Final
Uniform Federal Policy
Quality Assurance Project Plan

Operable Unit 6 – Asarco Sediments
Commencement Bay Nearshore/Tideflats
Superfund Site

Tacoma, Washington

Prepared for:

United States Environmental Protection Agency – Region 10

Prepared by:

CH2M HILL, Inc.
A wholly owned subsidiary of Jacobs Engineering Group Inc.
6312 S. Fiddler's Green Circle, Suite 300N
Greenwood Village, CO 80111

Design and Engineering Services (DES) Contract Line Item Number (CLIN) 3
Contract 68HE0318D0004
Task Order Number 68HE0724F0046
DCN: DES-R10-24F0046-02003

November 2024

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Acronyms and Abbreviations

Acronym	Definition
°C	degree(s) Celsius
%D	percent difference
%R	percent recovery
µg/L	microgram(s) per liter
ASTM	ASTM International
CA	corrective action
CAS	Chemical Abstracts Service
CC	continuing calibration
CCB	continuing calibration blank
CH2M	CH2M HILL, Inc.
CLP	Contract Laboratory Program
COC	contaminant of concern
CSL	cleanup screening level
CVAAS	cold vapor atomic adsorption spectrometry
DQE	data quality evaluation
DQI	data quality indicator
DQO	data quality objective
EB	equipment blank
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FD	field duplicate

Acronym	Definition
FOP	field operating procedure
FS	feasibility study
FSP	field sampling plan
FTL	Field Team Leader
GIS	geographic information system
GPS	global positioning system
HSM	Health and Safety Manager
IC	initial calibration
ICB	initial calibration blank
ICP-MS	inductively coupled plasma mass spectroscopy
ICS	interference check solution
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
LCS	laboratory control sample
LOQ	limit of quantitation
LSOP	laboratory standard operating procedure
MB	method blank
MDL	method detection limit
MEL	Manchester Environmental Laboratory
mg/kg	milligram(s) per kilogram
MPC	measurement performance criteria
MS	matrix spike

Acronym	Definition
MSD	matrix spike duplicate
N/A	not applicable
NREP	National Registry of Environmental Professionals
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PAL	project action level
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PDF	portable document format
PDI	pre-design investigation
PM	Project Manager
QA	quality assurance
QAM	Quality Assurance Manager
QAPP	Uniform Federal Policy Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
QMP	Quality Management Plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
RL	reporting limit
ROD	Record of Decision
ROV	remotely operated vehicle

Acronym	Definition
SAV	submerged aquatic vegetation
SL	Safety Liaison
SME	Subject Matter Expert
SMS	Sediment Management Standards
SOP	standard operating procedure
SQCM	Site Quality Control Manager
SQS	Sediment Quality Standards
STC	Senior Technical Consultant
SVOC	semivolatile organic compound
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TOCO	Task Order Contracting Officer
TOCOR	Task Order Contracting Officer's Representative
VOC	volatile organic compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

DISCLAIMER: If using a screen reader, adjustment to your default settings may be required.

Worksheets #1 and #2—Title and Approval Page

Site Name/Project Name: Commencement Bay Nearshore/Tideflats Asarco Sediments Operable Unit 6 /Pre-Design Investigation

Revision Number: 0

Site Locations: Tacoma, Washington

U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Information System Site Number/Code: WAD980726368

Operable Unit: Asarco Sediments/Groundwater Operable Unit 6 (OU6)

Document Title: *Uniform Federal Policy Quality Assurance Project Plan, Operable Unit 6 Asarco Sediments, Commencement Bay Nearshore/Tideflats Superfund Site*

Lead Organization: The EPA

Contractor Name: CH2M HILL, Inc. (CH2M), a wholly owned subsidiary of Jacobs Engineering Group Inc.

Contract Number: 68HE0318D0004

Contract Title: Design and Engineering Services (DES) Contract

Task Order Number: 68HE0724F0046

Preparers' Name and Organizational Affiliation: Evan Griffiths, Project Manager, CH2M

Preparer's Address, Telephone Number, and Email Address: 1100 11th Avenue NE, Suite 500, Bellevue, WA, 98004; (425-785-5216); evan.griffiths@jacobs.com

Preparation Date: 05/07/2024

1) Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as Superfund
2) Identify approval entity: EPA Region 10
3) The Uniform Federal Policy Quality Assurance Project Plan (QAPP) is (select one):
   ☐Generic ☒Project-Specific
4) List dates of scoping sessions that were held:

   Meetings between the EPA and CH2M were held on May 17, 2024, via teleconference, to discuss the remedial design (RD) tasks and obtain team endorsement of the approach and purpose for each task.

5) List dates and titles of QAPP and planning documents written for previous site work, if applicable:

- 1995 Final Phase 1 Data Report and Phase 2 Sampling and Analysis Approach: Expanded Remedial Investigation and Feasibility Study for Asarco Sediments Superfund Site (Parametrix 1995)
- 1996 Final Phase 2 Data Evaluation Report: Expanded Remedial Investigation and Feasibility Study for Asarco Sediments Superfund Site (Parametrix 1996a)
- 1996 Final Phase 2 Refinement of Options Report, Expanded Remedial Investigation and Feasibility Study for Asarco Sediments Superfund Site (Parametrix 1996b)
- July 2000 Commencement Bay Nearshore/Tideflats Superfund Site OU6 Record of Decision (ROD) (EPA 2000)
- 2004 Final Design Report for Sediment Dredging: Marine Sediments and Groundwater (Parametrix and Asarco Consulting 2004)
- 2007 Construction Monitoring Report for Offshore Sediment Capping (Anchor 2007)
- 2011 Pier and Piling Removal Construction Completion Report (Parametrix 2011)
- 2013 Point Ruston LLC, Final Construction Report Sediment Cap Phase (Hydrometrics 2013)
- 2016 Baseline Chemical Monitoring Report (BergerABAM 2016)
- 2021 Asarco Biological Assessment Amendment (USFWS 2021)
- 2022 Quality Management Plan (CH2M 2022)

6) List organizational partners (stakeholders) and connection with lead organization:

- The EPA Region 10 (lead agency)
- Metro Parks Tacoma
- Washington State Department of Transportation (WSDOT)
- Tacoma Yacht Club
- Breakwater Marina
- Washington Department of Natural Resources
- CH2M (lead agency's contractor—design and engineering)

7) List data users:

- The EPA Region 10
- CH2M

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

OPERABLE UNIT 6 ASARCO SEDIMENTS, COMMENCEMENT BAY NEARSHORE TIDEFLATS SUPERFUND SITE

PRE-DESIGN INVESTIGATION

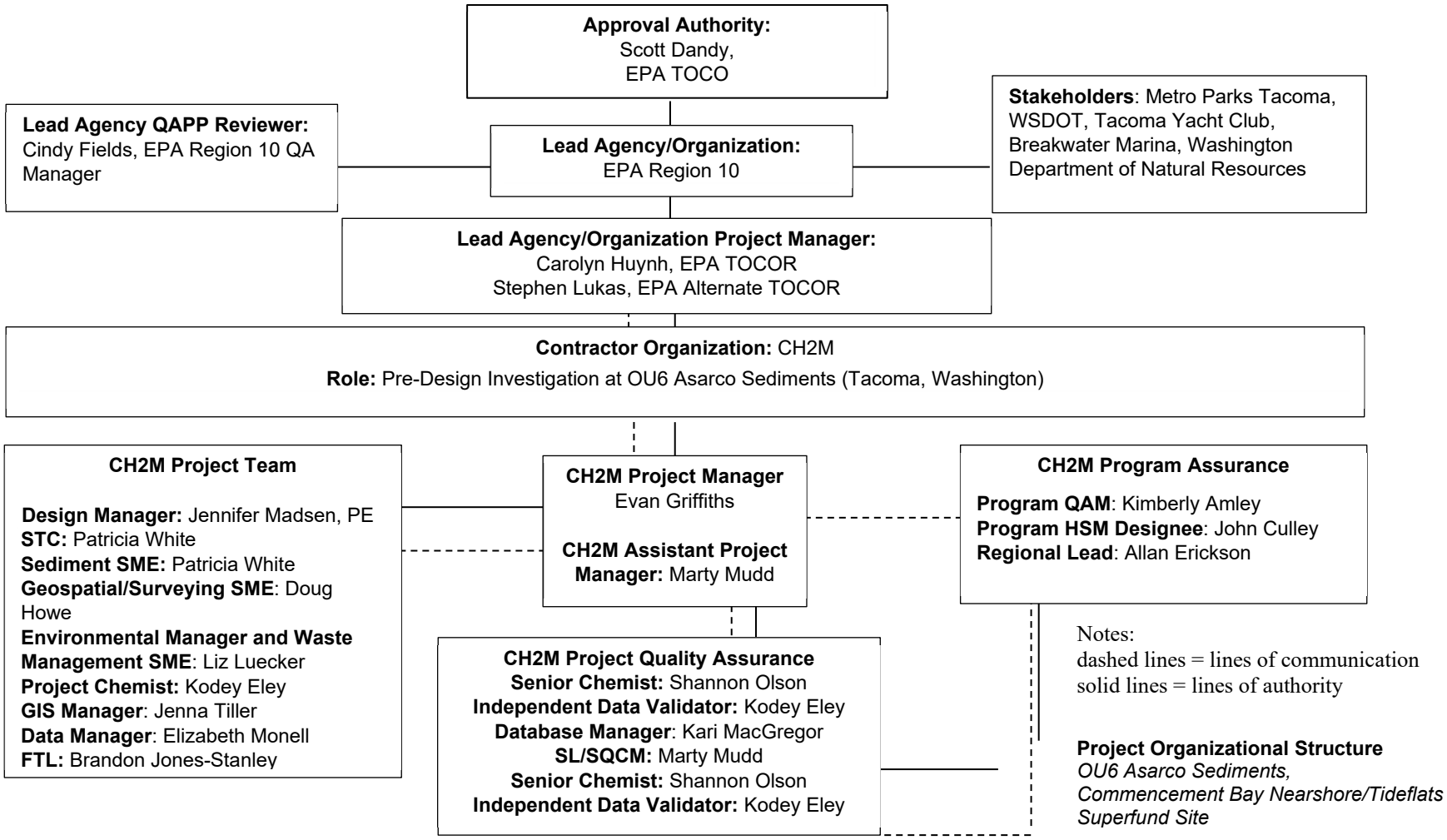
TACOMA, WASHINGTON

Task Order No. 68HE0724F0046/Contract No. 68HE0318D0004

Lead organization: The EPA
Prepared by: CH2M
Date: July 11, 2024
Document control number (DCN): DES-R10-24F0046-02003
Approved by:

Contractor Organization's Design and Engineering Project Manager (PM)	November 7, 2024	
	Evan Griffiths/CH2M	Date
Contractor Organization's Design and Engineering Program Quality Assurance Manager (QAM)	Kimberly Amley — Digitally signed by Kimberly Amley DN: cn=Kimberly Amley, c=US, o=Jacobs, email=kimberly.amley@jacobs.com Date: 2024.11.07 12:52:48 -05'00'	
	Kimberly Amley/CH2M	Date
Lead Agency's/Organization's Task Order Contracting Officer's Representative (TOCOR)	CAROLYN HUYNH — Digitally signed by CAROLYN HUYNH Date: 2024.11.12 14:24:02 -08'00'	
	Carolyn Huynh/EPA	Date
Region 10 Quality Assurance (QA) Manager	Raymond Wu — Digitally signed by Raymond Wu Date: 2024.11.13 11:26:40 -08'00'	
	Cindy Fields/EPA	Date

Worksheets #3 and #5—Project Organization and QAPP Distribution



Project Organizational Structure
OU6 Asarco Sediments, Commencement Bay Nearshore/Tideflats Superfund Site

OU6 Asarco Sediments Superfund Site – QAPP Recipients

QAPP Recipients	Title	Organization	Telephone Number	Email Address
Carolyn Huynh	Region 10 TOCOR	EPA	206-553-0454	Huynh.Carolyn@epa.gov
Stephen Lukas	Region 10 Alternate TOCOR	EPA	206-553-2111	Lukas.Stepehn@epa.gov
Cindy Fields	Region 10 QA Manager	EPA	206-553-0717	Fields.Cindy@epa.gov
Kimberly Amley	Program Quality Assurance Manager (QAM)	CH2M	248-412-7532	Kimberly.Amley@jacobs.com
Evan Griffiths	PM	CH2M	425-785-5216	Evan.Griffiths@jacobs.com
Marty Mudd	Assistant PM	CH2M	502-510-2507	Marty.Mudd@jacobs.com
Jennifer Madsen, PE	Design Manager	CH2M	425-233-3293	Jennifer.Madsen@jacobs.com
Patricia White	STC – Sediments	CH2M	617-721-2527	Patricia.White@jacobs.com
Doug Howe	SME – Geospatial/Surveying	CH2M	720-276-2333	Doug.Howe@jacobs.com
John Culley	Program Health and Safety Manager (HSM) Designee	CH2M	509-464-7228	John.Culley@jacobs.com
Liz Luecker	Environmental Manager/Waste Management SME	CH2M	425-233-3585	Liz.Luecker@jacobs.com
Shannon Olson	Senior Chemist	CH2M	262-388-3899	Shannon.Olson@jacobs.com
Kodey Eley	Project Chemist/Independent Data Validator	CH2M	253-334-6968	Kodey.Eley@jacobs.com
Kari MacGregor	Database Manager	CH2M	979-292-8583	Kari.Macgregor@jacobs.com
Elizabeth Monell	Data Manager	CH2M	720-286-0260	Elizabeth.Monell@jacobs.com
Jenna Tiller	GIS Manager	CH2M	513-595-7904	Jenna.Tiller@jacobs.com
Brandon Jones-Stanley	Field Team Lead (FTL)	CH2M	541-760-7130	Brandon.Jones-Stanley@jacobs.com

QAPP Recipients	Title	Organization	Telephone Number	Email Address
Marty Mudd	Safety Liaison (SL)	CH2M	502-510-2507	Marty.Mudd@jacobs.com
Marty Mudd	Site Quality Control Manager (SQCM)	CH2M	502-510-2507	Marty.Mudd@jacobs.com
TBD	Laboratory PM	CLP	TBD	TBD
TBD	Laboratory PM	Third-party Lab (TBD)	TBD	TBD

Note: QAPP will be submitted electronically. Not all project staff will receive copies of the QAPP, but it will be available to them as needed.

CLP = Contract Laboratory Program

GIS = geographic information system

STC = Senior Technical Consultant

TBD = to be determined

Worksheets #4, #7, and #8—Personnel Qualifications and Signoff Sheet

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Carolyn Huynh	Region 10 TOCOR	The EPA	Overall responsibility for all phases of work, review, and approval. The TOCOR is responsible for the technical administration of the task order and facilitates proper government surveillance of the contractor's performance. The TOCOR does not have authority to make any contractual commitments or to authorize changes on the government's behalf.	Available upon request
Stephen Lukas	Region 10 Alternate TOCOR	The EPA	Overall responsibility for all phases of work, review, and approval. The Alternate TOCOR is responsible for the technical administration of the task order and facilitates proper government surveillance of the contractor's performance. The Alternate TOCOR does not have authority to make any contractual commitments or to authorize changes on the government's behalf.	Available upon request
Cindy Fields	Region 10 QA Manager	The EPA	QAPP review and approval.	Available upon request
Meghan Dunn	Regional Sample Control Coordinator	The EPA	Assigns EPA sample numbers, EPA project codes, coordinates communication between CLP and the Project Chemist, coordinates communication between CLP and CH2M Analytical Coordinator for sample deliveries.	Available upon request
Kimberly Amley	Program QAM	CH2M	Accountable for the overall QA of the program. Evaluates task order quality and training requirements and supports implementation to meet quality requirements. Resolves disputes concerning quality through discussion and negotiation.	B.S., Geology; 25 years of experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
John Culley	Program HSM Designee	CH2M	Responsible for program health and safety, including review and approval of safety plans and subcontractors and monitoring program safety performance. Provides incident management and reporting support and conducts health and safety audits. Delegates responsibilities to alternate HSM (Sandra Wise) as applicable.	B.S., Environmental Management, A.A.S., Environmental Medicine; 28 years of experience; Certified Industrial Hygienist
Evan Griffiths	PM	CH2M	The primary point of contact for the TOCO and TOCOR. Responsible for executing the phases of the task order and efficiently applying the full resources of the project team. Responsible for distributing the current copies of project deliverables (including this QAPP) to individuals listed in Worksheets #3 and #5. Responsible for the technical, financial, administrative, and client-related aspects of the project and the project team. Plans the execution of the task order and identifies necessary staff. Organizes, directs, and manages personnel and resources. Communicates with the EPA TOCOR. Responds to and implements CAs.	Ph.D. Environmental Engineering; 25 years of experience
Marty Mudd	Assistant PM	CH2M	Provides guidance to the PM on all aspects of the project. Coordinates, directs, participates in, and reports site activities; confirms adherence to this QAPP; communicates issues to PM and field team; and subcontractor oversight.	M.S., Geological Engineering, 10 years of experience
Jennifer Madsen	Design Manager	CH2M	Provides technical design expertise for the RD and planning. Reviews the technical deliverables and confirms that deliverables and supporting design calculations are properly reviewed by qualified team members.	M.S., Civil and Environmental Engineering; 20 years of experience Professional Engineer: Washington and Utah

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Patricia White	STC	CH2M	Provides the project-specific technology function and is involved throughout the life of the project. Supports the quality and technical accuracy of the work. Monitors the scope, quality, and completeness through consultation and review of project deliverables. Confirms adherence to this QAPP. Prepares and reviews the technical deliverable.	M.S., Geology, 33 years of experience Professional Geologist: Washington and Virginia
Doug Howe	SME – Geospatial/Surveying	CH2M	Oversees survey activities as the licensed surveyor in responsible charge.	B.S., Surveying; A.A.S., Civil Engineering; 25 years of experience Professional Land Surveyor, Washington
Patricia White	SME – Sediments	CH2M	Provides technical expertise for the remedial investigation approach and planning related to the sediment sampling.	M.S., Geology, 33 years of experience Professional Geologist: Washington and Virginia
Liz Luecker	Environmental Manager and Waste Management SME	CH2M	Coordinates waste disposal activities. Ensures waste management complies with local, state, and federal laws and federal permitting requirements.	B.S., Engineering, 38 years of experience Professional Engineer: California, Washington, Vermont, North Dakota
Jenna Tiller	GIS Manager	CH2M	Provides GIS support, including, but not limited to, preparation of site-specific geospatial features suitable for the EPA Region 10 EDD submission and figure preparation.	M.S., Environmental Science, 6 years of experience
Shannon Olson	Senior Chemist	CH2M	Provides senior chemistry expertise.	M.S., Environmental Engineering, B.S., Environmental Science, 16 years of experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Kodey Eley	Project Chemist	CH2M	Assists with QAPP preparation, coordinates laboratory subcontractors, performs oversight of laboratory and data validation, and performs data evaluation. Instructs field personnel in sample preservation requirements. Coordinates with the analytical laboratory to confirm readiness of project-specific requirements and reviews analytical data as they become available to confirm conformance with quality standards. If the data review uncovers deficiencies, then the Project Chemist implements CAs in accordance with QAPP specifications.	M.B.A., Business Administration; B.S. Chemistry; 9 years of experience; NREP-Certified Environmental Scientist
Kodey Eley	Data Validator	CH2M	Performs data validation. Data validator has no responsibility for collecting or managing samples during the field event.	M.B.A., Business Administration; B.S. Chemistry; 9 years of experience; NREP-Certified Environmental Scientist
Elizabeth Monell	Database Manager	CH2M	Responsible for importing the sample and analytical data into the data management system; providing sample and analytical data for further evaluation, data verification, report preparation, and production; and transmitting validated analytical data in EDD 2a, 2b, or EDD 3 format. Responsible for confirming the laboratory and field data are delivered to the EPA in EDD-compliant formats.	M.S. Environmental Science, B.S. Natural Resources Planning, 6 years of experience
Kodey Eley	Analytical Point of Contact	CH2M	Coordinates with the EPA and Tier IV laboratory for field and laboratory schedules, and sample management.	M.B.A., Business Administration; B.S. Chemistry; 9 years of experience; NREP-Certified Environmental Scientist

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Brandon Jones-Stanley	FTL	CH2M	Coordinates, directs, participates in, and reports onsite activities; verifies adherence to the health and safety plan; communicates issues to PM, HSM, and field team; and provides subcontractor oversight.	M.Eng., Environmental Engineering, 17 years of experience
Marty Mudd	SQCM	CH2M	Confirms adherence to this QAPP. Communicates issues to the PM and field team. Notifies the PM of changes to the QAPP made in the field and the reasons within 24 hours. Documents deviations from the work plan in the field logbook and oversees quality for all field activities.	M.S., Geological Engineering, 10 years of experience
Marty Mudd	SL	CH2M	Oversees health and safety for field activities.	M.S., Geological Engineering, 10 years of experience
TBD	Laboratory PM	CLP/MEL	Manage sample tracking and maintain communication with the Regional Sample Control Coordinator.	TBD
TBD	Laboratory PM	Third-party Lab (TBD)	Manage sample tracking and maintain communication with the Project Chemist.	TBD

A.A.S = Associate of Applied Science

B.S. = Bachelor of Science

CA = corrective action

EDD = electronic data deliverable

M.B.A = Master of Business Administration

M.S. = Master of Science

MEL = Manchester Environmental Laboratory

NREP = National Registry of Environmental Professionals

TOCO = Task Order Contracting Officer

Special Training Requirements

Project Function	Specialized Training Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records/ Certificates[a]
Field Activities	Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Standard 40-hour training and annual 8-hour refresher	Registered training organization	Annually	All staff, including subcontracted personnel who enter the site	Field team staff, PM, and support staff who enter the site	CH2M Human Resources Department
Field Activities	Cardiopulmonary resuscitation and first aid	Registered training organization	Every 2 years	SL	Field team staff	CH2M Human Resources Department
Field Activities	SL-Hazardous Waste	Registered training organization	Every 3 years	SL	SL from CH2M	CH2M Human Resources Department
Quality	Field Quality Manager	CH2M	One Time	SQCM	SQCM from CH2M	CH2M Human Resources Department
Health and Safety	Health and Safety Plan	CH2M	Various, project-specific	All field staff, including subcontracted personnel working in the field	All field personnel from CH2M and subcontracted personnel	Signoff sheet at the end of the health and safety plan

[a] During work assignment planning, training requirements are compiled based on client, company, and regulatory requirements. Personnel are assessed based on their current qualifications, as well as training required to fill gaps in required skills or knowledge. Training is completed before workers perform tasks that have specific qualification or certification requirements. Records of this training, including certifications and licenses, are available at the project site, when appropriate, or in the office of the project team, or documented separately. Training methods, documentation, and protocols assuring trainings are satisfied can be found in the Quality Management Plan (QMP) (CH2M 2022).

Signoff Sheet

Organization: CH2M—To be signed once QAPP is approved by lead organization

Project Personnel	Title	Telephone Number	Signature	Date
Kimberly Amley	Program QAM	248-412-7532	Kimberly Amley Digitally signed by Kimberly Amley DN: cn=Kimberly Amley, c=US, o=Jacobs, email=kimberly.amley@jacobs.com Date: 2024.11.07 12:53:20 -05'00'	
Evan Griffiths	CH2M PM	425-785-5216		
Marty Mudd	Assistant PM SL, SQCM	502-510-2507		
Jennifer Madsen, PE	Design Manager	425-233-3293		
Patricia White	STC - Sediments	617-721-2527		
Doug Howe	SME – Geospatial/Surveying	720-276-2333		
John Culley	Program HSM Designee	509-464-7228		
Liz Luecker	Environmental Manager/Waste Management SME	425-233-3585		
Shannon Olson	Senior Chemist	262-388-3899		
Kodey Eley	Project Chemist/Independent Data Validator	253-334-6968		
Brandon Jones-Stanley	FTL	541-760-7130		
Kari MacGregor	Database Manager	979-292-8583		
Elizabeth Monell	Data Manager	720-286-0260		
Jenna Tiller	GIS Manager	513-595-7904		
Aaron Vogt	Field Team	530-339-2125		
Royal Stevens	Field Team	360-503-3912		
Steven Brand	Field Team	818-923-2046		

Organization: CH2M—To be signed once QAPP is approved by lead organization

Project Personnel	Title	Telephone Number	Signature	Date

Worksheet #6—Communication Pathways

Communication Drivers	Responsible Entity	Name	Telephone Number and Email Address	Procedure (for example, timing, pathways)
Communication with CH2M Contract Manager	EPA TOCO	Scott Dandy	Dandy.Scott@epa.gov.	Provides administrative direction to CH2M Contract Manager, authorizes contractual changes to the project, and maintains ability to stop work, if needed.
Communication with CH2M PM	EPA TOCOR EPA Alternate TOCOR	Carolyn Huynh Stephen Lukas (Alternate)	206-553-0454 Huynh.Carolyn@epa.gov 206-553-2111 Lukas.Stephen@epa.gov	Serves as primary point of contact for the EPA and provides approval of technical direction to CH2M PM.
Primary point of contact with the EPA TOCO and EPA TOCOR	CH2M PM	Evan Griffiths	425-785-5216 Evan.Griffiths@jacobs.com	Forwards materials and information about the project to the EPA TOCOR. Reports nonconformances identified in the field to the EPA TOCOR, as soon as practicable or within 24 hours of knowledge of the event and follows up with an email that provides detailed documentation of the event. Maintains responsibility for distributing the current copies of project deliverables (including this QAPP) to individuals listed in Worksheets #3 and #5.
Management of technical nonconformance	CH2M STC CH2M Program QAM	Patricia White Kimberly Amley	617-721-2527 Patricia.White@jacobs.com 248-412-7532 Kimberly.Amley@jacobs.com	Notifies the PM and QAM of problems by next business day.
Fieldwork coordination and document review	CH2M Assistant PM	Marty Mudd	502-510-2507 Marty.mudd@jacobs.com	Assists with scheduling and coordinating field activities. Provides office support and coordinates with FTL during field activities. Reviews daily field reports.

Communication Drivers	Responsible Entity	Name	Telephone Number and Email Address	Procedure (for example, timing, pathways)
Field staff discussion and inquiry	CH2M FTL	Brandon Jones-Stanley	541-760-7130 Brandon.jones-stanley@jacobs.com	Serves as a primary point of contact for field team and maintains responsibility for communicating back to the PM, as needed. Communicates by phone as needed with field staff during field sampling events and follows up with emails to document decisions and actions.
QAPP deviations in the field	CH2M SQCM	Marty Mudd	502-510-2507 Marty.mudd@jacobs.com	Immediately notifies the PM by phone and email of deviations from the QAPP made in the field and the reasons. Confirms that documentation of deviations from the work plan are kept in the field logbook and that deviations are made only with approval of the PM. The PM advises the EPA TOCOR of deviations from the QAPP and the SQCM prepares a sample plan alteration form for submittal to the EPA. Significant changes are reviewed and approved by the same personnel that approved the final QAPP document. No changes affecting the task order/contract can be implemented without TOCO approval.
Field progress reports	CH2M FTL	Brandon Jones-Stanley	541-760-7130 Brandon.jones-stanley@jacobs.com	Emails daily field progress reports to the PM. The PM provides weekly trip reports to the EPA TOCOR during active oversight.
Field CAs	CH2M SQCM	Marty Mudd	502-510-2507 Marty.mudd@jacobs.com	The need for corrective action for field issues is determined by the program QAM and the PM, in consultation with the SQCM. The PM verifies QAPP requirements are met by field staff. The SQCM notifies the PM immediately of needed field CAs.
Health and safety	CH2M SL	Marty Mudd	502-510-2507 Marty.mudd@jacobs.com	Reports health and safety incidents and near misses to the PM and HSM.

Communication Drivers	Responsible Entity	Name	Telephone Number and Email Address	Procedure (for example, timing, pathways)
Laboratory data quality and CAs	CH2M Project Chemist	Kodey Eley	253-334-6968 Kodey.Eley@jacobs.com	The need for CAs by the analytical laboratory will be determined by the Project Chemist. The Project Chemist will confirm QAPP requirements are met by the laboratory. No analytical data can be released until data are reviewed for completeness and conformance to analytical guidelines by the Project Chemist. The Project Chemist will review all data as soon as possible upon receipt from the validator.
Reporting laboratory data quality issues	TBD	TBD	TBD	All QA/quality control (QC) issues with field samples will be reported to the Project Chemist immediately. This includes sample receipt variances, data verification issues, data validation issues, and data CAs.
Release of analytical data	TBD	TBD	TBD	No analytical data can be released to CH2M and the EPA until it has been reviewed by the laboratory. No final data can be released to CH2M until verification is completed and the laboratory has approved the release.
QAPP amendments	Region 10 TOCOR Region 10 QA Manager	Carolyn Huynh Cindy Fields	206-553-0454 Huynh.Carolyn@epa.gov 206-553-0717 Fields.Cindy@epa.gov	Major changes to the QAPP must be reviewed and approved by the same personnel that reviewed and approved the final QAPP before the changes can be implemented. No changes affecting the task order/contract can be implemented without TOCO approval.

Worksheet #9—Project Planning Session Summary

Site Name:	OU6 Asarco Sediments - Commencement Bay Nearshore/Tideflats
Project Name and Site Location:	OU6 Asarco Sediments, Commencement Bay Nearshore/Tideflats Pre-Design Investigation, Tacoma, Washington
Projected Date(s) of Oversight:	Planned for November - December 2024
PM:	Evan Griffiths

Date and Location of Session: May 17, 2024 via Microsoft Teams

Scoping Session Purpose: Review data needs, extent of investigation, investigation components (surface and core sediments, upland survey, bathymetry, eelgrass inventory, benthic community, seep/groundwater, geophysics) and obtain team endorsement of the approach and purpose for this task.

Name	Title/Role	Affiliation	Phone #	Email Address
Evan Griffiths	PM	CH2M	425-785-5216	Evan.Griffiths@jacobs.com
Carolyn Huynh	TOCOR	EPA	206-553-0454	Huynh.Carolyn@epa.gov
Stephen Lukas	EPA Support, Alternate TOCOR	EPA	206-553-2111	Lukas.Stephen@epa.gov
Marty Mudd	Assistant PM	CH2M	502-510-2507	Marty.Mudd@jacobs.com
Jennifer Madsen	Design Manager	CH2M	425-233-3293	Jennifer.Madsen@jacobs.com
Tom Leigh	Sediment SME	CH2M	440-645-9250	Tom.Leigh@jacobs.com

9.1 Decisions and Discussion Items

EPA and CH2M discussed the following investigation objectives, which will address potential data gaps and facilitate the completion of the pre-design investigation (PDI). It is noted that some of the discussion items and proposed path forward discussed changed as the QAPP and field sampling plan (FSP) were developed.

- Documents
  - Task 2.1 – RD Work Plan – will develop as PDI work plan, keep high level and refer to QAPP and sampling analysis plan as needed and avoid duplication

- Task 2.4 – QAPP/ sampling analysis plan – avoid duplication of PDI work plan
- Task 2.6 – health and safety plan – will be developed when PDI is further developed

- Field Investigation
  - Perform site survey to develop topography and confirm property lines in the project area. Limits shown are sufficient but could include peninsula; will evaluate at desktop study first and then decide whether peninsula survey is needed to inform stability required for design.
  - Perform a bathymetry survey to develop underwater topography in project area, within the limits of OU6, including Yacht Basin, Northshore Area, Moderate Impact Area, Point Ruston, and down Ruston Way to Station 18.
  - Collect sediment cores from the Yacht Basin – Need cores to evaluate extent (vertical), less concerned with surface. Collect cores to 10 feet, analyze top 3 feet, hold the 3- to 10-foot section, then take composite 0 to 3 feet for disposal options.
  - Collect surface sediment samples from the Moderate Impact Area. The EPA to confirm if sampling is to be done in front of Point Ruston.
  - Collect surface and core samples from the Northshore Area to evaluate extent of contamination.
  - Establish spacing of transects. Spacing was determined to be okay; extend to Station 18.
  - Characterize the Yacht Basin. An estimated 12 to 16 samples and surface sediment to characterize the Yacht Basin.
  - Compare sediment analytical data to Washington Sediment Management Standards and ROD requirements.
  - Perform a wind/wave study (extent and period). Study will consist of a desktop analysis, and if necessary, fieldwork and additional data collection.
  - Note that surface water and groundwater sampling are not anticipated at this time.
  - Groundwater sampling is not anticipated at this time. – Groundwater may be sampled later depending on contamination level, if any, measured in seep samples.
  - Seeps – Location, Collect seep samples; determine location and quantity.
    - Plan on sampling on landward side (near Stations 5, 5.5, 6, and 6.5); wait to hear from the EPA as to whether CH2M can work there based on previous work done by Point Ruston.
    - Keep in mind that seeps have potential to impact remediation if they are contaminated, which could cause recontamination of sediment cap, if it is constructed.
  - Additional sampling of the pore water from the Yacht Basin may be required to support remedial design based on the review of the PDI data.
  - Manage investigation-derived waste (IDW) for sediment, cuttings, and municipal solid waste.
- Mobilization and Demobilization
  - Project Trailer – not needed.
  - Coordination with stakeholders – initial coordination will be through the EPA, then sampling details can go directly to stakeholders.

- Action Items
  - CH2M to share schedule with the EPA.
  - EPA to submit dates for QAPP scoping call.
  - EPA to submit dates for need for biota/benthic population study call (to be after May 20, 2024).

Worksheet #10—Conceptual Site Model

This section presents the relevant background information for the PDI and summarizes the relevant site-specific features and history.

10.1 Site Description

The former Asarco Tacoma Smelter Facility (Facility) is located on the western shore of Commencement Bay within the cities of Ruston and Tacoma, Washington. The Facility encompasses 67 acres of property. OU2 consists of the upland portion of the Facility, and OU6 consists of marine sediments located offshore of the Facility and groundwater underlying OU2. The OU2 ROD was signed in 1995, and the remedial action was initiated in 1999. The OU2 remedy included the following components: removal of source materials (waste material and highly contaminated soil) and onsite containment of excavated materials; and capping, surface water controls, shoreline armoring, and habitat restoration in selected intertidal areas. The ROD for OU6 was signed in 2000. The OU6 remedy is described further in Section 10.7.

OU6 includes marine sediments that extend approximately 1,000 feet offshore into Commencement Bay. Intertidal and subtidal slopes range from relatively flat to steep inclines (slopes to approximately 50 percent). The steepest submarine slopes were generally formed by placing molten slag directly into the water where it hardened in massive forms. Water depths in the steepest gradient areas, within OU6 are up to approximately 300 feet deep.

Approximately 30 acres of offshore intertidal and subtidal lands are owned by Point Ruston (a developer). The remainder is owned by the state of Washington and Metro Parks Tacoma. Contaminants of concern (COCs) include heavy metals (arsenic, copper, lead, and zinc). The shoreline and sediments offshore of the Facility have been capped as part of the OU6 remedy; however, the sediments in the Northshore Area, Moderate Impact Area, and Yacht Basin still need to be addressed.

10.2 Site History

From the 1890s to the 1960s, several sawmills operated in the area and wood waste was deposited along the shoreline. They were converted in 1912 to smelt and refine copper. Byproducts of the smelting operations were further refined to produce other marketable products, such as arsenic metal, arsenic trioxide, sulfuric acid, liquid sulfur dioxide, and copper reverberatory slag. Operation of the copper smelter ceased in 1985. Arsenic production was discontinued in 1986 and the facility was taken completely out of production. (EPA 2000)

10.2.1 Production and History of Slag

Slag was produced as a waste product during the smelting of copper from arsenic- and lead-bearing ores. The slag at the site is generally composed of dark brown iron-rich silicates that include metals such as arsenic, copper, and lead. The slag is similar in appearance to volcanic rock. It is either massive or granular, depending on the way it was processed and placed on the site. Massive slag is present where molten slag was poured directly into the waters of Commencement Bay. Contact with the cold water solidified the molten material in place. Granular slag was intentionally produced by passing molten slag through cold water streams to produce a sand- to gravel-sized material. This granular slag was then used as fill material throughout the Facility. The slag was used to extend the shoreline by approximately

500 feet outward into Commencement Bay. In addition, the Breakwater Peninsula is composed entirely of slag.

