;40 days to analysis
Soil	TCL Semi-Volatiles	Low	C-90 *(Ref: EPA 625)*	1 x 250g 1 x 250g(QC)	Glass, wide mouth	Cool, 4°C	To extraction: 14 days;40 days to analysis
Aqueous	Pesticides/PCBs	Low	C-91 *(Ref: EPA 608)*	2 X 1000ml 2 X1000 ml(QC)	Amber Glass	Cool, 4°C	To extraction: 7 days;40 days to analysis
Soil	Pesticides/PCBs	Low	C-91 *(Ref: EPA 608)*	1 x 100g 1 x 100g(QC)	Glass, wide mouth	Cool, 4°C	To extraction: 14 days;40 days to analysis

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	TAL Metals/Mercury	Low	C-109, C-116 *(Ref: EPA 200.7)* C- 110, C-112 *(Ref: EPA 245.1)*	1 X 500ml 1 X 250ml(QC)	Rigid Plastic	HNO3 to pH <2	6 months Hg- 28days
Soil	TAL Metals/Mercury	Low	C-109, C-116 *(Ref: EPA 200.7)* C- 110, C-112 *(Ref: EPA 245.1)*	1 X 250ml 1 X 250ml(QC)	Rigid Plastic	HNO3 to pH <2	6 months Hg- 28days
Soil	TCLP Metals/Mercury	Low	C-107, C-109, C-116 *(Ref: EPA 200.7)* C-107, C- 110, C-112 *(Ref: EPA 245.1)*	1 X 1000ml 1 X 1000ml(QC)	Rigid/Glass, wide mouth	Cool, 4°C	To extraction: 6 months Hg- 28days;6 months Hg- 28days to analysis
Soil	TCLP - Volatiles	Low-medium	C-106, C-89 *(Ref: EPA 624)*	2 X 100g or 1 x 100g And 2 x Encore Same (QC)	Glass, wide mouth and/ or Encore samplers	Cool, 4°C or Frozen (-10 to-14)	To extraction: 14 days; 14 days to analysis
Soil	TCLP – Semi-Volatiles	Low	C-107, C-90 *(Ref: EPA 625)*	1 X 1000g 1 x 1000g (QC)	Amber Glass	Cool, 4°C	To (TCLP_extraction): 14 days; 7 days after (TCLP_extraction); 40 days after 2nd extraction.
Soil	TCLP – Pesticides	Low	C-107, C-91 *(Ref: EPA 608)*	1 X 250g 1 x 250g (QC)	Glass, wide mouth	Cool, 4°C	To (TCLP_extraction): 14 days; 7 days after (TCLP_extraction); 40 days after 2nd extraction.
Soil	Cyanide	Low	C-28 *(Ref:* EPA 335.4)	1 X 20g 1 X 50g (QC)	Rigid/Glass, wide mouth	Cool, 4°C	14 days
Soil	TOC	N/A	C-88 *(Ref: SM 5310 B)*	1 x 50g 1 X 50g (QC)	Glass, wide mouth	Cool, 4°C	28 days
Soil	pH	N/A	C-24 *(Ref: EPA 4500-H+ B)*	1 X 100g 1 X 250g(QC)	Rigid Plastic, widemouth	Cool, 4°C	As soon as possible

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	BOD	N/A	C-21 *(Ref: SM 5210 B)*	1 X 2000 ml or 2 X 1000ml (QC)	Rigid Plastic	Cool, 4°C ;	48 hours
Aqueous	Ammonia	N/A	C-80 *(Ref: EPA 350.1)*	1 X 250 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C ; H_2SO_4 to pH < 2	28 days
Aqueous	Chloride	N/A	C-22 *(Ref: EPA 405.1)* C-94 *(Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	None	28 days
Aqueous	COD	N/A	C-53 *(Ref: EPA 410.4)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C ; H_2SO_4 to pH < 2	28 days
Aqueous	Fluoride	N/A	C-93 *(Ref: USGS-I-4327-85)* C-94 *(Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	None	28 days
Aqueous	Nitrite	N/A	C-79 *(Ref: EPA 353.2)* C-94 *(Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C	48 hours
Aqueous	Nitrate	N/A	C-79 *(Ref: EPA 353.2)* C-94 *(Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C	48 hours
Aqueous	Nitrite+ Nitrate	N/A	C-79 *(Ref: EPA 353.2)* C-94 *(Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C	28 days
Aqueous-Grab	Oil +Grease	N/A	C-95 *(Ref: EPA 1664A)*	1 X 1000 ml 3 X 1000ml (QC)	Glass	Cool, 4°C ; H_2SO_4 to pH < 2	28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous-Grab	Total Petroleum Hydrocarbon	N/A	C-95 *(Ref: EPA 1664A)*	1 X 1000 ml 3 X 1000ml (QC)	Glass	Cool, 4°C ; H_2SO_4 to pH < 2	28 days
Soil	Total Petroleum Hydrocarbon	N/A	C-95 *(Ref: EPA 1664A)*	250g 250g (QC)	Glass, wide mouth	Cool, 4°C	28 days
Aqueous	Total Phenols	N/A	C-29 *(Ref: EPA 420.4)*	1 X 250ml 1 X 250ml (QC)	Glass	Cool, 4°C ; H_2SO_4 to pH < 2	28 days
Aqueous	Sulfate	N/A	C-19 *(Ref: ASTM D516-02)* C-94 *(Ref: EPA 300.0)*	1 X 100ml 1 X 50ml (QC)	Rigid Plastic	Cool, 4°C	28 days
Aqueous	Sulfide	N/A	C-115 *(Ref: SM 4500-S^2D)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4°C ; ZnAcetate +NaOH pH > 9	7 days
Aqueous	Total Phosphorus	N/A	C-68 *(Ref: EPA 365.1)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C ; H_2SO_4 to pH < 2	28 days
Aqueous	TKN	N/A	C-40 *(Ref: EPA 351.2)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C ; H_2SO_4 to pH < 2	28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	Turbidity	N/A	C-81 *(Ref: EPA 351.2)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4°C	48 hours
Aqueous	Total Suspended Solids(TSS)/Volatile Suspended Solids(VSS)	N/A	C-33 *(Ref: SM 2540 D)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4°C	7 days
Aqueous	Total Dissolved Solids (TDS)	N/A	C-37 *(Ref: SM 2540 C)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4°C	7 days
Aqueous	Total Organic Carbon (TOC)	N/A	C-83 *(Ref: SM 5310 B)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4°C	28 days
NAPL	Ignitability	N/A	C-23 *(Ref: SW846 Method 1010)*	1 X 250ml 1 X 250ml (QC)	Glass, wide mouth or Metal Can	None	None
Aqueous	Specific Conductance	N/A	C-36 *(Ref: EPA 120.1)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4°C	28 days
Aqueous	Hexavalent Chromium	N/A	C-96 *(Ref: USGS-I-1230-85)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4°C/ Cool, 4°C pH= 9.3-9.7 Ammonium Sulfate Buffer solution	24 hours/ 28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	Alkalinity	N/A	C-18 *(Ref: SM 2320 B)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4°C	14 days
Aqueous	Total Coliform/ Fecal Coliform	N/A	B-6/B-8 *(Ref: SM 9221B/9221E)*	1 X 150ml 1 X 150ml (QC)	Rigid Plastic, wide mouth	Cool, 4°C ; $Na_2S_2O_3$, if Res CL present	6 hours
Sewage Sludge	Total Coliform /Fecal Coliform	N/A	B-6/B-8 *(Ref: SM 9221B/9221E)* *B-5/B-7 (Ref: SM 9222B/9222E)* Colilert-18 *(Ref: SM9223B)*	1 X 250g 1 X 250g (QC)	Rigid Plastic, wide mouth	Cool, 4°C	24 hours
Aqueous	Heterotrophic Plate Count	N/A	B-32 *(Ref: EPA 9215B)* *B-38 (Ref: Simplate IDEX)*	1X125 ml	Rigid Plastic, wide mouth	Cool, 4°C ; $Na_2S_2O_3$, if Res CL present	8 hours
Soil/Sediment	Grain (Particle) Size	N/A	Bio 8.3 *Ref: ASTM D422-63)*	1 X 16oz/500g/500ml 1 X 16oz/500g/500ml (QC)	Rigid Plastic/ Glass wide mouth	Cool, 4°C	None

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #23
(UFP-QAPP Manual Section 3.2.1)

Title:
Revision Number:

Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
Bio 8.3	Grain (Particle)Size, Rev 2.0, 3/07	Definite	Grain (Particle)Size	Soil Hydrometer	DESA	N
B-5/B-7	Total Coliform/ Fecal Coliform, Rev 2.0, 2/07	Definite	Total Coliform/ Fecal Coliform	N/A	DESA	N
B-6/B-8	Total Coliform/ Fecal Coliform, Rev 2.0, 2/07	Definite	Total Coliform/ Fecal Coliform	N/A	DESA	N
C-18	Alkalinity, , Rev 2.0, 3/07	Definite	Alkalinity	Auto Titrator System	DESA	N
C-19, C-94	Sulfate, Rev 2.0, 3//07, Anions by Ion Chromatography, Rev 2.0, 3/07	Definite	Sulfate	Spectrophotometer, AutoAnalyzer, IC	DESA	N
C-21	BOD/CBOD, Rev 2.0, 3/07	Definite	BOD	DO meter	DESA	N
C-22, C-94	Chloride, Rev 2.0, 3//07, Anions by Ion Chromatography, Rev 2.0, 3/07	Definite	Chloride	Titration unit, AutoAnalyzer,, IC	DESA	N
C-23	Ignitability, Rev 1.0, 1/06	Definite	Ignitability	Auto flash Point Test Instrument	DESA	N
C-24	pH, Rev 2.0, 3/07	Definite	pH	pH meter	DESA	N
C-28	Cyanides, Total, Rev 2.0, 3/07	Definite	Cyanide	AutoAnalyzer	DESA	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-29	Total Phenols, Rev 2.0, 3/07	Definite	Total Phenols	AutoAnalyzer	DESA	N
C-33	Total Suspended Solids(TSS)/Volatile Suspended Solids(VSS), Rev 2.0, 2/07	Definite	Total Dissolved Solids (TDS)	N/A	DESA	N
C-36	Specific Conductance, Rev 2.0, 3/07	Definite	Specific Conductance	Conductivity Meter	DESA	N
C-37	Total Dissolved Solids (TDS) , Rev 2.0, 2/07	Definite	Total Dissolved Solids (TDS)	N/A	DESA	N
C-40	TKN, Rev 2.0, 2/07	Definite	TKN	AutoAnalyzer	DESA	N
C-53	COD, Rev 2.0, 3/07	Definite	COD	COD Reactor, Spectrophotometer	DESA	N
C-68	Total Phosphorus, Rev 2.0, 12/06	Definite	Total Phosphorus	AutoAnalyzer	DESA	N
C-79, C-94	Nitrite, Nitrate, Nitrite+ Nitrate Rev 2.0, 2//07, Anions by Ion Chromatography, Rev 2.0, 12/06	Definite	Nitrite	AutoAnalyzer, IC	DESA	N
C-80	Ammonia, Rev 2.0, 12/06	Definite	Ammonia	AutoAnalyzer	DESA	N
C-81	Turbidity, Rev 2.0, 3/07	Definite	Turbidity	Turbidimeter	DESA	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-83	Total Organics in Aqueous, Rev 2.0, 3/07	Definite	Total Organics Carbon	TOC analyzer	DESA	N
C-88	Total Organics in Soil, Rev 1.0, 1/05	Definite	Total Organics Carbon	TOC analyzer	DESA	N
C-89	Analysis of Volatile Organic Compounds in Aqueous, Soil/Sediment and Waste Oil/Waste Organic Solvents Samples by Purge and Trap GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles(Aqueous)	GC-MS	DESA L	N
C-123	Analysis of Volatile Organic Compounds by Automated Closed System by Purge and Trap GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles(Low Soil)	GC-MS	DESA Laboratory	N
DW-1	Volatile Organics in Drinking Water by Purge and Trap by GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles (Trace)	GC-MS	DESA Laboratory	N
C-90	Analysis of Base/Neutral and Acid Compounds in Aqueous, Soil/Sediment and Waste Oil/Waste Organic Solvent Samples, Rev 2.0, 3/07	Definite	TCL Semi-Volatiles	GC-MS	DESA Laboratory	N
C-91	Analysis of Pesticides and PCBs in Aqueous, Soil/Sediments and Waste Oil/Transformer Fluid Matrices, Rev 2.0, 3/07	Definite	Pesticides/ PCBs	GC-ECD	DESA Laboratory	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-93, C-94	Fluoride, Rev 1.0, 1/05, Anions by Ion Chromatography, Rev 2.0, 12/06	Definite	Fluoride	AutoAnalyzer, Ion Selective Electrode, IC	DESA Laboratory	N
C-95	Oil +Grease, Total Petroleum Hydrocarbon Gravimetric, SPE, Rev 2.0, 03/07	Definite	Oil +Grease	SPE apparatus	DESA Laboratory	N
C-96	Hexavalent Chromium, Rev 2.0, 3/07	Definite	Hexavalent Chromium	Spectrophotometer	DESA Laboratory	N
C-109	Determination of Trace Elements in Aqueous Trace Metals in Aqueous, Soil/Sediment/Sludge- ICP-AES, Rev 2.0, 3/07	Definite	TAL Metals	ICP-AES	DESA Laboratory	N
C-110	Mercury Analysis in Water and Soil/Sediments By CVAAS, Rev 2.0, 3/07	Definite	Mercury	CVAA	DESA Laboratory	N
C-112	Trace Metals in Aqueous, Soil/Sediment/Sludge, Waste Oil/Organic Solvent and Biological tissue by Inductively Coupled Plasma-Mass Spectrometry, Rev 2.0, 3/07	Definite	TAL Metals	ICP-MS	DESA Laboratory	N
C-115	Sulfide, Rev 1.0, 3/07	Definite	Sulfide	Spectrophotometer	DESA Laboratory	N