10.2.2 Contaminant Source Areas

The slag material that underlies much of the Facility is characterized by high concentrations of arsenic and other metals, which impact the groundwater and sediment. The source materials areas were addressed as part of the OU 02 remedial action and are therefore not covered by this ROD for OU6, which was signed in July 2000.

10.3 Groundwater

Groundwater at the site is present in the shallow and deep aquifer systems. Monitoring indicates that site groundwater flows from the southwest to northeast and ultimately discharges to Commencement Bay. The general groundwater flow is northeast, toward the shoreline. Near the shoreline, groundwater levels constantly fluctuate in response to the tide in Commencement Bay.

Historically, groundwater has been adversely affected by direct contact with contaminated source materials or indirectly affected by infiltrating waters transporting contaminants to groundwater. In turn, site groundwater discharged to Commencement Bay and the Yacht Basin where the contaminants were released to the marine environment. The selected remedy for groundwater in the OU6 ROD was source removal, soil capping and surface water controls, groundwater interception/treatment, replacement of leaking subsurface water lines, and institutional controls and monitoring. The majority of the remedy elements were addressed by the requirements of the OU 02 ROD (EPA 1995). With the exception of stipulating institutional controls and long-term monitoring related to groundwater, the OU6 ROD did not require additional groundwater remedies over and above those implemented under the OU 02 remedial action.

10.4 Marine Sediments

Several studies have been completed to characterize and assess the potential effects of sediment contamination at the site to human health and to the environment. In 1996, an expanded remedial investigation (RI)/feasibility study (FS) of offshore sediments was completed to better define contaminant effects at the site (Parametrix 1996). Analyses of samples collected as part of these investigations included sediment chemistry (inorganic and organic chemical analyses), surface water chemistry, pore water chemistry, fish tissue analyses, benthic tissue analyses, bioassays, and benthic community structure analyses.

A total of 100 surface sediment stations were sampled for sediment chemical data as part of the Parametrix investigation conducted in 1996. During the Phase 1 Expanded RI/FS, 62 sediment stations were sampled for chemical, physical, and biological characteristics to identify an appropriate remedy for sediments. An additional 10 subsurface sediment samples were analyzed for chemistry and conventional parameters during the Phase 2 expanded RI/FS. Results from this FS indicated that the COCs in sediment were determined to be arsenic, copper, lead, and zinc. These metals or metalloids were contaminants with the highest concentrations encountered in surface and subsurface sediments. A significant amount of slag was found in sediment samples off the Breakwater Peninsula and immediately off the former smelter property. Slag contains the highest concentrations of metals including arsenic and lead but in a rock-like form (Parametrix 1996).

10.5 Site Uses

The site is not commonly used for recreational harvesting of shellfish and finfish. A recreational salmon fishery is located offshore of the northern portion of the Breakwater Peninsula. In addition, usual and accustomed fishing for the Puyallup Tribe occurs in this area. The Tacoma Yacht Club and the Breakwater Marina provide recreational boating services. Present and future recreational, commercial, and Tribal fishing will continue.

10.6 Human and Ecological Risk

10.6.1 Summary of Human Health Risk Assessment

A human health risk assessment was completed as part of the Asarco RI (Hydrometrics 1993) and is summarized in the 1995 ROD for OU2 (EPA 1995). A subsequent human health screening risk assessment focused on the risks associated with consuming fish from water near the site (Weston 1996). The primary exposure route was assumed to be ingestion because dermal contact and respiratory exposure were unlikely. Rock sole samples were collected from various areas, including a reference site. The risk assessment considered cancer and noncancer health impacts. Exposures from fish consumption were less than the EPA's Reference Dose, indicating unlikely noncancer health effects. The estimated cancer risk for sports fisherpersons was 6×10^{-6}, while subsistence fisherpersons faced a risk of approximately 2×10^{-4}.

10.6.2 Summary of Ecological Risk Assessment and Uncertainties

Ecological risk was evaluated by the Asarco Sediment/Groundwater Task Force, which was formed in 1996. This Task Force, comprising personnel from the EPA, Washington State Department of Ecology, National Oceanic and Atmospheric Administration, and other agencies, evaluated ecological risks from exposure to contaminants in groundwater and sediments.

10.6.2.1 Groundwater

Site groundwater ultimately discharges to Commencement Bay. Therefore, possible groundwater-related risks to aquatic life in the waters and marine sediments of Commencement Bay were evaluated. The Asarco Sediment/Groundwater Task Force considered the possible effects of metals loading to marine sediments and bay waters under both pre-and post-remediation conditions. The Task Force determined that arsenic and copper represented the primary COCs for groundwater discharging to Commencement Bay (Hydrometrics 1999). The findings of the Task Force regarding the impact of groundwater on the sediments and waters of Commencement Bay are summarized as follows:

- Under pre-remediation conditions, metals loading (in particular arsenic and copper) to Commencement Bay by groundwater and surface water discharge resulted in potential risks to aquatic organisms in the water column as indicated by the exceedance of applicable water quality criteria.
- Contaminants present in marine sediments at the site are believed to be primarily associated with historical contaminant source other than groundwater (for example, historical surface water discharges and erosion and deposition of slag particles).

10.6.2.2 Sediments

Based on information obtained during the Asarco RI, the EPA recognized that the Asarco Sediments Site (OU6) had characteristics that set it apart from other OUs in the Commencement Bay Nearshore/Tideflats area. Asarco sediments near the former smelter are different from most other sediments in Commencement Bay because of the presence of slag. Slag has high concentrations of metals, but these metals are bound in a rock-like form and are not necessarily available to the benthic community. Therefore, the sediments could have high metals concentrations, yet the biological community could be healthy. This difference was first noted in the Commencement Bay Nearshore/Tideflats ROD (EPA 1989) and later in the Upland Smelter Facility ROD (EPA 1995). The difference was further addressed by the Sediment Design Group, with representatives from the EPA, Washington State Department of Ecology, and National Oceanic and Atmospheric Administration. Supplemental marine sampling and analyses conducted at the Asarco Sediments Site (OU6) in 1989 and 1990 more clearly defined the peripheral areas where biological effects were observed (Parametrix 1990, 1991). An additional supplemental marine survey determined that benthos in the Yacht Basin were exhibiting toxic effects; however, it could not be determined what caused these effects. The EPA produced a supplemental FS that was based on this previously collected data (Weston 1993). To further define the areas and types of chemicals associated with potential contaminant effects, the EPA, Asarco, and agencies participating in the Asarco Sediment/Groundwater Task Force agreed that an expanded RI/FS should be conducted. The chemical and biological data used to complete the supplemental FS and the expanded RI/FS were obtained from 62 sampling stations in the offshore area. The EPA used the data from these 62 sampling stations to characterize potential ecological risks as presented in the ecological risk assessment and seafood consumption screening risk assessment (Weston 1996).

All of the data and evaluation measures were correlated and used in a "preponderance-of-evidence" approach to more fully identify current and potential impacts and risks to aquatic receptors. Because of the presence of slag, the bulk sediment chemistry results may not be representative of the actual toxicity of the sediments. Based on this difference between sediments at the Asarco Sediments Site and most other sediments in Commencement Bay, the Sediment Design Group relied upon best professional judgment, and gave greater weight to the benthic evaluation than to the chemistry and bioassay data. A total of five impact categories were assigned to the site. The relative locations of the categories at the site were then assembled into three zones called Impact Stations, which are described as follows:

- **Nonimpacted/Minimally Impacted Stations**. Approximately 61 percent of the stations were nonimpacted/minimally impacted stations. The nonimpacted and minimally impacted stations fall into three subcategories:
  - Stations that were considered to be currently unimpacted and posed no potential future risks to the aquatic organisms (for example, fish and other bottom-dwelling animals) because contaminant concentrations were less than state Sediment Quality Standards (SQS)
  - Stations that were considered to have no current impacts, but may have impacts in the future (i.e., these stations have chemical concentrations greater than state standards but biological testing showed no adverse impacts)
  - Stations that had a current minimal impact and may have impacts in the future (i.e., these stations had minor biological cleanup screening level [CSL] exceedances, but no chemical CSL exceedances)

- **Moderately Impacted Stations**. Moderately impacted stations were those that have a limited number of adverse biological impacts (i.e., a bioassay result indicated an impact of benthic abundance in a sediment sample that was significantly different from a reference sample), but the overall health of the biological community did not appear to be substantially impacted. For example, there were stations that had chemical and bioassay exceedances greater than corresponding Sediment Management Standards (SMS) criteria, but a healthy biological community. These stations included approximately 28 percent of the locations sampled.
- **Severely Impacted Stations**. Stations were considered severely impacted when sediment chemical concentrations exceeded CSLs and multiple biological impacts (for example, more than one biological test exhibited a significant effect) were observed. In addition, every station that had a benthic community structure that indicated a stressed environment was included in this category. Approximately 11 percent of the stations (170,000 square yards or approximately 35 acres) exhibited these characteristics.

10.7 Asarco Sediments/Groundwater OU6 Remedy

The selected remedy in the 2000 ROD for groundwater in OU6 is summarized in Section 10.3. The EPA's remedial action objective for sediment is as follows:

- Restore and preserve aquatic habitats by limiting and or preventing the exposure of environmental receptors to sediments with contaminants exceeding Washington State SMS (Washington Administrative Code [WAC] 173-204).

The selected remedy for OU6 Sediments includes the following elements (Figure 10-1):

- Dredge contaminated sediment in the Yacht Basin and place the dredged sediment beneath a low-permeability soil cap to be constructed on the upland portion of the Facility (i.e., OU 02). The sediments will be contained under the low-permeability cap at an elevation such that groundwater will not come in contact with the sediment.
- Monitor the dredged area in the Yacht Basin to verify that it does not become recontaminated.
- Cap contaminated sediments in selected offshore areas (Nearshore/Offshore and Northshore Areas).
- Monitor the sediment caps to confirm that they remain in place, continue to isolate the underlying contaminated sediment, become recolonized with healthy biological communities, and do not become recontaminated.
- Use institutional controls to prevent activities that could damage the sediment caps.
- Monitor the areas outside the capped and dredged areas to confirm that these areas meet remedial action objectives. The remediation cleanup level for the capping areas (Nearshore/Offshore and Northshore Areas) and the areas identified for long-term monitoring is based on the preponderance-of-evidence approach (WAC 173-340-320). The sediment cleanup levels for the dredging component of the remedy are summarized in Table 10-1.

Table 10-1. Sediment Cleanup Levels for Dredging in the Yacht Basin

Metal	Cleanup Level (mg/kg)	Basis
Arsenic	93	CSL (WAC 173-204-520)
Copper	390	CSL (WAC 173-204-520)
Lead	450	SQS (WAC 173-204-320)
Zinc	410	SQS (WAC 173-204-320)

mg/kg = milligram(s) per kilogram

10.8 Remedial Design/Remedial Action

Capping in the Nearshore/Offshore Area was completed in 2013. Asarco completed an RD for the Yacht Basin and Northshore Area in 2004 (Parametrix and Asarco Consulting 2004). Additional sediment core data were collected in the Yacht Basin as part of RD, and a pilot-scale sediment excavation and dewatering project was completed. The RD included design for the following elements: dredging and capping in the Yacht Basin, dredging in the Northshore Area, and sediment dewatering, transport, and disposal. This design was considered to provide an environmental benefit with a reduced cost and more rapid schedule than the remedy selected in the ROD. The remedy developed in the previous design was not constructed.

Worksheet #11—Project/Data Quality Objectives

Table 11-1. Data Quality Objectives

DQO Number	Step 1: Statement of Problem	Step 2: Identify Goals of the Study	Step 3: Identify Information Inputs	Step 4: Define Boundary Studies	Step 5: Develop Analytic Approach	Step 6: Specify Performance or Acceptance Criteria	Step 7: Develop Plan for Obtaining Data
1	***Problem Statement***: Capping in the Nearshore/Offshore Area has been completed, but dredging in the Yacht Basin, capping or dredging in the Northshore Area, and long-term monitoring in the Moderate Impact Area have not yet been initiated. Site conditions may have changed since the OU6 ROD was signed in 2000. ***General Intended Use of the Collected Data***: Updated chemical and physical data will be used to delineate the areas that require dredging and/or capping, refine remedial alternatives, and support RD.	***Goals:*** 1. Delineate the vertical and lateral extent of surface and subsurface sediment in the Yacht Basin and Northshore Area with metals concentrations exceeding the sediment cleanup levels provided in the OU6 ROD. 2. Delineate the lateral extent of surface sediment in the Moderate Impact Area and Nearshore/ Offshore Area with metals concentrations exceeding the sediment cleanup levels provided in the OU6 ROD. 3. Characterize sediment bed geotechnical characteristics of Yacht Basin and Northshore Area to support dredging and/or capping design. 4. Assess whether natural recovery through the deposition and accumulation of relatively cleaner sediment has occurred in the Yacht Basin. 5. Update bathymetry in the offshore areas and topography along the shoreline adjacent to these areas to determine the stability of the shoreline in areas that may be dredged. 6. Collect additional hydrographic survey data in the Yacht Basin to	• Metals concentrations in sediment (arsenic, copper, lead, and zinc) • Geotechnical parameters in Yacht Basin and Northshore Area sediment (TOC, grain size, percent solids, Atterberg Limits) • Sediment stratigraphy in the Yacht Basin • Bathymetric (multibeam sonar) and topographic survey data • Sub-bottom profiling and magnetometer survey data for the Yacht Basin and Northshore Area • Title report, publicly available property boundary information (e.g., assessor's office) • Historical data for metals concentrations in Yacht Basin sediments (Parametrix 1996; Parametrix and Asarco Consulting 2004)	• The lateral boundary includes the Yacht Basin, the Northshore Area, the Breakwater Peninsula Area, Moderate Impact Area, and Nearshore/Offshore Area and the adjacent shoreline area (Figure 11-1). • The vertical boundary for the Moderate Impact Area and Nearshore/Offshore Area is the top 4 inches of the sediment bed, and the vertical boundary for the Yacht Basin and Northshore Area is up to 10 feet below the sediment surface or refusal, whichever is shallower. • The chemical and physical data are "snapshot" surveys that represent a single point in time.	1. If the metals concentrations in a sediment sample in the Yacht Basin and Northshore Area exceed the sediment cleanup levels, then the sample location will be included in the remedial footprint. If the metals concentrations do not exceed sediment cleanup levels, then the sample location will not be included in the remedial footprint. 2. The metals data for the Moderate Impact Area and Nearshore/Offshore Area will be used to characterize current conditions and support long-term monitoring. 3. The geotechnical data (TOC, grain size, percent solids, Atterberg Limits) will be used to characterize sediments identified for capping and/or dredging in the OU6 ROD. 4. If metals concentrations in surface sediment in the Yacht Basin have declined since 2000, then it will be concluded that natural recovery has occurred. If metals concentrations have not declined or the results are inconclusive, then it will be concluded that natural recovery has not occurred. Sediment core logs of the sediment stratigraphy in the basin will be used to support this evaluation. 5. The bathymetric and topographic data will be used to create a digital elevation model of the project area. 6. The hydrographic survey data (multibeam sonar, sub-bottom	Sediment samples will be collected and hydrographic and topographic surveys will be conducted using the methods described in Worksheet #14. Performance criteria for analytical data are established based on PARCCS. Sensitivity requirements are established by the PALs presented in Worksheet #15. Requirements for other DQIs are presented in Worksheets #12, #28, and #37. Application of data verification/validation steps and DQIs in the overall assessment of data quality and usability is described in Worksheet #37. Hydrographic survey procedures will follow U.S. Army Corps of Engineers Engineer Manual EM 1110-2-1003 (Hydrographic Surveying) (USACE 2013).	The sampling design and rationale are provided in Worksheet #17. The activities planned are as follows: • Collection of surface sediment samples (0- to 4-inch depth interval) from 23 locations in the Moderate Impact Area and Nearshore/Offshore Area (Figure 11-2). Samples will be analyzed for arsenic, copper, lead, and zinc. • Collection of surface and subsurface sediment samples from 4 locations in the Northshore Area (Figure 11-3) and 21 locations in the Yacht Basin (Figure 11-4). Cores will be collected to the top of the native sand and gravel layer or to a maximum depth of 10 feet if the native sand and gravel layer is not encountered (i.e., to a depth of 10 feet or refusal, whichever is shallower). Surface sediment samples will be collected from the 0- to 4-inch depth interval and subsurface samples will be collected from 1-foot depth intervals to the bottom of the core. Samples will be analyzed for arsenic, copper, lead, zinc, TOC, grain size, percent solids, and Atterberg Limits. • Multibeam sonar (offshore) and land-based topographic (nearshore and onshore) surveys will be performed throughout the project area shown on Figure 11-1. • Sub-bottom profile and magnetometer surveys will be completed within the Yacht Basin and Northshore Area. • Desktop review of title report for the property and publicly available data by a licensed land surveyor to

DQO Number	Step 1: Statement of Problem	Step 2: Identify Goals of the Study	Step 3: Identify Information Inputs	Step 4: Define Boundary Studies	Step 5: Develop Analytic Approach	Step 6: Specify Performance or Acceptance Criteria	Step 7: Develop Plan for Obtaining Data
		identify debris and support dredging and/or capping design. ***Range of Possible Outcomes***: The areas requiring dredging, capping, and/or long-term monitoring have changed from those shown in the OU6 ROD. Additionally, current site conditions will influence the selection of remedial technologies and approaches. The areas requiring dredging, capping and/or long-term monitoring have not changed from those shown in the OU6 ROD.			profiling, and magnetometer) will be used to characterize the nature and extent of debris in the Yacht Basin and infer sediment stratigraphy between sediment core locations. 7. Property boundaries and easement, lease, state-owned aquatic lands, and environmental covenant boundaries will be determined as part of the topographic survey.		identify boundary locations, and field survey to confirm boundaries.
2	***Problem Statement:*** Eelgrass and certain macroalgae provide critical habitat, and eelgrass beds are a type of special aquatic site under Section 404 of the Clean Water Act. To be consistent with the Clean Water Act, eelgrass impact avoidance, minimization, and potential compensation are required before and after this project, depending on impacts and their temporal extent. The existing data set is insufficient to address project needs. ***General Intended Use of Collected Data:*** To minimize, avoid and limit impacts to the existing eelgrass beds in or near the project area.	***Goal:*** Determine the presence and spatial distribution of eelgrass and macroalgae within the OU6 project area to support dredging and/or capping design. Inform the biological assessment and Section 404 Clean Water Act substantive compliance. ***Range of Possible Outcomes:*** Perform PDI and design project to avoid impacts to Eelgrass. If impacts cannot be avoided, advanced surveys will be conducted to quantify impacts from the project to eelgrass and macroalgae and quantify the performance of mitigation actions.	Findings from the multibeam sonar bathymetric survey will be used to determine whether eelgrass or macroalgae are still present at the proposed project site.	The spatial boundaries include the eelgrass and macroalgae beds adjacent to and within the project area in OU6 (Figure 11-1) based on previous eelgrass surveys by Washington State Department of Natural Resources. Conducting surveys between June 1 and October 1 is strongly preferred because the full extent of eelgrass and macroalgae distribution can be more accurately mapped. However, preliminary surveys may be conducted at any time during the year.	A project site map indicating all survey transects and showing the qualitative distribution of eelgrass and macroalgae (boundaries of each patch), as well as substrate characterization along each transect. The map will also indicate depth contours and the location of the proposed project footprint.	The eelgrass and macroalgae habitat survey will be conducted by staff with the appropriate training and in accordance with the Washington Department of Fish and Wildlife Eelgrass/Macroalgae habitat interim survey guidelines.	Survey transect length and location will be determined by project design and site specifics and will include the landward margin of the eelgrass or macroalgae habitat, if present. Transect coverage will extend at least 25 feet waterward of the project footprint, and, if possible, to the outer margin of the eelgrass or macroalgae bed. To document the potential for eelgrass or macroalgae impacts from a project, at least one transect should be aligned along the proposed centerline of the project footprint. Additional transects should be conducted on either side of the project footprint at 10 and 25 feet from the outer edges of the proposed structure. The inner and outer edges of each eelgrass or macroalgae patch will be documented along each transect and noted on the site map. Areas where eelgrass and macroalgae are delineated will be verified using drop camera from vessel or ROV by CH2M scientists, biologists, and/or subcontractors qualified to identify eelgrass and macroalgae species in the project area. The intertidal portions of the project site will be verified via

DQO Number	Step 1: Statement of Problem	Step 2: Identify Goals of the Study	Step 3: Identify Information Inputs	Step 4: Define Boundary Studies	Step 5: Develop Analytic Approach	Step 6: Specify Performance or Acceptance Criteria	Step 7: Develop Plan for Obtaining Data
							walking the beach areas during low tide.
3	***Problem Statement:*** The characteristics of the sediment that will be dredged are unknown. Waste characterization is required to determine the proper disposal method. ***General Intended Use of Collected Data:*** These data would be used to identify whether dredged sediment would need to be sent to Subtitle C or D landfill.	***Goal:*** Determine an appropriate waste disposal method for dredged sediment based on bulk sediment and TCLP analysis to support remedial action. ***Range of Possible Outcomes:*** Sediments that may be dredged from the Yacht Basin and/or Northshore Area are determined to be hazardous. Sediments that may be dredged from the Yacht Basin and/or Northshore Area are determined to be nonhazardous.	• Concentrations of total PAHs in bulk sediment samples from representative core locations. Concentrations of RCRA metals in TCLP leachate samples from representative core locations.	**Spatial:** Sediment cores samples for bulk sediment and TCLP analysis will be collected from the Yacht Basin and Northshore Area. **Temporal:** Samples will represent a single point in time.	• If sediments that may be dredged from the Yacht Basin and/or the Northshore Area are determined to be hazardous, the RD will assume that dredged sediments will be disposed of at a Subtitle C landfill. • If sediments that may be dredged from the Yacht Basin and/or the Northshore Area are determined to be nonhazardous, the RD will assume that dredged sediments will be disposed of at a Subtitle D landfill.	Sediment core samples for bulk sediment and TCLP analysis must meet minimum requirements as defined in analytical LSOPs listed in Worksheet #23. Stage 1 validation will be performed as described in Worksheet #36.	The sampling design and rationale are provided in Worksheet #17. Trained CH2M personnel will collect sediment core samples for analysis of total PAHs in bulk sediment and TCLP RCRA metals from four representative core locations in the Yacht Basin and Northshore Area. Sediment samples will be extracted in accordance with Method SW-846 1311 prior to RCRA Metals. Samples for analysis of total PAHs in bulk sediment and TCLP RCRA Metals will be characterized using the laboratory methods identified in Worksheet #23. Additional sampling or analytical methods may be required at the request of the receiving facility. The EPA R10 and/or subcontracted laboratories will perform chemical analyses.
4	***Problem Statement:*** It is unknown if groundwater seepage along the shoreline has the potential to recontaminate sediments in the Yacht Basin and Northshore Area. Further investigation is required to assess the potential for recontamination. ***General Intended Use of Collected Data:*** To determine whether groundwater seepage is a potential source of recontamination.	***Goal:*** Determine whether metals concentrations in shoreline seeps pose a potential recontamination risk to sediments in the Northshore Area and Yacht Basin. ***Range of Possible Outcomes:*** Metals concentrations in shoreline seeps pose a potential recontamination risk to sediments in the Northshore Area and Yacht Basin. Metals concentrations in shoreline seeps do not pose a potential recontamination risk to sediments in the Northshore Area and Yacht Basin.	• Shoreline seep locations. • Total and dissolved arsenic, copper, lead, and zinc concentrations in water samples collected from the seeps.	Seep sampling will target the shoreline and intertidal area adjacent to the Northshore Area and Yacht Basin (Figure 11-5). The Yacht Basin South Seep Sample Area begins at the southeastern corner of the Yacht Basin and continues northwest to the WSDOT Ferry Terminal. Seep samples will be collected along the beach below the sidewalk and seawall. The North Shore Seep Sample Area will begin northwest of the WSDOT Ferry Terminal and continue to Anthony's Fish House Pier. Seep samples will be collected along the beach below the sidewalk and seawall.	If COC concentrations in a seep sample exceed the PALs provided in Worksheet #15-1b, then the seep will be further evaluated as a potential source of recontamination to sediments. If COC concentrations in a seep sample do not exceed these PALs, then the seep will not be considered a potential source of recontamination.	Groundwater seep samples will be collected using the methods described in Worksheet #14. Performance criteria for analytical data are established based on PARCCS. Sensitivity requirements are established by the PALs presented in Worksheet #15. Requirements for other DQIs are presented in Worksheets #12, #28, and #37. Application of data verification/validation steps and DQIs in the overall assessment of data quality and usability is described in Worksheet #37.	The sampling design and rationale are provided in Worksheet #17. The activities planned are as follows: • Seep sample locations will be identified during site reconnaissance. • All seep samples will be collected at the surface by CH2M staff using syringe samplers. • Approximately four seep samples will be collected along the shoreline in the Yacht Basin. • Approximately two seep samples will be collected along the shoreline adjacent to the Northshore Area. • Groundwater seep samples will be analyzed for total and dissolved arsenic, copper, lead, and zinc.

DQI = data quality indicator

DQO = data quality objective
LSOP = laboratory standard operating procedure
PAH = polycyclic aromatic hydrocarbon
PAL = project action level
PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity
RCRA = Resource Conservation and Recovery Act
ROV = remotely operated vehicle
TCLP = toxicity characteristic leaching procedure
TOC = total organic carbon

Who will use the data?

The data will be used by the EPA and CH2M.

What will the data be used for?

Data will be used to meet the objectives specified in Table 11-1.

What types of data are needed?

Data needs, including tasks, frequency of performance, and measurement parameters are included in Table 11-2.

Table 11-2. Data Needs

Task	Activity/ Objective	Frequency	Matrix	Parameters
Surface and subsurface sediment sampling in the Yacht Basin and Northshore Area and surface sediment sampling in the Moderate Impact Area and Nearshore/Offshore Area	Delineate the locations and extent of sediment with metals concentrations exceeding the sediment cleanup levels provided in the OU6 ROD.	One time during PDI	Sediment	Arsenic, copper, lead, and zinc
Surface and subsurface sediment sampling in the Yacht Basin and Northshore Area	Characterize the geotechnical characteristics of Yacht Basin and Northshore Area sediment.	One time during PDI	Sediment	Grain size, TOC, percent solids, Atterberg Limits
Multibeam sonar survey	Update bathymetry in the offshore areas and identify debris.	One time during PDI	N/A	N/A
Sub-bottom profile survey	Identify sediment layers and depth to native sand/gravel in the Yacht Basin and Northshore Area.	One time during PDI	N/A	N/A
Magnetometer Survey	Identify ferrous material in the Yacht Basin and Northshore Area.	One time during PDI	N/A	N/A

Task	Activity/ Objective	Frequency	Matrix	Parameters
Topographic survey	Develop topography along the upland shoreline of the Yacht Basin and Northshore Area.	One time during PDI	N/A	N/A
Eelgrass and macroalgae survey	Minimize, avoid, and limit impacts to eelgrass beds in the project area.	One time preliminary survey (multibeam sonar); follow on surveys in 2025 if required (between June 1 and October 1 is strongly preferred for follow on surveys).	N/A	N/A
Dredged material waste characterization	Characterize potential dredge material from the Yacht Basin and Northshore Area for offsite disposal options.	One time during PDI	Sediment	Total PAHs in bulk sediment and TCLP RCRA 8 metals, TCLP VOCs, TCLP SVOCs
Seep sampling	Determine whether metals concentrations in shoreline seeps pose a potential recontamination risk to sediments in the Northshore Area and Yacht Basin.	One time during PDI	Seep/groundwater	Total and dissolved arsenic, copper, lead and zinc

N/A = not applicable

SVOC = semivolatile organic compound

VOC = volatile organic compound

How "good" do the data need to be to support the environmental decision?

Non-analytical data will be evaluated in accordance with the FSP, which describes the field investigation activities. The analytical data should meet the PALs as specified in QAPP Worksheet #15. The QC requirements for analytical data are explained in QAPP Worksheet #37.

How many data are needed? (Number of samples for each analytical group, matrix, and concentration)

Worksheet #18 (Sampling Locations and Methods) summarizes the number of samples and the analytical parameters.

Where, when, and how should the data be collected/generated?

Detailed information on where and how the data will be collected is provided in the FSP. The project schedule is provided in Worksheet #16.

Who will collect and generate the data?

CH2M and subcontractor staff will collect sediment and groundwater/seep samples, perform the hydrographic and topographic surveys, and conduct the eelgrass survey. The analytical data will be generated by CH2M contracted labs or CLP labs as requested by the EPA.

How will the data be reported?

The data will be reported in accordance with the procedures outlined in Worksheets #34, #35, and #36. Electronic data (such as database management system and GIS) will be stored by CH2M for 10 years after project completion. Site activities will be recorded in project-specific logbooks or tablets in accordance with Field Operating Procedure (FOP)-01 in Appendix A.

How will the data be archived?

CH2M will be the custodian of the evidence file and maintain the contents of the evidence files for the project, including relevant records, such as access agreements, reports, logs, field notebooks, sketches, pictures, and data reviews, in a secured area with limited access. CH2M will keep records for 10 years after contract completion. As necessary, records may be transferred to an offsite records storage facility. The records storage facility must provide secure, controlled-access records storage. Additional information on data management is provided in the Data Management Plan (CH2M 2024a).

Worksheet #12—Measurement Performance Criteria

Worksheets #12-1 through #12-9 summarize the measurement performance criteria (MPC) for chemical and geotechnical analyses being performed for each matrix and analytical parameter. The MPC follow those defined in the referenced the EPA method or LSOPs. The quality of the data to be collected for this project will be verified through appropriate MPC established for both sampling procedures and analytical methods. The criteria relate to DQIs consisting of PARCCS. The DQIs are defined as follows:

- **Precision** refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.
- **Accuracy** refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.
- **Representativeness** describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.
- **Comparability** addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.
- **Completeness** is a measure of the amount of valid data collected using a measurement system. Completeness is expressed as a percentage of the number of measurements that are specified in this QAPP.
- **Sensitivity** is the ability of a method or instrument to detect the target analytes at the level of interest. Sensitivity can be measured by calculating the percent recovery of the analytes at the detection limit, which is the minimum concentration of an analyte that can be routinely identified and quantified greater than the method detection limit (MDL) by a laboratory.

The quality of the data to be collected for this project will be verified using appropriate MPC established for both sampling procedures and analytical methods. The MPC follow those defined in the referenced the EPA method or LSOP (Appendix B). The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall DQIs, in accordance with procedures described in Worksheet #37 (Data Usability Assessment). The results will be summarized in an overall data usability report.

Worksheet #12-1—Measurement Performance Criteria Table

Matrix: Seep
Analytical Group: Select Metals (Total)
Concentration Level: Low/Medium

Sampling Procedure[a]	Analytical Method SOP[b]	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)
FOP-04	TBD	Precision	RPD ≤ 30% (sediment); RPD ≤ 25% (groundwater)	Field duplicate	S & A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LOQ Verification	A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LCS	A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-04	TBD	Precision	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-04	TBD	Precision	All metals: ≤ 20% RPD	Laboratory duplicate	A
FOP-04	TBD	Representativeness	Analyte < QL	MB	A
FOP-04	TBD	Completeness	≥ 90%	Data completeness defined as data not qualified as rejected after validation	S & A
FOP-04	TBD	Comparability	Qualitative measure for field sampling procedures	LCS, MS/MSD	A
FOP-04	TBD	Sensitivity	Evidence of shift in instrument response (evidence of shift can be found in Worksheet #24 where calibration acceptance criteria are not met)	LCS, IC, CC	A

[a] Reference number from QAPP Worksheet #21

[b] Reference number from QAPP Worksheet #23

≥ = greater than or equal to

≤ = less than or equal to

CC = continuing calibration

IC = initial calibration

LCS = laboratory control sample

LOQ = Limit of Quantitation

MB = method blank

MS/MSD = matrix spike/matrix spike duplicate

QL = quantitation limit

RPD = relative percent difference

SOP = standard operating procedure

Worksheet #12-2—Measurement Performance Criteria Table

Matrix: Seep
Analytical Group: Select Metals (Dissolved)
Concentration Level: Low/Medium

Sampling Procedure[a]	Analytical Method SOP[b]	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)
FOP-04	TBD	Precision	RPD ≤ 30% (sediment); RPD ≤ 25% (groundwater)	FD	S & A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LOQ Verification	A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LCS	A
FOP-04	TBD	Accuracy/Bias	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-04	TBD	Precision	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-04	TBD	Precision	All metals: ≤ 20% RPD	Laboratory duplicate	A
FOP-04	TBD	Representativeness	Analyte < QL	MB	A
FOP-04	TBD	Completeness	≥ 90%	Data completeness defined as data not qualified as rejected after validation	S & A
FOP-04	TBD	Comparability	Qualitative measure for field sampling procedures	LCS, MS/MSD	A
FOP-04	TBD	Sensitivity	Evidence of shift in instrument response (evidence of shift can be found in Worksheet #24 where calibration acceptance criteria are not met)	LCS, IC, CC	A

[a] Reference number from QAPP Worksheet #21
[b] Reference number from QAPP Worksheet #23
≥ = greater than or equal to; ≤ = less than or equal to
FD = field duplicate

Worksheet #12-3—Measurement Performance Criteria Table

Matrix: Sediment
Analytical Group: Select Metals
Concentration Level: Low/Medium

Sampling Procedure[a]	Analytical Method SOP[b]	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)
FOP-50	TBD	Precision	RPD ≤ 30%	FD	S & A
FOP-50	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LOQ Verification	A
FOP-50	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LCS	A
FOP-50	TBD	Accuracy/Bias	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-50	TBD	Precision	Default to laboratory SOP criteria	MS/MSD	S & A
FOP-50	TBD	Precision	RPD ≤ 20%	Laboratory duplicate	A
FOP-50	TBD	Representativeness	Analyte < QL	MMB	A
FOP-50	TBD	Completeness	≥ 90%	Data completeness defined as data not qualified as rejected after validation	S & A
FOP-50	TBD	Comparability	Qualitative measure for field sampling procedures	LCS, MS/MSD	A
FOP-50	TBD	Sensitivity	Evidence of shift in instrument response (evidence of shift can be found in Worksheet #24 where calibration acceptance criteria are not met)	LCS, IC, CC	A

[a] Reference number from QAPP Worksheet #21

[b] Reference number from QAPP Worksheet #23

≥ = greater than or equal to

≤ = less than or equal to

Worksheet #12-4—Measurement Performance Criteria Table

Matrix: Sediment
Analytical Group: Grain Size
Concentration Level: N/A

Grain size performance criteria will be completed in accordance with the ASTM International (ASTM) standard for grain size analysis (ASTM 7928).

Worksheet #12-5—Measurement Performance Criteria Table

Matrix: Sediment
Analytical Group: Atterberg Limit
Concentration Level: N/A

The liquid limit and plastic limit of soils (along with the shrinkage limit) are collectively referred to as the Atterberg Limits. The Atterberg Limit standard test methods will be completed according to ASTM D4318.

Worksheet #12-6—Measurement Performance Criteria Table

Matrix: Sediment
Analytical Group: Percent Solids
Concentration Level: N/A

Percent solids is determined by the moisture content by mass of marine sediments. Performance criteria will be completed in accordance with the ASTM D2216 or equivalent.