QAPP Worksheet #24
(UFP-QAPP Manual Section 3.2.2)
Identify all analytical instrumentation that requires calibration and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Title:
Revision Number:
Revision Date:
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Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP-AES	See SOP C-109	See SOP C-109	See SOP C-109	See SOP C-109	Assigned Laboratory personnel	SOP C-109
ICP-MS	See SOP C-112	See SOP C-112	See SOP C-112	See SOP C-112	Assigned Laboratory personnel	SOP C-112
CVAAS	See SOP C-110	See SOP C-110	See SOP C-110	See SOP C-110	Assigned Laboratory personnel	SOP C-110
IC	See SOP C-94	See SOP C-94	See SOP C-94	See SOP C-94	Assigned Laboratory personnel	SOP C-94
Spectrophotometer	See SOP C-96	See SOP C-96	See SOP C-96	See SOP C-96	Assigned Laboratory personnel	SOP C-96
Colorimetric/AutoAnalyzer	See SOP C-28 Per manufacture's manual	See SOP C-28	See SOP C-28	See SOP C-28	Assigned Laboratory personnel	SOP C-28
GC-ECD	See SOP C-91	See SOP C-91	See SOP C-91	See SOP C-91	Assigned Laboratory personnel	SOP C-91
GC-MS	See SOP C- 90, C-89	See SOP C- 90, C-89	See SOP C- 90, C-89	See SOP C- 90, C-89	Assigned Laboratory personnel	SOP C- 90, C-89
TOC Analyzer	See SOP C-88, Per manufacture's manual	See SOP C-88	See SOP C-88	See SOP C-88	Assigned Laboratory personnel	SOP C-88
pH Electrode	See SOP C-24	See SOP C-24	See SOP C-24	See SOP C-24	Assigned Laboratory personnel	SOP C-24

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23). Details can be found in Equipment Calibration# SOP C-19

QAPP Worksheet #25
(UFP-QAPP Manual Section 3.2.3)
Identify all analytical instrumentation that requires maintenance, testing, or inspection and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Title:
Revision Number:
Revision Date:
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Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
See list of Instrument given in Worksheet #24	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #26
(UFP-QAPP Manual Appendix A)
Use this worksheet to identify components of the project-specific sample handling system. Record personnel, and their organizational affiliations, who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to delivery, to final sample disposal. Indicate the number of days field samples and their extracts/digestates will be archived prior to disposal.

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Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization):
Sample Packaging (Personnel/Organization):
Coordination of Shipment (Personnel/Organization):
Type of Shipment/Carrier:
SAMPLE RECEIPT AND ANALYSIS (Details in SOP G-25)
Sample Receipt (Personnel/Organization): OSCAR/DESA Laboratory
Sample Custody and Storage (Personnel/Organization): OSCAR/DESA Laboratory
Sample Preparation (Personnel/Organization): Laboratory Personnel/DESA Laboratory
Sample Determinative Analysis (Personnel/Organization): Laboratory Personnel/DESA Laboratory
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection):
Sample Extract/Digestate Storage (No. of days from extraction/digestion): up to 60 days
Biological Sample Storage (No. of days from sample collection):
SAMPLE DISPOSAL (Details in SOP G-6)
Personnel/Organization: DESA Laboratory
Number of Days from Analysis: 60 days

QAPP Worksheet #27
(UFP-QAPP Manual Section 3.3.3)
Describe the procedures that will be used to maintain sample custody and integrity. Include examples of chain-of-custody forms, traffic reports, sample identification, custody seals, sample receipt forms, and sample transfer forms. Attach or reference applicable SOPs.

Title:
Revision Number:
Revision Date:
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Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to):

Sample Custody Procedures (receipt of samples, archiving, disposal):

See LQMP, SOP G-25(OSCAR)

Sample Identification Procedures:

See LQMP, SOP G-25(OSCAR)

Chain-of-custody Procedures:

See LQMP, SOP G-25(OSCAR)

QAPP Worksheet #28 (Semi volatiles)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/ Soil
Analytical Group	SVOC
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	C-90 (Ref: EPA 625)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all DFTPP tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all DFTPP tune criteria
Initial Calibration	SOP C-90	% RSD +/- 35% Allowed to fail 10% of total number of analytes but % RSD not be more than 60%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 35% Allowed to fail 10% of total number of analytes but % RSD not be more than 60%

Continuing Calibration Check Standard (Alternate check standard) Method Blank	1 per analytical batch of ≤ 20 samples 1 per extraction batch of ≤ 20 samples	Min RRF 0.05 Max %D +/- 20% 10% of total analytes allowed to fail but not more than 60% < RL	Reanalyze, Qualify data Investigate source of contamination	Laboratory personnel Laboratory personnel	Accuracy Sensitivity Contamination	Min RRF 0.05 Max %D RRF +/- 20% 10% of total analytes allowed to fail but not more than 60% < RL
LCS/LFB	2 per extraction batch of ≤ 20 samples	Limits listed in Table3 in SOP C-90 for aqueous, manufacture's limits for soil % RPD < 30	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits listed in Table3 in SOP C-90 for aqueous, manufacture's limits for soil % RPD < 30
Matrix spikes	1 per extraction batch of ≤ 20 samples	Limits listed in Table3 in SOP C-90	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits listed in Table3 in SOP C-90
Internal Standards	Each sample, standard, blank	Factor of two (-50% to -100%)	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two (-50% to -100%)
Surrogates	Each sample, standard, blank	30%-120% for Base Neutrals 20-120% for Acids	Reinject, Qualify data as per SOP C-90	Laboratory personnel	Extraction efficiency, Accuracy	30%-120% for Base Neutrals 20-120% for Acids

QAPP Worksheet #28 (Metal+ Mercury)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Metals & Mercury
Concentration Level	Trace/Low
Sampling SOP	
Analytical Method/ SOP Reference	C-109,C-112, C-110 (Ref: EPA 200.7, 200.8, 245.1)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning/System Stability(ICP-MS)	As per C-112	Pass all the tune/stability criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all the tune/stability criteria
Initial Calibration Verification	Immediately following each calibration ,after every 10 samples and at the end of each analytical run	90%-110%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy	90%-110%

Continuing Calibration Check Standard (Alternate check standard)	Every 10 samples and at the end of each analytical run	80%-120%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	80%-120%
Initial Calibration Blank(ICB)	After ICV	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Continuing Calibration Blank(CCB)	After every CCV	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Low Level Check Standard	At Beginning and end of each analytical run	± 30% of the true value	Check Instrument, Re-calibrate	Laboratory personnel	Accuracy	± 30% of the true value
Interference Check Sample(ICP-200.7)	At Beginning and end of each analytical run	< RL Except Al ,Fe, Ca, K, Mg and Na	As per C-109	Laboratory personnel	Precision	< RL Except Al ,Fe, Ca, K, Mg and Na
Method blank	1 per extraction batch of ≤ 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
LCS/LFB	2 per extraction batch of ≤ 20 samples	Limits: Average Recovery ± 20% aqueous, ± 25% Soil) % RPD < 20(Aq), % RPD <25(Soil)	Qualify data	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery ± 20% aqueous, ± 25% Solids) % RPD < 20(Aq), % RPD <25(Soil
Matrix spikes	1 per extraction batch of ≤ 20 samples	Limits ± 20% aqueous, ± 25% Soil)	Qualify data	Laboratory personnel	Accuracy	Limits ± 20% aqueous, ± 25% Soil)
Serial Dilution Test(ICP-200.7)	Matrix spike sample	RPD < 20 %	Qualify data	Laboratory personnel	Precision	RPD < 20 %
Internal Standards(ICP-MS 200.8)	Each sample, standard, blank	Range of 0.60-1.87 of the original response in the calibration blank	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Range of 0.60-1.87 of the original response in the calibration blank

QAPP Worksheet #28 (Microbiology)
(UFP-QAPP Manual Section 3.4)

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soilds
Analytical Group	Microbiology
Concentration Level	N/A
Sampling SOP	
Analytical Method/ SOP Reference	See notes
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sterility or Performance Testing	Each lot of pre-prepared, ready to use medium or batch of medium prepared in the Laboratory, sample containers on a non-selective media	No growth	Investigate source of contamination Prepared Media is discarded	Laboratory personnel	Media selectivity, sensitivity Contamination	No growth
Method Blank	1 per preparation batch of 20 samples	No growth	Investigate source of contamination	Laboratory personnel	Contamination	No growth
Control Sample (LCS)- positive control	1 per preparation batch of 20 samples	Growth promotion	Reanalyzed	Laboratory personnel	Media selectivity, sensitivity	Growth promotion
Duplicate counts (Membrane Filtration or Heterotrophic Plate count)	Monthly on one positive sample for each month the test is performed	10% (different analyst) 5% (same analyst)	Qualify data	Laboratory personnel	Precision	10% (different analyst) 5% (same analyst)

Laboratory SOPs: B-5/B-7(*SM 9222B/D);* B-6/B-8(*SM 9221B/E*) , B-32; (*Ref: EPA 9215B); B-38(Ref: Simplate IDEX)*

QAPP Worksheet #28 (Pesticides/PCBs)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Pesticides/PCBs
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	C-91 (Ref: EPA 608)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Instrument Performance (PEM)	Beginning of each analytical run	Total breakdown <30%	Check Instrument	Laboratory personnel	Sensitivity Contamination	Total breakdown <30%
Initial Calibration	C-91 (Ref: EPA 608)	% RSD +/- 25% Not more than 10% of total analytes failure RSD not more than 30%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 25% Not more than 10% of total analytes failure RSD not more than 30%
Continuing Calibration Check Standard (Alternate check standard)	Beginning and the end of each analytical run	Max %D RRF +/- 25%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 25%
Method Blank	1 per extraction batch	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL

LCS/LFB	2 per extraction batch	Limits: Average Recovery 50-150% % RPD < 30	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 50-150% % RPD < 30
Matrix spikes	1 per extraction batch	Limits 30-150%	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits 30-150%
Surrogates	Each sample, standard, blank	Limits 30%-150%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 30%-150%

QAPP Worksheet #28 (Sanitary Chemistry)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Sanitary Chemistry
Concentration Level	Low/Medium
Sampling SOP	
Analytical Method/ SOP Ref	See notes below
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible	Data Quality Indicator (DQI)	Measurement Performance Criteria
Initial Calibration Verification (ICV)	Immediately after initial calibration	90%-110% of the true value except for TOC (± 15%)	Recalibrate	Corrective Action by Laboratory personnel	Accuracy/ Precision	90%-110% of the true value
Initial calibration Blank(ICB)	Immediately after ICV	< RL	Investigate source of contamination		Sensitivity Contamination	< RL
Continuing Calibration Verification (CCV) (Alternate check standard)	After every ten samples and at the end of the analytical run.	90%-110% of the true value	Reanalyze, Qualify data		Accuracy	90%-110% of the true value
Continuing Calibration Blank (CCB)		< RL	Investigate source of contamination		Sensitivity Contamination	< RL
Method Blank	1 per extraction /analytical batch					
Laboratory Control Sample (LCS/LFB)	2 per extraction batch of ≤ 20 samples	Limits: Average Recovery meet standard manufacturer's limits; % RPD < 20	Reanalyze, Qualify data		Accuracy/ Precision	Limits: Average Recovery meet standard manufacturer's limits; % RPD < 20
Matrix spike (MS)	1 per extraction batch of ≤ 20 samples	Limits 80-120%	Qualify data		Accuracy	Limits 80-120%

Laboratory SOPs: C-28,C-29,C-40, C-53,C-68,C-79, C-80,C-83, C-88, C-94,C-96 (Ref: EPA 335.4, 420.4, 351.2, 410.4, 365.1, 353.2, 350.1, SM 5310 B, EPA 300.0, I-1230-85)

QAPP Worksheet #28 (Sanitary Chemistry)
(UFP-QAPP Manual Section 3.4)

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Sanitary Chemistry
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	See notes below
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Control Sample (LCS/LFB)	2 per analytical batch of 20 samples	Limits: Average Recovery within the standard manufacture's limits or method limits; % RPD < 20	Reanalyzed or Qualify data	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery within the standard manufacture's limits % RPD < 20
Sample Duplicates - TSS,TDS, Specific Conductance, Turbidity, pH, Ignitability	1 per analytical batch of 20 samples	% RPD < 20	Affected sample Qualified	Laboratory personnel	Precision	% RPD < 20
Matrix spike (MS) - Alkalinity, Sulfate, Chloride, BOD/ cBOD	1 per extraction batch of 20 samples	Limits 80-120%	Affected sample Qualified	Laboratory personnel	Accuracy	Limits 80-120%

Laboratory SOPs: C-18,C-19,C-21, C-22, C-23, C-24, C-33, C-36, C-37, C-81
(Ref: SM 2320 B, ASTM D516-02, SM 5210 B, SM4500CI-C, SW 846 1010, SM 4500-H+ B, SM 2540 D, EPA 120.1, SM 2540 C, EPA 180.1)