Worksheet #12-7—Measurement Performance Criteria Table

Matrix: IDW/Dredge Waste Characterization – Solid and Aqueous
Analytical Group: TCLP 8 RCRA Metals
Concentration Level: Medium/High

Sampling Procedure[a]	Analytical Method SOP[b]	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)
FOP-10	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LOQ Verification	A
FOP-10	TBD	Accuracy/Bias	Default to laboratory SOP criteria	LCS	A
FOP-10	TBD	Precision	All metals: < 20% RPD	Laboratory duplicate	A
FOP-10	TBD	Representativeness	Metal < QL	MB	A
FOP-10	TBD	Completeness	≥ 90%	Data completeness defined as data not qualified as rejected after validation	S & A
FOP-10	TBD	Comparability	Qualitative measure for field sampling procedures	LCS	A
FOP-10	TBD	Sensitivity	Evidence of shift in instrument response (evidence of shift can be found in Worksheet #24 where calibration acceptance criteria are not met)	LCS, IC, CC	A

[a] Reference number from QAPP Worksheet #21[b] Reference number from QAPP Worksheet #23

≥ = greater than or equal to

≤ = less than or equal to

Worksheet #12-8—Measurement Performance Criteria Table

Matrix: IDW/Dredge Material Waste Characterization – Solid and Aqueous
Analytical Group: Total PAHs, TCLP VOCs, TCLP SVOCs
Concentration Level: Medium/High

Sampling Procedure[a]	Analytical Method SOP[b]	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)
FOP-10	TBD	Accuracy/Bias	Default to LSOP criteria	RL Verification	A
FOP-10	TBD	Accuracy/Bias	Default to LSOP criteria	LCS	A
FOP-10	TBD	Accuracy	Default to LSOP criteria	Surrogate Compounds	A
FOP-10	TBD	Representativeness	Concentration < RL	MB	A
FOP-10	TBD	Comparability	Qualitative measure for field sampling procedures	LCS	A
FOP-10	TBD	Completeness	≥ 90%	Data completeness defined as data not qualified as rejected after validation	S & A
FOP-10	TBD	Sensitivity	Evidence of shift in instrument response (evidence of shift can be found in Worksheet #24 where calibration acceptance criteria are not met)	LCS, IC, CC	A

[a] Reference number from QAPP Worksheet #21

[b] Reference number from QAPP Worksheet #23

≥ = greater than or equal to

< = less than

RL = reporting limit

Worksheet #13—Secondary Data Uses and Limitations

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	How Data Will Be Used	Limitations on Data Use
GIS mapping layers and coordinates	Historical project drawings presenting utilities and geodatabases	Data will be used to identify area feature locations within the project study area.	Review of data and professional judgment will be required to determine the acceptance, applicability, and usability of data.
Site survey data	Subcontractor-generated update of site conditions	Data will be reviewed to update the site base map to the most current conditions.	Review of data and professional judgment will be required to determine the acceptance, applicability, and usability of data.
Historical reports	Phase 2 Data Evaluation Report Expanded RI/FS (Parametrix 1996a), Final Design Report for Sediment Dredging (Parametrix and Asarco Consulting 2004)	Review analytical data against data collected in the 1990s and 2000s.	Review of data and professional judgment will be required to determine the acceptance, applicability, and usability of data.

Worksheets #14 and #16—Project Tasks and Schedule

Project Limits/Description

CH2M's scope of work is to perform a PDI of the OU6 Asarco Sediments in Commencement Bay, near Ruston and Tacoma, Washington. The investigation is being conducted to confirm site conditions and support the design of the selected remedial alternative, if warranted. The site project area is presented on Figure 11-1.

Combined Worksheets #14 and #16 provide an overview of project tasks and include a project schedule. Field activities and procedures are described in detail in the FSP. The following project tasks are described:

- General premobilization tasks
- Topographic survey
- Multibeam sonar survey
- Sub-bottom profile and magnetometer surveys
- Surface and subsurface sediment sampling
- Eelgrass survey
- Dredged material waste characterization
- Groundwater seep sampling
- Laboratory analysis
- Data management
- Data review and usability

General Premobilization Activities

Prior to each field mobilization, the following tasks will be performed, as appropriate for the specific field task:

- Coordinating site access and staging or mooring areas
- Preparing and reviewing the health and safety plan
- Procuring and chartering subcontractor and associated safety
- Holding project team technical field kickoff meeting
- Ordering and checking field equipment and supplies
- Coordinating with analytical laboratory for bottleware shipments
- Locating utilities or One-call

Topographic Survey Task/Activities:

- Use existing survey control on the project site.
- Set new survey control monuments, as needed.
- Search for field boundary monuments and other evidence in the field.
- Resolve preliminary boundary map with the found evidence and prepare a final boundary map file with survey-accurate property and right-of-way locations.
- Perform final QC for boundary survey.

Multibeam Sonar Survey

- Use existing survey control on the project site.
- Set new survey control monuments, as needed.
- Complete bathymetric survey of Yacht Basin, Northshore Area, Moderate Impact Area, Breakwater Peninsula, and Nearshore/Offshore Area in accordance with U.S. Army Corps of Engineers Engineer Manual EM 1110-2-1003 (Hydrographic Surveying) (USACE 2013).
- The multibeam sonar data will also be used to map eelgrass/macroalgae within OU6.

Sub-bottom Profile and Magnetometer Surveys in Yacht Basin and Northshore Area

The sub-bottom profile and magnetometer surveys will be performed by a qualified subcontractor using an appropriately sized and outfitted survey vessel.

Surface and Subsurface Sediment Sampling; Dredge Material Waste Characterization

The surface and subsurface sediment samples will be collected in accordance with the FSP and the associated FOPs in Appendix A. The following activities are associated with surface and subsurface sediment sampling:

- Decontaminate any nondedicated sampling equipment before sampling activities at each location.
- Collect surface sediment samples (0 to 4 inches below sediment surface) from 23 locations in the Moderate Impact Area and Nearshore/Offshore Area using mechanical sampling methods.
- Collect surface sediment (0 to 4 inches below sediment surface) and sediment core samples from 21 locations in the Yacht Basin and 4 locations in the Northshore Area using mechanical sampling methods and vibracore or hand-coring methods. The subsurface sediment samples will be collected from 1-foot depth intervals to the bottom of the core. A subset of coring locations has been designated for additional testing to inform dredged material waste characterization (Worksheet #17).
- Document as-sampled locations using the on-board global positioning system (GPS).
- Measure and record the water depths at each sample location and the times of the water depth measurements and sample collection.
- Record detailed field observations, including descriptions of the sediment in the grabs and cores, on project-specific sampling forms and/or in the field logbook.
- Collect samples to be submitted for analysis into the laboratory provided bottleware.
- Manage and dispose of any IDW in accordance with the Site Management Plan (CH2M 2024b).
- Ship samples to the laboratory for analysis.

Seep Sampling

Seep samples will be collected from up to six locations along the shoreline. The data from the samples will be used to assess whether the seeps are contaminated and could potentially recontaminate a sediment cap in the Yacht Basin and Northshore Area if those areas are capped. The procedure for sampling is summarized as follows:

- Locate seeps along shoreline.

- Excavate small hole approximately 6 inches wide and 6 inches deep.
- Wait for seep to fill.
- Test for water quality parameters (pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity) in seawater and seep water using flow through water quality meter.
- Fill a clean syringe with water and transfer contents to appropriate jar for total metals analysis.
- Insert inline filter, fill the syringe with filtered water and transfer contents to the appropriate jar for filtered metals analysis.
- Label jar appropriately.

Laboratory Analysis Tasks

The national Field and Analytical Services Teaming and Advisory Committee (FASTAC) procedure will be followed when acquiring laboratories for sample submittal. In order of preference, CLP or subcontracted laboratories will generate the data. The laboratory will be selected based on availability, ability to meet data objectives, and turnaround time.

The address for the CLP is TBD.

The address for the subcontracted laboratory is TBD.

The laboratory analyses will be performed in accordance with the analytical methods, this QAPP, and the LSOPs as defined in Worksheet #23 (Analytical SOPs).

14.1 Quality Control Tasks

QC will be monitored by properly implementing FOPs (Appendix A). Specific items related to QC are included on Worksheets #11, #12, #15, #22, #24, #25, #27, and #28.

14.2 Secondary Data

Refer to QAPP Worksheet #13.

14.3 Data Management Tasks

The Data Management Plan (submitted under a separate cover) serves as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

14.3.1 Sample Tracking

The Project Chemist is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of chains-of-custody from the field team are used to enter in sample identifications (IDs), collect data, and for analyses. Upon receipt of a sample receipt notice from the laboratory, the date received by the laboratory, and a date the electronic copy is due will be entered. Likewise, upon receipt of the electronic copy and EDD, the date they were

received will also be entered. The EDDs will be uploaded when received from the laboratory and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

The geotechnical, sonar, profile, and magnetometer surveys; topographic and property boundary survey; eelgrass and macroalgae survey data; and bathymetry data will be tracked and managed separately from the analytical data. The geotechnical results will be tabulated in a spreadsheet and submitted in portable document format (PDF) and the results summarized in the PDI report.

14.3.2 Data Types

The data will be added to the project database as they become available. The data will include new data collected in the field, analyzed by the laboratories and validated by an EPA-appointed validator; a third-party validator with prior approval from the TOCOR; or a CH2M chemist independent from field sample collection. The data source will be noted in the database.

14.3.3 Data Tracking and Management

Every data set received from analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent fashion. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of database entry for each data set will all be tracked and recorded in the project database.

14.3.4 Hard/Electronic Copy

The analytical laboratory data are stored electronically as a PDF and EDD in the project file. For this project, no hard copy data packages will be projected by the contract laboratories.

Measurements made during field data collection activities will be recorded in field logbooks, field forms, and sample processing logs. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks, field forms, and sample processing logs. Scans of field data will be stored electronically in the project file. All raw analytical laboratory data are stored electronically.

14.3.5 Data Input Procedures

Sampling information, such as sample ID, sample area and sampling date and time, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Other available field-related data collected will be either manually entered onto standard EDD templates for loading into the database or scanned and transferred to the project file. The EPA Scribe program will be used for field documentation for data that meet the functional and technical specifications of Scribe and generation of chains-of-custody.

14.3.6 Computer Database

The technical data, sample information, field observations, laboratory analytical results, and analytical data validation will be managed by CH2M in their data management system and the project file. Data that

meet the functional and technical specifications of Scribe will be submitted to the EPA using Scribe.net. Scribe.net is used in EPA Region 10 to store and analyze project data submissions.

The database will be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The database will be published to Scribe.net when field activities are complete and upon data import after each event. Validated laboratory data will be uploaded to Scribe. The completed Scribe project file will be published/archived to Scribe.net. Data that does not meet the functional and technical specifications of Scribe will be submitted to the EPA in project documents and deliverables (Section 14.5.10).

14.3.7 GIS Description

A project geodatabase will be agreed upon and set up prior to sampling by the PM, database manager, and GIS manager. Workflow for creating, maintaining, and organizing geospatial data will follow the Spatial Data Standard format for projects whenever possible.

An ArcView project or extension will be used, providing the following functionality: load and display project site base maps, display sampling station locations and associated sampling data (date, media, and results), and perform ad hoc queries to highlight sampling locations meeting user-entered criteria for sampling (for example, data by date, sample type, analyte, depth/elevation, result value, or any combination thereof). Results will be shown as stations highlighted on the map.

14.3.8 Documentation

Documenting data management activities is critical because it provides the following:

- An electronic copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified by database managers
- Continuity of data management operations when personnel changes occur

The Data Management Plan will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

14.3.9 Evidence File

Records and field measurements of all samples will be collected in field notebooks. Chain-of-custody forms and air bills will be prepared and retained for each sample. The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities. CH2M is the custodian of the evidence file and maintains the contents of the evidence files for the project, including all relevant records, reports, logs, field notebooks, sketches, photographs, final QAPP, contractor reports or deliverables, and data reviews in a secured area with limited access.

CH2M will keep records in the project file until project completion and retain all records for 10 years after contract completion or until the ROD is finalized. As necessary, records may be transferred to an offsite records storage facility. The records storage facility must provide secure, controlled-access records storage. Records of raw analytical laboratory data, QA data, and reports will be kept by the laboratories for 10 years.

14.3.10 Presentation of Investigation Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures depicting concentration isopleths or location-specific concentrations, cross sections, and conceptual site model representation
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ARCINFO or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

14.4 Assessment and Audit Tasks

Refer to Worksheets #31, #32, and #33.

14.5 Data Review Tasks

The laboratory will make sure that the data are complete for all samples received from field activities. All data from CLP and any subcontracted laboratory will be validated by an EPA-appointed validator, a third-party validator with prior approval from the TOCOR, or a CH2M chemist independent from field sample collection using the National Functional Guidelines (EPA 2020b, 2020c), LSOPs, and the QAPP. All analytical data will also be reviewed for completeness. Validated data and field logs will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Final data are placed in the database with qualifiers. Refer to Worksheets #34 though #37 for the tasks.

14.6 Documentation and Records

Observations, inspections, reviews of test results, and field measurements collected will be documented in field logbooks and electronically scanned as controlled documents. Additionally, a copy of the final QAPP and technical reviews will be maintained by the PM in the project files.

Worksheet #16 – Project Schedule

Activities	Organization	Anticipated Date(s) of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
Hydrographic surveys	CH2M subcontractor	Fall 2024	Winter 2024	Site survey CAD File and summary reports	Winter 2024
Surface and core sediments	CH2M and subcontractor	Fall 2024	Winter 2024	Analytical data and summary report	March 2025 (est)
Upland survey	CH2M	Fall 2024	Winter 2024	Site survey DWG	Winter 2024
Preliminary eelgrass survey	CH2M and subcontractor	Fall 2024	Winter 2024	Summary report	Winter 2024
Seep sampling	CH2M	Fall 2024	Winter 2024	Analytical data and summary report	March 2025 (est)

Worksheet #15-1a—Project Action Limits and Laboratory-specific Detection/Quantitation

Matrix: Sediment
Analytical Group: Select Metals
Concentration Level: Low/Medium

Analyte	CAS Number	Project Action Limits (mg/kg)[a]	Achievable Laboratory Limits[b] (CLP)		Achievable Laboratory Limits[b] (Commercial)	
			MDLs (mg/kg)	QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Arsenic	7440-38-2	93	TBD	0.50	TBD	TBD
Copper	7440-50-8	390	TBD	1.0	TBD	TBD
Lead	7439-92-1	450	TBD	0.50	TBD	TBD
Zinc	7440-66-6	410	TBD	2.5	TBD	TBD

[a] Project Action Limits are referenced from the Commencement Bay Nearshore/Tideflats ROD (EPA 2000).

[b] Analysis will be conducted by either a CLP laboratory or a commercial laboratory. Limits should be considered estimated and may not represent the current achievable limits of the selected laboratory and/or may be changed by the laboratory based on project-specific limits or special requests. TBDs/MDLs will not be known until the laboratory is assigned.

CAS = Chemical Abstracts Service

Worksheet #15-1b—Project Action Limits and Laboratory-specific Detection/Quantitation

Matrix: Groundwater
Analytical Group: Select Metals (Total and Dissolved)
Concentration Level: Low/Medium

Analyte	CAS Number	Project Action Limits[a] (µg/L)	Achievable Laboratory Limits[b] (CLP)		Achievable Laboratory Limits[b] (Commercial)	
			MDLs (µg/L)	QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Total						
Arsenic	7440-38-2	6.0	TBD	1.0	TBD	TBD
Copper	7440-50-8	3.1	TBD	2.0	TBD	TBD
Lead	7439-92-1	8.1	TBD	1.0	TBD	TBD
Zinc	7440-66-6	N/A	TBD	5.0	TBD	TBD
Dissolved						
Arsenic	7440-38-2	6.0	TBD	1.0	TBD	TBD
Copper	7440-50-8	3.1	TBD	2.0	TBD	TBD
Lead	7439-92-1	8.1	TBD	1.0	TBD	TBD
Zinc	7440-66-6	N/A	TBD	5.0	TBD	TBD

[a] Project action limits are referenced from the Commencement Bay Nearshore/Tideflats ROD (EPA 2000).

[b] Analysis will be conducted by either a CLP laboratory or a commercial laboratory. Limits should be considered estimated and may not represent the current achievable limits of the selected laboratory and/or may be changed by the laboratory based on project-specific limits or special requests. TBDs/MDLs will not be known until the laboratory is assigned.

µg/L = microgram(s) per liter

Worksheet #15-2—Project Action Limits and Laboratory-specific Detection/Quantitation

Matrix: Sediment
Analytical Group: Total Organic Carbon
Concentration Level: Low/Medium

Analyte	CAS Number	PAL (mg\kg)	Achievable Laboratory Limits[a] QLs (mg/kg)
TOC	57-12-5	NC	TBD

[a] Analysis will be conducted by either a CLP laboratory or a commercial laboratory. Limits should be considered estimated and may not represent the current achievable limits of the selected laboratory and/or may be changed by the laboratory based on project-specific limits or special requests. TBDs/MDLs will not be known until the laboratory is assigned.

NC = no criteria

Worksheet #15-3a—Project Action Limits and Laboratory-specific Detection/Quantitation

Matrix: IDW/Waste Characterization-Solid and IDW/Waste Characterization-Aqueous
Analytical Group: TCLP RCRA Metals, TCLP VOCs, and TCLP SVOCs
Concentration Level: Medium/High

Analyte	CAS Number	CFR 40 RCRA Project Action Limits (mg/L)[a]	Achievable Laboratory Limits	
			QLs (mg/kg)	QLs (mg/L)
TCLP RCRA Metals				
Arsenic	7440-38-2	5.0	0.50	0.010
Barium	7440-39-3	100	5.0	0.50
Cadmium	7440-43-9	1.0	0.50	0.0050
Chromium	7440-47-3	5.0	1.0	0.010
Lead	7439-92-1	5.0	0.50	0.010
Mercury	7439-97-6	0.2	0.10	0.0002
Selenium	7782-49-2	1.0	2.5	0.035
Silver	7440-22-4	5.0	0.50	0.010
TCLP VOCs				
1,1-Dichloroethene	75-35-4	0.7	0.005	0.050
1,2-Dichloroethane	107-06-2	0.5	0.005	0.050
1,4-Dichlorobenzene	106-46-7	7.5	0.005	0.050
2-Butanone	78-93-3	200	0.01	0.10
Benzene	71-43-2	0.5	0.005	0.050

Analyte	CAS Number	CFR 40 RCRA Project Action Limits (mg/L)[a]	Achievable Laboratory Limits	
			QLs (mg/kg)	QLs (mg/L)
Carbon tetrachloride	56-23-5	0.5	0.005	0.050
Chlorobenzene	108-90-7	100	0.005	0.050
Chloroform	67-66-3	6.0	0.005	0.050
Tetrachloroethene	127-18-4	0.7	0.005	0.050
Trichloroethene	79-01-6	0.5	0.005	0.050
Vinyl chloride	75-01-4	0.2	0.005	0.050
TCLP SVOCs				
2,4,5-Trichlorophenol	95-95-4	400	0.17	0.05
2,4,6-Trichlorophenol	88-06-2	2.0	0.17	0.05
2,4-Dinitrotoluene	121-14-2	0.13	0.17	0.05
2-Methylphenol	95-48-7	200	0.33	0.1
3-Methylphenol	108-39-4	200	N/A	0.1
4-Methylphenol	106-44-5	200	0.33	0.1
Hexachlorobenzene	118-74-1	0.13	0.17	0.05
Hexachlorobutadiene	87-68-3	0.5	0.17	0.05
Hexachloroethane	67-72-1	3.0	0.17	0.05
Nitrobenzene	98-95-3	2.0	0.17	0.05
Pentachlorophenol	87-86-5	100	0.33	0.1
Pyridine	110-86-1	5.0	N/A	0.1

[a] The project action limits in accordance with 40 CFR TCLP analysis limits, when applicable

CFR = *Code of Federal Regulations*

mg/L = milligram(s) per liter

Worksheet #15-3b—Project Action Limits and Laboratory-specific Detection/Quantitation

Matrix: IDW/Waste Characterization-Solid
Analytical Group: Total PAHs
Concentration Level: Medium/High

Analyte	CAS Number	SMS SCO Project Action Limits (mg/kg) [a]	Achievable Laboratory Limits	
			MDLs (mg/kg)	QLs (mg/kg)
2-Methylnaphthalene	91-57-6	38	TBD	0.0033
Acenaphthene	83-32-9	16	TBD	0.0033
Acenaphthylene	208-96-8	66	TBD	0.0033
Anthracene	120-12-7	220	TBD	0.0033
Benzo(a)anthracene	56-55-3	110	TBD	0.0033
Benzo(a)pyrene	50-32-8	99	TBD	0.0033
Benzo(b)fluoranthene	205-99-2	N/A	TBD	0.0033
Benzo(g,h,i)perylene	191-24-2	N/A	TBD	0.0033
Benzo(k)fluoranthene	207-08-9	N/A	TBD	0.0033
Chrysene	218-01-9	110	TBD	0.0033
Dibenz(a,h)anthracene	53-70-3	12	TBD	0.0033
Fluoranthene	206-44-0	160	TBD	0.0033
Fluorene	86-73-7	23	TBD	0.0033
Indeno(1,2,3-cd)pyrene	193-39-5	34	TBD	0.0033
Naphthalene	91-20-3	99	TBD	0.0033
Phenanthrene	85-01-8	100	TBD	0.0033
Pyrene	129-00-0	1,000	TBD	0.0033

[a] SMS (WAC 173-204-562).

Worksheet #17—Sampling Design and Rationale

The sampling design and rationale for the OU6 PDI are based on the project quality objectives and approach identified in Worksheet #11. Each of the project activities is discussed herein. The OU6 PDI consists of the following project activities:

- Surface sediment sampling and analysis in the Moderate Impact Area and Nearshore/Offshore Area to determine the extent and magnitude of metals concentrations exceeding ROD cleanup levels
- Surface and subsurface sediment sampling and analysis in the Yacht Basin and Northshore Area to determine the extent and magnitude of metals concentrations exceeding ROD cleanup levels, characterize the geotechnical properties of sediment, and determine the appropriate offsite disposal method for dredged sediment
- Hydrographic surveys to determine bathymetry, identify debris, and delineate areas of submerged aquatic vegetation (SAV)
- Nearshore/upland survey to determine topography
- Ecological investigation to determine the presence, spatial distribution, and density of eelgrass and macroalgae
- Dredged material waste characterization to determine the disposal method for RD
- Seep sampling and analysis to determine whether groundwater entering the Yacht Basin and Northshore Area has the potential to recontaminate the sediment remedy

The methods to be used to conduct the investigation are described in the FSP.

17.1 Surface Sediment Sampling in the Moderate Impact Area and Nearshore/Offshore Area

The surface sediment sample locations are shown on Figure 11-2 for the Moderate Impact Area and Nearshore/Offshore Area. A judgmental, systematic sampling approach will be used to determine the extent and magnitude of metals concentrations exceeding ROD cleanup levels in these areas and establish a baseline data set for long-term monitoring in the Moderate Impact Area. Seven evenly spaced transects were distributed across the Moderate Impact Area (Transects TR1 to TR7), with 2 to 3 sample locations on each transect, for a total of 15 sample locations. Sample locations are approximately 400 to 600 feet apart along each transect. This sampling design will provide an unbiased spatial representation of current conditions in these areas. An additional 8 samples will be collected from the Nearshore/Offshore Area: 3 samples will be collected from the Nearshore Cap and 5 samples will be collected beyond the capped area.

Surface sediment samples will be collected from the 0- to 4-inch depth interval, which is the general recommendation in the Sediment Cleanup User's Manual for representing the biologically active zone (Ecology 2019), and is consistent with the depth interval used in the Phase 1 Expanded RI/FS (Parametrix 1995). All surface sediment samples from the Moderate Impact and Nearshore/Offshore Areas will be analyzed for arsenic, copper, lead, and zinc.

17.2 Surface and Subsurface Sediment Sampling in the Northshore Area and Yacht Basin

The surface and subsurface sediment sample locations in the Northshore Area are shown on Figure 11-3. Four sample locations are distributed systematically throughout the area boundary. The data from these locations will be used to determine whether dredging or capping in the Northshore Area is still warranted.

The surface and subsurface sediment sample locations in the Yacht Basin are shown on Figure 11-4. Cores will be collected from the same locations that were sampled for pre-design in 2001 and from 2 of the intertidal locations that were sampled in 1997 for the refinement of the proposed remedy (Parametrix 2000). These 21 locations provide spatial coverage throughout the Yacht Basin and data that will be directly comparable to the historical results, which will facilitate an assessment of how conditions have changed since 2000.

Surface sediment samples in the Northshore Area and Yacht Basin will be collected from the 0- to 4-inch depth interval to represent the biologically active zone.

Subsurface samples will be collected from the sediment cores as follows:

- Subsurface samples will be collected in 1-foot intervals down to the bottom of each core to a maximum depth of 10 feet.

17.3 Hydrographic Surveys

Hydrographic surveys to be performed for the OU6 include the following:

- Multibeam sonar survey in the Breakwater Peninsula Area, Moderate Impact Area, Nearshore/Offshore Area, Northshore Area, and Yacht Basin. The primary purpose of this survey is to provide updated bathymetry within the project limits shown on Figure 11-1. The multibeam bathymetry data will also be used to identify debris in the areas designated for dredging and/or capping in the OU6 ROD (Yacht Basin and the Northshore Area), as well as to identify SAV.
- Sub-bottom profiling survey in the Yacht Basin and Northshore Area. The purpose of this survey is to determine the depth of the native sand/gravel layer and identify and correlate the sediment layers observed in the sediment cores. The sub-bottom profiling data will support the design of a precision dredging approach if precision dredging is included in the RD.
- Magnetometer survey in the Yacht Basin and Northshore Area. The purpose of this survey is to identify and delineate ferrous materials above and below the sediment surface.

17.4 Nearshore and Upland Topographic Survey

The purpose of the nearshore and upland topographic survey is to provide elevation data greater than the limits of the multibeam bathymetric survey. The projected survey area is shown on Figure 11-1. Land-based survey methods will be used for the topographic survey of the Nearshore Area above the mean lower low tide elevation and the upland limit of the project area.

17.5 Ecological Investigation

The U.S. Fish and Wildlife Service National Wetlands Mapper includes two classifications for the waters surrounding the Asarco OU6 project site: estuarine and marine deepwater – subtidal, and estuarine and marine wetland – intertidal (USFWS 2024). Within this part of the Puget Sound, the sampling design and rationale must provide updated information from vessel surveys to delineate where intertidal and submerged sensitive resources may be located.

In known or suspected eelgrass areas, the survey will delineate the spatial extent of eelgrass and macroalgae presence in the project area. If the project cannot be moved or redesigned to avoid direct eelgrass and macroalgae impacts, surveys will be required to quantify potential impacts. Surveys will be conducted by biologists who are qualified to identify the predominant eelgrass and macroalgae species in the project footprint.

CH2M and its subcontractors will perform a multibeam sonar survey to determine whether eelgrass or macroalgae are present at the proposed project site, evaluate if the sediment remedy can be located and constructed to avoid affecting eelgrass or macroalgae, and establish a location for the remedy that will minimize impacts when avoidance is not possible. The multibeam sonar survey will encompass the project limits shown on Figure 11-1 to delineate extents of potential SAV, such as eelgrass (*Zostera marina*). The purpose of the vessel survey is to characterize the bottom substrate and the spatial distribution of any SAV. The survey will use SOPs guided by the equipment and methodologies used for the annual submerged vegetation monitoring as prescribed by Washington State Department of Natural Resources (DNR 2014), U.S. Army Corps of Engineers' guidance (USACE 2018), and Washington State Department of Fish and Wildlife (2008) guidance. The survey approach will include the following components:

1) Multibeam sonar survey. By using the latest sonar technology specifically designed for mapping SAV distribution, this allows an entire project site to be surveyed efficiently from a single vessel. Note that the multibeam survey data will also be used to update the bathymetry and identify debris.
2) Drop camera verification. By using a towed video sled or a drop camera frame, underwater imagery may be collected for not only verifying the sonar survey, but also for aiding in aquatic species classification. If imagery data are to be used as a QA check of the sonar data, then a minimum of 10 percent of the area covered by sonar should be imaged.
3) Underwater ROV. The ROV system allows access to areas the survey vessel cannot safely navigate, such as under piers or shallow areas along rocky shores. The ROV can collect imagery and depth data that can be used to fill "gaps" in the sonar data coverage where needed.

17.6 Dredged Material Waste Characterization

The purpose of the dredged material waste characterization is to determine the waste characteristics of sediments that could be dredged from the Yacht Basin and Northshore Area so that offsite disposal options can be incorporated into the RD. Samples will be collected from one core location in the Northshore Area (Figure 11-3) and three spatially representative locations in the Yacht Basin (Figure 11-4). Waste characterization samples will be collected as a composite sample representing the top 2 feet of sediment from each core. The four sediment samples will be analyzed for total PAHs in bulk sediment and the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) in TCLP leachate samples.

17.7 Seep Sampling

The purpose of seep sampling along the shoreline of the Yacht Basin and Northshore Area is to assess whether metals concentrations in groundwater seeps pose a recontamination risk to the offshore areas. A site reconnaissance will be performed to identify the locations of seeps to be targeted for sampling. The location and number of seep samples will depend on the field conditions observed during the site reconnaissance. We have assumed we will collect up to six groundwater seep samples.

Seep samples will be collected from the shoreline and intertidal area at low tide using the syringe sampling method. Water quality parameters (pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity) will be measured in the field to determine whether the seeps are influenced by tidal drainage. Seep will be collected and analyzed for total and dissolved arsenic, copper, lead, and zinc.

The samples will be collected according to the FOP 999 in Appendix A. Refer to Worksheet #20 for QA sample requirements associated with seep sampling.

Worksheet #18—Sampling Locations and Methods

Sampling Location/ ID Number	Matrix	Depth (feet bml)	Analytical Group	Concentration Level	Number of Samples (identify FDs)	Sampling FOP Reference[a]	Rationale for Sampling Location
Yacht Basin and Northshore Area							
Surface sediment and core samples from 25 locations	Sediment	Surface (0 to 0.3) Core (0 to up to 10)	Select Metals (arsenic, copper, lead, zinc),	Low/moderate	1 surface sample per location(25 samples) Up to 10 samples per core per location (up to 250 samples)	FOP-50	Refer to Worksheets #10 and #17. Locations based on historical data.
Surface sediment and core samples from up to 25 locations	Sediment	Surface (0 to 0.3) Core (0 to up to 10)	TOC	N/A	1 surface sample per location(25 samples) Up to 10 samples per core per location (up to 250 samples)	FOP-50	Refer to Worksheets #10 and #17. Locations based on historical data.
Surface sediment core samples from up to 25 locations	Sediment	Surface (0 to 0.3) Core (0 to up to 10)	Grain Size, percent solids, Atterberg Limits	N/A	1 surface sample per locations (25 samples) Up to 10 samples per core per location	FOP-50	Refer to Worksheets #10 and #17. Locations based on historical data.

Sampling Location/ ID Number	Matrix	Depth (feet bml)	Analytical Group	Concentration Level	Number of Samples (identify FDs)	Sampling FOP Reference[a]	Rationale for Sampling Location
					(up to 250 samples)		
Sediment core samples from 4 locations	Sediment	0 to 2	Total PAHs in bulk sediment and TCLP 8 RCRA Metals	Low/moderate	4 (1 sample per core)	FOP-50	Refer to Worksheets #10 and #17. Locations based on historical data.
Moderate Impact Area and Nearshore/Offshore Area Sampling							
Surface sediment samples	Sediment	0 to 0.3	Select Metals (arsenic, copper, lead, zinc)	Low/moderate	Up to 23 (4) samples	FOP-50	Refer to Worksheets #10 and #17. Sample locations to be determined.
Seep Sampling							
Grab samples from up to six surface seeps.	Groundwater	N/A Surface Seep Sample	Total and Dissolved Select Metals	Low	Up to 6 samples	FOP-2, FOP-3, FOP-4 FOP-999	Refer to Worksheets #10 and #17. Locations selected that could potentially recontaminate capped areas.
Waste Management, Transport, and Disposal							
Unique IDs will be sequential	Soil/solid waste	N/A	TCLP RCRA 8 Metals, TCLP VOCs, TCLP SVOCs, and Total PAHs	Low/Medium	Up to 10 samples	FOP-10	Waste characterization
Unique IDs will be sequential	Aqueous	N/A	Total RCRA 8 Metals, VOCs, SVOCs, and Total PAHs	Low/Medium	Up to 10 samples	FOP-10	Waste characterization

[a] Reference number from QAPP Worksheet #21

Note: Unique IDs will include the location and the depth interval; refer to Worksheets #26 and #27.
bgs = below ground surface

Worksheets #19 and #30—Analytical SOP Requirements Table

Analytical SOP Requirements

Matrix	Analytical Group	Concen-tration Level	Analytical and Preparation Method/SOP Reference[a]	Containers (number, size, and type)[b]	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Sediment Sampling						
Sediment	Select Metals	Low/ Medium	TBD	Shared four-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	180 days to analysis
Sediment	TOC	Low/ Medium	TBD	One-time 4-ounce or larger wide-mouth glass jar	0 to 6°C	28 days (6 months if frozen at -20°C)
Sediment	Grain Size	N/A	TBD	Shared four-time 8-ounce or larger wide-mouth glass jar	N/A	N/A
Sediment	Atterberg Limits	N/A	TBD	Shared four-time 8-ounce or larger wide-mouth glass jar	N/A	N/A
Sediment	Percent Solids	N/A	TBD	Shared four-time 8-ounce or larger wide-mouth glass jar	N/A	N/A
Sediment	TCLP RCRA Metals	Medium/ High	TBD	Two-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to TCLP 180 days to analysis
Sediment	Total PAHs	Medium/ High	TBD	One-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to extraction 40 days to analysis
Groundwater/Seep Sampling						
Groundwater/ Seep	Total Select Metals	Low/ Medium	TBD	One-time 500-mL poly	0 to 6°C; HNO_3	180 days to analysis (28 days for mercury)
Groundwater/ Seep	Dissolved Select Metals	Low/ Medium	TBD	One-time 500-mL poly	0 to 6°C; HNO_3 (field filtered)	180 days to analysis (28 days for mercury)

Matrix	Analytical Group	Concen-tration Level	Analytical and Preparation Method/SOP Reference[a]	Containers (number, size, and type)[b]	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Waste Characterization Sampling						
IDW-Solid	TCLP RCRA Metals	Medium/ High	TBD	Two-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to TCLP 180 days to analysis
IDW-Solid	Total PAHs	Medium/ High	TBD	One-time 4-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to extraction 40 days to analysis
IDW-Solid	TCLP VOCs	Medium/ High	TBD	One-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to TCLP 180 days to analysis
IDW-Solid	TCLP SVOCs	Medium/ High	TBD	One-time 8-ounce or larger wide-mouth glass jar	0 to 6°C	14 days to TCLP 180 days to analysis
IDW-Aqueous	TCLP RCRA 8 Metals	Medium/ High	TBD	One-time 500-mL poly	0 to 6°C; HNO_3	180 days to analysis (28 days for mercury)
IDW-Aqueous	TCLP VOCs	Medium/ High	TBD	Two-time 1-L glass amber	0 to 6°C	7 days to TCLP 40 days to analysis
IDW-Aqueous	TCLP SVOCs	Medium/ High	TBD	Two-time 1-L glass amber	0 to 6°C	7 days to TCLP 40 days to analysis
IDW-Aqueous	Total PAHs	Medium/ High	TBD	Two-time 1-L glass amber	0 to 6°C	7 days to extraction 40 days to analysis

[a] Specify the appropriate reference letter or number from the analytical SOPs table (Worksheet #23).

[b] Triplicate volume will be provided for aqueous samples requiring an MS/MSD.

°C = degree(s) Celsius

HNO_3 = nitric acid

mL = milliliter(s)

L = liter(s)

Analytical Services

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Data Package Turnaround Time	Primary Laboratory/ Organization (Name and Address, Contact Person, and Telephone Number)	Backup Laboratory/ Organization (Name and Address, Contact Person, and Telephone Number)
Sediment	Select Metals, TOC, Grain Size, Percent Solids, Atterberg Limits, TCLP RCRA Metals, Total PAHs	Low/ Medium	TBD	Level IV – 56 calendar days Level IV – 21 calendar days for CLP (42 calendar days for final validated data) Level IV – 21 calendar days for Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory
Groundwater	Total and Dissolved Select Metals	Low/ Medium	TBD	Level IV – 56 calendar days Level IV – 21 calendar days for CLP (42 calendar days for final validated data) Level IV – 21 calendar days for Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory
IDW-Solid	TCLP RCRA Metals Total PAHs TCLP VOCs TCLP SVOCs	Medium/ High	TBD	Level IV – 56 calendar days Level IV – 21 calendar days for CLP (42 calendar days for final validated data) Level IV – 21 calendar days for Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Data Package Turnaround Time	Primary Laboratory/ Organization (Name and Address, Contact Person, and Telephone Number)	Backup Laboratory/ Organization (Name and Address, Contact Person, and Telephone Number)
IDW-Aqueous	TCLP RCRA 8 Metals Total PAHs TCLP VOCs TCLP SVOCs	Medium/ High	TBD	Level IV – 56 calendar days Level IV – 21 calendar days for CLP (42 calendar days for final validated data) Level IV – 21 calendar days for Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory	CLP/MEL and/or Subcontract Laboratory

[a] Specify the appropriate reference letter or number from the analytical SOPs table (Worksheet #23).