QAPP Worksheet #28 (Volatiles-Low)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

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Revision Number:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	VOC
Concentration Level	Low(Aq)/Medium (soil
Sampling SOP	
Analytical Method/ SOP Reference	C-89 (Ref: EPA 624)
Sampler's Name	
Field Sampling Organization:	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Corrective Action by Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP C-89	% RSD +/- 35% Not more than 10% of total analytes failure % RSD not more than 60%	Check Instrument, Reanalyze		Accuracy/ Precision	% RSD +/- 35% Not more than 10% of total analytes failure % RSD not more than 60%
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch of 20 samples	Max %D RRF +/- 30% Not more than 10% of total analytes failure % D not more than 60%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 30% Not more than 10% of total analytes failure % D not more than 60%
Method Blank	1 per extraction batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	

LCS/LFB	2 per extraction batch of 20 samples	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% % RPD < 20
Matrix spikes	1 per extraction batch of 20 samples	Table 4 of C-89 compound specific (full range- 17-259%)	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Table 4 of C-89 compound specific (full range- 17-259%)
Internal Standards	Each sample, standard, blank	Factor of two(-50% to + 100%) from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two(-50% to + 100%) from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Limits 70%-130%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 70%-130%

QAPP Worksheet #28 (Volatiles-Low)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

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Revision Number:
Revision Date:
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QC Samples Table

Matrix	Soil
Analytical Group	VOC
Concentration Level	Low
Sampling SOP	
Analytical Method/ SOP Reference	C-123 (Ref: EPA 624)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP C-123	% RSD +/- 50% Min RRF 0.010	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 50% Min RRF 0.010
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch of 20 samples	Max %D listed in Table 4A of C-123	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D listed in Table 4A of C-123
Method Blank	1 per extraction batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL

Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	
LCS/LFB	2 per extraction batch of 20 samples	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% % RPD < 20
Matrix spikes	1 per extraction batch of 20 samples	Table 8 of C-123 compound specific (full range- 17-259%)	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Table 8 of C-123 compound specific (full range- 17-259%)
Internal Standards	Each sample, standard, blank	Factor of two(-50% to + 100%) from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two(-50% to + 100%) from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Table 7 of C-123	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Table 7 of C-123

QAPP Worksheet #28 (Volatiles- Trace)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous
Analytical Group	VOC
Concentration Level	Trace
Sampling SOP	
Analytical Method/ SOP Reference	DW-1 (Ref: EPA 524.2)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP DW-1	% RSD +/- 20% Not more than 10% of total analytes failure	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 20% Not more than 10% of total analytes failure
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch	Max %D RRF +/- 30% Not more than 10% of total analytes failure	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 30% Not more than 10% of total analytes failure

Method Blank	1 per extraction batch	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	
LCS/LFB	2 per extraction batch	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% RPD 20%
Matrix spikes	1 per extraction batch	Limits 70-130%	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits 70-130%
Internal Standards	Each sample, standard, blank	+/- 40% from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	+/- 40% from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Limits 80%-120%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 80%-120%

QAPP Worksheet #29
(UFP-QAPP Manual Section 3.5.1)
Identify the documents and records that will be generated for all aspects of the project including, but not limited to, sample collection and field measurement, on-site and off-site analysis, and data assessment.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Chains-of-Custody	Internal Chains-of-Custody		Sample acceptance checklist	Customer Service Survey Cards
Packing Slips and Sample Tags	Sample Preparation Log		PT Sample Results	Telephone Logs
Request Forms and Associated Correspondence	Standard Traceability Record		Training Records	Procurement Request Forms
	Instrument Analysis Log			
Sample Acceptance Checklist	QC summary checklist with all relevant information		MDL Study Records	Equipment Maintenance Logs
LIMS Sample Receipts	Sample Analysis Data		Initial DOC / CDOC Records	Validated Computer Software Records
Automated OSCAR Logs	Instrument Calibration Data		Internal Audit Reports	
sample identification numbers	Instrument/ Computer Printouts		Corrective Action Reports	
	Definition of Qualifiers		External Assessment	
	Cover Letter		NELAC Accreditation	
	Approval Form			
	Case Narrative			
	Final Report			

QAPP Worksheet #31
(UFP-QAPP Manual Section 4.1.1)
Identify the type, frequency, and responsible parties of planned assessment activities that will be performed for the project.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Planned Project Assessments Table

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 Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
PT	Semiannually	External	NELAC	PT provider	Laboratory Personnel	Laboratory Personnel	Laboratory QA Officer
NELAC	Every two years	External	NELAC	Florida DOH	Laboratory QA Officer	Laboratory Personnel	Florida DOH
INTERNAL AUDIT	Monthly	Internally	DESA Laboratory	Laboratory QA Officer	Laboratory Personnel	Laboratory Personnel	Laboratory QA Officer

QAPP Worksheet #32

(UFP-QAPP Manual Section 4.1.2)
For each type of assessment describe procedures for handling QAPP and project deviations encountered during the planned project assessments.

Title:
Revision Number:
Revision Date:
Page ___ of ____

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Proficiency Testing (PT)	Letter with PT failure indicated	Laboratory QA Officer	30 days after the audit	Investigate the reason for the PT failure	Laboratory QA Officer	45 days after the CA report
NELAC	Audit Report with Non-conformance to QAPP, SOPs, NELAC+LQMP	Laboratory Management	30 days after the audit	Investigate and have a corrective action plan for the deficiencies	Florida DOH	30 days after receiving notification
INTERNAL	Audit Report with Non-conformance to QAPP, SOPs, NELAC Regulations	Laboratory Management	30 days after the audit	Investigate and have a corrective action plan for the deficiencies	Laboratory QA Officer	45 days after the CA report

QAPP Worksheet #34
(UFP-QAPP Manual Section 5.2.1)
Describe the processes that will be followed to verify project data. Manual (Section 5.1). Describe how each item will be verified, when the activity will occur, and what documentation is necessary, and identify the person responsible. *Internal* or *external* is in relation to the data generator.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of Custody	Chain-of-custody forms will be verified against the sample cooler they represent. Sample Acceptance Checklist is completed. The OSCAR staff supervisor utilizes the analyses request information and the external COC to review the accuracy and completeness of LIMS log-in entries, as reflected on the LIMS Sample Receipt Form Details can be found in Quality Management Plan, SOP G-25	Internal	OSCAR Personnel DESA Laboratory
Analytical data package/ Final Report	The procedures for data review : 1- Data reduction/review by Primary Analyst. 2- Review complete data package (raw data) by independent Peer Reviewer 3- The Sample Project Coordinator reviews the project documentation for completeness followed by a QA review by the QAO 4- Final review by Branch Chief/Section Chief prior to release, this review is to ensure completeness and general compliance with the objectives of the project. This final review typically does not include a review of raw data. Details can be found in the Quality Management Plan.	Internal	Primary Analyst, Peer Reviewer, Sample Project Coordinator, Quality Assurance Officer, Section Chief/ Branch Chief. DESA Laboratory

QAPP Worksheet #35

UFP-QAPP Manual Section 5.2.2
Describe the processes that will be followed to validate project data. Validation inputs include items such as those listed in Table 9 of the UFP-QAPP Manual (Section 5.1). Describe how each item will be validated, when the activity will occur, and what documentation is necessary and identify the person responsible. Differentiate between steps IIa and IIb of validation.

Revision Number:
Revision Date:

Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
	Chain of Custody	Chain-of-custody forms will be verified against the sample cooler they represent. Sample Acceptance Checklist is completed. The OSCAR staff supervisor utilizes the analyses request information and the external COC to review the accuracy and completeness of LIMS log-in entries, as reflected on the LIMS Sample Receipt Form . Details can be found in Quality Management Plan, SOP G-25	OSCAR Personnel DESA Laboratory
	Analytical data package/ Final Report	The procedures for data review : 1- Data reduction/review by Primary Analyst. 2- Review complete data package (raw data) by independent Peer Reviewer 3- The Sample Project Coordinator reviews the project documentation for completeness followed by a QA review by the QAO 4- Final review by Branch Chief/Section Chief prior to release, this review is to ensure completeness and general compliance with the objectives of the project. This final review typically does not include a review of raw data. Details can be found in the Quality Management Plan.	Primary Analyst, Peer Reviewer, Sample Project Coordinator, Quality Assurance Officer, Section Chief/ Branch Chief. DESA Laboratory

* DESA performs the validation.

Appendix E

Appendix E

Screening Level Tables

CDM

Table 1
Soil Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Residential Direct Contact Soil Remediation Standard (NJRDCSRS)[1]	NJDEP Non-Residential Direct Contact Soil Remediation Standard (NJNRDCSRS)[2]	NJDEP Default Impact to Groundwater Soil Remediation Standard (NJIGWSRS)[3]	Ambient Concentrations of Extractable Metals Urban Coastal Plain[4]		Human Health Screening Level (EPA RSL)[5]	Ecological Screening Level			Screening Criteria[9]
					Median Concentration	90th Percentile Concentration		EPA EcoSSLs[6]	Soil PRGs[7]	EPA Region 5[8]	
Inorganic Analytes (mg/kg)											
7429-90-5	Aluminum	78,000	NL	3,900	6,800	10,800	7,740 n	NL	NL	NL	3,900
7440-36-0	Antimony	31	450	6 PQL	<DL	<DL	3.13 n	0.27	5	0.142	0.142
7440-38-2	Arsenic	19 *	19 *	19 *	5.2	13.6	0.389 ca	18	9.9	5.7	0.389
7440-39-3	Barium	16,000	59,000	1,300	28.3	65.8	1530 n	330	283	1.04	1.04
7440-41-7	Beryllium	16	140	0.5	<DL	0.68	15.6 n	21	10	1.06	0.5
7440-43-9	Cadmium	78	78	1	<DL	<DL	7 n	0.36	4	0.00222	0.00222
7440-70-2	Calcium	NL	NL	NL	995	2,000	NL	NL	NL	NL	995
7440-47-3	Chromium	NL	NL	NL	11.8	34.7	100,000 m	26 a	0.4	0.4	0.4
18540-29-9	Chromium (hexavalent)	240	20	NL	NA	NA	0.293 ca	130	NL	NL	0.293
7440-48-4	Cobalt	1,600 *	590	59	<DL	<DL	2.34 n	NL	20	0.14	0.14
7440-50-8	Copper	3,100	45,000	7,300	9.3	33.3	313 n	28	60	5.4	5.4
57-12-5	Cyanide	1,600	23,000	13	NA	NA	156 n	NL	NL	1.33	1.33
7439-89-6	Iron	NL	NL	NL	8,830	21,100	5,480 n	NL	NL	NL	5,480
7439-92-1	Lead	400	800	59	37.6	144	40 n	11	40.5	0.0537	0.0537
7439-95-4	Magnesium	NL	NL	NL	673	1,870	NL	NL	NL	NL	673
7439-96-5	Manganese	11,000	5,900	42	62.4	206	183 n	220	NL	NL	42
7439-97-6	Mercury	23	65	0 PQL	<DL	0.21	0.56 n	NL	0.00051	0.1	0.00051
7440-02-0	Nickel	1,600	23,000	31	<DL	12.3	155 n	38	30	13.6	12.3
7440-09-7	Potassium	NL	NL	NL	<DL	1,750	NL	NL	NL	NL	1,750
7782-49-2	Selenium	390	5,700	7	<DL	<DL	39.1 n	0.52	0.21	0.0276	0.0276
7440-22-4	Silver	390	5,700	1 PQL	<DL	<DL	39.1 n	4.2	NL	4.04	1
7440-23-5	Sodium	NL	NL	NL	<DL	<DL	NL	NL	NL	NL	NL
7440-28-0	Thallium	5	79	3 PQL	<DL	<DL	100,000 m	NL	1	0.0569	0.0569
7440-62-2	Vanadium	78	1,100	NL	16	35.5	0.548 n	7.8	2	1.59	0.548
7440-66-6	Zinc	23,000	110,000	600	39.9	106	2,350 n	46	8.5	6.62	6.62
Volatile Organic Compounds (µg/kg)											
71-55-6	1,1,1-Trichloroethane	290,000	4,200,000	200	NA	NA	640,000 s	NL	NL	29,800	200
79-34-5	1,1,2,2-Tetrachloroethane	1,000	3,000	5 PQL	NA	NA	562 ca	NL	NL	127	5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NL	NL	NL	NA	NA	910,000 s	NL	NL	NL	910,000
79-00-5	1,1,2-Trichloroethane	2,000	6,000	10	NA	NA	1,070 ca	NL	NL	28,600	10
75-34-3	1,1-Dichloroethane	8,000	24,000	200	NA	NA	3,310 ca	NL	NL	20,100	200
75-35-4	1,1-Dichloroethene	11,000	150,000	5	NA	NA	24,300 n	NL	NL	8,280	5
87-61-6	1,2,3-Trichlorobenzene	NL	NL	NL	NA	NA	4,890 n	NL	20,000	NL	4,890
120-82-1	1,2,4-Trichlorobenzene	73,000	820,000	400	NA	NA	6,190 n	NL	20,000	11,100	400
96-12-8	1,2-Dibromo-3-chloropropane	80	200	5 PQL	NA	NA	5.35 ca	NL	NL	35.2	5
106-93-4	1,2-Dibromoethane	8	40	5 PQL	NA	NA	33.7 ca	NL	NL	1,230	5
95-50-1	1,2-Dichlorobenzene	5,300,000	59,000,000	11,000	NA	NA	191,000 n	NL	NL	2,960	2,960
107-06-2	1,2-Dichloroethane	900	3,000	5 PQL	NA	NA	432 ca	NL	NL	21,200	5
78-87-5	1,2-Dichloropropane	2,000	5,000	5 PQL	NA	NA	895 ca	NL	NL	32,700	5
541-73-1	1,3-Dichlorobenzene	5,300,000	59,000,000	12,000	NA	NA	NL	NL	NL	37,700	12,000
106-46-7	1,4-Dichlorobenzene	5,000	13,000	1,000	NA	NA	2,440 ca	NL	20,000	546	546
123-91-1	1-4 Dioxane	NL	NL	NL	NA	NA	44,100 ca	NL	NL	NL	44,100
78-93-3	2-Butanone	3,100,000	44,000,000	600	NA	NA	2,780,000 n	NL	NL	89,600	600