Worksheet #20—Field Quality Control Summary

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[a]	Number of Samples	Number of FDs	Number of MS/ MSD Sets	Number of EBs[b]	Total Number of Samples
Yacht Basin (Surface Sample)								
Sediment	Select Metals (arsenic, copper, lead, zinc),	Low/ Medium	TBD	21	2	2	2	27
Sediment	TOC	Low/ Medium	TBD	21	2	2	2	27
Sediment	Grain Size, Atterberg Limits, Percent Solids	Low/ Medium	TBD	21	2	2	2	27
Yacht Basin (Core Samples)								
Sediment	Select Metals (arsenic, copper, lead, zinc),	Low/ Medium	TBD	210	20	20	20	270
Sediment	TOC	Low/ Medium	TBD	210	20	20	20	270
Sediment	Grain Size, Atterberg Limits, Percent Solids	Low/ Medium	TBD	210	20	20	20	270
Sediment	TCLP RCRA 8 Metals and Total PAHs	Low/Medium	TBD	4	0	0	0	4

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[a]	Number of Samples	Number of FDs	Number of MS/ MSD Sets	Number of EBs[b]	Total Number of Samples
Moderate Impact Area and Nearshore/Offshore Area								
Sediment	Select Metals (arsenic, copper, lead, zinc)	Low/ Medium	TBD	23	2	2	2	29
Northshore Area (Surface Samples)								
Sediment	Select Metals (arsenic, copper, lead, zinc),	Low/ Medium	TBD	4	1	1	1	7
Sediment	TOC	Low/ Medium	TBD	4	1	1	1	7
Sediment	Grain Size, percent solids, Atterberg Limits	Low/ Medium	TBD	4	1	1	1	7
***Northshore Area* (*Core Samples*)**								
Sediment	Select Metals (arsenic, copper, lead, zinc)	Low/ Medium	TBD	40	4	2	1	47
Sediment	TOC	Low/ Medium	TBD	40	4	2	1	47
Sediment	Grain Size, percent solids, Atterberg Limits	Low/ Medium	TBD	40	0	0	0	40

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[a]	Number of Samples	Number of FDs	Number of MS/ MSD Sets	Number of EBs[b]	Total Number of Samples
IDW (assume collect composite sample from 10 drums)								
Solid IDW	TCLP RCRA metals, TCLP VOCs, TCLP SVOCs, and Total PAHs	Medium/ High	TBD	10	0	0	0	10
Aqueous IDW	RCRA metals, VOCs, SVOCs, and Total PAHs	Medium/ High	TBD	10	0	0	0	10
Seep Sampling								
Seep water	Select Total and Dissolved Metals	Low/ Medium	TBD	12	2	2	2	18

[a] Reference number from QAPP Worksheet #23

[b] The number of equipment blanks is dependent upon the number of field teams per event. EBs will be collected at a rate of once per week per field team using nondedicated equipment.

Notes:

Field QC samples are not applicable to geotechnical and IDW parameters and are not included on this worksheet.
EB = equipment blank

Worksheet #21—Field Standard Operating Procedures

Reference Number	Title, Revision, Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (check if yes)	Comments
FOP-01	Note Taking and Field Logbook, R1, May 2022	CH2M	Procedural guidance	☐	
FOP-03	Field Water Quality Measurements and Calibration, R0, October 2020	CH2M	Procedural guidance	☐	
FOP-04	Groundwater/Seep Sampling Procedures, R0, October 2020	CH2M	Procedural guidance	☐	
FOP-05	Field QA/QC Sample Preparation, R1, November 2023	CH2M	Procedural guidance	☐	
FOP-06	Field Personnel and Equipment Decontamination Procedures, V0, 10/2020	CH2M	Procedural guidance	☐	
FOP-07	Sample Handling and Chain-of-Custody, V0, 10/2020	CH2M	Procedural guidance	☐	
FOP-08	Packing and Shipping of Environmental Samples, V0, 10/2020	CH2M	Procedural guidance	☐	
FOP-10	Investigation and Remediation-derived Waste Management, V0, 09/2020	CH2M	Procedural guidance, UN-certified 55-gallon steel drums	☐	
FOP-16	GPS Coordinate Data Collection Procedures, V0, 10/2020	CH2M	Procedural guidance	☐	
FOP-47	GNSS Survey, R0, June 2023	CH2M	Procedural guidance	☐	

Reference Number	Title, Revision, Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (check if yes)	Comments
FOP-50	Sediment Sampling Procedures, V0, 09/2023	CH2M	Procedural guidance	☐	
FOP-58	Sediment-Vibracore Sampling Procedures, V0, 0/2024	CH2M	Procedural guidance	☐	
FOP-999	Syringe Surface for Seep Water Sampling	CH2M	Procedural guidance	☐	

GNSS = global navigation satellite system

UN = United Nations

Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection

Generalized field equipment calibration, maintenance, testing, and inspection protocol for activities conducted for the project are discussed in this worksheet.

22.1 Field Instrument Calibration

Field personnel will be aware of and follow appropriate manufacturer maintenance and calibration requirements for measuring and testing equipment under their control. Operating manuals and vendor-supplied QC procedures will be available to personnel in the field. Compliance with maintenance, calibration/standardization, and recordkeeping procedures results in the collection of quality data. Field instruments requiring calibration or calibration verification may include those listed in Table 22-1.

Equipment operated by subcontractors will be calibrated by the subcontractors in accordance with their respective equipment SOPs and applicable procedures. Calibration and preventive maintenance procedures apply to government-furnished, leased, and rented equipment. Calibration standards will be traceable to reference standards commonly used by the industry, such as the National Institute for Standards and Technology, where appropriate. These calibration and maintenance procedures do not apply to rulers, tape measures, levels, or other such devices when normal commercial standards provide acceptable accuracy.

22.2 Field Instrument Storage, Maintenance, Testing, and Inspection

Equipment will be stored in accordance with operation manuals. While in storage, each piece of measuring and test equipment will contain a unique number or marking that is readily legible and traceable to calibration and maintenance records.

Upon receipt and before the acceptance of government-furnished, leased, or rented equipment, a designated field team member will perform an initial instrument inspection consisting of a maintenance document review and a functional or operational check to verify that the equipment is in proper working order. Field personnel will review maintenance records to verify that periodic maintenance activities are current and that equipment-specific QC procedures are included with the instrument. In addition, field personnel will complete an inspection of measuring equipment to verify that the equipment is working consistently and appears to be in satisfactory condition for its intended use, as specified in the operation manuals or vendor-supplied QC procedures.

Equipment deficiencies will be noted, addressed, and resolved during initial instrument inspection and before equipment acceptance. Equipment replacement or an equivalent substitution will be required in cases where equipment deficiencies are not resolved during the initial inspection.

An item discovered to be out of calibration or in need of maintenance will not be used until the required service is completed. If equipment does not conform to operation criteria as specified in the operation manual, then the nonconformance will be documented in the project field logbook and the equipment returned to its source. Data generated from field instruments with calibrations outside manufacturer- or project-specified calibration criteria will not be used.

Table 22-1. Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	FOP[a]	Title or Position of Responsible Person	Frequency	Acceptance Criteria	Corrective Action
Multiparameter Water Quality Meter	Oxidation-reduction potential: 2 standard solutions pH: 2 standard solutions Conductivity: 1 standard solution Temperature: no standard solution Turbidity: 2 standard solutions Dissolved oxygen: 2 standard solutions	FOP-03	FTL or field team member	Daily before first field measurement and after final field measurement	± 10 millivolts ± 0.01 pH unit ± 3% ± 0.1°C ± 10% ± 10%	Repeat calibration process; correct measurements for drift if necessary.
Submeter GPS receivers, optical stations, and associated equipment	Model-specific, according to manufacturer's recommendation	FOP-16	FTL or field team member	Daily	Model-specific, according to manufacturer's recommendation	If GPS fails to calibrate, do not use this equipment.

[a] Refer to the project FOPs table (Worksheet #21).

Worksheet #23—Analytical SOPs

Reference Number[a]	Title, Revision, Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
	Analysis of Metals SW-846-6010D; or SFAM01.1	Definitive	Metals (Sediment, Groundwater, Waste Characterization)	ICP-AES		☐
	Analysis of Mercury SW-846-7470A/7471B; or SFAM01.1	Definitive	Mercury (IDW/Waste Characterization)	CVAAS		
	Analysis of PAHs/SVOCs SW-846-8270E; or SFAM01.1	Definitive	Total PAHs/TCLP SVOCs (IDW/Waste Characterization)	GC-MS		
	Analysis of VOCs SW-846-8260d; or SFAM01.1	Definitive	TCLP VOCs (IDW/Waste Characterization)	GC-MS		
	Total Organic Carbon SW-846 Method 9060, or PSEP_TOC	Definitive	TOC (Sediment)	CVAAS or combustion		☐
	ASTM E112 Grain size number	Definitive	Geotechnical	Sieve		
	ASTM D4318 Standard test liquid limits - Atterberg	Definitive	Geotechnical	N/A		
	ASTM D2216 Standard test method for laboratory determination of water content of soils	Definitive	Geotechnical	Gravimetric		
	Toxicity Characteristics Leaching Procedure (TCLP) SW 846 1311; or SFAM01.1 ICP-AES analysis.	Definitive	TCLP (IDW/Waste Characterization, Sediment)	N/A		

a = To be updated upon selection of laboratory
CVAAS = cold vapor atomic adsorption spectrometry
GC-MS = gas chromatography mass spectrometry
ICP-MS = inductively coupled plasma mass spectrometry

Worksheet #24—Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
GC/MS (for PAHs, SVOCs, VOCs in Sediment and IDW/Waste Characterization)	IC	Instrument receipt, instrument change (new column, source cleaning), when CCV is out of criteria.	Minimum five-point initial – r2 ≥ 0.99, RF ≥ 0.010, and RSD ≤ 20% or 40%, depending on compound	Inspect the system for problems, clean the ion source, change the column, service the purge and trap device, and take CAs to achieve the technical acceptance criteria.	Laboratory QA Manager (TBD)	TBD
	A mid-level calibration standard and a blank	One per analytical batch	Default to laboratory criteria.	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria.		
ICP-MS (for Metals in Sediment, Groundwater and IDW) and CVAAS (for Mercury in IDW)	IC	Instrument receipt, major instrument change, at the start of each day.	Minimum six-point curve and a calibration blank for all analytes. r >0.995	Inspect the system for problems, clean the system, verify operating conditions, and take CAs to achieve the technical acceptance criteria.	Laboratory QA Manager (TBD)	TBD
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > QL	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		

[a] Refer to Worksheet #23 for analytical methods.

> = greater than

> = greater than or equal to

QL = quantitation limit

r = correlation coefficient

Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
ICP-MS (for Metals in Sediment, Groundwater and IDW) and CVAAS (for Mercury in IDW)	ICV	Nebulizer, injection tube, flame optimization, gas supply, and detector inspections.	Once after each IC, prior to beginning a sample run.	All analytes within 90–110 %R (85-115 %R for Mercury).	Correct problem and re-run ICV. If that fails, correct problem and repeat IC.	Laboratory QA Manager (TBD)	TBD
	CCV	Nebulizer, injection tube, flame optimization, gas supply, and detector inspections.	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	All analytes within 90–110 %R (85-115 %R for Mercury).	Repeat IC and reanalyze all samples analyzed since the last successful calibration verification.		
	ICS (ICP Analysis Only)	Per manufacturer's instructions.	After beginning of the analytical run and every 12 hours.	ICS-A and ICS-AB: Within 15% of mean value or results must be within ±2 times the analyte's QL of the established mean value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.		

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
GC/MS (for PAHs, SVOCs, VOCs in Sediment and IDW/Waste Characterization)	ICV	Connections, cleanliness of detector, leak checks, and other items specified by instrument manufacturer.	After each initial calibration, and prior to analyzing samples.	%D ≤ 25 or 40, depending on compound.	Correct problem and re-run ICV. If that fails, correct problem and repeat IC.	Laboratory QA Manager (TBD)	TBD
	CCV	Connections, cleanliness of detector, leak checks, and other items specified by instrument manufacturer.	At the beginning of each 12-hour shift immediately after BFB tune.	%D ≤ 25 or 40, depending on compound.	Repeat IC and reanalyze all samples analyzed since the last successful calibration verification.		
	BFB tune	Injector syringe, injector septum, injector liner/seal, injector port, guard column, column splitter, analytical column, ion source, detector, traps, and gas supply inspections.	Every 12 hours.	Refer to method for specific ion criteria.	Retune and/or clean source.		
	Retention time window position establishment	Per manufacturer's instructions.	Once after each IC for each analyte and surrogate.	Position will be set using the midpoint standard of the IC curve when IC is performed. On days when IC is not performed, the initial CCV is used.	N/A		

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
	RRT	Per manufacturer's instructions.	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then re-run IC. Flagging criteria are not appropriate.		
Carbonaceous Analyzer (for TOC in Sediment)	ICV	Connections, cleanliness of detector, leak checks, and other items specified by instrument manufacturer.	Immediately following IC.	Default to LSOP criteria.	Correct problem and re-run ICV. If that fails, correct problem and repeat IC.	Laboratory QA Manager (TBD)	TBD
	CCV	Connections, cleanliness of detector, leak checks, and other items specified by instrument manufacturer.	Default to laboratory criteria.	Default to LSOP criteria.	Repeat IC and reanalyze all samples analyzed since the last successful calibration verification.		

[a] Refer to Worksheet #23 for identification of analytical methods.

Notes:

Equipment inspection and maintenance activities to be conducted as in accordance with instrument manufacturers recommendations

%D = percent difference

%R = percent recovery

CCV = continuing calibration verification

ICS = interference check solutions

ICV = initial calibration verification

Worksheets #26 and #27—Sample Handling, Custody, and Disposal

Sample Collection, Packaging, and Shipment
Sample Collection (Personnel/Organization): FTL/CH2M
Sample Packaging (Personnel/Organization): FTL/CH2M
Coordination of Shipment (Personnel/Organization): FTL/CH2M
Type of Shipment/Carrier: Federal Express Overnight
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): TBD, subcontracted third-party lab/CLP/MEL
Sample Custody and Storage (Personnel/Organization): TBD, subcontracted third-party lab/CLP/MEL
Sample Preparation (Personnel/Organization): TBD, subcontracted third-party lab/CLP/MEL
Sample Determinative Analysis (Personnel/Organization): TBD, subcontracted third-party lab/CLP/MEL
Sample Archiving
Field Sample Storage (No. of days from sample collection): Refer to QAPP Worksheet #19 for allowable holding time.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Refer to QAPP Worksheet #19 for allowable holding time.
Sample Disposal
Personnel/Organization: TBD, subcontracted third-party lab/CLP/MEL
Number of Days from Analysis: TBD and the subcontracted third-party laboratory, will retain samples for at least 90 days and sample extracts for at least 30 days, after submittal, pending the need for reanalysis. CLP/MEL will retain samples for at least 60 days and sample extracts for at least 1 year (metal digestates will be retained for 180 days), after submittal, pending the need for reanalysis.

Field Sample Custody Procedures

Sample handling, packaging, and shipping of environmental sample will be performed in accordance with FOP-07 and FOP-8 and documentation and chain-of-custody procedures will be performed in accordance with FOP-7.

Sample coolers will be shipped to arrive at CLP/MEL and subcontracted third-party laboratories the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day. The commercial laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered. The RSCC will be notified for CLP/MEL shipments. The CLP and MEL COC xml files will be uploaded to the CLPSS Portal for CLP, and provided to the RSCC for MEL.

Regulations for packaging, marking/labeling, and shipping of hazardous materials and wastes are promulgated by the U.S. Department of Transportation. Air carriers that transport hazardous materials, in particular Federal Express, require compliance with the current edition of the International Air Transport Association Dangerous Goods Regulations, which applies to shipment and transportation of hazardous materials by air carrier. Following current International Air Transport Association regulations will ensure compliance with U.S. Department of Transportation regulations.

Laboratory Sample Custody Procedures

Upon sample receipt, the laboratory sample custodian will verify package seals, open the packages, check temperature blanks, record temperatures, verify sample integrity, and inspect contents against chain-of-custody forms. The Project Chemist will be contacted to seek resolution of any discrepancies between sample containers and chain-of-custody forms through contract-defined channels of communication. Once the shipment and chain-of-custody form are in agreement, the sample custodian will initiate an internal chain-of-custody form (CH2M subcontract laboratories only), as well as supply the laboratory task manager with a sample acknowledgment letter. When applicable, sample preservation will be checked and pH will be documented. If the sample temperatures are outside the required range, the laboratory will contact the Project Chemist as to the proper course of action.

Samples will be logged in and assigned a unique laboratory number (CH2M subcontract laboratories only);that number will be used by all laboratory personnel handling samples to ensure all sample information is captured. Analyses required will be specified by codes assigned to samples at login. Labels containing the laboratory sample number are generated and placed on sample bottles.

After the laboratory labels the samples, they will be moved to controlled and monitored refrigerators where they will be maintained at 4°C.

When the analyst is ready to prepare and/or analyze the sample(s), an appropriate member of the sample management department will locate the sample(s) in the locked refrigerator, sign and date the internal sample tracking form, and provide the sample(s) to the analyst. When the analyst is finished with the sample(s), unused portions will be returned to an appropriate member of the sample management department for replacement in a secure refrigerator. The analyst will sign and date internal chain-of-custody forms. In the event that entire samples are depleted during analysis, a notation of “sample depleted” or “entire sample used” will be written on the internal chain-of-custody forms.

Samples will be stored in designated secure, refrigerated storage areas. Samples and sample extracts will be maintained in a secure storage until disposal. No samples or extracts will be disposed of without prior to the Project Chemist. The sample custodian will note the sample disposal date in the sample ledger. The laboratory will dispose of samples in accordance with applicable regulations.

Documentation will be placed in a single, secured project file maintained by the laboratory PM. The file will consist of agreements, correspondence, memoranda, notes, and data.

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation, field data, and notes will be filed with the laboratory data. Filed materials may only be removed by authorized personnel on a temporary basis. The name of the person removing the file will be recorded. Laboratories will retain project files and data packages for 10 years, unless otherwise agreed upon.

Sample Identification Procedures

A sample numbering system will be used to identify each sample, including duplicate samples. The sample number will be a unique identifier.

Each sample to be analyzed by MEL or CLP must be labeled with the EPA Sample ID. The EPA Sample ID is assigned by the RSCC and is a unique eight-digit number in the format YYWW####, where YY is the year (24 for calendar year 2024), WW is a two-digit week code, and #### is an assigned four-digit number. Additionally, sample labels must include a two-digit bottle tag code. The tag code, along with the Sample ID, will uniquely identify each bottle. The tag for unpreserved bottles consists of the letter N followed by a number. For example, four unpreserved bottles collected as part of one Sample ID are given the tag codes N1, N2, N3, and N4. Each sample to be analyzed by MEL must be labeled with the EPA Project Code. The EPA Project Code is assigned by the RSCC.

Each sample, regardless of analytical protocol, will also be assigned a CH2M site-specific identifier, which will contain a site, media, and sample-specific location identifier that indicates where the sample was obtained. Soil samples will also use a numbering system that will include the sample depth.

The sample number and station location identifier will be included on the sample tag and the chain-of-custody record.

The site-specific identifier is based on the following system.

Normal Environmental Samples

Field sample ID will vary slightly, based on media sampled.

Sediment Samples

Sediment samples will be identified as follows:

[Site]-[Media]-[Station Location]-[Depth Indicator]

Where:

[Site] = The site references the OU6 Asarco Sediments Superfund Site, which will be identified as "OU6" on the sample.

[Media] = This refences the media sampled:

- Surface Sediment "SS"
- Core Sediment "CS"

[Station Location] = This identifier identifies the unique name of the sampling location. For example, a sediment sample collected from sediment location 1 would be identified as "001" on the sample.

[Depth Indicator] = This identifies the top and bottom depth intervals, separated by a slash. The depth will be represented in feet below mudline (bml). For example, "1.0/2.0" indicates a sample collected from an interval of 1.0 to 2.0 foot bml.

Example

OU6-SS-001-1.0/2.0 is a subsurface sediment sample collected from soil core location 1, collected from an interval of 1.0 to 2.0 foot bml.

Aqueous Samples

Seep samples will be identified as follows:

[Site]-[Media]-[Station Location]-[Date]

Where:

[Site] = The site references the OU6 Asarco Sediments Superfund Site, which will be identified as "OU6" on the sample.

[Media] = This refences the media sampled:

- Seep Water "SW"

[Date] = This identifier indicates the date the sample was collected. The date will be identified using a MMDDYY format.

Example:

OU6-SW-SP01-101624 is a groundwater seep sample collected from seep location SP-01 on October 16, 2024.

Investigation-derived Waste Samples

IDW samples will be identified as follows:

[Site]-[IDW]-[Media]-[Date]

Where:

[Site] = The site references the OU6 Asarco Sediments Superfund Site, which will be identified as "OU6" on the sample.

[IDW] = This indicates the sample is an IDW sample.

[Media] = This refences the media sampled, or "SO" for soil and "W" for liquid.

[Date] = This identifier indicates the date the sample was collected. This is required for IDW samples because multiple IDW samples may be collected in a day. The date will be identified using a MMDDYY format.

Example:

- OU6-IDW-SO-101624 is a soil IDW sample collected on October 16, 2024.
- OU6 -IDW-W-101624 is a liquid IDW sample collected on October 16, 2024.

Field Quality Assurance and Quality Control Samples

Field QA/QC samples will be identified using the following:

- EBs that are not associated with an individual station location are numbered sequentially and are identified by the first two letters of the station location code.
- FDs will be submitted in the same format as the normal sample, but with "-FD" at the end.
- MS/MSD samples are not identified in the station location identifier but on the chain-of-custody form.

Examples:

- OU6-EB-001 is the first EB collected.
- OU6-SW-SP01-101624-FD is a field duplicate for the groundwater sample collected from seep location SP-01 on October 16, 2024.

Chain-of-custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information in accordance with FOP-07, Superfund Sample Handling and COC Procedures (Appendix A).

Worksheet #28-1—Analytical Quality Control and Corrective Action

Matrix: Seep
Analytical Groups: Total and Dissolved Metals

Concentration Level: Low/Medium
Sampling SOP: FOPs -04, -05
Analytical Method/ SOP Reference: TBD
Sampler's Name: FTL
Field Sampling Organization: CH2M
Analytical Organization: TBD

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI
MB/ICB/CCB	1 per analytical batch	All analytes < QL	Correct problem, then re-prepare and analyze MB and all samples processed with the contaminated blank.	TBD or CLP QA Manager	Representativeness
Serial Dilution	1 per 20 samples	Concentration of reported analytes are > 50 times the MDL and RPD >10%	Correct problem, then re-prepare and analyze the serial dilution and all samples in the affected analytical batch.	TBD or CLP QA Manager	Sensitivity
Internal Standards	Every sample, spiked sample, standard, and MB	Recovery within limits stated in method	Inspect instrument for malfunctions and reanalyze sample.	TBD or CLP QA Manager	Precision

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI
MS/MSD	1 per 20 samples	Concentration of reported analytes are <4 times the spike added. Recovery within limits stated in method and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	TBD or CLP QA Manager	Accuracy/Precision/ Comparability
PDS (ICP Analysis Only)	After any analyte (except silver and mercury) fails serial dilution	Recovery within limits stated in method	If the PDS is outside of accuracy tolerances, flag PDS results.	TBD or CLP QA Manager	Accuracy/Bias
Laboratory Duplicate	1 per analytical batch	< 20%	If the duplicate is outside of accuracy tolerances, flag duplicate results.	TBD or CLP QA Manager	Precision
LCS	1 per analytical batch	Recovery within limits stated in method	Correct problem, then re-prepare and analyze the LCS and all samples in the affected analytical batch.	TBD or CLP QA Manager	Accuracy/Bias/Comparability/ Sensitivity

> = greater than

< = less than

CCB = continuing calibration blank

ICB = initial calibration blank

ICP = inductively coupled plasma

PDS = post-digestion spike

Worksheet #28-2—Analytical Quality Control and Corrective Action

Matrix: Sediment
Analytical Groups: TOC
Concentration Level: Low/Medium
Sampling SOP: FOP-50
Analytical Method/ SOP Reference: TBD
Sampler's Name: FTL
Field Sampling Organization: CH2M
Analytical Organization: TBD

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI
MB/ICB/CCB	1 per analytical batch	All analytes < QL	Correct problem, then re-prepare and analyze MB and all samples processed with the contaminated blank.	TBD or CLP QA Manager	Representativeness
MS/MSD	1 per 20 samples	Recovery within limits stated in method and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	TBD or CLP QA Manager	Accuracy/Precision/ Comparability
LCS	1 per analytical batch	Recovery within limits stated in method	Correct problem, then re-prepare and analyze the LCS and all samples in the affected analytical batch.	TBD or CLP QA Manager	Accuracy
Laboratory Duplicate	1 per analytical batch	RPD within limits stated in method	If the duplicate is outside of accuracy tolerances, flag duplicate results.	TBD or CLP QA Manager	Accuracy/Precision

< = less than

Worksheet #28-3—Analytical Quality Control and Corrective Action

Matrix: Sediment
Analytical Groups: Metals
Concentration Level: Low/Medium
Sampling SOP: FOP-50
Analytical Method/ SOP Reference: TBD
Sampler's Name: FTL
Field Sampling Organization: CH2M
Analytical Organization: TBD

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI
MB/ICB/CCB	1 per analytical batch	All analytes < QL	Correct problem, then re-prepare and analyze MB and all samples processed with the contaminated blank.	TBD or CLP QA Manager	Representativeness
MS/MSD	1 per 20 samples	Recovery within limits stated in method and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	TBD or CLP QA Manager	Accuracy/Precision/ Comparability
LCS	1 per analytical batch	Recovery within limits stated in method	Correct problem, then re-prepare and analyze the LCS and all samples in the affected analytical batch.	TBD or CLP QA Manager	Accuracy
Laboratory Duplicate	1 per analytical batch	RPD within limits stated in method	If the duplicate is outside of accuracy tolerances, flag duplicate results.	TBD or CLP QA Manager	Accuracy/Precision

< = less than

Worksheet #28-4—Analytical Quality Control and Corrective Action

Matrix: Sediment (IDW/Waste Characterization)
Analytical Groups: TCLP RCRA Metals, TCLP VOCs, TCLP SVOCs, and Total PAHs
Concentration Level: Low/Medium
Sampling SOP: FOP-50
Analytical Method/ SOP Reference: TBD
Sampler's Name: FTL
Field Sampling Organization: CH2M
Analytical Organization: TBD

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI
MB/ICB/CCB	1 per analytical batch	All analytes < QL	Correct problem, then re-prepare and analyze MB and all samples processed with the contaminated blank.	TBD or CLP QA Manager	Representativeness
MS/MSD	1 per 20 samples	Recovery within limits stated in method and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	TBD or CLP QA Manager	Accuracy/Precision/ Comparability
LCS	1 per analytical batch	Recovery within limits stated in method	Correct problem, then re-prepare and analyze the LCS and all samples in the affected analytical batch.	TBD or CLP QA Manager	Accuracy
Laboratory Duplicate	1 per analytical batch	RPD within limits stated in method	If the duplicate is outside of accuracy tolerances, flag duplicate results.	TBD or CLP QA Manager	Accuracy/Precision

> = greater than

< = less than

Worksheet #29—Project Documents and Records

This worksheet addresses field records, analytical laboratory records, and project assessment records in Tables 29-1, 29-2, and 29-3, respectively.

Table 29-1. Field Records

Field Records[a]	Generation (Individual/ Organization)	Verification (Individual/ Organization)	Data Format	Storage Location/archival
Field logbooks	Brandon Jones-Stanley/CH2M FTL	Evan Griffiths/CH2M PM	PDF Scan	Hard copies of field records will be temporarily stored at the CH2M project/field office. Field-generated hard copy documents and records will be scanned at the end of each field event and stored electronically on the project SharePoint. Archived records will be maintained on a CH2M SharePoint for 10 years after contract closeout. Hard copy documents and records that cannot be maintained electronically will be archived at a private storage facility for 10 years after contract closeout. Information regarding record retention, standard record management, and tracking practices is outlined in Worksheet #14 Section 14.3. Project records will be maintained and distributed by the CH2M PM. The CH2M PM is responsible for distributing the current copies of project deliverables (including this QAPP) to individuals listed in Worksheets #3 and #5.
Field forms with reported field sample results[b]			PDF Scan	
Field equipment calibration logs			PDF Scan	
Field equipment maintenance, testing, and inspection logs			PDF Scan	
Surveys [c]			PDF Scan, dwg	
Waste profile information			PDF Scan	
Photographs			Electronic, jpg	
Field Instructions			PDF Scan	
QAPP field team recipient signature page			PDF Scan	
Health and safety briefing information	Marty Mudd/CH2M SL	John Culley/CH2M HSM Designee	PDF Scan	
Staff health and safety records			PDF Scan for onsite records or CH2M Human Resources Department database	

Field Records[a]	Generation (Individual/ Organization)	Verification (Individual/ Organization)	Data Format	Storage Location/archival
Copies of the EPA access agreements	Marty Mudd/CH2M Assistant PM	Evan Griffiths/CH2M PM	PDF Scan	
Scribe database	Kodey Eley/CH2M Sample Manager	Elizabeth Monell/CH2M Data Manager and Shannon Olson/CH2M Senior Chemist	Project/Event Scribe	
Sample tracking table			Excel Table	
Air bills			PDF Scans	
Chain-of-custody records			Scribe	
Project database for field data[c]	Elizabeth Monell/CH2M Data Manager	Kari MacGregor/CH2M Database Manager	EQuIS	

[a] Data archiving will be done by CH2M, and data will be stored at a private storage facility for 10 years after contract closeout.

[b] Field electronic data deliverables captured by mobile data collection devices will be reviewed by the SQCM and submitted to the Database Manager for upload to EQuIS.

[c] Surveys include topographic, bathymetric, magnetometer, sub-bottom profiling, and multibeam.

[d] The CH2M Data Manager will upload applicable field electronic data deliverables provided by the field team to EQuIS.

Table 29-2. Analytical Laboratory Records

Analytical Laboratory Records[a]	Generation (Individual/ Organization)	Verification (Individual/ Organization)	Data Format	Storage Location/Archival
Sample receipt, custody, and tracking records	CLP, Subcontracted Laboratories/Laboratory PMs	Kodey Eley/CH2M Project Chemist	PDF Scan	Analytical laboratory records will be provided by the laboratory in electronic format and stored on the CH2M project SharePoint. Analytical laboratory record archiving at project closeout will be completed by CH2M. Archived records will be maintained on a CH2M SharePoint for 10 years after contract closeout. Information regarding record retention, standard record management, and tracking practices is outlined in this QAPP. Project records will be maintained and distributed by the CH2M PM. The CH2M PM is responsible for distributing the current copies of project deliverables (including this QAPP) to individuals listed in Worksheets #3 and #5.
Narrative				
Standard traceability logs				
Equipment calibration logs				
Sample preparation logs				
Run logs				
Equipment maintenance, testing, and inspection logs				
Reported results for standards, QC checks, and QC samples				
Instrument printout (raw data) for field samples, standards, QC checks, and QC samples				
Data package completeness checklists				
Extraction/cleanup records				
Raw data (stored electronically)				
QA review records QC review checklists				
Project database for laboratory analytical data [b]	Elizabeth Monell /CH2M Data Manager	Kari MacGregor/CH2M Database Manager	EQuIS	

[a] The format of the full hard copy data package is described in the LSOPs. The laboratory data package will be organized such that the analytical results are reported on a per analytical batch basis, unless otherwise specified. The laboratory will verify that the quality, content, and format comply with the latest requirements and contract requirements. All data will be provided electronically as a PDF file. Delivery time for data from the laboratory will vary based on project-specific data use.

[b] An EDD is required for laboratory data unless otherwise stated. The laboratory will provide an EDD in the current Universal EDD and EQuIS format. The data will undergo QA reviews prior to being loaded to the project database. In addition to the summary data deliverable, a full-supporting raw data deliverable package is required from the laboratory.

Table 29-3. Project Assessment Records

Project Assessments	Generation (Individual/Organization)	Generation (Individual/Organization)	Data Format	Storage Location/archival
Daily Reports	Brandon Jones-Stanley/CH2M FTL	Evan Griffiths/CH2M PM	PDF Scan	Assessment documents or records will be maintained in electronic format and stored on the CH2M project SharePoint. Assessment record archiving at project closeout will be completed by CH2M. Archived records will be maintained on a CH2M SharePoint for 10 years after contract closeout. Information regarding record retention, standard record management, and tracking practices is outlined in this QAPP. Project records will be maintained and distributed by the CH2M PM. The CH2M PM is responsible for distributing the current copies of project deliverables (including this QAPP) to individuals listed in Worksheets #3 and #5.
Trip Reports			PDF Scan	
QA Review Records	Elizabeth Monell/CH2M Data Manager	Kari MacGregor/CH2M Database Manager	EDD Checker	
Data Verification Reports	Kodey Eley/CH2M Project Chemist	Shannon Olson/CH2M Senior Chemist	PDF Scan	
Sample Tracking Table/Database				
CA Forms				
Data Validation Reports	Kodey Eley/CH2M Data Validator	Shannon Olson/CH2M Senior Chemist	Validation Memorandum (native format) or PDF Scan	

The laboratory data will undergo QA review using CH2M's EQuIS Data Processor checker prior to being loaded to the project database.

Delivery time for data from the laboratory will vary based on project-specific data use.

Project documents and records are managed in in accordance with Federal Acquisition Regulation requirements and the data management approach described this QAPP.

Sample Tracking Program

The EPA Scribe program will be used for field documentation and generation of chains-of-custody. The Scribe data set export will be used to verify EDD completeness. Refer to the EPA Office of Solid Waste and Emergency Response 9240.0-44, *Contract Laboratory Program Guidance for Field Samplers* (EPA 2020a).

Project-specific Deliverables

Project records will be maintained and distributed by the PM. Information regarding record retention, standard record management, and tracking practices is outlined in the QMP (CH2M 2022).

Analytical data will be exported into a format consistent with the EDD format specified by EPA Region 10. Data will be submitted to EPA Region 10 via Scribe.net.

Documentation and reports specified in this QAPP will be retained in Adobe PDF format.

Worksheets #31, #32, and #33—Assessments and Correction Action

Assessments:

Assessment Type[a]	Frequency	Assessment Deliverable	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)	Projected Delivery Date(s)
Field Progress Report	Daily during field activities	Summarizing email	Brandon Jones-Stanley, FTL, CH2M	Evan Griffiths, PM, CH2M will submit daily reports to EPA TOCOR	Daily during field activities
Field Audit by the EPA[c]	TBD	Email/letter with results of audit	Carolyn Huynh, EPA TOCOR or Cindy Fields, QAPP Reviewer, EPA	Evan Griffiths, PM, CH2M	TBD
Operational Readiness Review	Prior to field activities	Operational readiness review checklist	Marty Mudd, SQCM CH2M Evan Griffiths, PM, CH2M Kimberly Amley, Portfolio QAM, CH2M John Culley, HSM Designee, CH2M	Allan Erickson, Regional Lead, CH2M	Prior to mobilization to site
Operational Progress Reviews	Monthly or as determined by CH2M Management	CH2M internal reporting system (Polaris)	Evan Griffiths, PM, CH2M	Allan Erickson, Regional Lead, CH2M	Monthly or as determined by CH2M Management
Project QA Reports/Management Assessment	Varies	Varies	CH2M Management (Varies)	Evan Griffiths, PM, CH2M	Varies
Data Review and Verification	For all analytical delivery packages	Email of deficiencies	QA officer, CLP/MEL QA officer, third-party lab Kodey Eley, Project Chemist, CH2M	Kodey Eley, Project Chemist, CH2M Shannon Olson, Senior Chemist CH2M	After arrival of data from the laboratory and during data verification activities

Assessment Type[a]	Frequency	Assessment Deliverable	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)	Projected Delivery Date(s)
Data Validation	One after all data are validated	Data validation report	Kodey Eley, Data Validator, CH2M	Evan Griffiths, PM, CH2M	21 business days after receipt of validated data
Data Validation Audit	TBD (Up to 10%)	Data validation summary report	Cindy Fields, QAPP Reviewer, EPA	Carolyn Huynh, EPA TOCOR and Evan Griffiths, PM, CH2M	30 business days after receipt of validated data
Data Quality Evaluation Report	One after project completion	Data evaluation Summary report	Kodey Eley, Project Chemist, CH2M Evan Griffiths, PM, CH2M	Carolyn Huynh, EPA TOCOR	45 business days after project completion
Client Feedback	Annually	Contractor performance assessment reporting system	Carolyn Huynh, EPA TOCOR	Evan Griffiths, PM, CH2M	TBD

Assessments and Corrective Action:

Assessment Type[a]	CA Documentation[b]	Person(s) Responsible for Identifying and Implementing CAs (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)	Timeframe for CA
Daily field documentation reviews	Field notes/email	Brandon Jones-Stanley, FTL, CH2M	Evan Griffiths, PM, CH2M	As soon as notification of CA is received
Data review and verification	CA reports and/or updated case narratives and corrected data submissions	Kodey Eley, Project Chemist, CH2M QA officer, CLP/MEL QA officer, third-party lab	Kodey Eley, Project Chemist, CH2M	3 to 5 business days

[a] Internal assessments and CA activities will be completed as outlined in the QMP (CH2M, 2022).

[b] Specific actions that recipients are expected to take will be identified in the report.

Worksheet #34—Data Verification and Validation Inputs

To confirm that scientifically sound data of known and documented quality are used in making environmental decisions, the following three-step data review will be performed. Step I (verification) will confirm that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Step II (validation) will assess whether the sampling and analytical processes comply with the contract-specific and the QAPP-specific requirements. Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made. Worksheets #34 to #37 describe the processes to be followed. Worksheet #34 establishes the procedures that will be followed to verify project data including sampling documents and analytical data package. The items subject to verification and validation are listed in the following table.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Field SOPs	X	
3	Laboratory SOPs	X	
4	Laboratory certifications and detection limits	X	X
5	Scopes of Work	X	
Field Records			
6	Field logbooks	X	X
7	Boring logs	X	X
8	Field forms	X	X
9	Chain-of-custody forms	X	X
10	Waste manifests and/or disposal records	X	X
Analytical Data Package			
11	Cover sheet (laboratory identifying information)	X	X
12	Case narrative	X	X
13	Internal laboratory chain-of-custody	X	X
14	Sample receipt records	X	X
15	Sample chronology (date/time of receipt, date/time of prep, date/time of analysis)	X	X
16	QL/MDL establishment and verification	X	X
17	Standards traceability	X	X
18	Instrument calibration records	X	X
19	Definition of laboratory qualifiers	X	X

Item	Description	Verification (completeness)	Validation (conformance to specifications)
20	Results reporting forms	X	X
21	Laboratory and field QC sample results	X	X
22	Electronic laboratory report	X	X
23	Documentation of data quality issues and their resolution, including CAs	X	X
24	EDD	X	X

Worksheet #35—Data Verification Procedures

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field Notes/Logbook	Verify that records are present and complete for each day of field activities. Verify boring logs. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements.	Internal	Brandon Jones-Stanley, FTL, CH2M Marty Mudd, SQCM, CH2M Evan Griffiths, PM, CH2M
FOPs	Verify that the sampling FOPs were followed.	Internal	Marty Mudd, SQCM, CH2M
Chain-of-Custody and Shipping Forms	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook and sample processing log. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (for example, MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Internal	Marty Mudd, SQCM, CH2M Scribe Staff, CH2M Kodey Eley, Project Chemist, CH2M
LSOPs	Verify that the analytical SOPs were followed.	Internal/External	QA officer, CLP/MEL QA officer, third-party lab Kodey Eley, Project Chemist, CH2M

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Laboratory Data	All laboratory data packages will be verified externally by the laboratory performing the work for completeness and technical accuracy prior to submittal. As the first step in the data verification process, 100% of the data will be examined to determine the usability of the EDD and PDF results. Specifically, a comparison of the PDF to the EDD and the completeness of the data package will be reviewed and verified. If a data package is determined to be unusable, the evaluator will immediately notify the laboratory PM or QA manager and the PM. Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the chains-of-custody to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present. The data verification will be conducted to assess the quality and defensibility of the data and to check the chain-of-custody forms. The CH2M chemist will review the validated analytical results against the DQOs to assess whether the data are acceptable.	Internal/External	QA officer, CLP/MEL QA officer, third-party lab Kodey Eley, Project Chemist, CH2M

Worksheet #36—Data Validation Procedures

The objective of the data validation is to assess the performance associated with the analysis to determine the quality of the data. Data validation will be accomplished by evaluating whether the collected data comply with the predefined project requirements (including method, procedural, or contractual requirements) and by comparing the collected data with criteria established based on the project DQOs.

All types of data, including screening data and definitive data, are relevant to the usability assessment. A validation summary is provided in Table 36-1. Sections 36.1 through 36.7 focus on the data review requirements for definitive data only.

Table 36-1. Validation Summary

Matrix	Analytical Group	Required Deliverable	Validation Percentage	Validation Criteria	Data Validator (title and organizational affiliation)
Sediment	Select Metals, TOC	Stage 4 Data Report and EQuIS compatible EDD	100%	Electronic and/or Manual Stage 2B[a] validation in accordance with the EPA National Functional Guidelines[b,c], LSOPs, and QAPP criteria	CH2M chemist independent from field sample collection
Sediment	Grain Size, Percent Solids, Atterberg Limits	Standard PDF and/or excel output	100% of the data will be reviewed for completeness	Manual Stage 1[a] validation in accordance with LSOPs and QAPP criteria	CH2M chemist independent from field sample collection
Seep	Select Metals, TOC	Stage 4 Data Report and EQuIS compatible EDD	100%	Electronic and/or Manual Stage 2B[a] validation in accordance with the EPA National Functional Guidelines[b,c], LSOPs, and QAPP criteria	CH2M chemist independent from field sample collection
IDW/Waste Characterization–Soil	TCLP RCRA metals, TCLP VOCs, TCLP SVOCs, and Total PAHs	Stage 4 Data Report and EQuIS compatible EDD	100% of the data will be reviewed for completeness	Electronic and/or Manual Stage 1[a] validation in accordance with LSOPs and QAPP criteria	CH2M chemist independent from field sample collection

Matrix	Analytical Group	Required Deliverable	Validation Percentage	Validation Criteria	Data Validator (title and organizational affiliation)
IDW/Waste Characterization - Aqueous	TCLP RCRA metals, TCLP VOCs, TCLP SVOCs, and Total PAHs	Stage 4 Data Report and EQuIS compatible EDD	100% of the data will be reviewed for completeness	Electronic and/or Manual Stage 1[a] validation in accordance with LSOPs and QAPP criteria	CH2M chemist independent from field sample collection

[a] Stage 1 or 2B in accordance with *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA 2009)

[b] EPA 2020b

[c] EPA 2020c

36.1 Data Verification/Validation Scope Overview

A CH2M chemist independent from field sample collection will perform a Stage 2B data validation in accordance with the *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA 2009), the site-specific QAPP, and LSOPs on 100 percent of the laboratory-generated data from CLP/MEL and subcontracted laboratories. Data from CLP will undergo an electronic review by EPA QA chemists. Data from MEL will undergo validation by MEL chemists equivalent to Stage 4. The EPA Functional Guidelines (EPA 2020b, 2020c) will be used as guidance for this data validation. The CH2M chemist will validate all field QC sample results (field blanks and FDs) and apply data qualifiers as necessary. The CH2M chemist will perform a Stage 1 validation on the IDW data in accordance with the *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA 2009). Additionally, a 10 percent comparison between the validated results and laboratory-issued EDD will be performed to confirm accuracy.

36.2 Field Data Review

Field-generated information may include field logbooks, sample chain-of-custody forms, shipping documents, photographs, sampling observations, sample labels, Scribe exports, and other miscellaneous field observations. All field measurements and or field log information will be entered into field logbooks and digital data capture (data dashboard) and reviewed daily by the SQCM or designee. The designee may be a qualified field geologist, engineer, environmental scientist, and/or technician.

36.3 Laboratory Data Review Requirements

All analytical data generated by the laboratory will be verified before submittal to the CH2M Project Chemist. The internal data review process, which is multitiered, will include all aspects of data generation, reduction, and QC assessment. In each laboratory analytical section, the analyst performing the tests will review 100 percent of the definitive data. After the analyst's review has been completed, 100% of the data will be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria. Elements for review or verification at each level include the following:

- Sample receipt procedures and conditions
- Sample preparation, temperature, and analytical holding times
- Appropriate SOPs and analytical methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Documentation completeness (for example, all anomalies in the preparation and analysis have been identified, appropriate CAs have been taken and documented in the case narrative[s], associated data have been appropriately qualified, and anomaly forms are complete)
- Accuracy and completeness of data deliverables (PDF and electronic)

36.4 Laboratory Data Evaluation

The calibration, QC, CAs, and flagging requirements for definitive data are shown in Worksheets #12, #15, #24, and #28. The laboratory may apply data qualifiers based on its review or add a note in the laboratory case narrative. The definitions of any data qualifiers applied by the laboratory must be defined in the case narrative. Data qualifiers should be applied by the laboratory as part of their internal validation activities. Flagging criteria apply when acceptance criteria are not met and CAs were not successful or not performed. The data qualifiers are reviewed by the supervisor of the respective analytical sections after the first and second level reviews of the laboratory data have been performed.

The CH2M Project Chemist or qualified designee will subsequently evaluate the flags applied by the laboratory as part of their data review and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification will be provided.

36.5 Data Verification Guidelines

The CH2M Project Chemist will review the data verification performed by the laboratory for completeness and accuracy. Data verification may be done electronically or manually, or by a combination of both. The verification process includes the following:

- Sampling documentation (such as the chain-of-custody form)
- Preservation summary and technical holding times
- Presence of all analyses and analytes requested
- Use of the required sample preparation and analysis procedures
- The method detection and quantitation limits evaluated against the project requirements
- The correctness of the concentration units
- Case narrative

36.6 Data Validation Guidelines

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic process of evaluating the compliance of the data with the predefined requirements of the project (including method, procedural, or contractual requirements) and compliance of the data against criteria based on the quality objectives documented in this QAPP. The purpose of data validation is to assess the performance associated with the analysis to determine the quality of the data. Data validation includes a determination of the reasons for any failure to meet performance requirements, and an evaluation of the impact of such failures on the usability of the data. The Project Chemist may add or delete data qualifier flags during validation. Data validation guidelines have been developed in accordance with the method requirements, professional judgment, and general EPA National Functional Guidelines requirements (EPA 2020b, 2020c).

The following information will be reviewed as part of a Stage 2B type data validation:

- Chain-of-custody documentation
- Preservation, temperature, and analytical holding time
- QC sample frequencies
- MBs
- LCS

- MS/MSDs (where applicable)
- Internal standards (where applicable)
- Serial dilutions (where applicable)
- Post-digestion spikes (where applicable)
- Calibration blanks (where applicable)
- Laboratory duplicates (where applicable)
- Initial and continuing calibration information
- FD precision
- Case narrative review and other method-specific criteria

The verification and validation process will be performed by a combination of electronic and manual methods and includes data flagging for issues related to MBs, LCSs, FDs, holding time, and reconciliation of dilutions and re-extractions. Data flags, as well as the reason for each flag, are entered into an electronic database and made available to the data users. A final flag is applied to the data by the data validator/chemist after evaluating all flags entered into the database and selecting the most conservative of the validation flags.

If, during the data review and verification process, a systematic problem or other major issue with the data is identified, the data validator/chemist will contact the laboratory's PM or QA Manager. Additional evaluation of the data may be performed including an in-depth review of the raw data to verify accuracy followed by analysis and interpretation of the data in the context of the project objectives and end-use as part of the usability assessment.

A data quality evaluation (DQE) report will be prepared summarizing the findings and discussing their impact on data usability. It will be incorporated into the final data evaluation summary report.

36.7 Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, J, J+, J-, UJ, and U. Their definitions are summarized in Table 36-2.

Table 36-2. Verification/Validation Data Qualifiers

Qualifier	Description
R	The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision-making.
J	Estimated: The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria.
J+	Estimated high: The analyte was positively identified; the quantitation is a high estimation because of discrepancies in meeting certain analyte-specific QC criteria.
J-	Estimated low: The analyte was positively identified; the quantitation is a low estimation because of discrepancies in meeting certain analyte-specific QC criteria.
UJ	Estimated: The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.
U	Undetected: The analyte was analyzed for, but not detected.

Table 36-3 presents the general data validation guidelines with consideration to the EPA National Functional Guidelines to be used for applying the data qualifiers to the samples.

Table 36-3. Data Qualifying Conventions—General

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time	Time exceeded for extraction or analysis	J for positive results; R or UJ for nondetects[a]	All analytes in the sample
Sample Preservation	Sample not preserved (if sample preservation was not done in the field but was performed at the laboratory upon sample receipt, no flagging is required)	J for positive results; R or UJ for nondetects[a]	Sample
Sample Integrity	Temperature out of control	J for positive results; R or UJ for nondetects[a]	Sample
Initial Calibration	All analytes must be within method specified criteria	J for positive results; R or UJ for nondetects[a]	All associated samples in analysis batch
Second Source Check or Continuing Calibration	All analytes must be within method specified criteria	High Bias: J for positive results, no flag for nondetects Low Bias: J for positive results, UJ for nondetects R for all nondetects greater than twice the control criteria	All associated samples in analysis batch
Low-level Calibration Check or Interference Check Sample	All analytes must be within 20% of expected value	High Bias: J for positive results, no flag for nondetects Low Bias: J for positive results, UJ for nondetects R for all nondetects greater than twice the control criteria	All associated samples in analysis batch
Internal Standards	Area/Retention Time > upper control limit Area/Retention Time < lower control limit	J for positive results, no flag for nondetects J for positive results; UJ for nondetects	Sample
LCS	% R > upper control limit %R < lower control limit %R < 10%	J for positive results, no flag for nondetects J for positive results; UJ for nondetects J for positive results; R for nondetects	The specific analyte(s) in all samples in the associated batch

QC Requirement	Criteria	Flag	Flag Applied To
Blanks (FB & EB)	Analyte(s) detected (use the blank of the highest concentration)	If blank contamination is ≥ the QL, U flag sample results < the QL or ≥ the RL but < the blank concentration and report the result at the QL. If blank contamination is < the QL, U flag the sample results < the QL and report the result at the QL.	All samples in preparation, field, or analytical batch, whichever one applies
FDs	RPD > 30% (for sediment) RPD > 25% (for groundwater)	J for positive results, no flag for nondetects	The specific analyte(s) in the associated sample Note: No flagging is required for results less than the QL
Laboratory Duplicates	RPD > 20%	J for positive results, no flag for nondetects	The specific analyte(s) in the associated sample
MS/MSD and Post-digestion Spikes	%R > upper control limit %R < lower control limit MS/MSD %R < 10% MS/MSD RPD > 30% Sample concentration > 4 times the spike concentration Excessive dilution[a]	J for positive results, no flag for nondetects J for positive results; UJ for nondetects J for positive results; R for nondetects J for positive results, no flag for nondetects No flag required No flag required	The specific analyte(s) in the parent sample
Serial Dilutions	All analytes must be within 10% of expected value Sample concentration < 50x MDL	J positive results, UJ for nondetects No flag required	The specific analyte(s) in the parent sample
Retention Time Window	Analyte within established window	R for all results	Sample

[a] Based on analyte-specific review

> = greater than

≥ = greater than or equal to

< = less than

FB = field blank

Worksheet #37—Data Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether project execution and resulting data meet the project DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

Sections 37.1 through 37.4 summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision-making for the project. These sections describe how data quality issues will be addressed and how limitations of the use of the data will be handled.

37.1 Summary of Usability Assessment Processes

Data gaps may be present if (1) a sample is not collected, (2) a sample is not analyzed for the requested parameters, or (3) the data are determined to be unusable. The need for further investigation will be determined on a case-by-case basis, depending on whether data can be extrapolated from adjacent sample locations, and whether the data are needed based on the results from adjacent sample locations.

The CH2M Project Chemist and the laboratory will confirm that the collected data meet the limits of detection, limits of quantitation, and laboratory QC limits specified in this document. During the data validation assessment, nonconformances will be documented, and data will be qualified accordingly. The CH2M Project Chemist will determine whether the data are usable based on the requirements specified in this document.

The data as qualified by the validator/Project Chemist are considered usable, with the exception of rejected data. Estimated and/or biased results are considered usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and/or senior technical consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defendable manner.

37.2 Evaluation Procedures to Assess Project-specific Overall Measurement Error

Overall measurement error is normally associated with both sampling design and quality and quantitative measures performed in both the field and laboratory. In-depth assessment will be performed during the data review and validation processes to assess conformance with the field SOPs, LSOPs, and objectives of this document. Qualifiers will be used to indicate overall usability of the data.

37.3 Personnel Responsible for Performing Usability Assessment

- Project Chemist, CH2M
- PM, CH2M
- FTL and SQCM, CH2M
- Various SMEs, CH2M

37.4 Usability Assessment Documentation

The results will be assembled and reported for an overall quality assessment in the final data evaluation summary report. QC issues and overall usability of the data, including any biases, will be included in a DQE report, which will be provided as an appendix to the final data evaluation summary report. The DQE will identify precision and accuracy exceedances with respect to the laboratory QA/QC performance for each batch of samples, as well as comparability of FDs and laboratory duplicates. Discussion will cover PARCCS criteria as described in Sections 37.4.1 through 37.4.6.

37.4.1 Precision

Precision is the measurement of the variability associated with the sampling and analytical process. It is determined by analysis of duplicate field and/or laboratory samples and measures variability introduced by both the laboratory and field operations. FD samples should be analyzed to assess field precision at a frequency as described in Worksheet #20 (Field QC Sample Summary). Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses, such as laboratory duplicate and LCS/LCS duplicate samples. Multiple LCS analyses over the duration of the project can also be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

The required control limits for LCS duplicate and laboratory duplicate precision for each method, matrix, and analyte are provided in Worksheet #12. For duplicate sample results, the precision is evaluated using the RPD. For replicate results, the precision is measured using the relative standard deviation. The formula for the calculation of RPD is as follows:

If calculated from duplicate measurements:

$$RPD = \frac{(C_1 - C_2)\, x\, 100\%}{(C_1 + C_2) / 2} \quad (1)$$

Where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use RSD rather than RPD:

$$RSD = (s / \bar{y})\ x\ 100\% \quad (2)$$

Where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation, S, is defined as follows:

$$S = \sqrt{\sum_{i=1}^{n} \frac{(yi - \bar{y})^2}{n-1}} \quad (3)$$

Where:

S	=	standard deviation
yi	=	measured value of the ith replicate
$\bar{y}$	=	mean of replicate analyses
n	=	number of replicates

37.4.2 Accuracy

Accuracy reflects the total error associated with a measurement. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. Analytical accuracy is measured by comparing the %R of analytes spiked into an LCS and/or MS to a control limit.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included as *%R* from pure and sample matrices. Accuracy requirements are listed for each method, matrix, and analyte in Worksheet #12.

The formula for the calculation of accuracy is included as follows as percent recovery:

$$\%R = 100\% \; x \left[\frac{S - U}{C_{sa}} \right] \quad (4)$$

Where:

$\%R$	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{sa}	=	actual concentration of spike added

For situations where a standard reference material is used instead of or in addition to matrix spikes:

$$\%R = 100\% \; x \left[\frac{C_m}{C_{sm}} \right] \quad (5)$$

Where:

$\%R$	=	percent recovery
C_m	=	measured concentration of standard reference material
Csm	=	actual concentration of standard reference material

37.4.3 Representativeness

Representativeness is a qualitative term that refers to the degree in which data accurately and precisely depict the characteristics of a population, whether referring to the distribution of contaminant within a sample, a sample within a matrix, or the distribution of a contaminant at a site. Representativeness is determined by appropriate program design, with consideration of elements such as sampling locations. Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Assessment of representativeness will be achieved through use of the standard field sampling and analytical procedures. Decisions regarding sample locations process and numbers and the statistical sampling design are documented in Worksheets #10, #11, and #17.

37.4.4 Completeness (Statistical)

Completeness is a measure of the amount of valid data obtained compared with the amount expected under correct, normal conditions. It is calculated for the aggregation of data for each analyte measured as a compound of concern for the project objectives. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. The goal for completeness, based on specific project goals, is 90 percent.

Completeness is defined as follows for all measurements:

$$\%C = 100\%\ x\left[\frac{V}{T}\right] \qquad (6)$$

Where:

$\%C$	=	percent completeness
V	=	number of measurements judged valid
T	=	total number of measurements

37.4.5 Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms supports the assessment of comparability. Historical comparability can be achieved through consistent use of methods and documentation procedures throughout the project. Assessment of comparability is considered subjective and the results should be interpreted by experienced environmental professionals with a clear knowledge of the DQOs and project decisions.

37.4.6 Sensitivity

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet project-specific objectives. It is important to be able to detect the target analytes at the levels of interest. Sensitivity requirements include the establishment of various limits such as calibration requirements, instrument MDLs, and QLs. The project QA/QC on method requirements has been established to be compliant with the EPA National Functional Guidelines (EPA 2020b, 2020c). Project-specific QLs are established in Worksheet #15 based on PAL objectives.

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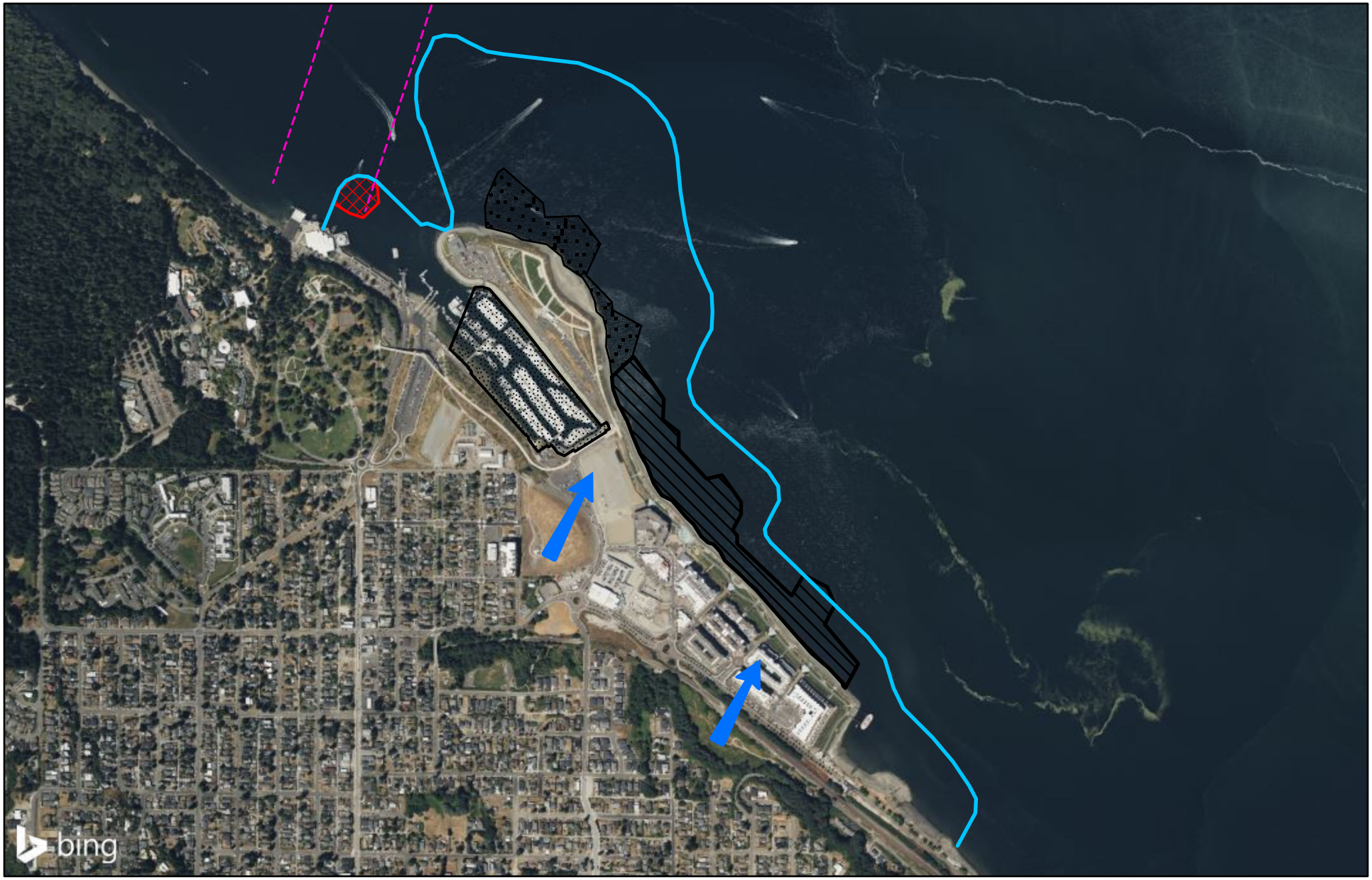
Figures



LEGEND

- Groundwater Flow
- Moderate Impact Area
- Nearshore Cap by Point Ruston
- Northshore Area
- Breakwater Peninsula Area
- Yacht Basin
- Cable Area

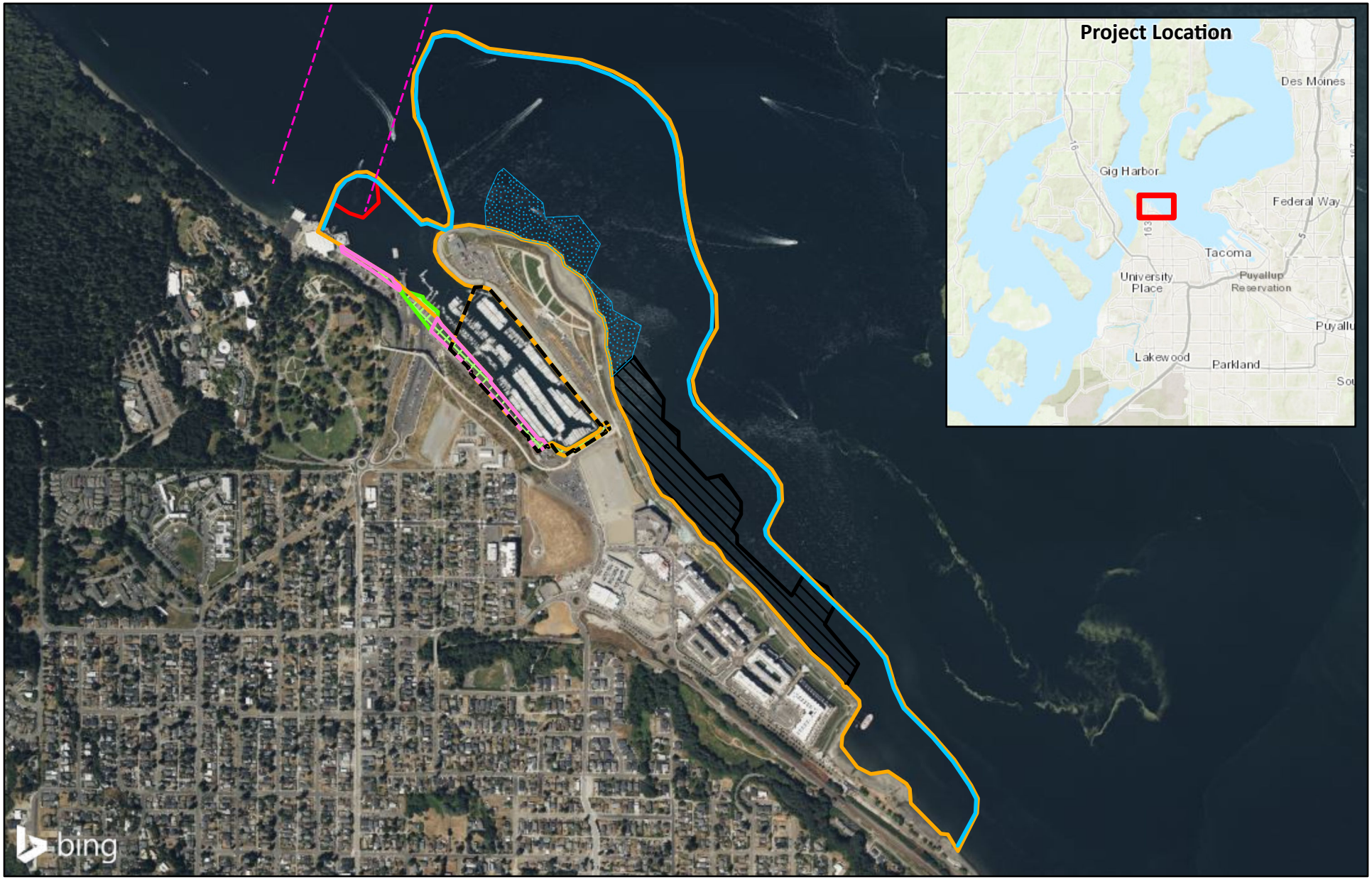
N

0 1,600 Feet

Scale: 1:20,000 1 in. = 1,667 ft.

Figure 10-1
Marine Sediment Remedy
ASARCO Operable Unit 6
Tacoma, Washington

ch2m



LEGEND

- Sediment Sampling and Bathymetric Survey Boundary
- Seep Sampling Boundary
- Upland Survey Boundary
- Breakwater Peninsula Area
- Moderate Impact Area
- Northshore Area
- Yacht Basin
- Nearshore Cap by Point Ruston
- Cable Area

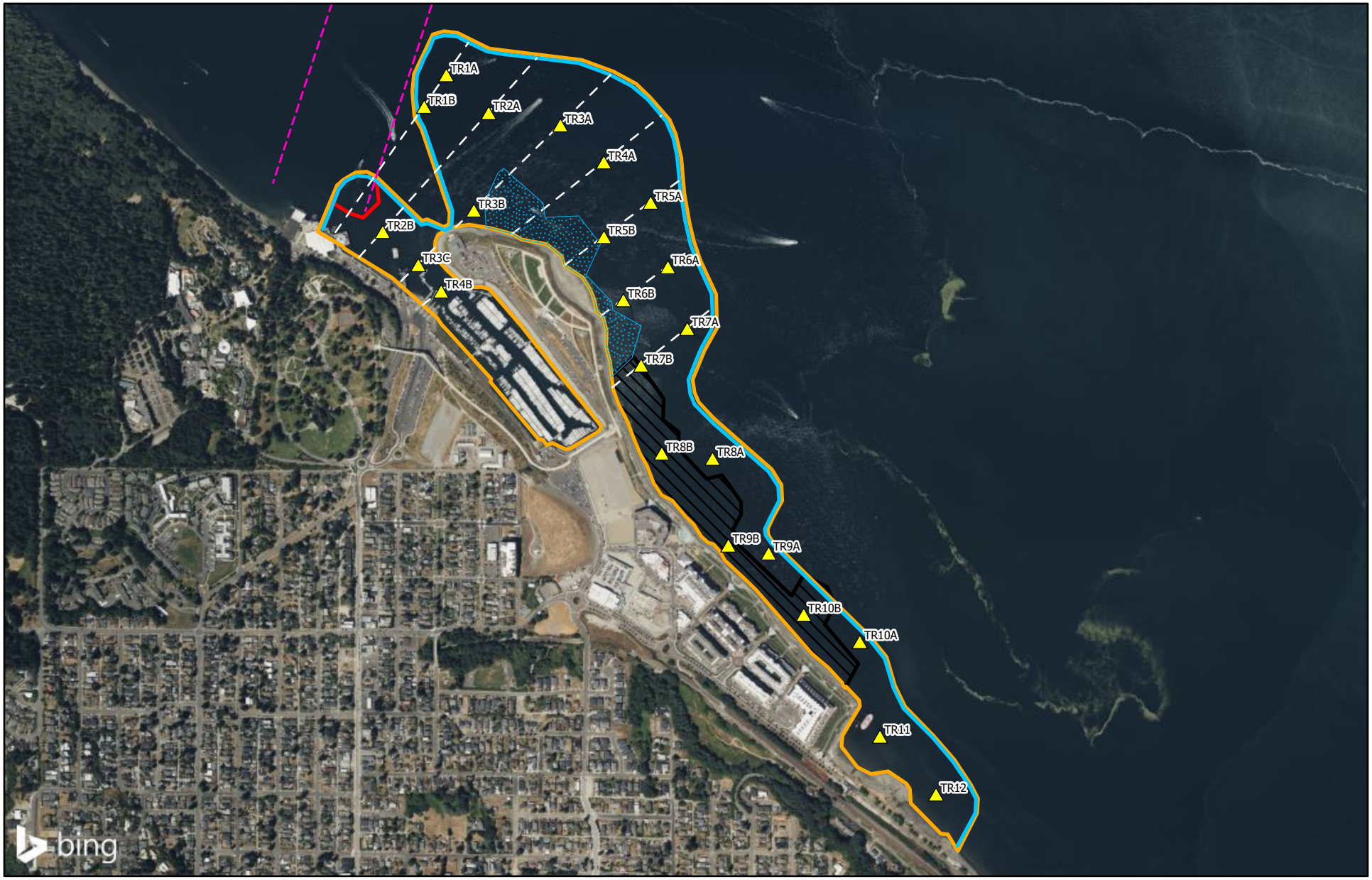
N

0 1,600 Feet

Scale: 1:20,000 1 in. = 1,667 ft.

Figure 11-1
Site Layout
ASARCO Operable Unit 6, Tacoma, Washington

ch2m



LEGEND

- Proposed Surface Sediment Sample Locations
- Proposed Sample Transects
- Sampling and Bathymetric Survey Boundaries
- Moderate Impact Area
- Northshore Area
- Breakwater Peninsula Area
- Nearshore Cap by Point Ruston
- Cable Area

N

0 1,600 Feet

Scale: 1:20,000 1 in. = 1,667 ft.