Table 1
Soil Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

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					Median Concentration	90th Percentile Concentration		EPA EcoSSLs[6]	Soil PRGs[7]	EPA Region 5[8]	
591-78-6	2-Hexanone	NL	NL	NL	NA	NA	20,900 n	NL	NL	12,600	12,600
108-10-1	4-Methyl-2-pentanone	NL	NL	NL	NA	NA	532,000 n	NL	NL	443,000	443,000
67-64-1	Acetone	70,000,000	NL	12,000	NA	NA	6,130,000 n	NL	NL	2,500	2,500
71-43-2	Benzene	2,000	5,000	5 PQL	NA	NA	1,080 ca	NL	NL	255	5
74-97-5	Bromochloromethane	NL	NL	NL	NA	NA	NL	NL	NL	NL	NL
75-27-4	Bromodichloromethane	1,000	3,000	5 PQL	NA	NA	273 ca	NL	NL	540	5
75-25-2	Bromoform	81,000	280,000	20	NA	NA	61,500 ca	NL	NL	15,900	20
74-83-9	Bromomethane	25,000	59,000	30	NA	NA	732 n	NL	NL	235	30
75-15-0	Carbon Disulfide	7,800,000	110,000,000	4,000	NA	NA	82,100 n	NL	NL	94.1	94.1
56-23-5	Carbon Tetrachloride	600	2,000	5 PQL	NA	NA	248 ca	NL	NL	2,980	5
108-90-7	Chlorobenzene	510,000	7,400,000	400	NA	NA	29,400 n	NL	40,000	13,100	400
75-00-3	Chloroethane	220,000	1,100,000	NL	NA	NA	1,450,000 n	NL	NL	NL	220,000
67-66-3	Chloroform	600	2,000	200	NA	NA	295 ca	NL	NL	1,190	200
74-87-3	Chloromethane	4,000	12,000	NL	NA	NA	11,900 n	NL	NL	10,400	4,000
156-59-2	cis-1,2-Dichloroethene	230,000	560,000	200	NA	NA	78,200 n	NL	NL	NL	200
10061-01-5	cis-1,3-Dichloropropene	NL	NL	5 **, PQL	NA	NA	1,660 c**	NL	NL	398	5
110-82-7	Cyclohexane	NL	NL	NL	NA	NA	117,000 s	NL	NL	NL	117,000
124-48-1	Dibromochloromethane	3,000	8,000	5 PQL	NA	NA	680 ca	NL	NL	2,050	5
75-71-8	Dichlorodifluoromethane	490,000	230,000,000	25,000	NA	NA	18,400 n	NL	NL	39,500	18,400
100-41-4	Ethylbenzene	7,800,000	110,000,000	8,000	NA	NA	5,390 ca	NL	NL	5,160	5,160
98-82-8	Isopropylbenzene	NL	NL	NL	NA	NA	205,000 n	NL	NL	NL	205,000
79-20-9	Methyl Acetate	78,000,000	NL	14,000	NA	NA	7,820,000 n	NL	NL	NL	14,000
1634-04-4	Methyl Tert-Butyl Ether	110,000	320,000	200	NA	NA	43,300 ca	NL	NL	NL	200
108-87-2	Methylcyclohexane	NL	NL	NL	NA	NA	NL	NL	NL	NL	NL
75-09-2	Methylene Chloride	34,000	97,000	7	NA	NA	10,700 ca	NL	NL	4,050	7
100-42-5	Styrene	90,000	260,000	2,000	NA	NA	628,000 n	NL	300,000	4,690	2,000
127-18-4	Tetrachloroethene	2,000	5,000	5 PQL	NA	NA	554 ca	NL	NL	9,920	5
108-88-3	Toluene	6,300,000	91,000,000	4,000	NA	NA	497,000 n	NL	200,000	5,450	4,000
156-60-5	trans-1,2-Dichloroethene	300,000	720,000	400	NA	NA	15,300 n	NL	NL	784	400
10061-02-6	trans-1,3-Dichloropropene	NL	NL	5 **, PQL	NA	NA	1,660 c**	NL	NL	398	5
79-01-6	Trichloroethene	7,000	20,000	7	NA	NA	2,820 ca	NL	NL	12,400	7
75-69-4	Trichlorofluoromethane	23,000,000	340,000,000	22,000	NA	NA	78,700 n	NL	NL	16,400	16,400
75-01-4	Vinyl Chloride	700	2,000	5 PQL	NA	NA	60 ca	NL	NL	646	5
1330-20-7	Xylenes (Total)	12,000,000	170,000,000	12,000	NA	NA	62,700 n	NL	NL	10,000	10,000
Semi-Volatile Organic Compounds (µg/kg)											
92-52-4	1,1'-Biphenyl	3,100,000	34,000,000	90,000	NA	NA	214,000 s	NL	NL	NL	90,000
95-94-3	1,2,4,5-Tetrachlorobenzene	NL	NL	NL	NA	NA	1,830 n	NL	NL	2,020	1,830
108-60-1	2,2'-oxybis(1-Chloropropane)	23,000	67,000	NL	NA	NA	4,570 ca	NL	NL	19,900	4,570
95-95-4	2,4,5-Trichlorophenol	6,100,000	68,000,000	44,000	NA	NA	611,000 n	NL	9,000	14,100	9,000
88-06-2	2,4,6-Trichlorophenol	19,000	74,000	200 PQL	NA	NA	6,110 n	NL	4,000	9,940	200
120-83-2	2,4-Dichlorophenol	180,000	2,100,000	200 PQL	NA	NA	18,300 n	NL	NL	87,500	200

Table 1
Soil Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

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					Median Concentration	90th Percentile Concentration		EPA EcoSSLs[6]	Soil PRGs[7]	EPA Region 5[8]	
105-67-9	2,4-Dimethylphenol	1,200,000	14,000,000	700	NA	NA	122,000 n	NL	NL	10	10
51-28-5	2,4-Dinitrophenol	120,000	1,400,000	300 PQL	NA	NA	12,200 n	NL	20,000	60.9	60.9
121-14-2	2,4-Dinitrotoluene	700	3,000	200 ####, PQL	NA	NA	1,560 ca	NL	NL	1280	200
606-20-2	2,6-Dinitrotoluene	700	3,000	200 ####, PQL	NA	NA	6,120 n	NL	NL	32.8	32.8
91-58-7	2-Chloronaphthalene	NL	NL	NL	NA	NA	175,000 s	NL	NL	12.2	12.2
95-57-8	2-Chlorophenol	310,000	2,200,000	500	NA	NA	39100 n	NL	NL	243	243
91-57-6	2-Methylnaphthalene	230,000	2,400,000	5,000	NA	NA	31,300 n	NL	NL	3,240	3,240
95-48-7	2-Methylphenol	310,000	3,400,000	NL	NA	NA	306,000 n	NL	NL	NL	306,000
88-74-4	2-Nitroaniline	39,000	23,000,000	NL	NA	NA	60,600 n	NL	NL	74,100	39,000
88-75-5	2-Nitrophenol	NL	NL	NL	NA	NA	NL	NL	NL	1,600	1,600
91-94-1	3,3'-Dichlorobenzidine	1,000	4,000	200 PQL	NA	NA	1,080 ca	NL	NL	646	200
99-09-2	3-Nitroaniline	NL	NL	NL	NA	NA	NL	NL	NL	3,160	3,160
534-52-1	4,6-Dinitro-2-methylphenol	6,000	68,000	300 PQL	NA	NA	611 n	NL	NL	144	144
101-55-3	4-Bromophenyl-phenylether	NL	NL	NL	NA	NA	NL	NL	NL	NL	NL
59-50-7	4-Chloro-3-methylphenol	NL	NL	NL	NA	NA	611,000 n	NL	NL	NL	611,000
106-47-8	4-Chloroaniline	NL	NL	NL	NA	NA	2,430 ca	NL	NL	1,100	1,100
7005-72-3	4-Chlorophenyl-phenylether	NL	NL	NL	NA	NA	NL	NL	NL	NL	NL
106-44-5	4-Methylphenol	31,000	340,000	NL	NA	NA	30,600 n	NL	NL	163,000	30,600
100-01-6	4-Nitroaniline	NL	NL	NL	NA	NA	24,300 ca	NL	NL	21,900	21,900
100-02-7	4-Nitrophenol	NL	NL	NL	NA	NA	NL	NL	7,000	5,120	5,120
83-32-9	Acenaphthene	3,400,000	37,000,000	74,000	NA	NA	344,000 n	29,000 f	20,000	682,000	20,000
208-96-8	Acenaphthylene	NL	300,000,000	NL	NA	NA	NL	29,000 f	NL	682,000	29,000
98-86-2	Acetophenone	2,000	5,000	2,000	NA	NA	782,000 n	NL	NL	300,000	2,000
120-12-7	Anthracene	17,000,000	30,000,000	NL	NA	NA	1,720,000 n	29,000 f	NL	1,480,000	29,000
1912-24-9	Atrazine	210,000	2,400,000	200 PQL	NA	NA	2,110 ca	NL	NL	NL	200
100-52-7	Benzaldehyde	6,100,000	68,000,000	NL	NA	NA	782,000 n	NL	NL	NL	782,000
56-55-3	Benzo(a)anthracene	600	2,000	NL	NA	NA	148 ca	1,100 g	NL	5,210	148
50-32-8	Benzo(a)pyrene	200	200	NL	NA	NA	14.8 ca	1,100 g	NL	1,520	14.8
205-99-2	Benzo(b)fluoranthene	600	2,000	NL	NA	NA	148 ca	NL	NL	59,800	148
191-24-2	Benzo(g,h,i)perylene	380,000,000	30,000,000	NL	NA	NA	NL	1,100 g	NL	119,000	1,100
207-08-9	Benzo(k)fluoranthene	6,000	23,000	NL	NA	NA	1,480 ca	NL	NL	148,000	1,480
111-91-1	bis(2-Chloroethoxy)methane	NL	NL	NL	NA	NA	18,300 n	NL	NL	302	302
111-44-4	bis(2-Chloroethyl)ether	400	2,000	200 PQL	NA	NA	214 ca	NL	NL	23,700	200
117-81-7	bis-(2-Ethylhexyl)phthalate	35,000	140,000	NL	NA	NA	34,700 ca	NL	NL	925	925
85-68-7	Butylbenzylphthalate	1,200,000	14,000,000	NL	NA	NA	256,000 ca	NL	NL	239	239
105-60-2	Caprolactam	31,000,000	340,000,000	8,000	NA	NA	3,060,000 n	NL	NL	NL	8,000
86-74-8	Carbazole	24,000	96,000	NL	NA	NA	NL	NL	NL	NL	24,000
218-01-9	Chrysene	62,000	230,000	NL	NA	NA	14,800 ca	1,100 g	NL	4,730	1,100
53-70-3	Dibenzo(a,h)anthracene	200	200	NL	NA	NA	15 ca	1,100 g	NL	18,400	14.8
132-64-9	Dibenzofuran	NL	NL	NL	NA	NA	7,820 n	NL	NL	NL	7,820
84-66-2	Diethylphthalate	49,000,000	550,000,000	57,000	NA	NA	4,890,000 n	NL	100,000	24,800	24,800
131-11-3	Dimethylphthalate	NL	NL	NL	NA	NA	NL	NL	NL	734,000	734,000
84-74-2	Di-n-butylphthalate	6,100,000	68,000,000	NL	NA	NA	611,000 n	NL	200,000	150	150
117-84-0	Di-n-octylphthalate	2,400,000	27,000,000	NL	NA	NA	NL	NL	NL	709,000	709,000

Table 1
Soil Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Residential Direct Contact Soil Remediation Standard (NJRDCSRS)[1]	NJDEP Non-Residential Direct Contact Soil Remediation Standard (NJNRDCSRS)[2]	NJDEP Default Impact to Groundwater Soil Remediation Standard (NJIGWSRS)[3]	Ambient Concentrations of Extractable Metals Urban Coastal Plain[4]		Human Health Screening Level (EPA RSL)[5]	Ecological Screening Level			Screening Criteria[9]
					Median Concentration	90th Percentile Concentration		EPA EcoSSLs[6]	Soil PRGs[7]	EPA Region 5[8]	
206-44-0	Fluoranthene	2,300,000	24,000,000	NL	NA	NA	229,000 n	1,100 g	NL	122,000	1,100
86-73-7	Fluorene	2,300,000	24,000,000	110,000	NA	NA	229,000 n	29,000 f	NL	122,000	29,000
118-74-1	Hexachlorobenzene	300	1,000	NL	NA	NA	303 ca	NL	NL	199	199
87-68-3	Hexachlorobutadiene	6,000	25,000	NL	NA	NA	6,110 n	NL	NL	39.8	39.8
77-47-4	Hexachlorocyclopentadiene	45,000	110,000	NL	NA	NA	36,600 n	NL	10,000	755	755
67-72-1	Hexachloroethane	35,000	140,000	200 PQL	NA	NA	6,110 n	NL	NL	596	200
193-39-5	Indeno(1,2,3-cd)pyrene	600	2,000	NL	NA	NA	148 ca	1,100 g	NL	109,000	148
78-59-1	Isophorone	510,000	2,000,000	200 PQL	NA	NA	511,000 ca	NL	NL	139,000	200
91-20-3	Naphthalene	6,000	17,000	16,000	NA	NA	3,570 ca	29,000 f	NL	99.4	99.4
98-95-3	Nitrobenzene	31,000	340,000	200 PQL	NA	NA	4,790 ca	NL	NL	1310	200
621-64-7	N-Nitroso-di-n-propylamine	200	300	200 PQL	NA	NA	69.4 ca	NL	NL	NL	69.4
86-30-6	N-Nitrosodiphenylamine	99,000	390,000	200	NA	NA	99,100 ca	NL	NL	545	200
87-86-5	Pentachlorophenol	3,000	10,000	300 PQL	NA	NA	2,970 ca	2,100	3,000	119	119
85-01-8	Phenanthrene	NL	300,000,000	NL	NA	NA	NL	29,000 f	NL	45,700	29,000
108-95-2	Phenol	18,000,000	210,000,000	5,000	NA	NA	1,830,000 n	NL	30,000	NL	5,000
129-00-0	Pyrene	1,700,000	18,000,000	NL	NA	NA	172,000 n	1,100 g	NL	78,500	1,100
Pesticides/Polychlorinated Biphenyls (µg/kg)											
72-54-8	4,4'-DDD	3,000	13,000	NL	NA	NA	2,020 ca	21 b	NL	758	21
72-55-9	4,4'-DDE	2,000	9,000	NL	NA	NA	1,430 ca	21 b	NL	596	21
50-29-3	4,4'-DDT	2,000	8,000	NL	NA	NA	1,720 ca	21 b	NL	3.5	3.5
309-00-2	Aldrin	40	200	NL	NA	NA	28.6 ca	NL	NL	3.32	3.32
319-84-6	alpha-BHC	100	500	2 PQL	NA	NA	77.1 ca	NL	NL	99.4	2
5103-71-9	alpha-Chlordane	200	1,000	NL	NA	NA	NL	NL	NL	224 c	200
319-85-7	beta-BHC	400	2,000	2 PQL	NA	NA	270 ca	NL	NL	3.98	2
319-86-8	delta-BHC	400 ###	2,000 ###	2 ###, PQL	NA	NA	NL	NL	NL	9,940	2
60-57-1	Dieldrin	40	200	NL	NA	NA	30.3 ca	4.9	NL	NL	4.9
959-98-8	Endosulfan I	470,000	6,800,000	2,000	NA	NA	NL	NL	NL	119	119
33213-65-9	Endosulfan II	470,000	6,800,000	2,000	NA	NA	NL	NL	NL	119	119
1031-07-8	Endosulfan Sulfate	470,000	6,800,000	1,000	NA	NA	NL	NL	NL	35.8	35.8
72-20-8	Endrin	23,000	340,000	600	NA	NA	1,830 n	NL	NL	10.1	10.1
7421-93-4	Endrin aldehyde	23,000 ##	340,000 ##	600 ##	NA	NA	NL	NL	NL	10.5	10.5
53494-70-5	Endrin ketone	23,000 ##	340,000 ##	600 ##	NA	NA	NL	NL	NL	NL	600
58-89-9	gamma-BHC (Lindane)	400	2,000	2 PQL	NA	NA	516 ca	NL	NL	5	2
5103-74-2	gamma-Chlordane	200	1,000	NL	NA	NA	NL	NL	NL	224 c	200
76-44-8	Heptachlor	100	700	NL	NA	NA	108 ca	NL	NL	5.98	5.98
1024-57-3	Heptachlor epoxide	70	300	NL	NA	NA	53.3 ca	NL	NL	152	53.3
72-43-5	Methoxychlor	390,000	5,700,000	NL	NA	NA	30,600 n	NL	NL	19.9	19.9
8001-35-2	Toxaphene	600	3,000	NL	NA	NA	441 ca	NL	NL	119	119
12674-11-2	Aroclor-1016	200 #	1,000 #	NL	NA	NA	393 n	NL	371 d	0.332 d	0.332
11104-28-2	Aroclor-1221	200 #	1,000 #	NL	NA	NA	141 ca	NL	371 d	0.332 d	0.332
11141-16-5	Aroclor-1232	200 #	1,000 #	NL	NA	NA	141 ca	NL	371 d	0.332 d	0.332
53469-21-9	Aroclor-1242	200 #	1,000 #	NL	NA	NA	221 ca	NL	371 d	0.332 d	0.332
12672-29-6	Aroclor-1248	200 #	1,000 #	NL	NA	NA	221 ca	NL	371 d	0.332 d	0.332

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CAS Number	Chemical Name	NJDEP Residential Direct Contact Soil Remediation Standard (NJRDCSRS)[1]	NJDEP Non-Residential Direct Contact Soil Remediation Standard (NJNRDCSRS)[2]	NJDEP Default Impact to Groundwater Soil Remediation Standard (NJIGWSRS)[3]	Ambient Concentrations of Extractable Metals Urban Coastal Plain[4]		Human Health Screening Level (EPA RSL)[5]	Ecological Screening Level			Screening Criteria[9]
					Median Concentration	90th Percentile Concentration		EPA EcoSSLs[6]	Soil PRGs[7]	EPA Region 5[8]	
11097-69-1	Aroclor-1254	200 #	1,000 #	NL	NA	NA	112 n	NL	371 d	0.332 d	0.332
11096-82-5	Aroclor-1260	200 #	1,000 #	NL	NA	NA	221 ca	NL	371 d	0.332 d	0.332
37324-23-5	Aroclor-1262	200 #	1,000 #	NL	NA	NA	NL	NL	371 d	0.332 d	0.332
11100-14-4	Aroclor-1268	200 #	1,000 #	NL	NA	NA	NL	NL	371 d	0.332 d	0.332

Source:

[1] NJDEP 2008. Residential Direct Contact Health Based Criteria and Soil Remediation Standards (Last Revised 6/2008); http://www.state.nj.us/dep/srp/guidance/rs/, downloaded November 14, 2008

[2] NJDEP. 2008. Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standards (Last Revised 6/2008); http://www.state.nj.us/dep/srp/guidance/rs/, downloaded November 14, 2008

[3] NJDEP 2008. Guidance Document, Development of Site-Specific Impact to Groundwater Soil Remediation Standards Using the Soil-Water Partition Equation (Revised December 2008); http://www.state.nj.us/dep/srp/guidance/rs/igw_intro.htm, downloaded February 3, 2009

[4] NJDEP 2003. Ambient Levels of Metals in New Jersey Soils

[5] EPA 2009. EPA Regional Screening Level (RSL) for residential soil, based on cancer risk of 1×10^{-6} and non-cancer hazard index of 0.1. December. http://www.epa.gov/region09/superfund/prg/index.html

[6] EPA Ecological Soil Screening Levels (EcoSSLs). http://www.epa.gov/ecotox/ecossl/

[7] Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals (PRGs) for Ecological Endpoints. Prepared for the U.S. Department of Energy, Office of Environmental Management Contract No. DE-AC05-84OR21401.

[8] EPA 2003. EPA Region 5 Resource Conservation and Recovery Act (RCRA) Ecological Screening Levels.

[9] Screening criteria are the lowest values

mg/kg - milligrams per kilogram
µg/kg - microgram per kilogram
NL - not listed
NA - not applicable or not available
PQL - practical quantitation level
DL - detection limit
- criteria for PCBs
- criteria for endrin
- criteria for beta-BHC
- criteria for mixture of 2,4-dinitrotoluene and 2,6-dinitrotoluene
* - based on natural background levels as noted in NJDEP criteria
** - value for 1,3-dichloropropene

ca - value based on cancer effects
n - value based on noncancer effects
m - concentration may exceed ceiling limit
s - concentration may exceed saturation concentration
a - value for chromium (trivalent)
b - value for DDT and metabolites
c - value for chlordane
d - value for PCBs
f - value for low molecular weight polyaromatic hydrocarbons
g - value for high molecular weight polyaromatic hydrocarbons

Table 2
Surface Water and Pore Water Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Surface Water Quality Standards (SWQS)[1]	National Recommended Water Quality Criteria (NRWQC)[2]	EPA Region 3[3]	Screening Criteria[4]
Inorganic Analytes (µg/L)					
7429-90-5	Aluminum	NL	NL	87 d	87
7440-36-0	Antimony	NL	NL	500	500
7440-38-2	Arsenic	36	36	12.5	12.5
7440-39-3	Barium	NL	NL	4 d	4
7440-41-7	Beryllium	NL	NL	0.66 d	0.66
7440-43-9	Cadmium	8.8	8.8	0.12	0.12
7440-70-2	Calcium	NL	NL	116,000 d	116,000
7440-47-3	Chromium	NL	NL	57.5	57.5
18540-29-9	Chromium (hexavalent)	50	50	1.5	1.5
7440-48-4	Cobalt	NL	NL	23 d	23
7440-50-8	Copper	5.6	3.1	3.1	3.1
7439-89-6	Iron	NL	NL	300 d	300
7439-92-1	Lead	24	8.1	8.1	8.1
7439-95-4	Magnesium	NL	NL	82,000 d	82,000
7439-96-5	Manganese	NL	NL	120 d	120
7439-97-6	Mercury	0.94	0.94	0.016	0.016
7440-02-0	Nickel	22	8.2	8.2	8.2
7440-09-7	Potassium	NL	NL	53,000 d	53,000
7782-49-2	Selenium	71	71	71	71
7440-22-4	Silver	1.9 a	1.9 a	0.23	0.23
7440-23-5	Sodium	NL	NL	680,000 d	680,000
7440-28-0	Thallium	NL	NL	21.3	21.3
7440-62-2	Vanadium	NL	NL	20 d	20
7440-66-6	Zinc	81	81	81	81
Volatile Organic Compounds (µg/L)					
71-55-6	1,1,1-Trichloroethane	NL	NL	312	312
79-34-5	1,1,2,2-Tetrachoroethane	NL	NL	90.2	90.2
76-13-1	1,1,2-Trichloro-1,2,2-triflouroethane	NL	NL	NL	NL
79-00-5	1,1,2-Trichloroethane	NL	NL	550	550
87-61-6	1,2,3-Trichlorobenzene	NL	NL	8 d	8
75-34-3	1,1-Dichloroethane	NL	NL	47 d	47
75-35-4	1,1-Dichloroethene	NL	NL	2,240	2,240
120-82-1	1,2,4-Trichlorobenzene	NL	NL	5.4	5.4

Table 2
Surface Water and Pore Water Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Surface Water Quality Standards (SWQS)[1]	National Recommended Water Quality Criteria (NRWQC)[2]	EPA Region 3[3]	Screening Criteria[4]
100-01-6	4-Nitroaniline	NL	NL	NL	NL
100-02-7	4-Nitrophenol	NL	NL	71.7	71.7
83-32-9	Acenaphthene	NL	NL	6.6	6.6
208-96-8	Acenaphthylene	NL	NL	NL	NL
98-86-2	Acetophenone	NL	NL	NL	NL
120-12-7	Anthracene	NL	NL	0.18	0.18
1912-24-9	Atrazine	NL	NL	1.8 d	1.8
100-52-7	Benzaldehyde	NL	NL	NL	NL
56-55-3	Benzo(a)anthracene	NL	NL	0.018 d	0.018
50-32-8	Benzo(a)pyrene	NL	NL	0.015 d	0.015
205-99-2	Benzo(b)fluoranthene	NL	NL	NL	NL
191-24-2	Benzo(g,h,i)perylene	NL	NL	NL	NL
207-08-9	Benzo(k)fluoranthene	NL	NL	NL	NL
111-91-1	bis(2-Chloroethoxy)methane	NL	NL	NL	NL
111-44-4	bis(2-Chloroethyl)ether	NL	NL	NL	NL
117-81-7	bis(2-Ethylhexyl)phthalate	NL	NL	16 d	16
85-68-7	Butylbenzylphthalate	NL	NL	29.4	29.4
105-60-2	Caprolactum	NL	NL	NL	NL
86-74-8	Carbazole	NL	NL	NL	NL
218-01-9	Chrysene	NL	NL	NL	NL
53-70-3	Dibenz(a,h)anthracene	NL	NL	NL	NL
132-64-9	Dibenzofuran	NL	NL	65	65
84-66-2	Diethylphthalate	NL	NL	75.9	75.9
131-11-3	Dimethyl phthalate	NL	NL	580	580
84-74-2	Di-n-butylphthalate	NL	NL	3.4	3.4
117-84-0	Di-n-octylphthalate	NL	NL	22 d	22
206-44-0	Fluoranthene	NL	NL	1.6	1.6
86-73-7	Fluorene	NL	NL	2.5	2.5
118-74-1	Hexachlorobenzene	NL	NL	0.0003 d	0.0003
87-68-3	Hexachlorobutadiene	NL	NL	0.3	0.3
77-47-4	Hexachlorocyclopentadiene	NL	NL	0.07	0.07
67-72-1	Hexachloroethane	NL	NL	9.4	9.4
193-39-5	Indeno(1,2,3-cd)pyrene	NL	NL	NL	NL
78-59-1	Isophorone	NL	NL	129	129