Figure 11-2
Surface Sediment Sample Locations-
Moderate Impact Area
ASARCO Operable Unit 6
Tacoma, Washington

ch2m

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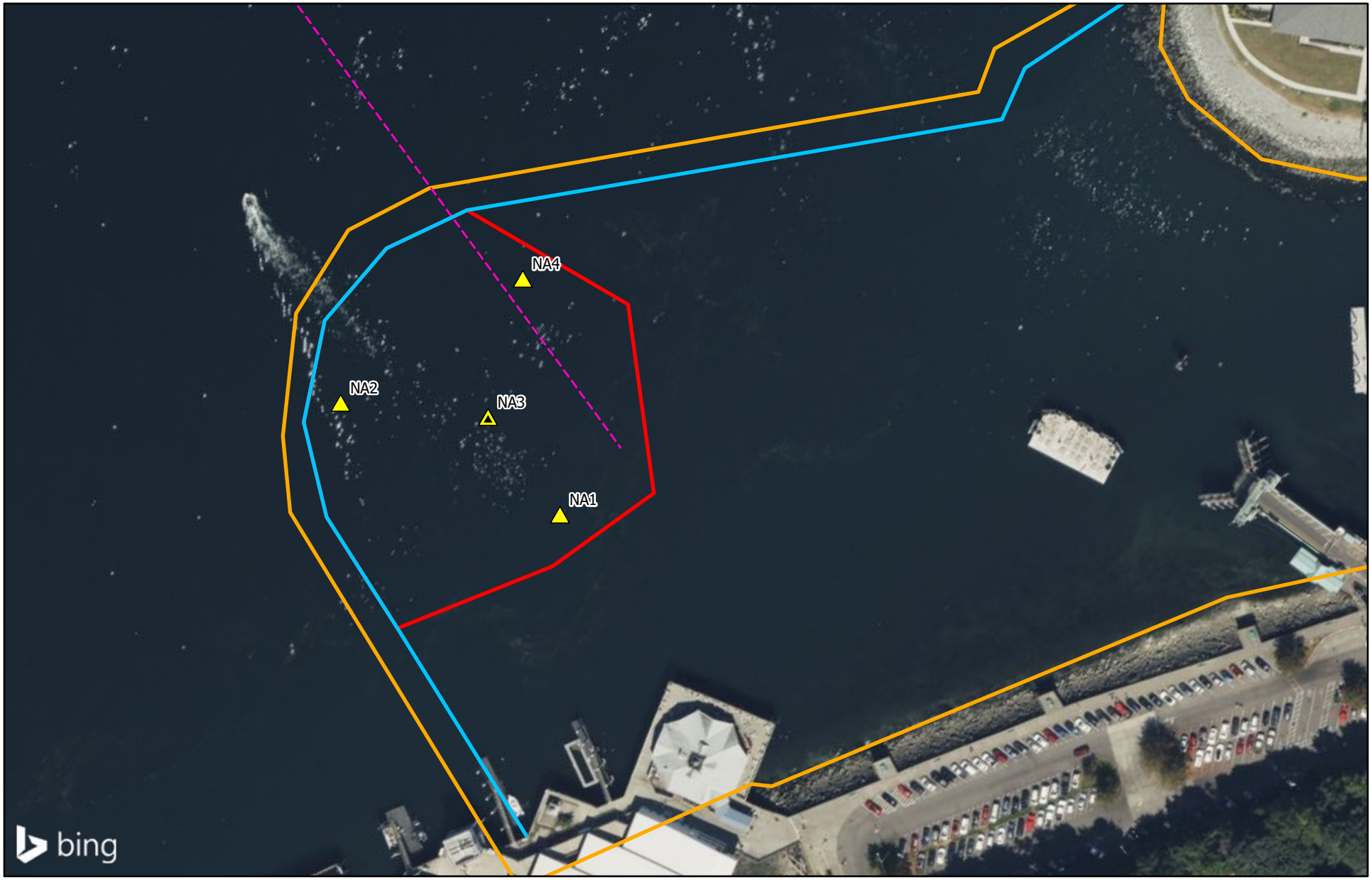

LEGEND

- Proposed Surface Sediment and Core Location
- Core Sample for TCLP Analysis
- Sediment Sampling and Bathymetric Survey Boundary
- Moderate Impact Area
- Northshore Area
- Cable Area

N

0 240 Feet

Scale: 1:2,284 1 in. = 190 ft.

Figure 11-3
Surface Sediment and Core Sample Locations - Northshore Area
ASARCO Operable Unit 6
Tacoma, Washington

ch2m

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LEGEND

- Proposed Surface Sediment and Core Location
- Core Sample for TCLP Analysis

N

0 240 Feet

Scale: 1:3,200 1 in. = 267 ft.

**Points were digitized from Parametrix (2004) and represent the approximate station locations. Locations YB16 and YB18 were slightly adjusted to avoid structures.*

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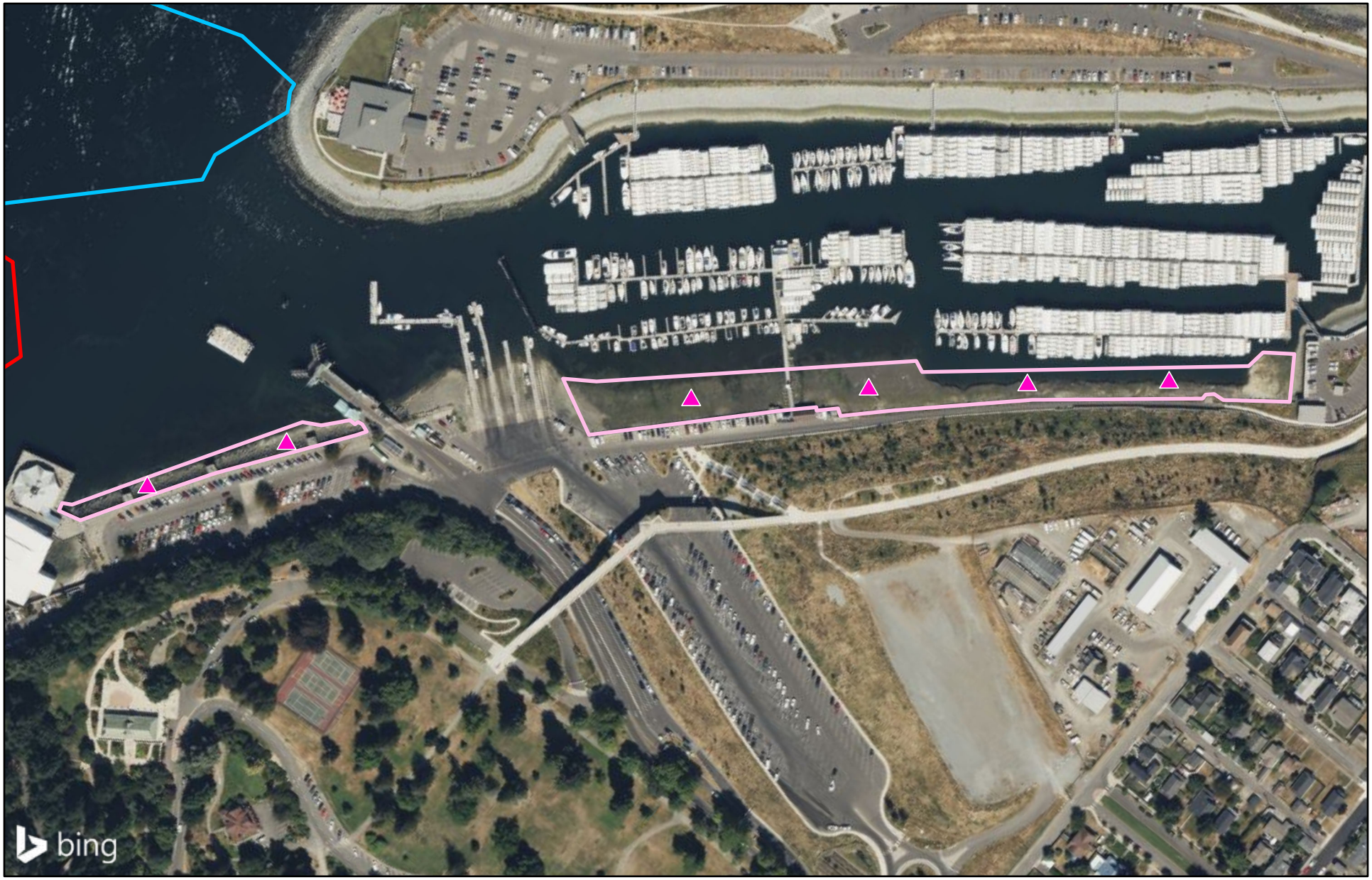
Figure 11-4
Surface Sediment and Core Sample Locations - Yacht Basin
ASARCO Operable Unit 6
Tacoma, Washington

ch2m



LEGEND

- Proposed Conceptual Seep Sample Location
- Moderate Impact Area
- Northshore Area
- Seep Sample Boundaries

Note: Actual seep sample locations will be identified during a site reconnaissance.

0 400 Feet

Scale: 1:4,600 1 in. = 383 ft.

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Figure 5-1
Seep Sample Locations
ASARCO Operable Unit 6
Tacoma, Washington

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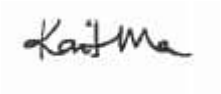
Appendix A
Field Operating Procedures

Field Operating Procedure-01
Note Taking and Field Logbook

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE 01

Note Taking and Field Logbook

1.1 Purpose

This Field Operating Procedures (FOP) presents general guidelines for recording field and sampling information in a field logbook.

1.2 Scope

This is a general description of how to record field and sampling information in a field logbook to support site characterization, risk assessment, and evaluation of remedial alternatives.

1.3 Equipment and Materials

- Field logbook
- Indelible black ink pen
- Write-in-the-rain pen (for extreme weather conditions—cold/rain)

1.4 Procedures and Guidelines

- All information pertinent to a field or sampling effort will be recorded in a bound field logbook that will be initiated at the start of the first onsite activity. The field logbook will consist of a bound notebook with consecutively numbered pages that cannot be removed. The outside front cover of the logbook will contain the project (site) name and the specific activity (for example, supplemental remedial investigation). The inside front cover will include the following:
- Site name and U.S. Environmental Protection Agency task order number
- Project number
- Project Manager's name and mailing address
- Sequential logbook number
- Start date and end date of logbook

Each page will be consecutively numbered, dated, and initialed. All entries will be made in indelible black ink, and all corrections will consist of line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include the following:

- Time of arrival and departure of site personnel, site visitors, and equipment
- Instrument calibration information, including make, model, and serial number of the equipment calibrated
- Description of significant activities for the day

- Documentation of photographs taken during field activities (for example, date, time, and description of photograph)
- Field observations (for example, sample description, weather, unusual site conditions or observations, and sources of potential contamination)
- Detailed description of the sampling location, including a sketch when necessary
- Details of the sample site (for example, coordinates [*x*, *y*], water elevation [*z*], casing diameter and depth, and integrity of the casing)
- Sampling methodology and matrix, including distinction between grab and composite samples
- Names of field team members and subcontractors
- Start or completion time of sample collection activities
- Field measurements (for example, water depths and sediment probe depths)
- Type of sample (for example, sediment, groundwater, surface water, soil, and debris)
- Number, depth, and volume of sample collected
- Field sample number
- Requested analytical determinations
- Sample preservation
- Quality control samples associated with the sample
- Sample shipment information including chain-of-custody form number and laboratory, carrier, date, and time
- Health and safety issues (including level of personal protective equipment)
- Signature and date by personnel responsible for observations

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

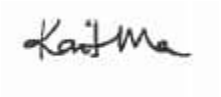
1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-03
Field Water Quality Measurements and Calibration

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE-03

Field Water Quality Measurements and Calibration

1.1 Purpose

This field operating procedure (FOP) provides a general guideline for using the YSI 600XLM or similar device for field water quality measurements such as pH, specific conductance, dissolved oxygen, ORP, and temperature and using a HACH turbidity meter or similar device for measuring turbidity. The operator's manual should be consulted for detailed calibration and operating procedures.

1.2 Scope

All water quality measurements will be taken in accordance with this FOP. Record keeping to document calibration activities and environmental sample results will be documented in the field log book in accordance with *FOP-01 Note Taking and Field Logbook*.

1.3 Equipment and Materials

- Nitrile gloves
- Field Notebook
- YSI 600XLM Water Quality Meter, or similar device
- Distilled or deionized water in spray bottle
- Nonionic detergent in spray bottle
- Calibration standard solution for pH (4, 7, and 10), conductivity, and ORP
- HACH turbidity meter, or similar device

1.4 Procedures and Guidelines

1.4.1 Calibration

Prior to each day's use, clean the YSI probe according to the manufacturer's direction and calibrate using specified solutions. Follow the instructions provided with the water quality meter. If there is a problem with calibration, the meter will return an error. In this case, the cause of the error must be researched in the manual or with the supplier of the equipment before using. Calibrate temperature probe with a laboratory grade thermometer using hot and cold tap water to establish accuracy over a range of temperatures.

Prior to each day's use, confirm calibration of the HACH turbidity meter according to the manufacturer's direction. Turbidity will be measured in NTUs.

1.4.2 Sample Measurement

As the water passes through the probe, allow readings to stabilize and record in the field notebook or on proper documentation sheets.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Verify meters are calibrated
- Clean probe with nonionic detergent such as Alconox® Powdered Precision Cleaner and rinse with deionized or distilled water before calibrating, between calibration fluids, and when done
- Refer to operations manual for recommended maintenance
- Check batteries, and have a replacement set on hand
- Store the YSI probe must be stored in non-deionized water when not in use to prevent damage to the DO membrane. If the membrane is damaged, the replacement method can be found in the manual.
- The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

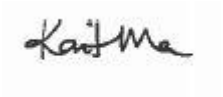
1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-04
Groundwater Sampling Procedures

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE-04

Groundwater Sampling Procedures

1.1 Purpose

This field operating procedure (FOP) presents general guidelines for collecting groundwater or groundwater grab samples from monitoring wells using low-flow sampling techniques. *FOP-02 Water Level and Total Depth Measurements* should be consulted in conjunction with this FOP.

1.2 Scope

This FOP is applicable to low-flow sampling techniques. This FOP does not cover purging and sampling of monitoring wells by bailing or other high-flow methods. Refer project-specific requirements for material or equipment substitutions, as applicable.

1.2.1 Water Quality Indicator Parameters

The six field indicator parameters to be monitored include dissolved oxygen, turbidity, ORP, specific conductance, pH, and temperature. Of the parameters, dissolved oxygen, ORP, specific conductance, pH, and temperature are moderately to extremely sensitive to contact with atmospheric oxygen and will be measured in-line using a flow-through cell. Turbidity also will be measured separately to reduce the influence of suspended solids that are retained in the flow-through cell. Indicator parameters will be monitored continuously during purging and values recorded every 5 minutes or whenever at least one system volume has cycled through the flow cell.

1.2.1.1 Dissolved Oxygen, ORP, Specific Conductance, pH, and Temperature

The stabilization criteria for dissolved oxygen, ORP, specific conductance, pH, and temperature are three successive readings separated by a time interval sufficient to pump at least one sampling tubing volume plus flow-through cell volume of water through the system at a flow rate equal to or greater than 100 milliliters per minute (mL/min) but less than 500 mL/min while not lowering the water level in the well more than 0.3 foot, within the following ranges:

- Dissolved oxygen: ±10 percent for values greater than 0.5 mg/L
- Eh (ORP): ±10 millivolts (mV)
- Conductivity: ±3 percent (micromhos per centimeter (μmho/cm))
- pH: ±0.1 unit
- Temperature: ±3 percent (degrees Celsius,°C)

Note: A minimum of three system volumes must be purged before evaluating whether stabilization criteria are met and purging is complete before sampling.

1.2.1.2 Turbidity

It should be noted that natural turbidity levels in ground water may exceed 5 nephelometric turbidity units (NTU). If the other parameters stabilize but turbidity remains greater than 5 NTUs, field personnel should continue purging at the determined sustainable flow rate until turbidity readings are ±10 percent NTUs. If turbidity does not stabilize, the project manager should be notified. It should be noted that

turbidity measurements may not stabilize within the aforementioned criteria before collecting a sample in accordance with the procedures for purging a low-recovery well.

1.3 Equipment and Materials

- Field logbook and waterproof pen
- Clean latex or nitrile gloves
- New United Nations (UN)-approved 55-gallon steel drums steel drums with labels or other Environmental Manager-approved container
- Clean 5-gallon bucket
- Groundwater pump
  - Adjustable rate, submersible pumps are preferred (centrifugal or bladder pump)
  - Peristaltic pump with portable battery may be used with caution. U.S Environmental Protection Agency (EPA) guidance states that that "suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds."
- Water level meter
- Groundwater quality meter capable of collecting groundwater quality parameters using a flow-through cell (YSI or similar water quality meter; capable of measuring temperature, specific conductance, dissolved oxygen, turbidity, pH, and oxidation-reduction potential [Eh, or ORP] or equivalent)
- Turbidity meter to obtain more accurate turbidity readings
- T connector
- Disposable Teflon tubing
- Disposable silicone tubing (for peristaltic)
- Measuring cup to assess flow rate
- 1-micron filter for dissolved phase target analyte list (TAL) metals sample collection
- Stopwatch
- Equipment/instrument decontamination materials (see *FOP-06 Personnel and Equipment Decontamination Procedures*)
- Laboratory-supplied analytical sample containers

1.4 Procedures and Guidelines

1. Set up and calibrate instruments in accordance with manufacturer's instructions.
2. Decontaminate sampling equipment and other instruments to be placed in the monitoring well riser before sampling in accordance with the *FOP-06 Personnel and Equipment Decontamination Procedures.*
3. Measure the depth to groundwater before performing low-flow sampling, as described in the *FOP-02 Water Level and Total Depth Measurements*. Do not measure the depth to the bottom of the

well at this time in order to reduce the possibility that accumulated sediment in the well will be disturbed. Obtain total well depth from the monitoring well development log, or acquire total depth during water level measurements, but the well should not be sampled the same day as depth to bottom is measured.

4. Place field equipment and supplies on clean plastic sheeting to minimize contamination.
5. Determine the system volume, which is the volume of water that will pass through the tubing in the well, pump, and flow-through cell. A minimum of three system volumes must be purged before evaluating whether stabilization criteria are met and purging is complete before sampling.
6. Follow these procedures if using a peristaltic pump:
    a. Connect the silicone tubing to the peristaltic pump.
    b. Lower the Teflon tubing slowly to the top of the water column. The field team should use a tape measure to measure out the tubing.
    c. Place the Teflon tubing intake at the depth where the highest contaminant concentrations are present. If this depth is unknown, place the tubing intake in the middle of the well screen if the entire length of the well screen is below the potentiometric surface. If the potentiometric surface is within the well screen, the intake should be set approximately 2 feet off the bottom of the well to minimize the intake of fines accumulated on the bottom of the well and maximize the length of water column above the Teflon tubing intake.
    d. Cut the Teflon tubing, secure to the top of the well riser with a clamp, and connect to the silicone tubing in the peristaltic pump. Allow extra tubing in case the water does not recharge as fast as the pumping rate, so the tubing can be lowered farther into the well.
    e. Ensure that the pump flow direction is correct on the peristaltic pump. It is best to verify the flow direction before connecting the Teflon tubing by inserting the silicone tubing in a cup of distilled water.
    f. Connect silicone tubing to the water quality meter flow through cell (bottom connector). Run the outlet tubing (upper connector) to the 5-gallon bucket.
7. Follow these procedures if using a centrifugal pump:
    a. Connect Teflon tubing to pump.
    b. Lower the pump slowly to the required depth, and use a tape measure to measure the tubing.
    c. Place the pump intake at the depth where the highest contaminant concentrations are present. If this depth is unknown, place the pump intake in the middle of the well screen if the entire length of the well screen is below the potentiometric surface. If the potentiometric surface is within the well screen, the intake should be set approximately 2 feet off the bottom of the well to minimize the intake of fines accumulated on the bottom of the well and maximize the length of water column above the tubing intake.
    d. Connect the Teflon tubing to the bottom of the flow through cell. Run the outlet tubing from the upper connector to the 5-gallon bucket.
8. Start pumping. Purge rate should be less than 500 mL/min. Monitor the water level carefully after beginning the pumping process.

9. Turn on the groundwater parameter field instrument and let the readings stabilize. Once temperature has stabilized for 30 seconds, record initial groundwater parameters and depth to groundwater on a groundwater purging and sampling form.
10. Containerize purged groundwater initially in a plastic 5-gallon bucket and subsequently transfer to a 55-gallon steel drum or other labeled storage container.
11. Purge to stability with a total water surface drop of 0.3 foot or less if water level is stable or only slowly dropping, to ensure stagnant water stored in the well casing is not being sampled and that only fresh groundwater is sampled.
12. Monitor carefully if water level has dropped more than 0.3 foot. Consider lowering the purge rate to keep the water level drop to less than 0.3 foot.
13. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.
14. Disconnect the Teflon tubing from the flow-through cell if the well was purged. Groundwater samples must never be collected from the outlet of the flow-through cell. When collecting samples, ensure that the flow rate of the pump is equal to or less than the flow rate used to purge the monitoring well. Collect groundwater samples directly from the outlet of the Teflon tubing starting with volatile organic compound (VOC) samples first.
15. Dissolved phase TAL metals are to be collected by attaching a 1-micron filter to the silicone tubing and purging the water through the filter and into the sample container.
16. Label the sample containers following the collection of groundwater samples, and place the samples in an ice-bearing cooler away from sources of cross-contamination.
17. Remove the Teflon tubing from monitoring well and discard. Secure the well cap and lid on the well immediately after removing the tubing to prevent objects from being dropped in the well.
18. Decontaminate all equipment and instruments in accordance with the *FOP-06 Personnel and Equipment Decontamination Procedures*.
19. Store instruments in accordance with the manufacturer's instructions.
20. Purged groundwater will be handled in accordance with the project-specific plans.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Ensure that the water quality meters are calibrated and cared for in accordance with manufacturer's instructions.
- Keep sampling system and monitoring probes out of direct sunlight.

- Verify dissolved oxygen readings by checking reported dissolved oxygen against a chart and correlating theoretical readings at actual site temperatures. Do not record any dissolved oxygen readings that are outside theoretical limits, such as negative concentrations.
- Check that the flow direction switch on the peristaltic pump is in the correct direction. Flow in the wrong direction may create bubbles in the well riser, thus affecting dissolved oxygen readings.
- Charge battery to peristaltic pump and water quality meter when not in use. Low battery on the water quality meter may not allow unit to connect properly with sonde.
- The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

1.7 Attachments

- Groundwater Purging and Sampling Form.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

EPA. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.* September 19, 2017.

Monitoring Well

Field Data Sheet

Well Number: Field Crew: Purpose of Sampling:

Site: Field Conditions:

WELL CONDITION

Well Pad	Acceptable	Not Acceptable	Explain:
Protective Casing	Acceptable	Not Acceptable	Explain:
Well Casing	Acceptable	Not Acceptable	Explain:
Locking Cap	Acceptable	Not Acceptable	Explain:
Well Label	Acceptable	Not Acceptable	Explain:

PURGE METHOD

Date: Time: Method:

Total Well Depth (ft) =

Depth to Water (ft): =

Water Column (ft): =

1 volume

Comments:

OBSERVATIONS

Odor: None , Low , High , H_2S , Fuel Like , Other:

Comments:

FIELD PARAMETERS

Time	Volume (gal) --	Rate (mL/min) --	pH (s.u.) +/- 0.1 s,u,	DO (mg/L) +/- 10%	ORP (mV) +/- 10 mV	Specific Conductance (mS/cmc) +/- 3%	Temp (^oC) +/- 3%	Turbidity (NTU) <10 NTU	Depth to water (feet) --

SAMPLING

Date: Time:

Sample ID: Method of Sample Collection:

Analytical Parameters:

Q.C. Sample Type: MS/MSD Duplicate Duplicate Sample ID:

Q.C. Parameters:

Trash picked up? Well locked?

SIGNED/SAMPLER:

Field Operating Procedure-05
Field Quality Assurance/Quality Control Sample Preparation

Author: Kimberly Amley 5/4/2022

Author

Approver: Scott Pratt 5/4/2022

Technical Reviewer

FIELD OPERATING PROCEDURE-05

Field Quality Assurance/Quality Control Sample Preparation

1.1 Purpose

The purpose of this field operating procedure (FOP) is to describe the methods for collecting quality assurance (QA)/quality control (QC) samples for soil, water, and air matrices. Not all QA/QC samples presented in this FOP will be required on every project. Refer to project-specific plans for the required QA/QC samples and frequency.

1.2 Scope

The general protocols for preparing QA/QC samples are outlined. These standard procedures may be changed as required, dependent upon site conditions, equipment, or project-specific requirements.

1.3 Equipment and Materials

Generally, the equipment/apparatus required to collect QA/QC samples is the same as the equipment/apparatus required to collect the environmental samples. Refer to the specific FOP for sample matrix-specific information (i.e., sampling procedures, reagents/preservative, and equipment required). QA/QC samples will require some or all of the following equipment:

- Blank liquid (use ASTM International [ASTM] Type II or laboratory-grade water)
- Millipore (or similar) deionized water
- Laboratory-provided performance evaluation (PE) sample
- Sample bottles or canisters as appropriate
- Gloves
- Preservatives as appropriate

1.4 Procedures and Guidelines

The following subsections discuss QA/QC samples for soil, water, and air matrices.

1.4.1 Field Duplicate and Split Samples

Field duplicate and split samples are field samples obtained from one location, homogenized, and divided into separate containers. They are treated as separate samples throughout the sample handling and analytical process. The samples are used to assess precision by comparing analytical results for two parts of the sample from the same location.

Requests from clients, regulatory agencies, or primary responsible parties for split samples should be honored. Split samples are collected following the sample procedures for field duplicate samples using sample containers, blank samples, preservatives, sample courier, chain-of-custody forms, etc. provided by the requesting agency or party.

Field duplicate and split samples must be prepared and analyzed for the same parameters by the same methods to demonstrate the reproducibility of the sampling and analytical techniques. Refer to project-specific requirements for minimum field duplicate and split sample frequency, or if required by the project.

- Aqueous Sample Matrix: Alternatively fill sample containers from the same sampling device for duplicate and split samples of aqueous matrices. Volatile organic compound (VOC) samples should be collected first into two 40-milliter vials until there is a positive meniscus, then seal the vials. Fill containers by alternating between the two sample container sets during filling.
- Nonaqueous Volatiles Sample Matrix: Volatile duplicate samples must be taken before mixing the sample and before collecting any samples for nonvolatile organic analyses. For VOC samples of soil, isolate the depth stratum from which the sample is taken, fill the VOC sample container, and seal the container as quickly as possible.
- Nonaqueous Nonvolatile Sample Matrix: Homogenize (mix) the sample by filling a decontaminated stainless-steel bowl with the collected sample and mixing with a decontaminated stainless-steel instrument. Once mixed, the sample should be divided in half, and the sample containers should be filled by scooping sample material alternatively from each half.
- Air Sample Matrix: Place two identical samplers next to each other, pull air from one source, and split into two canisters with a manifold.

Document and ship samples in accordance with the procedures for other samples.

1.4.2 Equipment Blank Samples

Equipment blanks (also referred to as rinsate blanks) are used to assess the effectiveness of decontamination procedures using laboratory-grade water. Equipment blank samples are collected after decontaminating sampling equipment that has contacted the sample. Refer to project-specific requirements for minimum equipment blank sample frequency, or if required by the project..

To collect an equipment blank for VOC analysis from the surface of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-milliter vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook, as well as the type and lot number of the water used.

For nonvolatiles analyses, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces that contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles. Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decontamination. When decontamination is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

Document and ship samples in accordance with the procedures for other samples.

1.4.3 Collocated Samples

Collocated samples are collected adjacent to the primary field sample to determine variability of the soil and contaminant(s) within a small area. Analytical results are used to assess site variation in the

immediate sample area. Typically, collocated samples are collected between 1 to 3 feet away from the primary sample location.

Collocated air samples are collected by placing two identical samplers next to each other, and either: (1) air is drawn from one source and split with a manifold, or (2) two pumps are set adjacent to each other and each collect a sample at the same flow rate. Depending upon the methods used to collect and analyze the samples, collocated samples can determine the variation due to both sampling error and precision in the analyses (e.g., using thermally desorbed adsorbent tubes), or to isolate the variation due to sampling error only (e.g., using solvent-extracted tubes and Summa canisters).

Collocated samples are collected from the same sample interval, using the same method, and for the same parameters as the primary sample. Refer to the project-specific requirements on the minimum frequency for collocated samples, or if required by the project.

1.4.4 PE Samples

PE samples are used to assess the overall accuracy of the analytical laboratory and detect any bias in the analytical method used. These samples are usually prepared by a third party, using a quantity of analyte(s) that is known to the preparer but unknown to the laboratory. The analyte(s) used to prepare the PE sample is the same as the analyte(s) of concern. Laboratory accuracy is evaluated by comparing the percentage of analyte identified in the PE sample (percent recovery) with the analytical results of the site samples. Refer to project-specific requirements for the minimum frequency of PE samples per analyte of interest per matrix, or if required by the project.

1.4.5 Field Blank Samples

Field blanks are collected for aqueous and air sample matrixes. Field blanks are used to assess potential sources of contamination resulting from exposure to the ambient air. Field blanks are samples that undergo the full handling and shipping process of an actual sample. Field blanks are designed to detect potential sample contamination that may occur during field operations or during shipment. An aqueous sample field blank consists of two identical sets of laboratory-cleaned sample containers. One set of containers is filled at the laboratory with deionized water and the other set is taken to the site empty. At the most contaminated area of the site, pour Millipore or deionized water directly in the empty sample containers. An air sample field blank is opened with the other sampling media, resealed, and carried through the sampling process.

Field blanks are analyzed for the same parameters as site samples. Refer to project-specific requirements for minimum field blank sample frequency, or if required by the project. The field blank must be associated with an actual sampling period. Document and ship field blank samples in accordance with the procedures for other samples.

1.4.6 Trip Blank Samples

Trip blanks (also referred to as travel blanks) are only required for volatile organics analysis and are prepared by the laboratory and shipped with the empty sample containers. Trip blanks are handled, transported, and analyzed in the same manner as the other volatile organic samples. The trip blank shall be placed in the container at the beginning of the day. Trip blanks are used to evaluate contamination error associated with sample handling and shipment, or laboratory handling and analysis. Trip blank contamination indicates the blank water itself was of questionable quality or contamination occurred during transport and/or storage of the samples. Refer to the project-specific requirements for the

minimum frequency of trip blanks per container used to transport volatile organic samples, or if required on the project.

The air matrix trip blank is prepared and added to the site samples after sampling has been completed, just prior to shipping samples for analysis. If the absorbent tubes were sealed from the manufacturer, their seals should be broken at this point. For absorbent tubes that have been recycled and resealed by the laboratory, there is no need to break these temporary seals prior to shipping. Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling. A trip blank for an impinger-based sampling method consists of an aliquot of impinger reagent that is shipped back to the laboratory with the samples. Submit trip blanks at a rate of 5 percent of the total samples or a minimum of one per sampling event, or as outlined in the project-specific requiremetns.

1.4.7 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike (MS)/matrix spike duplicate (MSD) samples are used to assess proficiency on analyte recovery as a function of analyte loss during transport and storage of the collected samples and as a function of the analytical procedures and equipment. MS/MSD samples shall be collected following the same procedure as a field duplicate but at triple volume, Refer to project-specific requirements for minimum MS/MSD sample frequency, or if required by the project.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Verify sampling procedures with project-specific modifications.
- Verify documentation of sufficient volume to collect QA/QC samples.
- Verify QA/QC samples are collected at the requested frequency.
- Do not use non-decontaminated equipment to prepare blank(s).
- Use ASTM-Type II or laboratory-grade water to prepare blank(s).
- Field quality control sample and frequency will be reviewed by the Site Quality Control Manager.

1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-06
Field Personnel and Equipment Decontamination Procedures

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE-06

Field Personnel and Equipment Decontamination Procedures

1.1 Purpose

This Field Operating Procedure (FOP) provides general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially-contaminated environments.

1.2 Scope

This FOP provides a general description of decontamination procedures. Refer project-specific requirements for material or equipment substitutions, as applicable. Wastes will be managed in accordance with *FOP-10 Investigation and Remdiation-derived Waste Management*.

1.3 Equipment and Materials

- Distilled or deionized water
- Nonionic detergent such as Alconox® Powdered Precision Cleaner, 2.5 percent Liquinox, or equivalent phosphate-free detergent and water solution
- Large plastic pails or tubs for nonionic detergent and water, scrub brushes, squirt bottles for detergent solution, resealable plastic bags, and paper towels
- United Nations (UN)-approved 55-gallon steel drum, trash bags, or other approved equivalent for disposal of waste
- Chemical-resistant gloves (that is, nitrile gloves)
- Aluminum foil

1.4 Procedures and Guidelines

This FOP describes the general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

1.4.1 Personnel Decontamination Procedures

The following procedures are to be performed after the completion of tasks, when the potential for contamination exists, and upon leaving the exclusion zone:

1. Wash boots in detergent solution, and then rinse with water. If disposable latex booties are worn over boots in the work area, remove and discard into a UN-approved 55-gallon drum, trash bag, or project-specific approved container.
2. Remove and discard outer chemical-resistant gloves into a UN-approved 55-gallon drum, trash bag, or project-specific approved container.

3. Remove disposable coveralls (Tyveks) and discard into a UN-approved 55-gallon drum, trash bag, or project-specific approved container (if worn).
4. Remove respirator (if worn). Dispose of filter cartridges in a UN-approved 55-gallon drum, trash bag, or project-specific approved container and replace daily.
5. Remove inner gloves and discard in a UN-approved 55-gallon drum, trash bag, or project-specific approved container.
6. Shower entire body at the end of the work day, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

1.4.2 Nondedicated Sampling Equipment Decontamination

Reusable sampling equipment is decontaminated after each use as follows:

1. Wear chemical-resistant gloves.
2. Rinse and scrub with potable water to remove gross contamination, as applicable.
3. Wash all equipment surfaces that come into contact with potentially contaminated soil and water with nonionic detergent solution.
4. Rinse with approved water.
5. Rinse with distilled water.
6. Completely air dry or wipe dry with a clean paper towel. Wrap exposed areas with aluminum foil (shiny side out) and/or enclose equipment in clean plastic for transport and handling if equipment will not be used immediately.
7. Collect all rinsate and place in a UN-approved 55-gallon drum or project-specific approved container.
8. Dispose of decontamination materials (for example, plastic sheeting and tubing) that have come into contact with used decontamination fluids or sampling equipment in UN-approved 55-gallon drum, trash bag, or project-specific approved container.

1.4.3 Health and Safety Monitoring Equipment Decontamination

1. Wrap soil contact points in plastic before use to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with detergent solution, and finally two times with a towel wet with distilled water.
3. Dispose of all used paper towels in a UN-approved 55-gallon drum, trash bag, or project-specific approved container.

1.4.4 Sample Container Decontamination

The outside of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedures for sample container decontamination are as follows:

1. Wipe container with a paper towel dampened with detergent solution, or immerse in the solution after the containers have been sealed. Repeat the above steps using potable water.

2. Dispose of all used detergent solution and paper towels in a UN-approved 55-gallon drum, trash bag, or project-specific approved container, keeping liquids and solids in separate containers.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Record equipment decontamination procedures in the field logbook.
- The Site Quality Control Manager will verify decontamination procedures are performed and documented in the field logbook.

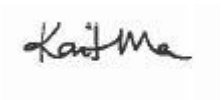
1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-07
Sample Handling and Chain-of-Custody

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE 07

Sample Handling and Chain-of-Custody

1.1 Purpose

This Field Operating Procedure (FOP) defines "custody" and describe protocols for documenting the transfer of custody from one party to the next (for example, from the site to the laboratory). A documented custody trail is established using a U.S. Environmental Protection Agency (EPA) chain-of-custody form that uniquely identifies each sample container, and who has possession of it from the sample's origin to its destination. The chain-of-custody form also describes the sampling point, date, time, and analysis parameters.

1.2 Scope

This is a general description of how to document the transfer of custody of samples from one party to the next. Sample personnel should be aware that a sample is considered n a person's custody if the sample meets the following conditions:

- It is in a person's actual possession
- It is in view after being in a person's possession
- It is locked up so that no one can tamper with it after it has been in physical custody

When samples leave the custody of the sampler, possession must be documented and the cooler must be custody-sealed, if shipped. Data generated from the use of this FOP may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

1.3 Equipment and Materials

- Computer with Scribe software loaded
- Laser printer with paper (8.5 × 11 inch) and ink cartridge (black)
- Printable labels
- Adhesive labels (generated by Scribe software)
- Indelible black ink pen
- Bubble wrap
- 2-gallon resealable plastic bags for ice
- Packing/strapping tape
- Custody seals

1.4 Procedures and Guidelines

1.4.1 Chain-of-Custody Forms

The chain-of-custody form (see Attachment 1 for example) must contain the following information:

- Case Number/Client Number: If a Contract Laboratory Program (CLP) laboratory is used, enter the case number provided by EPA's Regional Sample Control Center Coordinator. If the CLP is not used, enter the SAS number provided by the sample and analytical coordinator.
- EPA Region: Enter Region "5", for example.
- Site Name/State: Enter the site name and state.
- Project Leader: Enter the project manager's name.
- Action: "Remedial Investigation" or "Site Characterization", for example
- Sampling Co.: "CH2M"
- Sample No.: This is the unique number that will be used for sample tracking. For CLP, this number is taken from a block of numbers assigned by the EPA Regional Sample Control Center Coordinator. For non-CLP, the CH2M sample coordinator will assign the number.
- Matrix: Describes the sample media (for example, "Sediment").
- Sampler Name: The name of the sampler or sample team leader.
- Concentration (of chemicals of concern if known, from previous sampling events): Low (L), Low/Medium (M) or High (H).
- Sample type: "Grab" or "Composite."
- Analysis: This indicates the analyses required for each sample.
- Preservative: Document what preservative has been added to the sample (for example, "HCl," "Ice Only," "None").
- Station Location: This is the CH2M Station Location Identifier.
- Sample Collect Date/Time: Use military time.
- Quality Control (QC) Type: This is for field QC only, and includes field duplicates.
- Date shipped: The date that samples are relinquished to the shipping carrier.
- Carrier Name: (for example, "FedEx").
- Airbill: Air bill number used for shipping.
- Shipped to: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use "Sample Custodian".
- Chain-of-Custody Record fields: The sampler's signature must appear in the "Relinquished By" field. The date and time (military time) must also be included.
- Although the samples are "relinquished" to the shipping carrier, the shipping carrier does not have access to the samples if the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the chain-of-custody form.