Table 2
Surface Water and Pore Water Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Surface Water Quality Standards (SWQS)[1]	National Recommended Water Quality Criteria (NRWQC)[2]	EPA Region 3[3]	Screening Criteria[4]
91-20-3	Naphthalene	NL	NL	1.4	1.4
98-95-3	Nitrobenzene	NL	NL	66.8	66.8
621-64-7	N-Nitroso-di-n-propylamine	NL	NL	120	120
86-30-6	N-Nitrosodiphenylamine	NL	NL	33,000	33,000
87-86-5	Pentachlorophenol	7.9	7.9	7.9	7.9
85-01-8	Phenanthrene	NL	NL	1.5	1.5
108-95-2	Phenol	NL	NL	58	58
129-00-0	Pyrene	NL	NL	0.24	0.24
Pesticides/Polychlorinated Biphenyls (µg/L)					
72-54-8	4,4'-DDD	NL	NL	0.025	0.025
72-55-9	4,4'-DDE	NL	NL	0.14	0.14
50-29-3	4,4'-DDT	0.001	0.001	0.0065	0.001
309-00-2	Aldrin	1.3 a	1.3 a	0.13	0.13
319-84-6	alpha-BHC	NL	NL	25	25
5103-71-9	alpha-Chlordane	0.004 b	0.004 b	NL	0.004
319-85-7	beta-BHC	NL	NL	NL	NL
319-86-8	delta-BHC	NL	NL	141 d	141
60-57-1	Dieldrin	0.0019	0.0019	0.11	0.0019
959-98-8	Endosulfan I (alpha)	0.0087	0.0087	0.051 d	0.0087
33213-65-9	Endosulfan II (beta)	0.0087	0.0087	0.051 d	0.0087
1031-07-8	Endosulfan sulfate	NL	NL	0.009	0.009
72-20-8	Endrin	0.0023	0.0023	0.01	0.0023
7421-93-4	Endrin aldehyde	NL	NL	NL	NL
53494-70-5	Endrin ketone	NL	NL	NL	NL
58-89-9	gamma-BHC (Lindane)	0.16 a	0.16 a	0.016	0.016
5103-74-2	gamma-Chlordane	0.004 b	0.004 b	NL	0.004
76-44-8	Heptachlor	0.0036	0.0036	0.0019 d	0.0019
1024-57-3	Heptachlor expoxide	0.0036	0.0036	0.0019 d	0.0019
72-43-5	Methoxychlor	0.03	NL	0.03	0.03
8001-35-2	Toxaphene	0.0002	0.002	0.21	0.0002
12674-11-2	Aroclor-1016	0.03 c	0.03 c	0.000074 d,e	0.000074
11104-28-2	Aroclor-1221	0.03 c	0.03 c	0.000074 d,e	0.000074
11141-16-5	Aroclor-1232	0.03 c	0.03 c	0.000074 d,e	0.000074
53469-21-9	Aroclor-1242	0.03 c	0.03 c	0.000074 d,e	0.000074

Table 2
Surface Water and Pore Water Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	NJDEP Surface Water Quality Standards (SWQS)[1]	National Recommended Water Quality Criteria (NRWQC)[2]	EPA Region 3[3]	Screening Criteria[4]
12672-29-6	Aroclor-1248	0.03 c	0.03 c	0.000074 d,e	0.000074
11097-69-1	Aroclor-1254	0.03 c	0.03 c	0.000074 d,e	0.000074
11096-82-5	Aroclor-1260	0.03 c	0.03 c	0.000074 d,e	0.000074
37324-23-5	Aroclor-1262	0.03 c	0.03 c	0.000074 d,e	0.000074
11100-14-4	Aroclor-1268	0.03 c	0.03 c	0.000074 d,e	0.000074

Source:

[1] New Jersey Department of Environmental Protection. 2009. Surface Water Quality Standards, Saline Water Chronic Values. August.

[2] EPA 2009. National Recommended Water Quality Criteria (NRWQC), Saltwater Criterion Continuous Concentrations. http://www.epa.gov/ost/criteria/wqctable

[3] EPA 2006. EPA Region 3 Biological Technical Assistance Group (BTAG) Marine Screening Benchmarks, Mid-Atlantic Risk Assessment: Ecological Risk Assessment, http://www.epa.gov/reg3hwmd/risk/eco/index.htm

[4] Screening criteria are the lowest values

µg/L - micrograms per liter
NL - not listed
a - no chronic value available; acute value used
b - value for chlordane
c - value for PCBs
d - freshwater value used as directed
e - value for total PCBs

Table 3
Sediment Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	Human Health Screening Level[1]	Ecological Screening Level			Screening Criteria[5]
			NJDEP ER-L[2]	NOAA[3]	EPA Region 3[4]	
Inorganic Analytes (mg/kg)						
7429-90-5	Aluminum	7,740 n	NL	NL	NL	7,740
7440-36-0	Antimony	3.13 n	NL	NL	2 a	2
7440-38-2	Arsenic	0.389 ca	8.2	7.24	7.24	0.389
7440-39-3	Barium	1530 n	NL	130.1	NL	130.1
7440-41-7	Beryllium	15.6 n	NL	NL	NL	15.6
7440-43-9	Cadmium	7 n	1.2	0.68	0.68	0.68
7440-70-2	Calcium	NL	NL	NL	NL	NL
7440-47-3	Chromium	100,000 m	81	52.3	52.3	52.3
18540-29-9	Chromium (hexavalent)	0.293 ca	NL	NL	NL	0.293
7440-48-4	Cobalt	2.34 n	NL	NL	50 a	2.34
7440-50-8	Copper	313 n	34	18.7	18.7	18.7
7439-89-6	Iron	5,480 n	NL	NL	2,000 a	2,000
7439-92-1	Lead	40 n	47	30.24	30.2	30.2
7439-95-4	Magnesium	NL	NL	NL	NL	NL
7439-96-5	Manganese	183 n	NL	NL	460 a	183
7439-97-6	Mercury	0.56 n	0.15	0.13	0.13	0.13
7440-02-0	Nickel	155 n	21	15.9	15.9	15.9
7440-09-7	Potassium	NL	NL	NL	NL	NL
7782-49-2	Selenium	39.1 n	NL	NL	2 a	2
7440-22-4	Silver	39.1 n	1	0.73	0.73	0.73
7440-23-5	Sodium	NL	NL	NL	NL	NL
7440-28-0	Thallium	100,000 m	NL	NL	NL	100,000
7440-62-2	Vanadium	0.548 n	NL	NL	NL	0.548
7440-66-6	Zinc	2,350 n	150	124	124	124
Volatile Organic Compounds (µg/kg)						
71-55-6	1,1,1-Trichloroethane	640,000 s	NL	NL	856	856
79-34-5	1,1,2,2-Tetrachloroethane	562 ca	NL	NL	202	202
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	910,000 s	NL	NL	NL	910,000
79-00-5	1,1,2-Trichloroethane	1,070 ca	NL	NL	570	570
75-34-3	1,1-Dichloroethane	3,310 ca	NL	NL	NL	3,310
75-35-4	1,1-Dichloroethene	24,300 n	NL	NL	2780	2,780
120-82-1	1,2,4-Trichlorobenzene	6,190 n	NL	NL	473	473
96-12-8	1,2-Dibromo-3-chloropropane	5.35 ca	NL	NL	NL	5.35
106-93-4	1,2-Dibromoethane	33.7 ca	NL	NL	NL	33.7
95-50-1	1,2-Dichlorobenzene	191,000 n	NL	NL	989	989
107-06-2	1,2-Dichloroethane	432 ca	NL	NL	NL	432
78-87-5	1,2-Dichloropropane	895 ca	NL	NL	NL	895
87-61-6	1,2,3-Trichlorobenzene	4,890 n	NL	NL	858 a	858
541-73-1	1,3-Dichlorobenzene	NL	NL	NL	842	842

Table 3
Sediment Screening Criteria for Data Gap Analysis
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CAS Number	Chemical Name	Human Health Screening Level[1]	Ecological Screening Level			Screening Criteria[5]
			NJDEP ER-L[2]	NOAA[3]	EPA Region 3[4]	
106-46-7	1,4-Dichlorobenzene	2440 ca	NL	NL	460	460
123-91-1	1,4-Dioxane	44,100 ca	NL	NL	NL	44,100
78-93-3	2-Butanone	2,780,000 n	NL	NL	NL	2,780,000
591-78-6	2-Hexanone	20,900 n	NL	NL	NL	20,900
108-10-1	4-Methyl-2-pentanone	532,000 n	NL	NL	NL	532,000
67-64-1	Acetone	6,130,000 n	NL	NL	NL	6,130,000
71-43-2	Benzene	1,080 ca	340	NL	137	137
74-97-5	Bromochloromethane	NL	NL	NL	NL	NL
75-27-4	Bromodichloromethane	273 ca	NL	NL	NL	273
75-25-2	Bromoform	61,500 ca	NL	NL	1,310	1,310
74-83-9	Bromomethane	732 n	NL	NL	NL	732
75-15-0	Carbon Disulfide	82,100 n	NL	NL	0.851 a	0.851
56-23-5	Carbon Tetrachloride	248 ca	NL	NL	7,240	248
108-90-7	Chlorobenzene	29,400 n	NL	NL	162	162
75-00-3	Chloroethane	1,450,000 n	NL	NL	NL	1,450,000
67-66-3	Chloroform	295 ca	NL	NL	NL	295
74-87-3	Chloromethane	11,900 n	NL	NL	NL	11,900
156-59-2	cis-1,2-Dichloroethene	78,200 n	NL	NL	NL	78,200
10061-01-5	cis-1,3-Dichloropropene	NL	NL	NL	NL	NL
110-82-7	Cyclohexane	117,000 s	NL	NL	NL	117,000
124-48-1	Dibromochloromethane	680 ca	NL	NL	NL	680
75-71-8	Dichlorodifluoromethane	18,400 n	NL	NL	NL	18,400
100-41-4	Ethylbenzene	5,390 ca	1,400	NL	305	305
98-82-8	Isopropylbenzene	205,000 n	NL	NL	86 a	86
79-20-9	Methyl Acetate	7,820,000 n	NL	NL	NL	7,820,000
1634-04-4	Methyl Tert-Butyl Ether	43,300 ca	NL	NL	NL	43,300
108-87-2	Methylcyclohexane	NL	NL	NL	NL	NL
75-09-2	Methylene Chloride	10,700 ca	NL	NL	NL	10,700
100-42-5	Styrene	628,000 n	NL	NL	7,070	7,070
127-18-4	Tetrachloroethene	554 ca	450	NL	190	190
108-88-3	Toluene	497,000 n	2,500	NL	1,090	1,090
156-60-5	trans-1,2-Dichloroethene	15,300 n	NL	NL	NL	15,300
10061-02-6	trans-1,3-Dichloropropene	NL	NL	NL	NL	NL
79-01-6	Trichloroethene	2,820 ca	1,600	NL	8,950	1,600
75-69-4	Trichlorofluoromethane	78,700 n	NL	NL	NL	78,700
75-01-4	Vinyl Chloride	59.7 ca	NL	NL	NL	59.7
1330-20-7	Xylenes (total)	62,700 n	120	NL	NL	120
Semi-volatile Organic Compounds (µg/kg)						
92-52-4	1,1'-Biphenyl	214,000 s	NL	NL	1,220 a	1,220
95-94-3	1,2,4,5-Tetrachlorobenzene	1,830 n	NL	NL	47,000	1,830

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CAS Number	Chemical Name	Human Health Screening Level[1]	Ecological Screening Level			Screening Criteria[5]
			NJDEP ER-L[2]	NOAA[3]	EPA Region 3[4]	
108-60-1	2,2'-oxybis(1-Chloropropane)	4,570 ca	NL	NL	NL	4,570
58-90-2	2,3,4,6-Tetrachlorophenol	183,000 n	NL	NL	284 a	284
95-95-4	2,4,5-Trichlorophenol	611,000 n	NL	NL	819	819
88-06-2	2,4,6-Trichlorophenol	6,110 n	NL	NL	2,650	2,650
120-83-2	2,4-Dichlorophenol	18,300 n	NL	NL	117 a	117
105-67-9	2,4-Dimethylphenol	122,000 n	NL	NL	29 a	29
51-28-5	2,4-Dinitrophenol	12,200 n	NL	NL	NL	12,200
121-14-2	2,4-Dinitrotoluene	1,560 ca	NL	NL	41.6 a	41.6
606-20-2	2,6-Dinitrotoluene	6,120 n	NL	NL	NL	6,120
91-58-7	2-Chloronaphthalene	175,000 s	NL	NL	NL	175,000
95-57-8	2-Chlorophenol	39,100 n	NL	NL	344	344
91-57-6	2-Methylnaphthalene	31,300 n	70	20.2	20.2	20.2
95-48-7	2-Methylphenol	306,000 n	NL	NL	NL	306,000
88-74-4	2-Nitroaniline	60,600 n	NL	NL	NL	60,600
88-75-5	2-Nitrophenol	NL	NL	NL	NL	NL
91-94-1	3,3'-Dichlorobenzidine	1,080 ca	NL	NL	2,060	1,080
99-09-2	3-Nitroaniline	NL	NL	NL	NL	NL
534-52-1	4,6-Dinitro-2-methylphenol	611 n	NL	NL	NL	611
101-55-3	4-Bromophenyl-phenylether	NL	NL	NL	1,230 a	1,230
59-50-7	4-Chloro-3-methylphenol	611,000 n	NL	NL	NL	611,000
106-47-8	4-Chloroaniline	2,430 ca	NL	NL	NL	2,430
7005-72-3	4-Chlorophenyl-phenylether	NL	NL	NL	NL	NL
106-44-5	4-Methylphenol	30,600 n	NL	NL	670 a	670
100-01-6	4-Nitroaniline	24,300 ca	NL	NL	NL	24,300
100-02-7	4-Nitrophenol	NL	NL	NL	NL	NL
83-32-9	Acenaphthene	344,000 n	16	6.71	6.71	6.71
208-96-8	Acenaphthylene	NL	44	5.87	5.87	5.87
98-86-2	Acetophenone	782,000 n	NL	NL	NL	782,000
120-12-7	Anthracene	1,720,000 n	85	46.9	46.9	46.9
1912-24-9	Atrazine	2,110 ca	NL	NL	6.62 a	6.62
100-52-7	Benzaldehyde	782,000 n	NL	NL	NL	782,000
56-55-3	Benzo(a)anthracene	148 ca	261	74.8	74.8	74.8
50-32-8	Benzo(a)pyrene	14.8 ca	430	88.8	88.8	14.8
205-99-2	Benzo(b)fluoranthene	148 ca	NL	NL	NL	148
191-24-2	Benzo(g,h,i)perylene	NL	170 a	NL	170 a	170
207-08-9	Benzo(k)fluoranthene	1,480 ca	240 a	NL	240 a	240
111-91-1	bis(2-Chloroethoxy)methane	18,300 n	NL	NL	NL	18,300
111-44-4	bis(2-Chloroethyl)ether	214 ca	NL	NL	NL	214
117-81-7	bis(2-Ethylhexyl)phthalate	34,700 ca	NL	182	182	182
85-68-7	Butylbenzylphthalate	256,000 ca	NL	NL	16,800	16,800
105-60-2	Caprolactam	3,060,000 n	NL	NL	NL	3,060,000

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CAS Number	Chemical Name	Human Health Screening Level[1]	Ecological Screening Level			Screening Criteria[5]
			NJDEP ER-L[2]	NOAA[3]	EPA Region 3[4]	
86-74-8	Carbazole	NL	NL	NL	NL	NL
218-01-9	Chrysene	14,800 ca	384	108	108	108
53-70-3	Dibenz(a,h)anthracene	14.8 ca	63	6.22	6.22	6.22
132-64-9	Dibenzofuran	7,820 n	NL	NL	7,300	7,300
84-66-2	Diethylphthalate	4,890,000 n	NL	NL	218	218
131-11-3	Dimethylphthalate	NL	NL	NL	NL	NL
84-74-2	Di-n-butylphthalate	611,000 n	NL	NL	1,160	1,160
117-84-0	Di-n-octyl phthalate	NL	NL	NL	NL	NL
206-44-0	Fluoranthene	229,000 n	600	113	113	113
86-73-7	Fluorene	229,000 n	19	21.2	21.2	19
118-74-1	Hexachlorobenzene	303 ca	NL	NL	20 a	20
87-68-3	Hexachlorobutadiene	6,110 n	NL	NL	NL	6,110
77-47-4	Hexachlorocyclopentadiene	36,600 n	NL	NL	139	139
67-72-1	Hexachloroethane	6,110 n	NL	NL	804	804
193-39-5	Indeno(1,2,3-c,d)pyrene	148 ca	200 a	NL	17 a	17
78-59-1	Isophorone	511,000 ca	NL	NL	NL	511,000
91-20-3	Naphthalene	3,570 ca	160	34.6	34.6	34.6
98-95-3	Nitrobenzene	4,790 ca	NL	NL	NL	4,790
621-64-7	N-Nitroso-di-n-propylamine	69.4 ca	NL	NL	NL	69.4
86-30-6	N-Nitrosodiphenylamine	99,100 ca	NL	NL	422,000	99,100
87-86-5	Pentachlorophenol	2,970 ca	NL	NL	7,970	2,970
85-01-8	Phenanthrene	NL	240	86.7	86.7	86.7
108-95-2	Phenol	1,830,000 n	NL	NL	420 a	420
129-00-0	Pyrene	172,000 n	665	153	153	153
Pesticides/Polychlorinated Biphenyls (µg/kg)						
72-54-8	4,4'-DDD	2,020 ca	NL	1.22	1.22	1.22
72-55-9	4,4'-DDE	1,430 ca	2.2	2.07	2.07	2.07
50-29-3	4,4'-DDT	1,720 ca	1.6 b	1.19	1.19	1.19
309-00-2	Aldrin	28.6 ca	2 a	NL	2 a	2
319-84-6	alpha-BHC	77.1 ca	3 a,c	NL	1360	3
5103-71-9	alpha-Chlordane	NL	7 a,d	NL	NL	7
319-85-7	beta-BHC	270 ca	3 a,c	NL	5 a	3
319-86-8	delta-BHC	NL	3 a,c	NL	6400 a	3
60-57-1	Dieldrin	30.3 ca	2 a	0.72	0.72	0.72
959-98-8	Endosulfan I	NL	NL	NL	2.9 a	2.9
33213-65-9	Endosulfan II	NL	NL	NL	14 a	14
1031-07-8	Endosulfan sulfate	NL	NL	NL	0.357	0.357
72-20-8	Endrin	1,830 n	3 a	NL	2.67	2.67
7421-93-4	Endrin aldehyde	NL	NL	NL	NL	NL
53494-70-5	Endrin ketone	NL	NL	NL	NL	NL

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Sediment Screening Criteria for Data Gap Analysis
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CAS Number	Chemical Name	Human Health Screening Level[1]	Ecological Screening Level			Screening Criteria[5]
			NJDEP ER-L[2]	NOAA[3]	EPA Region 3[4]	
5103-74-2	gamma-Chlordane	NL	7 a,d	NL	NL	7
76-44-8	Heptachlor	108 ca	NL	NL	68 a	68
1024-57-3	Heptachlor epoxide	53.3 ca	5 a	NL	0.6	0.6
58-89-9	gamma-BHC (Lindane)	516 ca	NL	0.32	0.32	0.32
72-43-5	Methoxychlor	30,600 n	NL	NL	29.6	29.6
8001-35-2	Toxaphene	441 ca	NL	0.1	536	0.1
12674-11-2	Aroclor-1016	393 n	23 e	21.6 e	40 e	21.6
11104-28-2	Aroclor-1221	141 ca	23 e	21.6 e	40 e	21.6
11141-16-5	Aroclor-1232	141 ca	23 e	21.6 e	40 e	21.6
53469-21-9	Aroclor-1242	221 ca	23 e	21.6 e	40 e	21.6
12672-29-6	Aroclor-1248	221 ca	23 e	21.6 e	40 e	21.6
11097-69-1	Aroclor-1254	112 n	23 e	63.3	63.3	23
11096-82-5	Aroclor-1260	221 ca	23 e	21.6 e	40 e	21.6
37324-23-5	Aroclor-1262	NL	23 e	21.6 e	40 e	21.6
11100-14-4	Aroclor-1268	NL	23 e	21.6 e	40 e	21.6

Source:

[1] EPA 2009. EPA Regional Screening Level (RSL) for residential soil, based on cancer risk of 1×10^{-6} and non-cancer hazard index of 0.1. December. http://www.epa.gov/region09/superfund/prg/index.html

[2] New Jersey Site Remediation Program. 2003. Marine/Estuarine Sediment Screening Guidelines.Effects Range-Low values

[3] Buchman, M.F., 2008. NOAA Screening Quick Reference Tables, NOAA OR and R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration

[4] EPA 2006. EPA Region 3 Biological Technical Assistance Group (BTAG) Marine Sediment Screening Benchmarks, Mid-Atlantic Risk Assessment: Ecological Risk Assessment, http://www.epa.gov/reg3hwmd/risk/eco/index.htm

[5] Screening criteria are the lowest values

mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
ca - value based on cancer effects
n - value based on noncancer effects
m - concentration may exceed ceiling limit
s - concentration may exceed saturation concentration

a - freshwater value used as directed
b - value for total DDT
c - value for BHC
d - value for chlordane
e - value for total PCBs

Table 4
Groundwater Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	7/08 NJ Groundwater Quality Standards Class IIA Water (NJ GQS)[1]	6/03 EPA National Primary Drinking Water Standards (EPA MCL)[2]	2/05 NJ Drinking Water Standards (NJ MCL)[3]	Human Health Screening Level (EPA RSL)[4]	Screening Criteria[5]
Inorganic Analytes (µg/L)						
7429-90-5	Aluminum	200	NL	200 **	3,650 n	200
7440-36-0	Antimony	6	6	6	1.46 n	1.46
7440-38-2	Arsenic	3	10	5	0.0448 ca	0.0448
7440-39-3	Barium	6,000	2,000	2,000	730 n	730
7440-41-7	Beryllium	1	4	4	7.3 n	1
7440-43-9	Cadmium	4	5	5	1.83 n	1.83
7440-70-2	Calcium	NL	NL	NL	NL	NL
7440-47-3	Chromium	70	100	100	NL	70
18540-29-9	Chromium (hexavalent)	70 ###	100 ###	100 ###	0.0431 ca	0.0431
7440-48-4	Cobalt	NL	NL	NL	1.1 n	1.1
7440-50-8	Copper	1,300	1,300 TT	1,300 [AL]*	146 n	146
57-12-5	Cyanide	100	200	200	73 n	73
7439-89-6	Iron	300	NL	300 **	2,560 n	300
7439-92-1	Lead	5	15 TT	15 [AL]*	NL	5
7439-95-4	Magnesium	NL	NL	NL	NL	NL
7439-96-5	Manganese	50	NL	50 **	87.6 n	50
7439-97-6	Mercury	2	2	2	0.0565 n	0.0565
7440-02-0	Nickel	100	NL	NL	73 n	73
7440-09-7	Potassium	NL	NL	NL	NL	NL
7782-49-2	Selenium	40	50	50	18.3 n	18.3
7440-22-4	Silver	40	NL	100 **	18.3 n	18.3
7440-23-5	Sodium	50,000	NL	50,000 **	NL	50,000
7440-28-0	Thallium	2	2	2	NL	2
7440-62-2	Vanadium	NL	NL	NL	0.256 n	0.256
7440-66-6	Zinc	2,000	NL	5,000 **	1,100 n	1,100
Volatile Organic Compounds (µg/L)						
71-55-6	1,1,1-Trichloroethane	30	200	30	913 n	30
79-34-5	1,1,2,2-Tetrachloroethane	1	NL	1	0.0671 ca	0.0671
79-00-5	1,1,2-Trichloroethane	3	5	3	0.242 ca	0.242
76-13-1	1,1,2-Tricholoro-1,2,2-trifluoroethane	NL	NL	NL	5,920 n	5,920
75-34-3	1,1-Dichloroethane	50	NL	50	2.42 ca	2.42
75-35-4	1,1-Dichloroethene	1	7	2	34 n	1

Table 4
Groundwater Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
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CAS Number	Chemical Name	7/08 NJ Groundwater Quality Standards Class IIA Water (NJ GQS)[1]	6/03 EPA National Primary Drinking Water Standards (EPA MCL)[2]	2/05 NJ Drinking Water Standards (NJ MCL)[3]	Human Health Screening Level (EPA RSL)[4]	Screening Criteria[5]
87-61-6	1,2,3-Trichlorobenzene	NL	NL	NL	2.92 n	2.92
120-82-1	1,2,4-Trichlorobenzene	9	70	9	0.412 n	0.412
96-12-8	1,2-Dibromo-3-chloropropane	0.02	0.2	NL	0.000316 ca	0.000316
106-93-4	1,2-Dibromoethane	0.03	0.05	NL	0.00653 ca	0.00653
95-50-1	1,2-Dichlorobenzene	600	600	600	37 n	37
107-06-2	1,2-Dichloroethane	2	5	2	0.149 ca	0.149
78-87-5	1,2-Dichloropropane	1	5	5	0.386 ca	0.386
541-73-1	1,3-Dichlorobenzene	600	NL	600	NL	600
106-46-7	1,4-Dichlorobenzene	75	75	75	0.427 ca	0.427
78-93-3	2-Butanone	300	NL	NL	706 n	300
591-78-6	2-Hexanone	100 (ignc)+	NL	NL	4.66 n	4.66
108-10-1	4-Methyl-2-pentanone	NL	NL	NL	199 n	199
67-64-1	Acetone	6,000	NL	NL	2,180 n	2,180
71-43-2	Benzene	1	5	1	0.413 ca	0.413
74-97-5	Bromochloromethane	NL	NL	NL	NL	NL
75-27-4	Bromodichloromethane	1	80	80	0.117 ca	0.117
75-25-2	Bromoform	4	80	80	8.51 ca	4
74-83-9	Bromomethane	10	NL	NL	0.866 n	0.866
75-15-0	Carbon Disulfide	700	NL	NL	104 n	104
56-23-5	Carbon Tetrachloride	1	5	2	0.199 ca	0.199
123-91-1	1-4 Dioxane	NL	NL	NL	6.11 ca	6.11
108-90-7	Chlorobenzene	50	100	50	9.13 n	9.13
75-00-3	Chloroethane	100 (ignc)+	NL	NL	2,090 n	100
67-66-3	Chloroform	70	80	80	0.193 ca	0.193
74-87-3	Chloromethane	NL	NL	NL	18.8 n	18.8
156-59-2	cis-1,2-Dichloroethene	70	70	70	36.5 n	36.5
10061-01-5	cis-1,3-Dichloropropene	1	NL	NL	0.433 c*	0.433
110-82-7	Cyclohexane	100 (ignc)+	NL	NL	1250 n	100
124-48-1	Dibromochloromethane	1	80	80	0.147 ca	0.147
75-71-8	Dichlorodifluoromethane	1,000	NL	NL	39.5 n	39.5
100-41-4	Ethylbenzene	700	700	700	1.48 ca	1.48
98-82-8	Isopropylbenzene	700	NL	NL	67.9 n	67.9
79-20-9	Methyl Acetate	7,000	NL	NL	3,650 n	3,650