- Sample(s) to be used for laboratory QC: This identifies which samples are to be used for matrix spike/matrix spike duplicate analyses.
- Indicate if shipment for case is complete: Use “Y” or “N”.
- Chain-of-Custody Seal Number: Record the custody seal numbers that appear on the Regional custody seals, as applicable, that can be found on the shipping container. There is usually a minimum of two per shipping container during shipment.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

1. All sample containers must be properly labeled.
2. Each cooler/box (canisters only) must have a chain-of-custody form, and the samples in the cooler/box (canisters only) must match what is on the chain-of-custody form (as identified by the laboratory-provided sample tags for the canisters).
3. Each chain-of-custody form must be properly relinquished (signature, date, time).
4. If shipped, the custody seal numbers must be written on each chain-of-custody form.
5. The shipping cooler/box (canisters only) must be custody sealed in two places: front and back; coolers/boxes (canisters only) transported by laboratory courier do not require custody seals.
6. Chain-of-custody forms will be completed with required sampling information.
7. If the designated sampler relinquishes samples to other sampling or field crew members for packing or other purposes, the sampler will complete the chain-of-custody form prior to this transfer.
8. Appropriate personnel will sign and date chain-of-custody forms to document the sample custody transfer.
9. Original chain-of-custody forms will be placed in resealable plastic bags and will accompany the shipment; copies will be retained by the sampler for sampling records.
10. If samples are sent by common carrier, bills of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation.
11. Commercial carriers will not be required to sign off on chain-of-custody forms if the forms are sealed inside the sample cooler and the custody seals remain intact.
12. Packaging, marking, labeling, and shipping of samples will comply with the regulations promulgated by the U.S. Department of Transportation in the *Code of Federal Regulations* (49 CFR 171-177).

1.7 Attachments

Attachment 1. Quick Guide to Using Scribe.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

ERT

USER MANUAL for

SCRIBE CLP SAMPLING

TABLE OF CONTENTS

Modification Date: June 11, 2010

INTRODUCTION

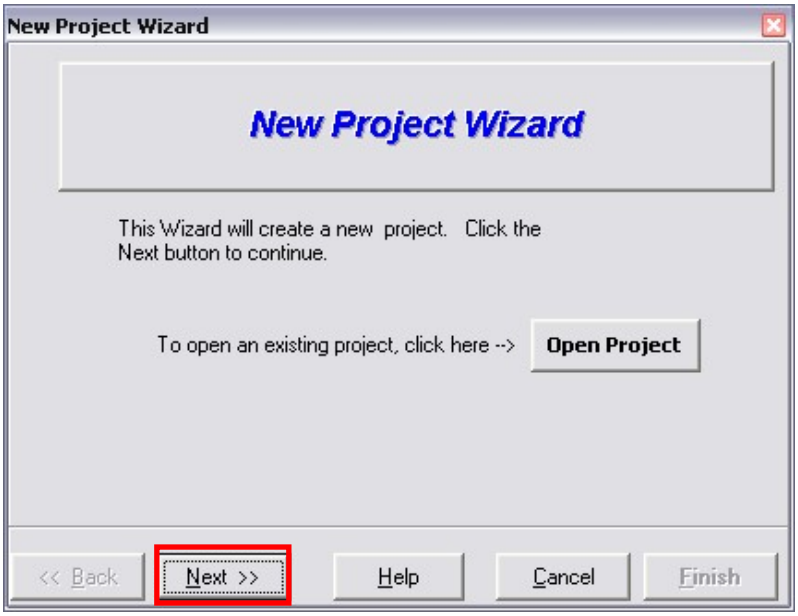
The intent of this User Guide is to provide a basic overview of how to use Scribe to create a new sampling project and manage samples collected for the EPA's Contract Lab Program (CLP). Scribe provides support for CLP sample documentation including the CLP Chain of Custody (COC) reports and the CLP XML format.Query. This document also assumes that the user is already familiar with the Scribe application for sampling. Otherwise, please refer to the Scribe User guides for detailed Scribe application instructions.

Create a New Project

New Project Wizard

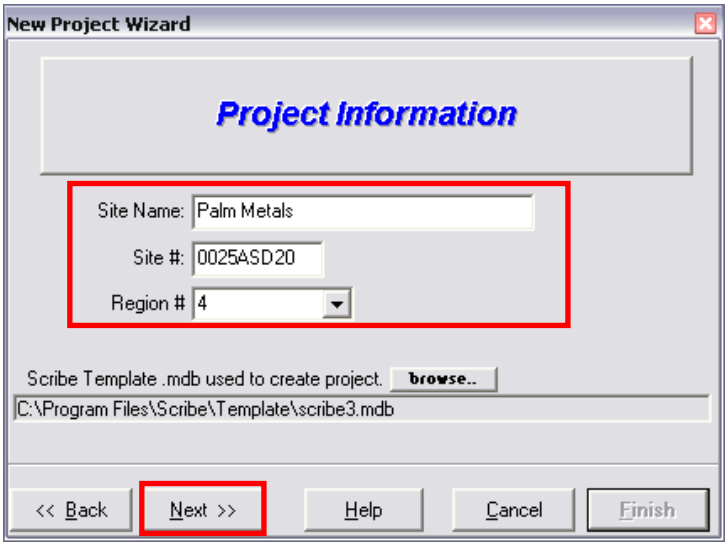
If you are starting Scribe for the first time after installation, the New Project Wizard will run automatically. Otherwise, to create a new project in Scribe:

1. Click on '**File'**.
2. Select '**New Project'**.
3. A New Project Wizard window is displayed.



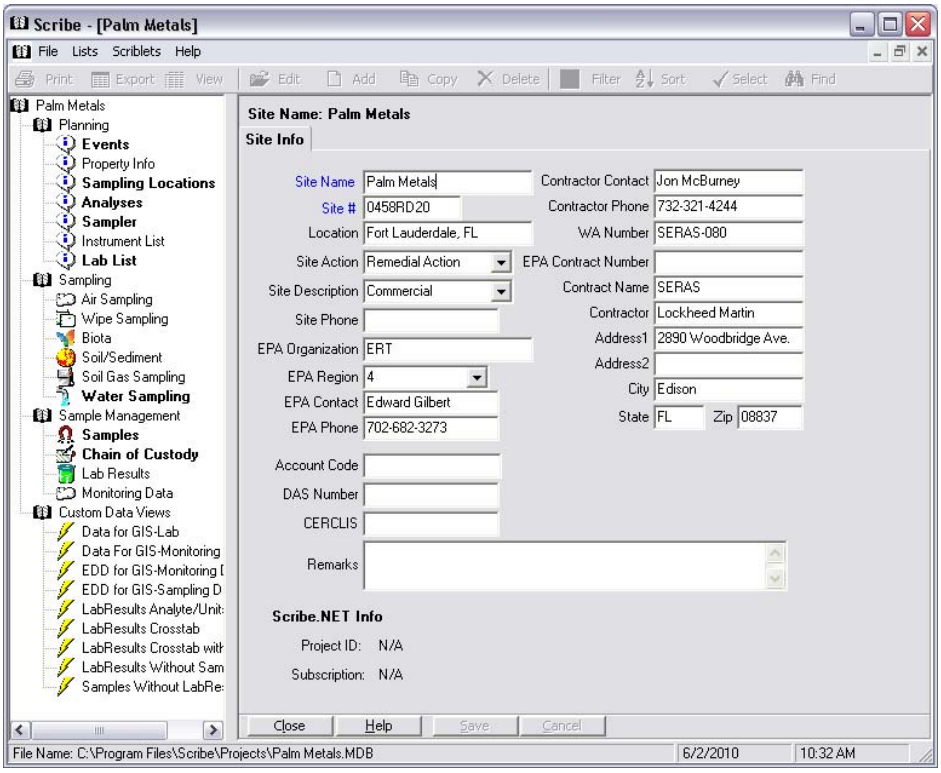
4. Click '**Next'** to continue.

5. Enter the Project Information.



6. Enter the **Site Name**, **Site #** and **EPA Region #**.

7. Click '**Next**' and then click '**Finish**' to create the new project.



The New Project Wizard closes and the "**Site Info**" screen displays. ONLY the field names in **BLUE** are required but we recommend completing as many fields as possible.

CLP SAMPLING IN SCRIBE

CLP Samples

CLP Analyses

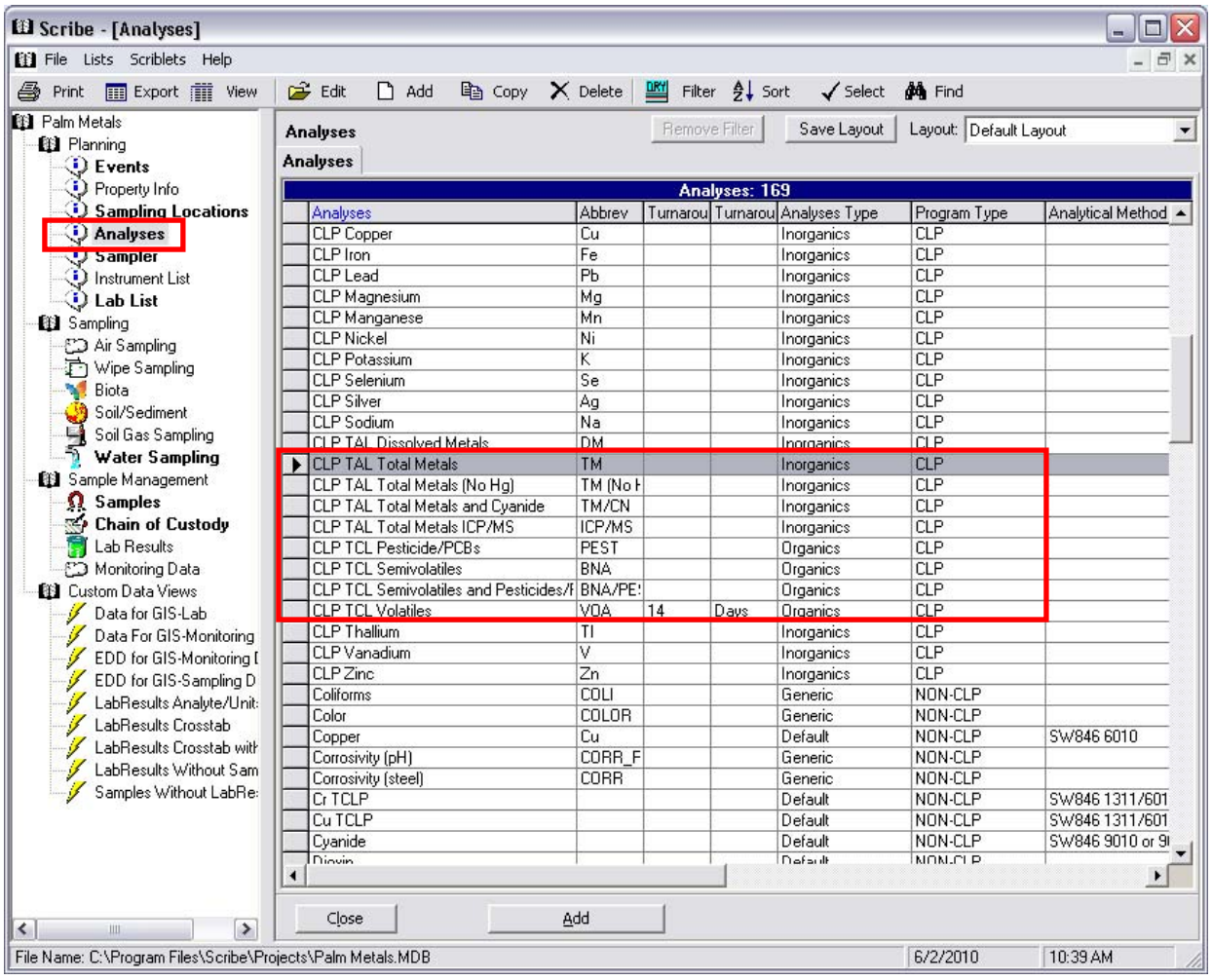
The Scribe Analyses List now includes CLP Analyses. To view or modify the list:

1. Click on "**Analyses**" in the left Navigation Pane. This section is used to manage a list of Analyses including the Program Type and Analysis Type. For example:

   Analysis: CLP TAL Total Metals

   Program Type: CLP

   Analyses Type: Inorganics



CLP/Tag Settings

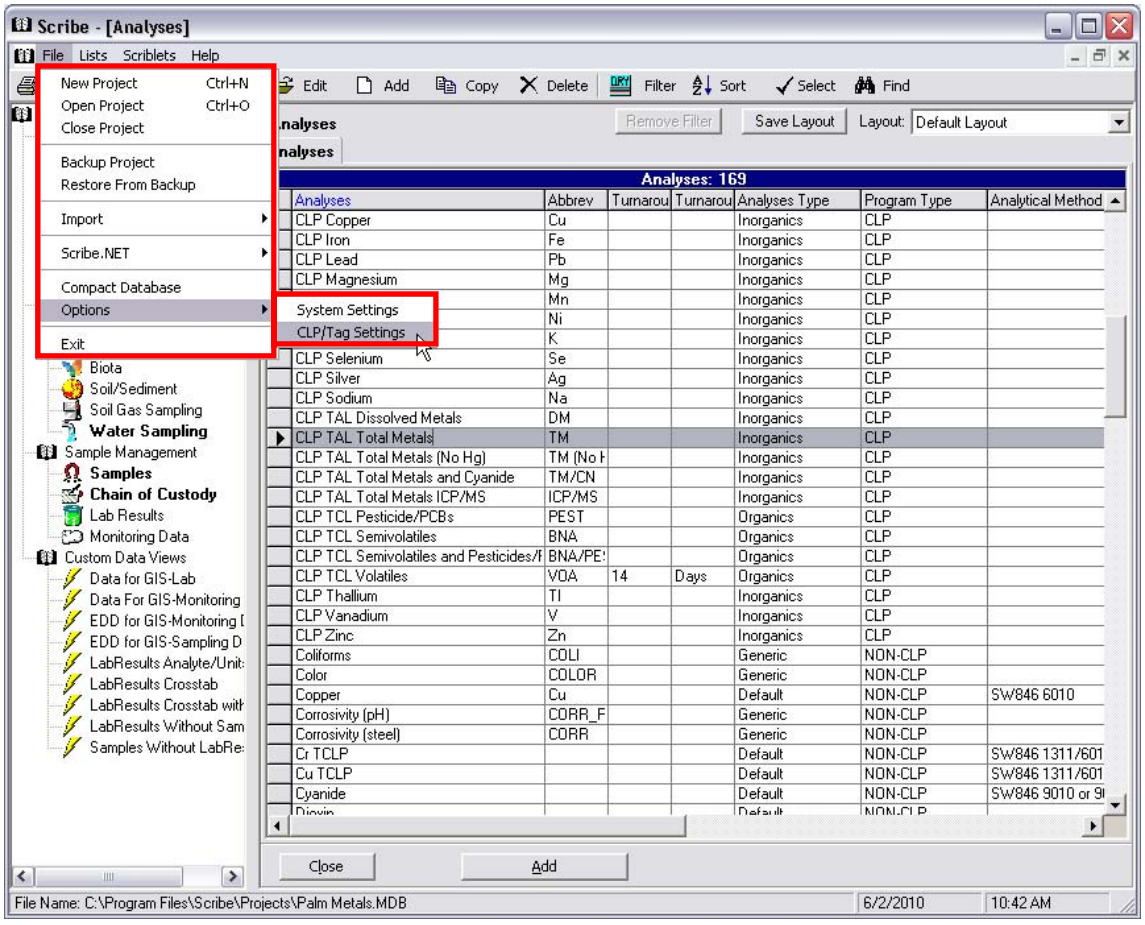
A new feature included with CLP Analyses is the ability to set defaults for the CLP Tags. When a CLP Analysis is selected for a sample, Scribe will assign a CLP Sample number. You can set the **Next CLP Sample number** and **Next Tag number** similar to a sample mask but not exactly.

The CLP Sample # and the Tag # is a field that will update as Samples are added to Scribe. This number is a DISPLAY of the Next number to be assigned. It is editable so that you may customize the next CLP Sample Number that you would like Scribe to assign to your samples.

The numbers auto-increment as samples are added using the CLP business rules.

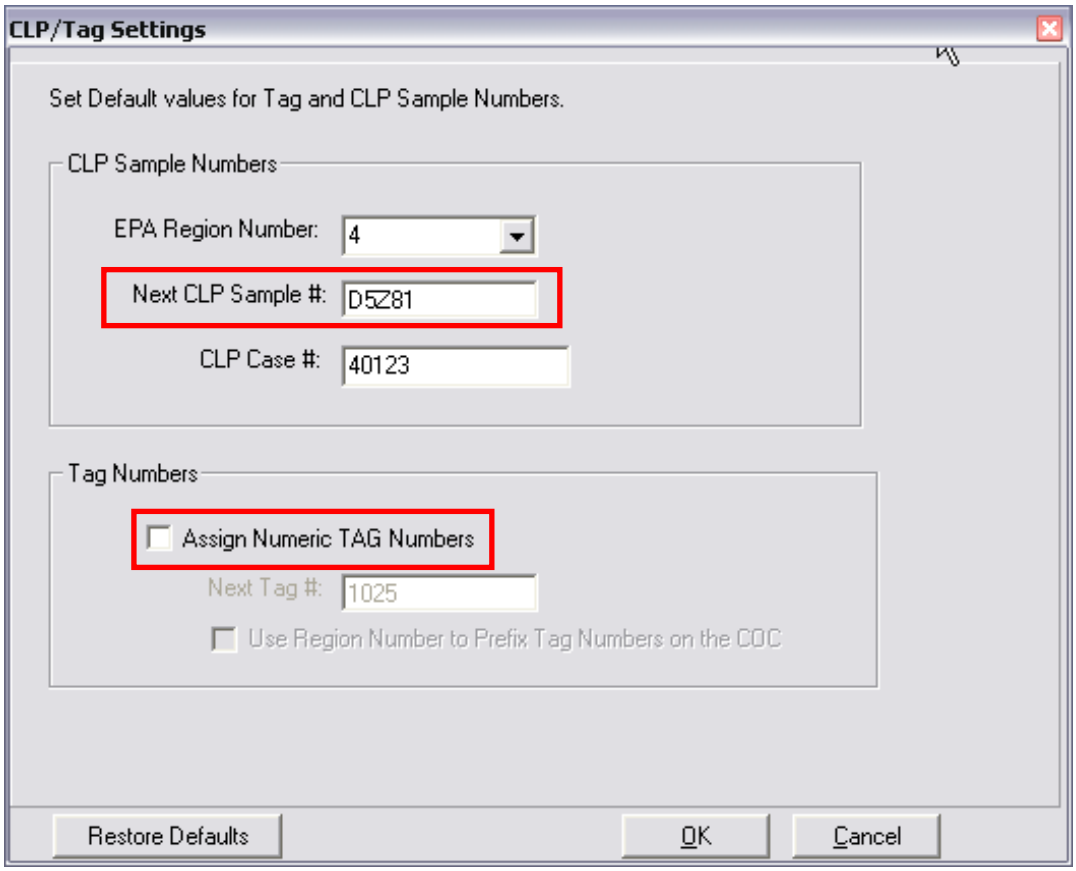
To modify the default settings:

1. Click on **File**.
2. Select **Options**.
3. Select **CLP/Tag Settings**.



4. The window for CLP/Tag Settings is displayed.

5. Input the appropriate information and click the '**OK**' button to Save and Close.



Adding CLP Samples and Assigning Analyses

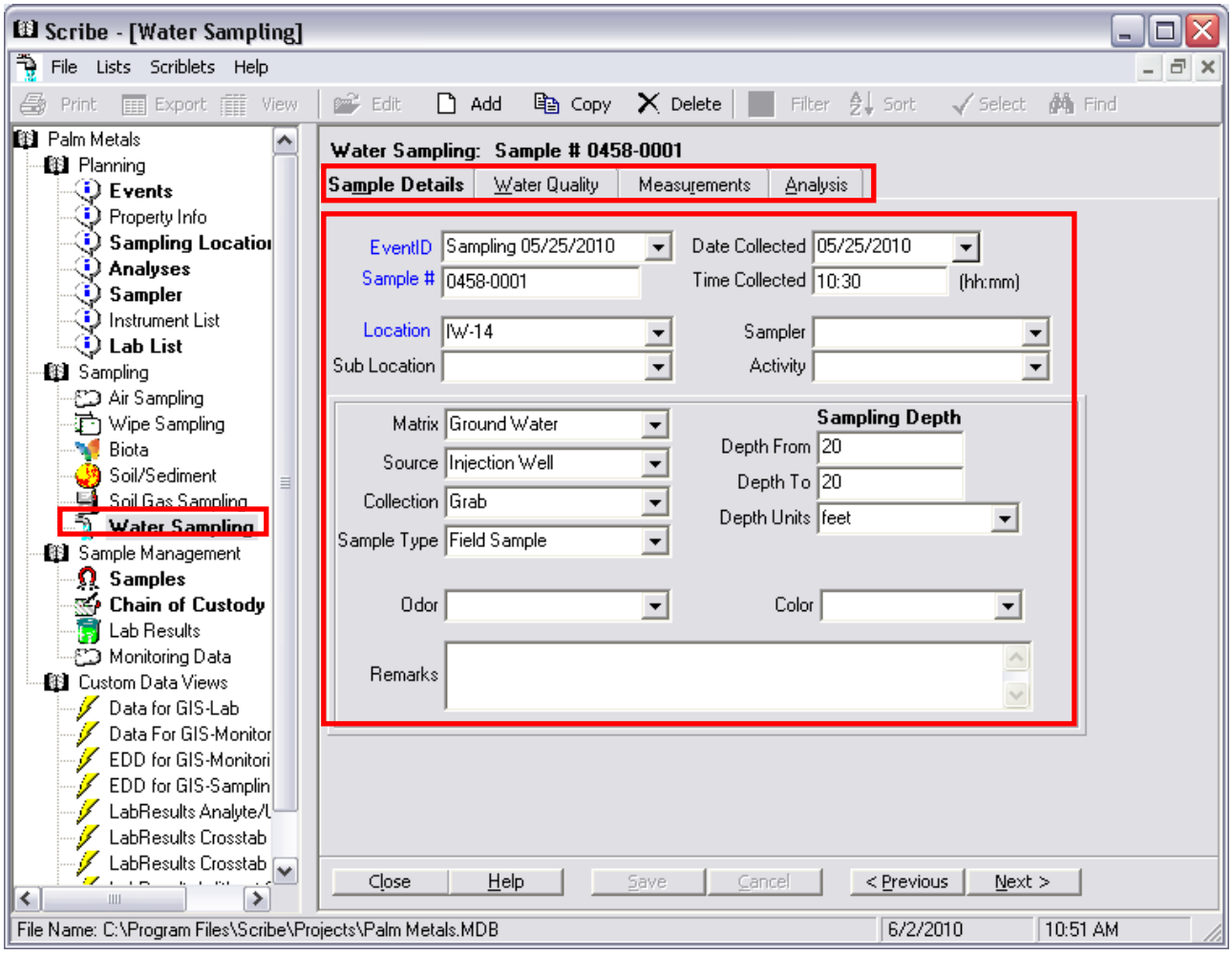
Depending on the type of sampling, click on the appropriate sampling task under Sampling in the left Navigation Pane. For example,

1. Click on '**Water Sampling'** in the left Navigation bar.

2. To add a Water Sample, click the '**Add**' button on the top menu.

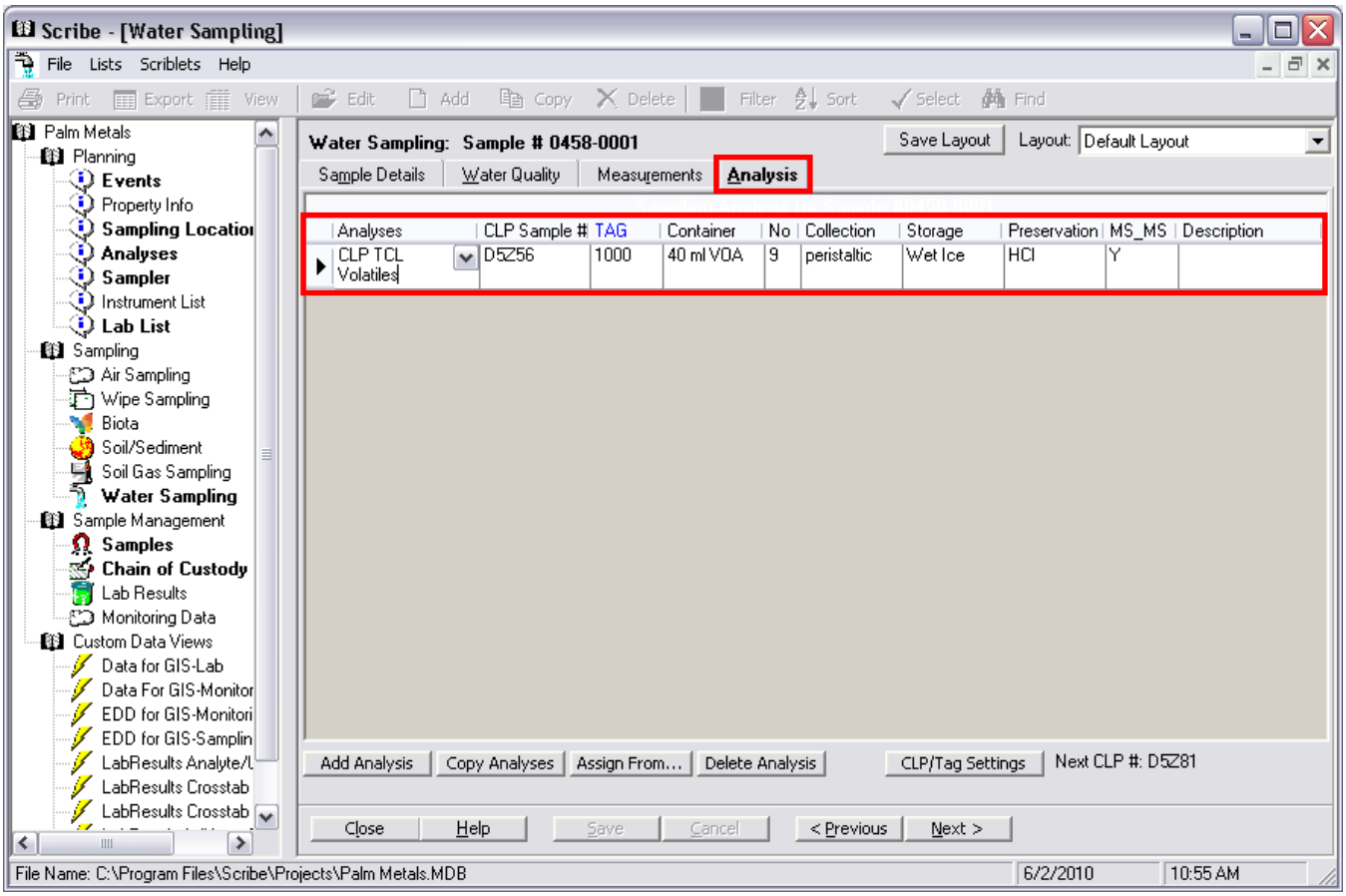
3. Enter sample information into the "**Sample Details"** screen.

Note: There are additional detail screens on the Water Quality and Measurements tabs. These tabs vary by sampling task. The details on the **Analysis** tab must be completed to assign an analysis to your sample.



Enter Analysis information for the Sample and assign CLP Sample and Tag numbers.

4. Click on the **Analysis** tab.
5. Click in the **Analyses field**.
6. Click on the **down arrow** for a list of the CLP Analyses that we referred to earlier.
7. Select an Analysis.



8. For a CLP Analysis, a Tag number and a CLP Sample number is assigned based on the CLP/Tag Settings.
9. To assign additional Analyses to sample containers, click the '**Add Analysis'** button.
10. When all analyses have been added, click the '**Close**' button on the bottom of the window to save and close.

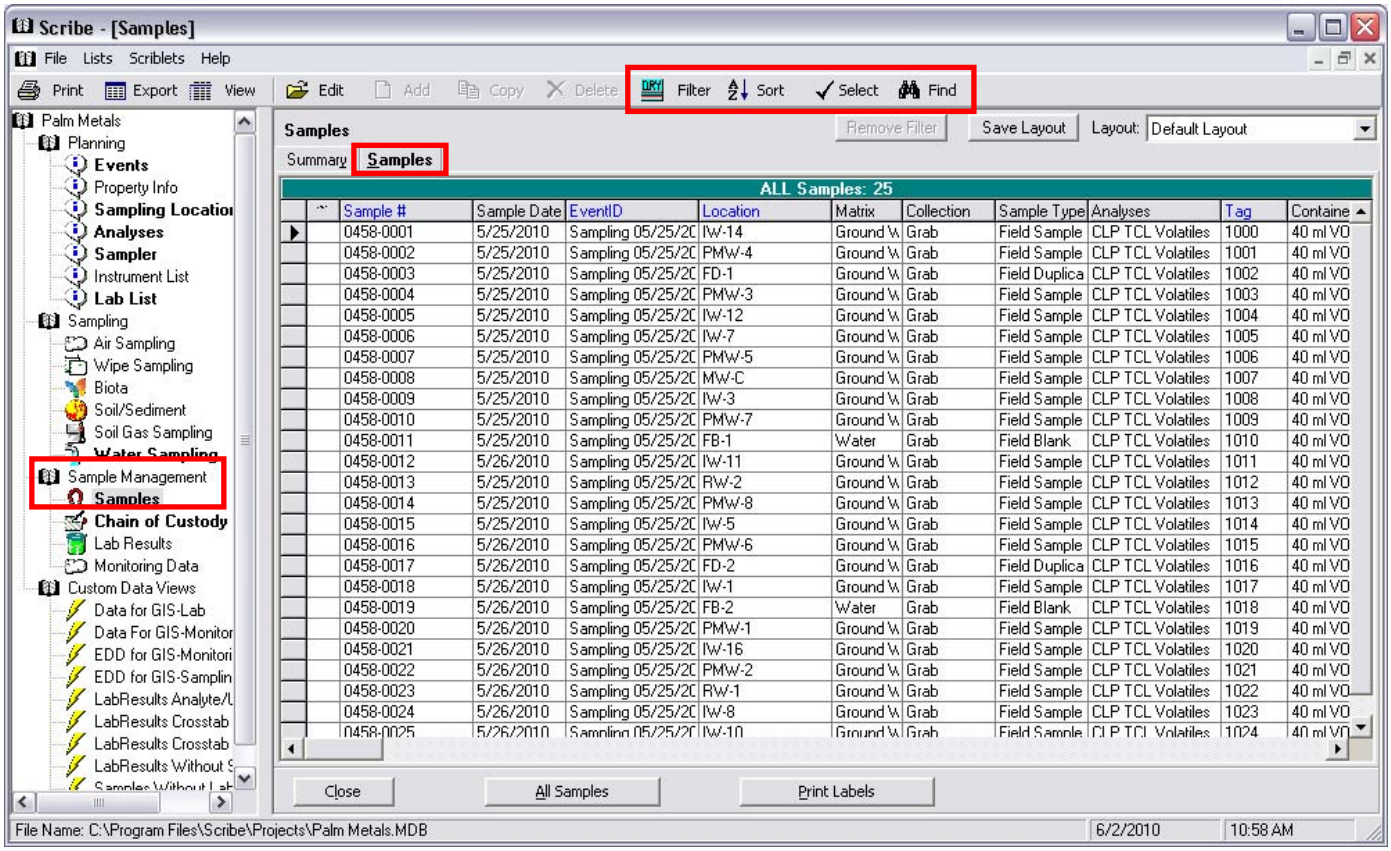
View Samples

Sample Management

Under Sample Management in the left Navigation Pane, you can view and manage all samples using Find, Filter and Sort. The options to Print labels and Chains of Custody are also available.

To view samples:

1. Click on '**Samples**' under Sample Management in the left Navigation Pane.

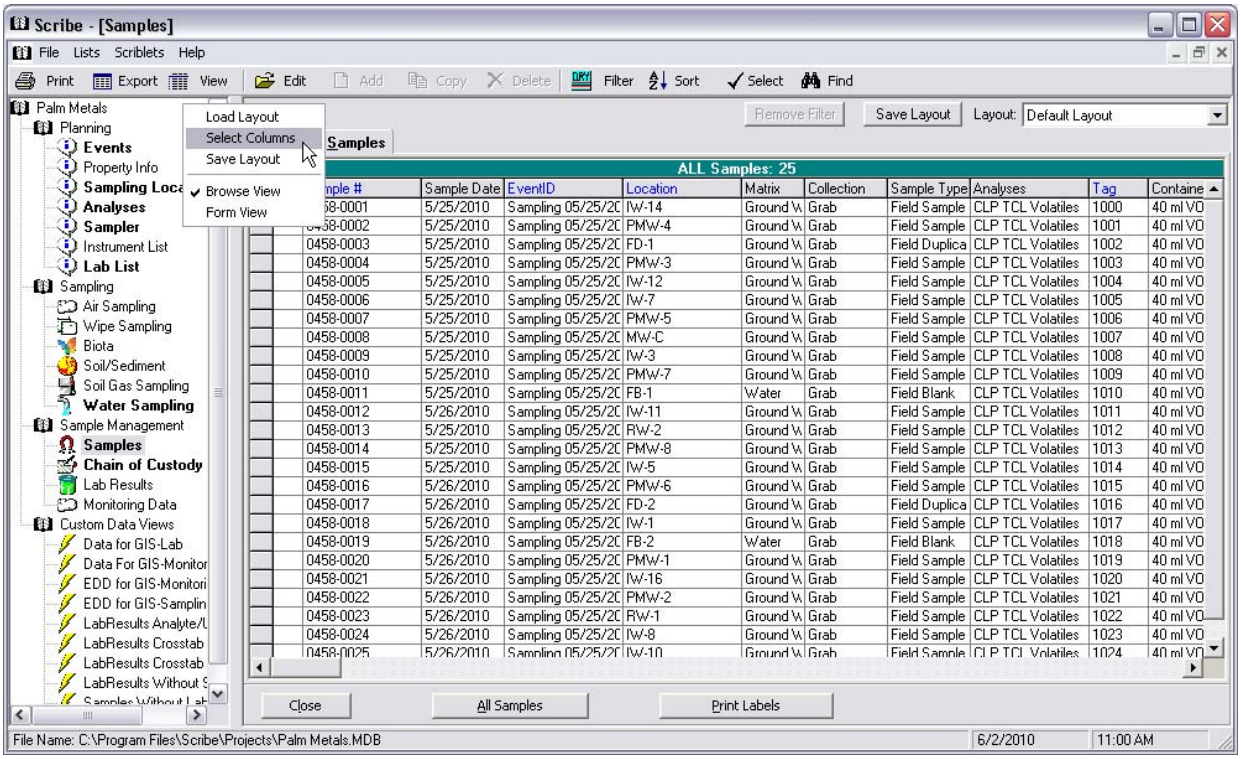


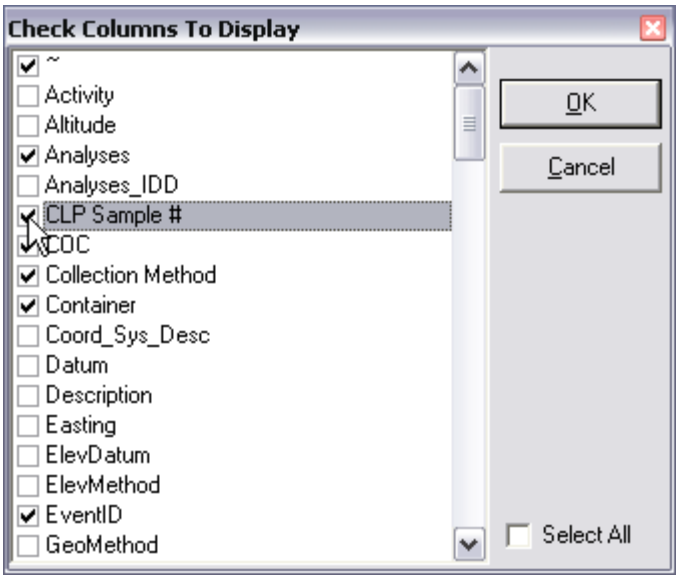
2. To filter your view of samples, RT-click on the field to filter on and select the '**Filter for…'** option. For multi-level filters, click the '**Filter'** button on the top menu bar.