Table 4
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CAS Number	Chemical Name	7/08 NJ Groundwater Quality Standards Class IIA Water (NJ GQS)[1]	6/03 EPA National Primary Drinking Water Standards (EPA MCL)[2]	2/05 NJ Drinking Water Standards (NJ MCL)[3]	Human Health Screening Level (EPA RSL)[4]	Screening Criteria[5]
1634-04-4	Methyl Tert-Butyl Ether	70	NL	70	12.5 ca	12.5
108-87-2	Methylcyclohexane	NL	NL	NL	NL	NL
75-09-2	Methylene Chloride	3	5	3	4.8 ca	3
100-42-5	Styrene	100	100	100	162 n	100
127-18-4	Tetrachloroethene	1	5	1	0.108 ca	0.108
108-88-3	Toluene	600	1,000	1,000	228 n	228
156-60-5	trans-1,2-Dichloroethene	100	100	100	10.7 n	10.7
10061-02-6	trans-1,3-Dichloropropene	1	NL	NL	0.433 c*	0.433
79-01-6	Trichloroethene	1	5	1	2.01 ca	1
75-69-4	Trichlorofluoromethane	2,000	NL	NL	129 n	129
75-01-4	Vinyl Chloride	1	2	2	0.0162 ca	0.0162
1330-20-7	Xylenes (Total)	1,000	10,000	1,000	20.3 n	20.3
Semi-Volatile Organic Compounds (µg/L)						
92-52-4	1,1'-Biphenyl	400	NL	NL	183 n	183
95-94-3	1,2,4,5-Tetrachlorobenzene	NL	NL	NL	1.1 n	1.1
108-60-1	2,2'-oxybis(1-Chloropropane)	300	NL	NL	0.323 ca	0.323
95-95-4	2,4,5-Trichlorophenol	700	NL	NL	365 n	365
88-06-2	2,4,6-Trichlorophenol	20	NL	NL	3.65 n	3.65
120-83-2	2,4-Dichlorophenol	20	NL	NL	11 n	11
105-67-9	2,4-Dimethylphenol	100	NL	NL	73 n	73
51-28-5	2,4-Dinitrophenol	40	NL	NL	7.3 n	7.3
121-14-2	2,4-Dinitrotoluene	10 #	NL	NL	0.217 ca	0.217
606-20-2	2,6-Dinitrotoluene	NL	NL	NL	3.65 n	3.65
91-58-7	2-Chloronaphthalene	600	NL	NL	292 n	292
95-57-8	2-Chlorophenol	40	NL	NL	18.3 n	18.3
91-57-6	2-Methylnaphthalene	NL	NL	NL	14.6 n	14.6
95-48-7	2-Methylphenol	NL	NL	NL	183 n	183
88-74-4	2-Nitroaniline	NL	NL	NL	36.5 n	36.5
88-75-5	2-Nitrophenol	NL	NL	NL	NL	NL
91-94-1	3,3'-Dichlorobenzidine	30	NL	NL	0.149 ca	0.149
99-09-2	3-Nitroaniline	NL	NL	NL	NL	NL
534-52-1	4,6-Dinitro-2-methylphenol	NL	NL	NL	0.365 n	0.365
101-55-3	4-Bromophenyl-phenylether	NL	NL	NL	NL	NL

Table 4
Groundwater Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	7/08 NJ Groundwater Quality Standards Class IIA Water (NJ GQS)[1]	6/03 EPA National Primary Drinking Water Standards (EPA MCL)[2]	2/05 NJ Drinking Water Standards (NJ MCL)[3]	Human Health Screening Level (EPA RSL)[4]	Screening Criteria[5]
59-50-7	4-Chloro-3-methylphenol	NL	NL	NL	365 n	365
106-47-8	4-Chloroaniline	30	NL	NL	0.336 ca	0.336
7005-72-3	4-Chlorophenyl-phenylether	NL	NL	NL	NL	NL
106-44-5	4-Methylphenol	NL	NL	NL	18.3 n	18.3
100-01-6	4-Nitroaniline	NL	NL	NL	3.36 ca	3.36
100-02-7	4-Nitrophenol	NL	NL	NL	NL	NL
83-32-9	Acenaphthene	400	NL	NL	219 n	219
208-96-8	Acenaphthylene	NL	NL	NL	NL	NL
98-86-2	Acetophenone	700	NL	NL	365 n	365
120-12-7	Anthracene	2,000	NL	NL	1,100 n	1,100
1912-24-9	Atrazine	3	3	3	0.292 ca	0.292
100-52-7	Benzaldehyde	NL	NL	NL	365 n	365
56-55-3	Benzo(a)anthracene	0.1	NL	NL	0.0295 ca	0.0295
50-32-8	Benzo(a)pyrene	0.1	0.2	0.2	0.00295 ca	0.00295
205-99-2	Benzo(b)fluoranthene	0.2	NL	NL	0.0295 ca	0.0295
191-24-2	Benzo(g,h,i)perylene	NL	NL	NL	NL	NL
207-08-9	Benzo(k)fluoranthene	0.5	NL	NL	0.295 ca	0.295
111-91-1	bis(2-Chloroethoxy)methane	NL	NL	NL	11 n	11
111-44-4	bis(2-Chloroethyl)ether	7	NL	NL	0.0119 ca	0.0119
117-81-7	bis-(2-Ethylhexyl)phthalate	3	6	6	4.8 ca	3
85-68-7	Butylbenzylphthalate	100	NL	NL	35.4 ca	35.4
105-60-2	Caprolactam	NL	NL	NL	1,830 n	1,830
86-74-8	Carbazole	NL	NL	NL	NL	NL
218-01-9	Chrysene	5	NL	NL	2.95 ca	2.95
53-70-3	Dibenzo(a,h)anthracene	0.3	NL	NL	0.00295 ca	0.00295
132-64-9	Dibenzofuran	NL	NL	NL	3.65 n	3.65
84-66-2	Diethylphthalate	6,000	NL	NL	2,920 n	2,920
131-11-3	Dimethylphthalate	NL	NL	NL	NL	NL
84-74-2	Di-n-butylphthalate	700	NL	NL	365 n	365
117-84-0	Di-n-octylphthalate	100	NL	NL	NL	100
206-44-0	Fluoranthene	300	NL	NL	146 n	146
86-73-7	Fluorene	300	NL	NL	146 n	146
118-74-1	Hexachlorobenzene	0.02	1	1	0.042 ca	0.02

Table 4
Groundwater Screening Criteria for Data Gap Analysis
Raritan Bay Slag Site
Old Bridge, New Jersey

CAS Number	Chemical Name	7/08 NJ Groundwater Quality Standards Class IIA Water (NJ GQS)[1]	6/03 EPA National Primary Drinking Water Standards (EPA MCL)[2]	2/05 NJ Drinking Water Standards (NJ MCL)[3]	Human Health Screening Level (EPA RSL)[4]	Screening Criteria[5]
87-68-3	Hexachlorobutadiene	1	NL	NL	0.862 ca	0.862
77-47-4	Hexachlorocyclopentadiene	40	50	50	21.9 n	21.9
67-72-1	Hexachloroethane	7	NL	NL	3.65 n	3.65
193-39-5	Indeno(1,2,3-cd)pyrene	0.2	NL	NL	0.0295 ca	0.0295
78-59-1	Isophorone	40	NL	NL	70.8 ca	40
91-20-3	Naphthalene	300	NL	300	0.143 ca	0.143
98-95-3	Nitrobenzene	6	NL	NL	0.122 ca	0.122
621-64-7	N-Nitroso-di-n-propylamine	10	NL	NL	0.00961 ca	0.00961
86-30-6	N-Nitrosodiphenylamine	10	NL	NL	13.7 ca	10
87-86-5	Pentachlorophenol	0.1	1	1	0.56 ca	0.1
85-01-8	Phenanthrene	NL	NL	NL	NL	NL
108-95-2	Phenol	2,000	NL	NL	1,100 n	1,100
129-00-0	Pyrene	200	NL	NL	110 n	110
Pesticides/Polychlorinated Biphenyls (µg/L)						
72-54-8	4,4'-DDD	0.1	NL	NL	0.28 ca	0.1
72-55-9	4,4'-DDE	0.1	NL	NL	0.198 ca	0.1
50-29-3	4,4'-DDT	0.1	NL	NL	0.198 ca	0.1
309-00-2	Aldrin	0.04	NL	NL	0.00396 ca	0.00396
319-84-6	alpha-BHC	0.02	NL	NL	0.0107 ca	0.0107
5103-71-9	alpha-Chlordane	0.5 ##	2 ##	0.5 ##	NL	0.5
12674-11-2	Aroclor-1016	0.5	0.5	0.5	0.256 n	0.256
11104-28-2	Aroclor-1221	0.5	0.5	0.5	0.0068 ca	0.0068
11141-16-5	Aroclor-1232	0.5	0.5	0.5	0.0068 ca	0.0068
53469-21-9	Aroclor-1242	0.5	0.5	0.5	0.0336 ca	0.0336
12672-29-6	Aroclor-1248	0.5	0.5	0.5	0.0336 ca	0.0336
11097-69-1	Aroclor-1254	0.5	0.5	0.5	0.0336 ca	0.0336
11096-82-5	Aroclor-1260	0.5	0.5	0.5	0.0336 ca	0.0336
37324-23-5	Aroclor-1262	0.5	0.5	0.5	NL	0.5
11100-14-4	Aroclor-1268	0.5	0.5	0.5	NL	0.5
319-85-7	beta-BHC	0.04	NL	NL	0.0374 ca	0.0374
319-86-8	delta-BHC	NL	NL	NL	NL	NL
60-57-1	Dieldrin	0.03	NL	NL	0.0042 ca	0.0042
959-98-8	Endosulfan I	40	NL	NL	NL	40

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33213-65-9	Endosulfan II	40	NL	NL	NL	40
1031-07-8	Endosulfan Sulfate	40	NL	NL	NL	40
72-20-8	Endrin	2	2	2	1.1 n	1.1
7421-93-4	Endrin aldehyde	NL	NL	NL	NL	NL
53494-70-5	Endrin ketone	NL	NL	NL	NL	NL
58-89-9	gamma-BHC (Lindane)	0.03	0.2	0.2	0.0611 ca	0.03
5103-74-2	gamma-Chlordane	0.5 ##	2 ##	0.5 ##	NL	0.5
76-44-8	Heptachlor	0.05	0.4	0.4	0.0149 ca	0.0149
1024-57-3	Heptachlor epoxide	0.2	0.2	0.2	0.00739 ca	0.00739
72-43-5	Methoxychlor	40	40	40	18.3 n	18.3
8001-35-2	Toxaphene	2	3	3	0.0611 ca	0.0611

Source:

[1] New Jersey Ground Water Quality Standards Class IIA (NJAC 7:9C), July 7, 2008, downloaded November 13, 2008

[2] EPA National Primary Drinking Water Standards, EPA 816-F-03-016, June 2003, downloaded November 13, 2008

[3] New Jersey Drinking Water Standards, February 2005 (http://www.state.nj.us/dep/watersupply/standard.htm), downloaded November 13, 2008

[4] EPA 2009. EPA Regional Screening Level (RSL) for tap water, based on cancer risk of 1×10^{-6} and non-cancer hazard index of 0.1. December. http://www.epa.gov/region09/superfund/prg/index.html

[5] Screening criteria are the lowest values

µg/L - micrograms per liter
NL - not listed
MCL - Maximum Contaminant Level
TT - Treatment Technique
[AL] - Action Level
+ - New Jersey Interim Specific & Generic Groundwater Quality Criteria, July 7, 2008
(ignc) - Interim Generic Non-carcinogenic Criteria provided by NJDEP (100 ppb default for noncarcinogenic synthetic organic chemical)
- criteria is for a mixture of 2,4-dinitrotoluene and 2,6-dinitrotoluene
- criteria is for chlordane
- criteria is for chromium
* - an action level is not an MCL. It is a trigger point at which remedial action is to take place.
** - secondary standards
*** - based on 1,3-dichloropropene

ca - value based on cancer effects
n - value based on noncancer effects
m - concentration may exceed ceiling limit
s - concentration may exceed saturation concentration

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