3. To sort your view of samples, RT-click on the column heading and select a sort option. For advanced sort options, click on the '**Sort'** button on the top menu bar.

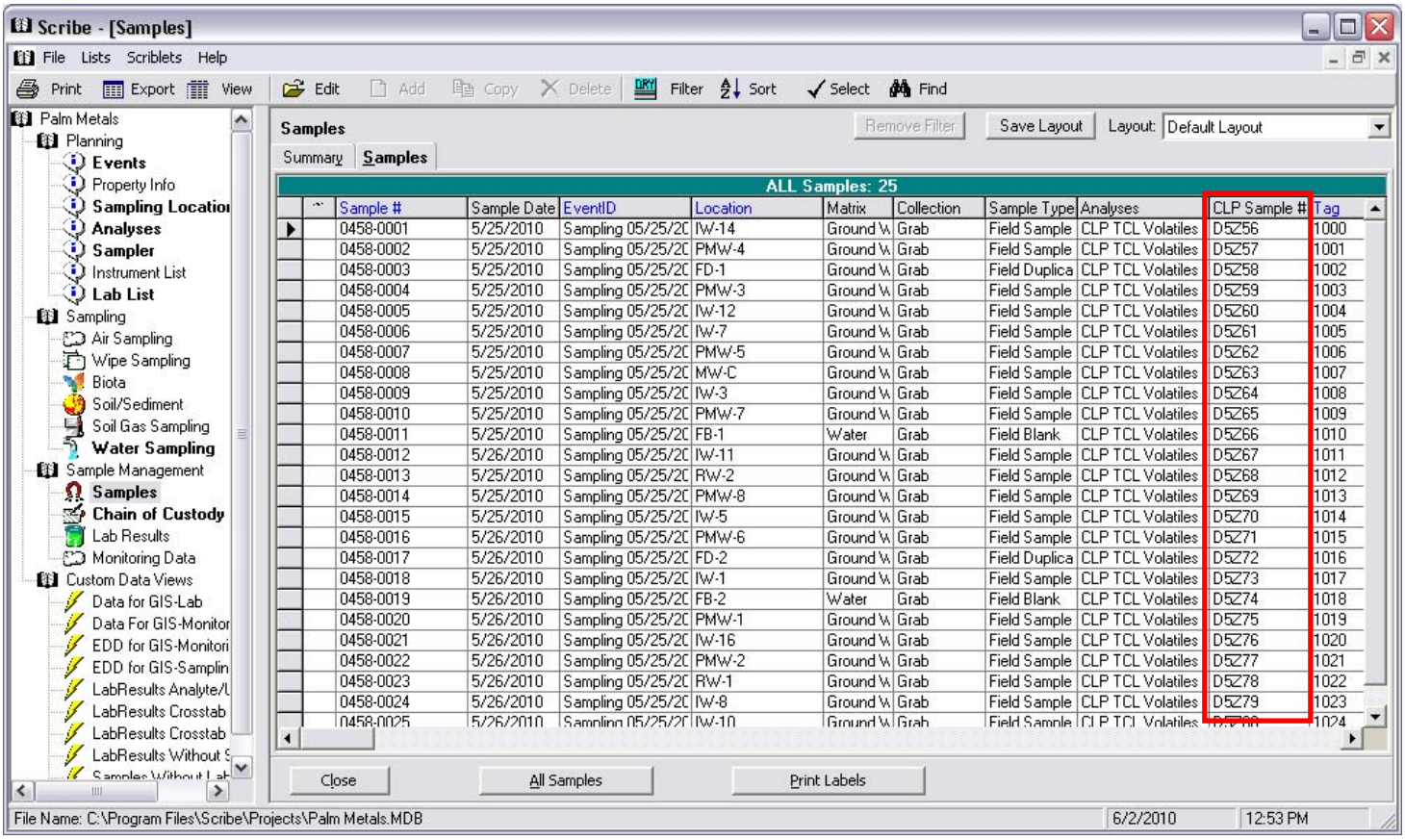
4. To find a particular sample(s), RT-click on the field and select the appropriate option. For multi-level finds, click the '**Find'** button on the top menu bar.

5. To see CLP Sample information including the **CLP Sample #,** click the drop-down menu for the Layout field on the top right corner of the window and select the '**CLP Layout**'.





6. The **CLP Sample #** column is now exposed.



LABELS AND CHAIN OF CUSTODY

CLP Sample Labels

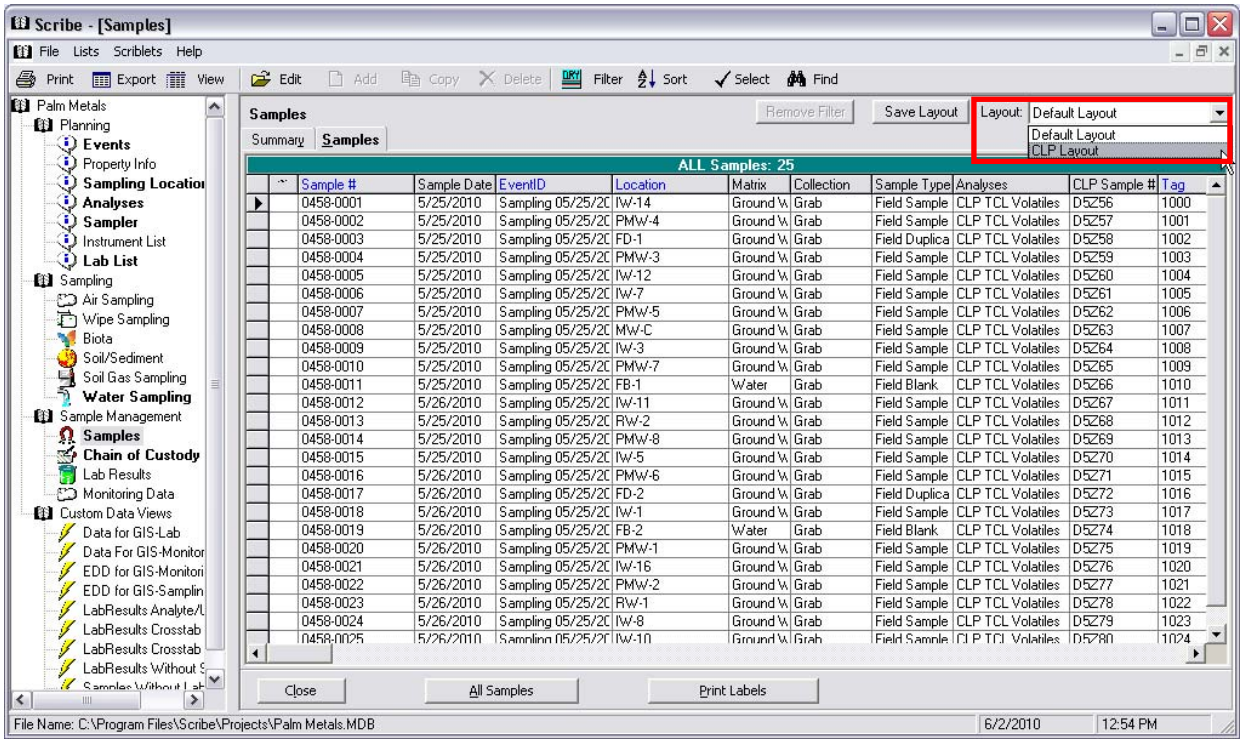
Print Sample Labels

Label options are available through the Samples View. Click on '**Samples**' under Sample Management in the left Navigation Pane. All samples shown on the screen are available to be printed on labels. You can apply Filters, Finds and Sorts to limit the display to the Samples you wish to see.

To configure your labels and print:

1. Click on **drop-down menu** for the Layout field on the top right corner.

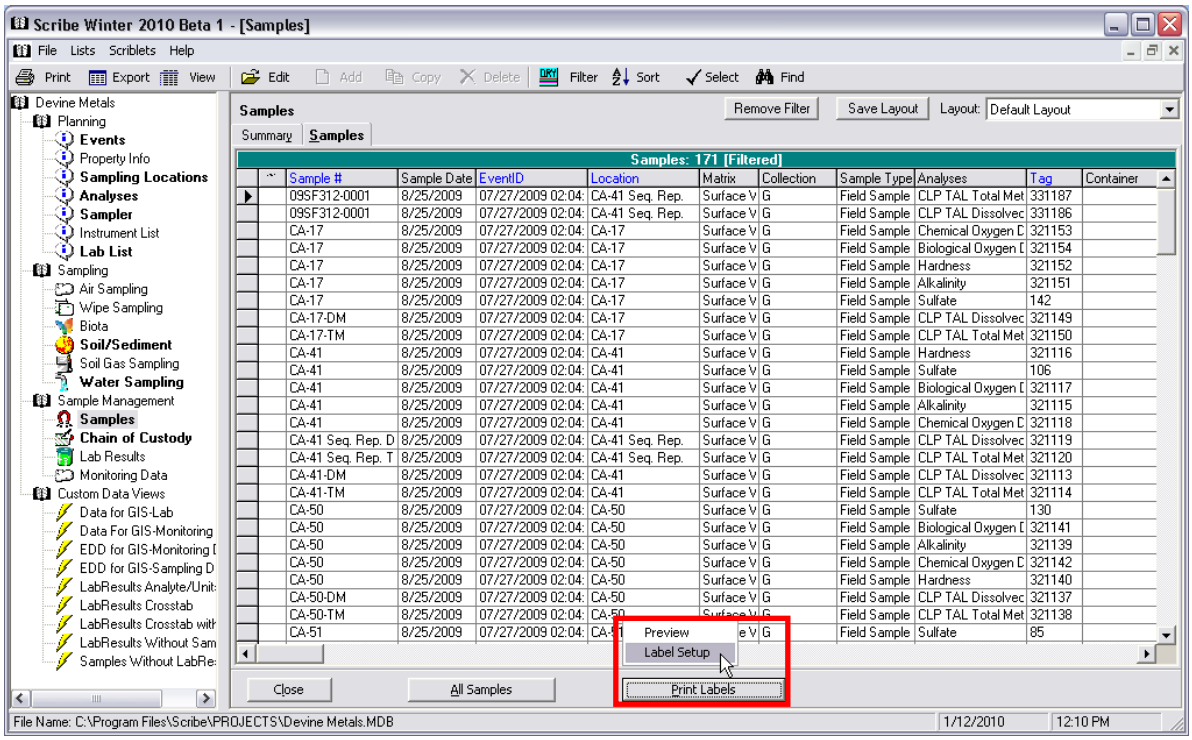
2. Select '**CLP Layout'**. This layout will replace the default Scribe Sample # with the CLP Sample # on the default label layout.

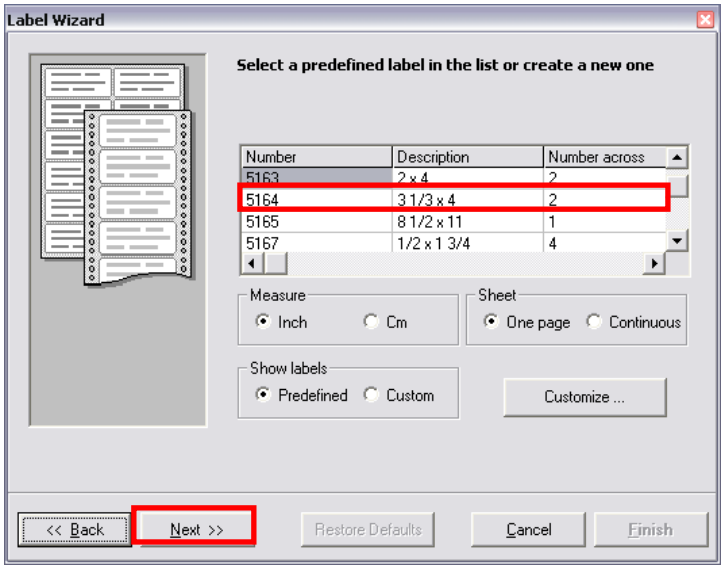


3. Click the '**Print Labels'** button on the bottom of the window.

4. Select '**Label Setup'** if it's the first time you are setting up a label.

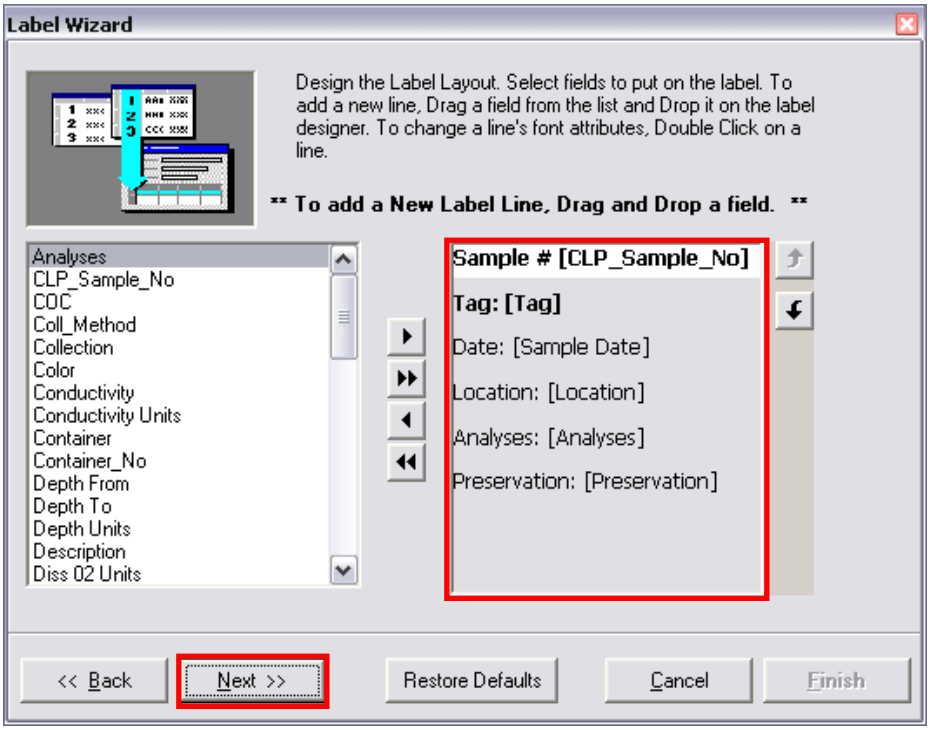
5. Select a pre-defined label format that matches your labels.





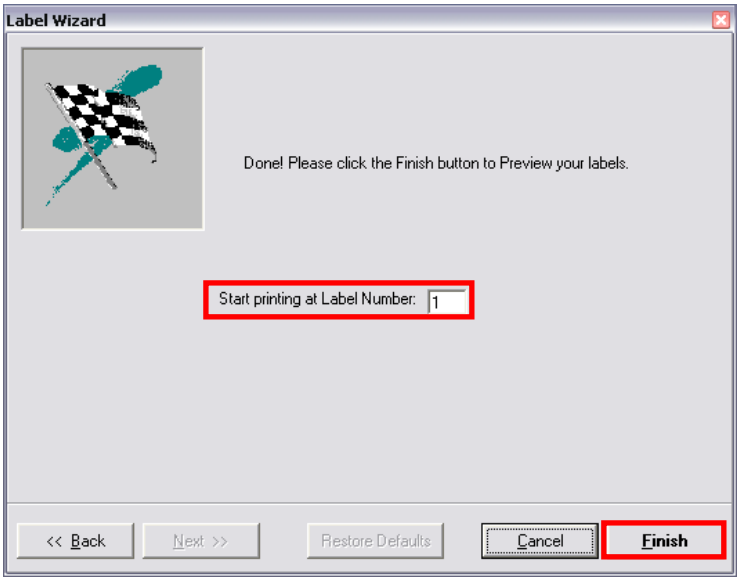
6. Click '**Next**' to continue.

7. Design your label by adding/removing fields to or use the default design. **Note:** The CLP Sample number instead of the Scribe Sample number will be printed on the label.

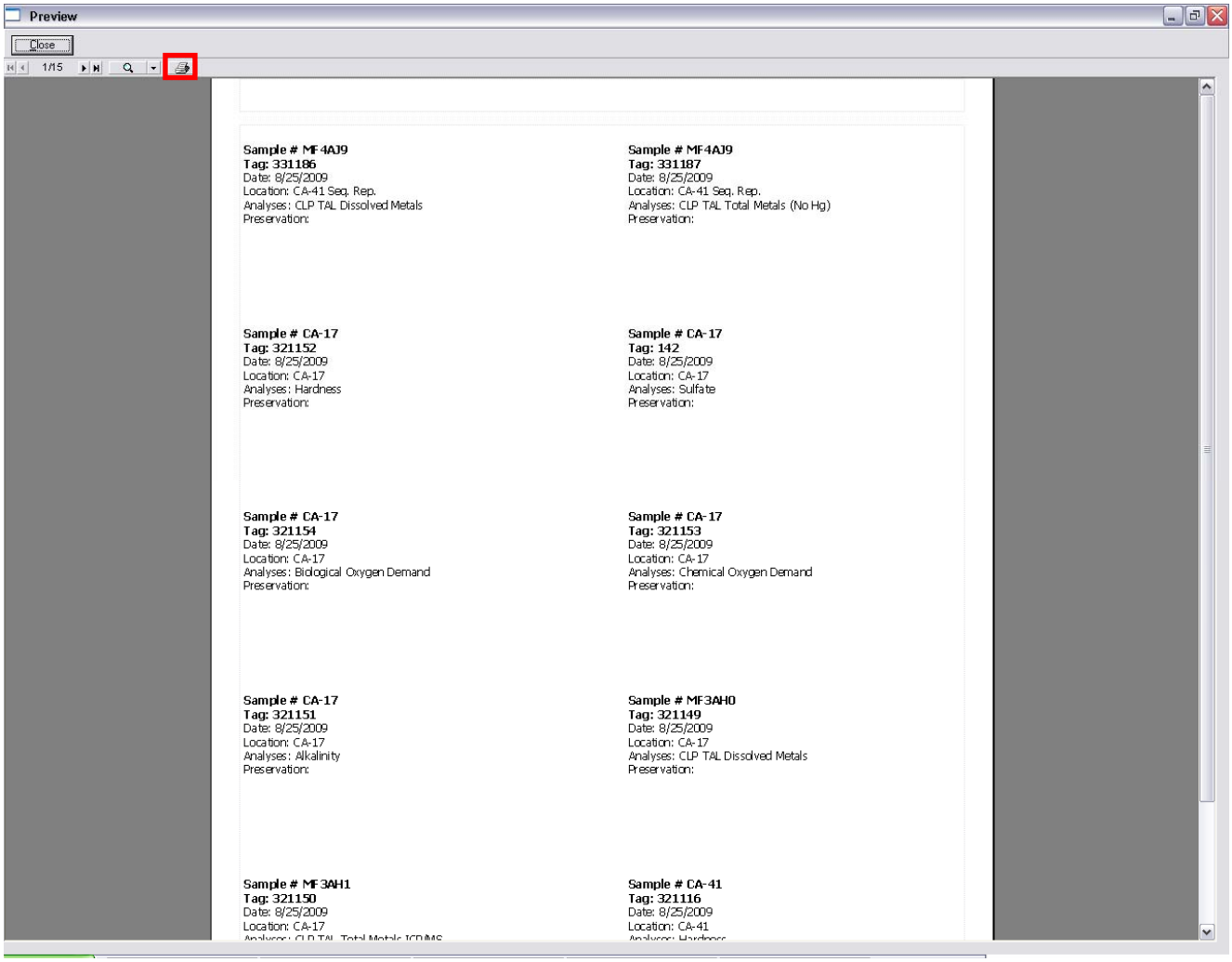


8. Click '**Next**' to continue.

9. If you need to print on half a sheet of labels, use this option to select which label to print on first. Otherwise, click '**Finish**' to continue.



10. A preview of the labels to be printed is displayed.



11. Click on the Printer icon on the top menu bar to print the labels.

Chain of Custody

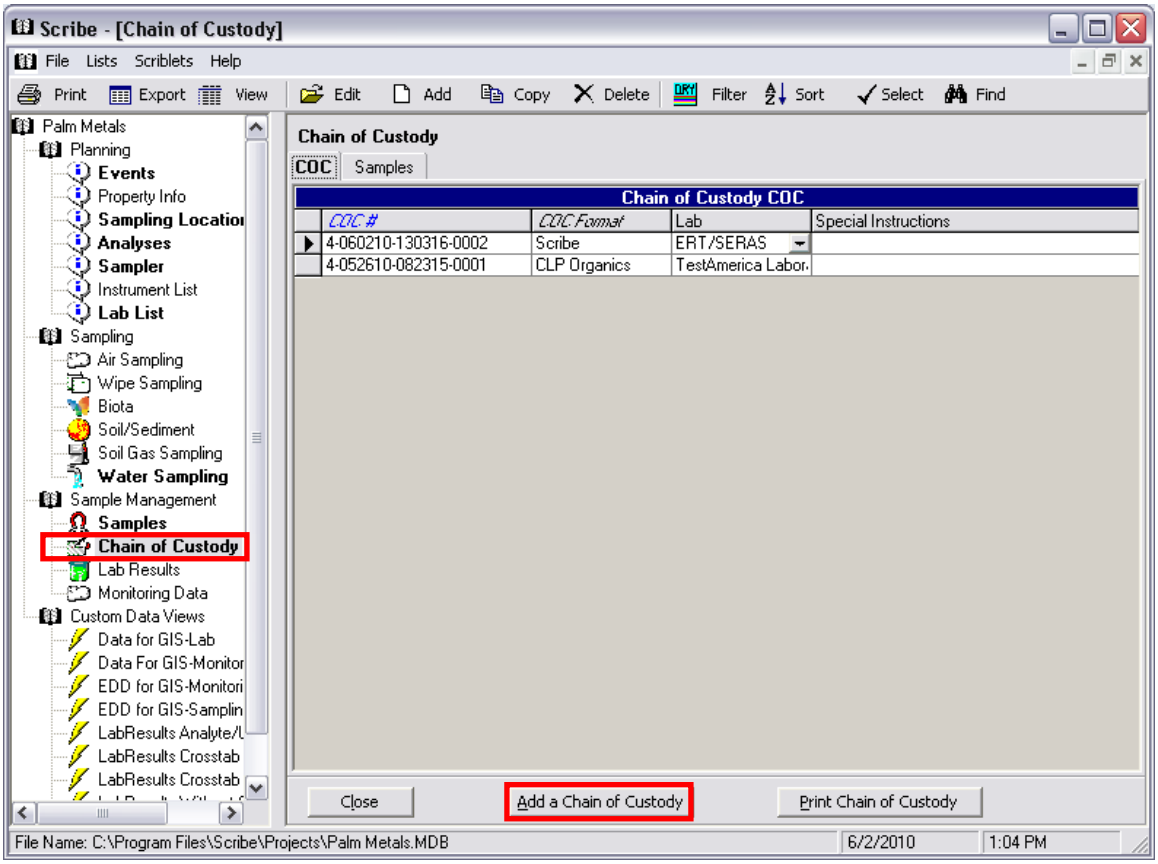
A new feature in Scribe to support CLP sampling is the COC Format for the Chain of Custody. The COC Format option modifies the COC form to adhere to COC standards and requirements. It also controls what samples can be assigned to the COC. For example, Samples with Inorganics analyses can only be assigned to the CLP Inorganics format on the COC.

Note: After submitting samples to the CLP labs, it is recommended that users request the labs to return lab results in electronic format i.e. a spreadsheet (.xls) or a comma-separated text (.csv). Scribe has a Custom Import feature that will import lab result data and marry them up with the sampling data. This effectively eliminates transcription errors and reduces data processing time. See the "Scribe Manual Advanced Part III" for importing details.

Create COC and Assign Samples

To manage and print a Chain of Custody (COC), a COC needs to be created and then samples have to be assigned to the COC:

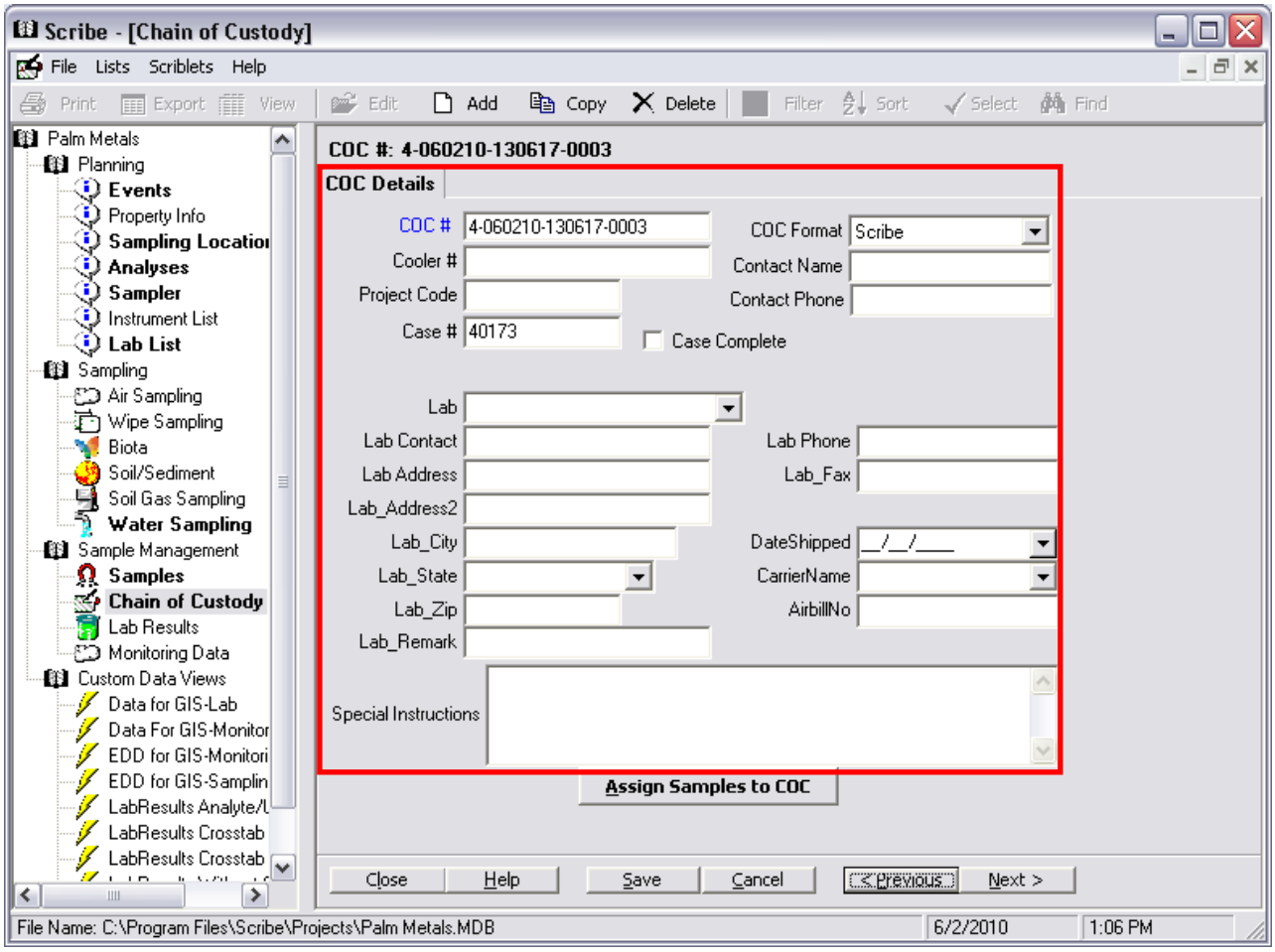
1. Select '**Chain of Custody**' under Sample Management in the left Navigation Pane.



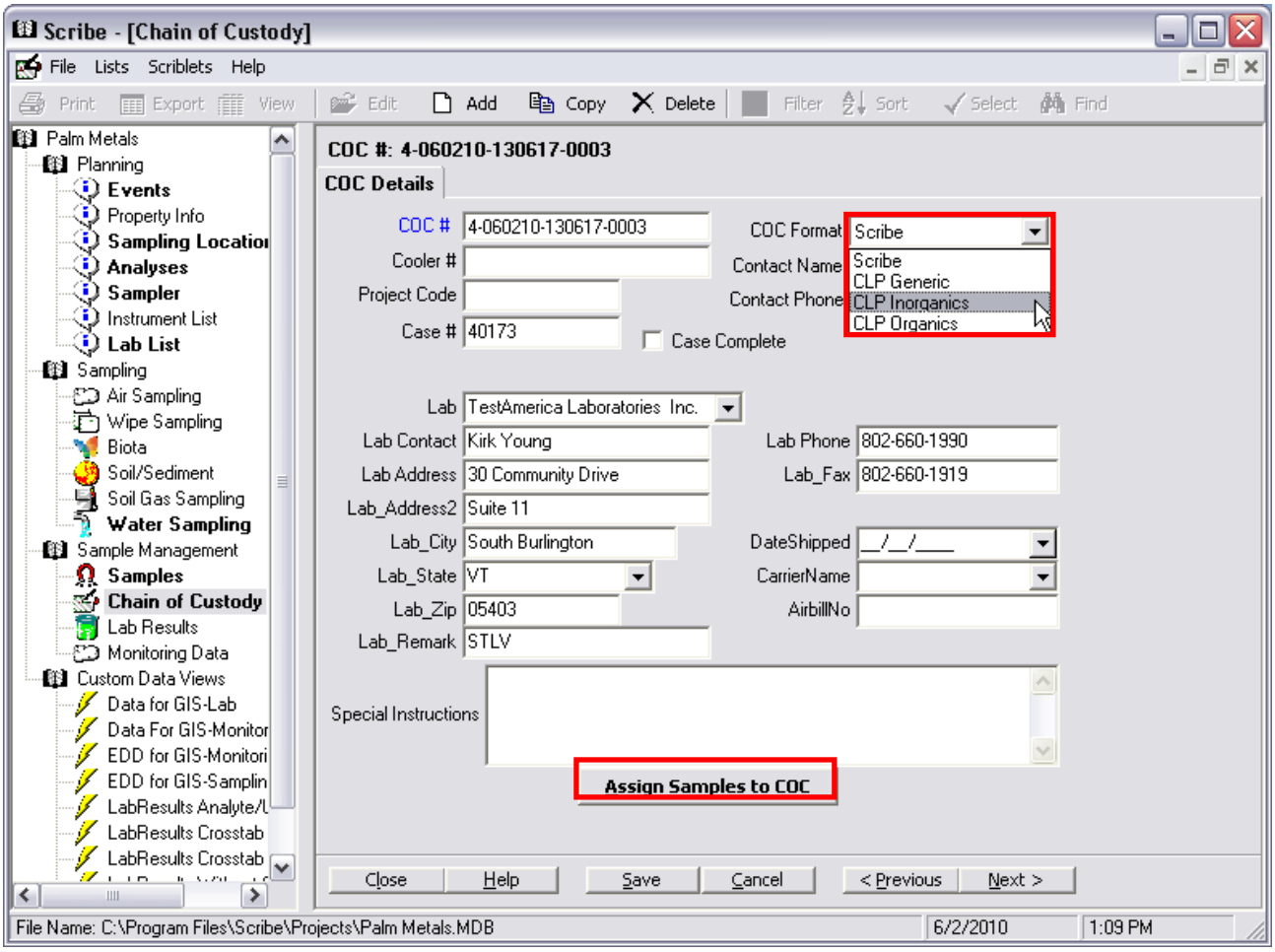
2. Click the '**Add a Chain of Custody**' button on the bottom of the window.

3. The "**COC Details**" screen is displayed.

4. Complete the form by entering other fields such as the **Case #, Cooler #, Lab, and Lab Phone**.

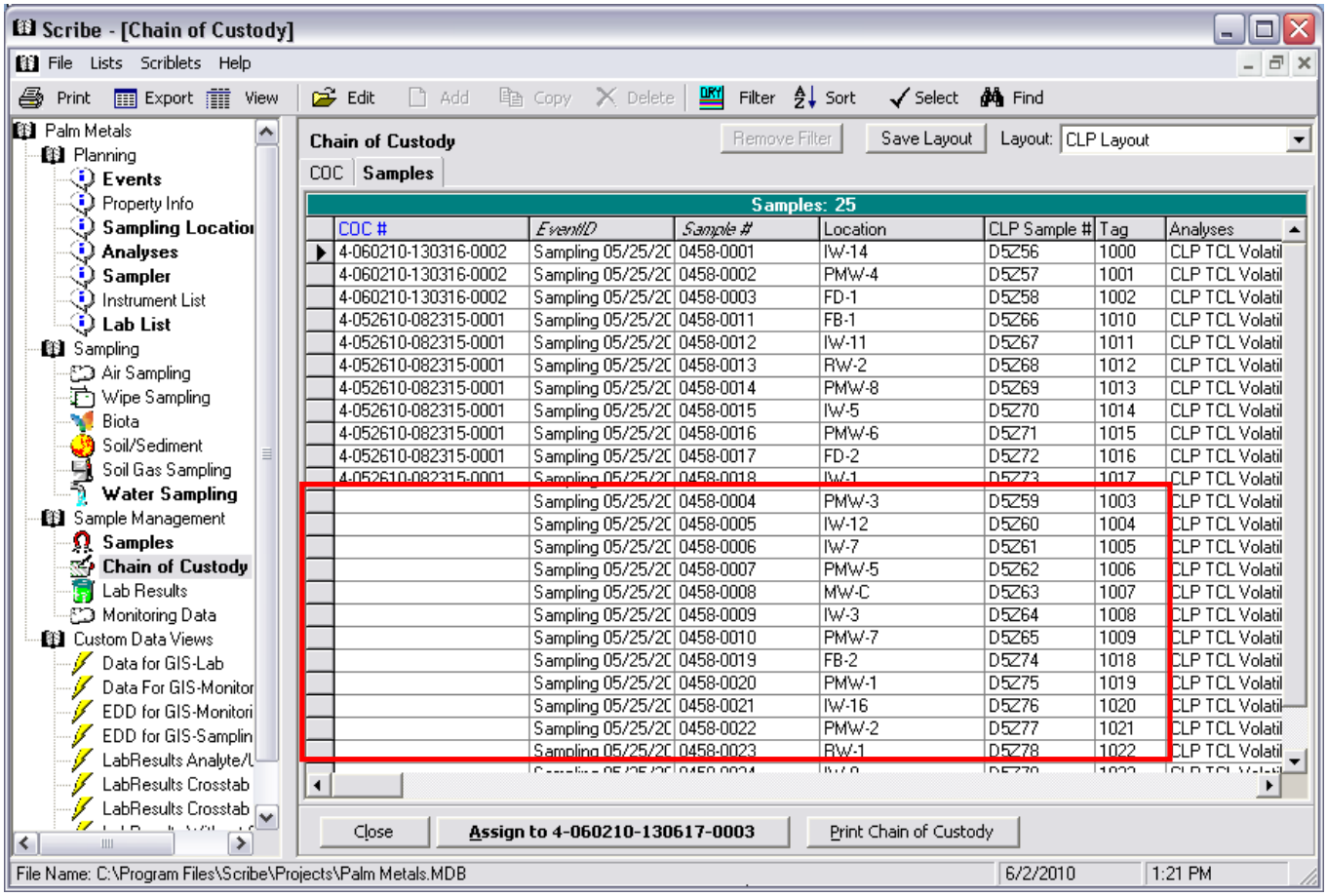


5. Select the appropriate **COC Format** based on the type of COC Samples you are packing. For example, if you are creating a COC for Inorganics, select COC Inorganics. The CLP Generic COC option should be used if you are submitting samples to a program other than CLP but one that requires a CLP/F2L type COC for generating CLP type XML files. Based on the format setting you select, the system will filter for only those types of samples that can be added to this COC.



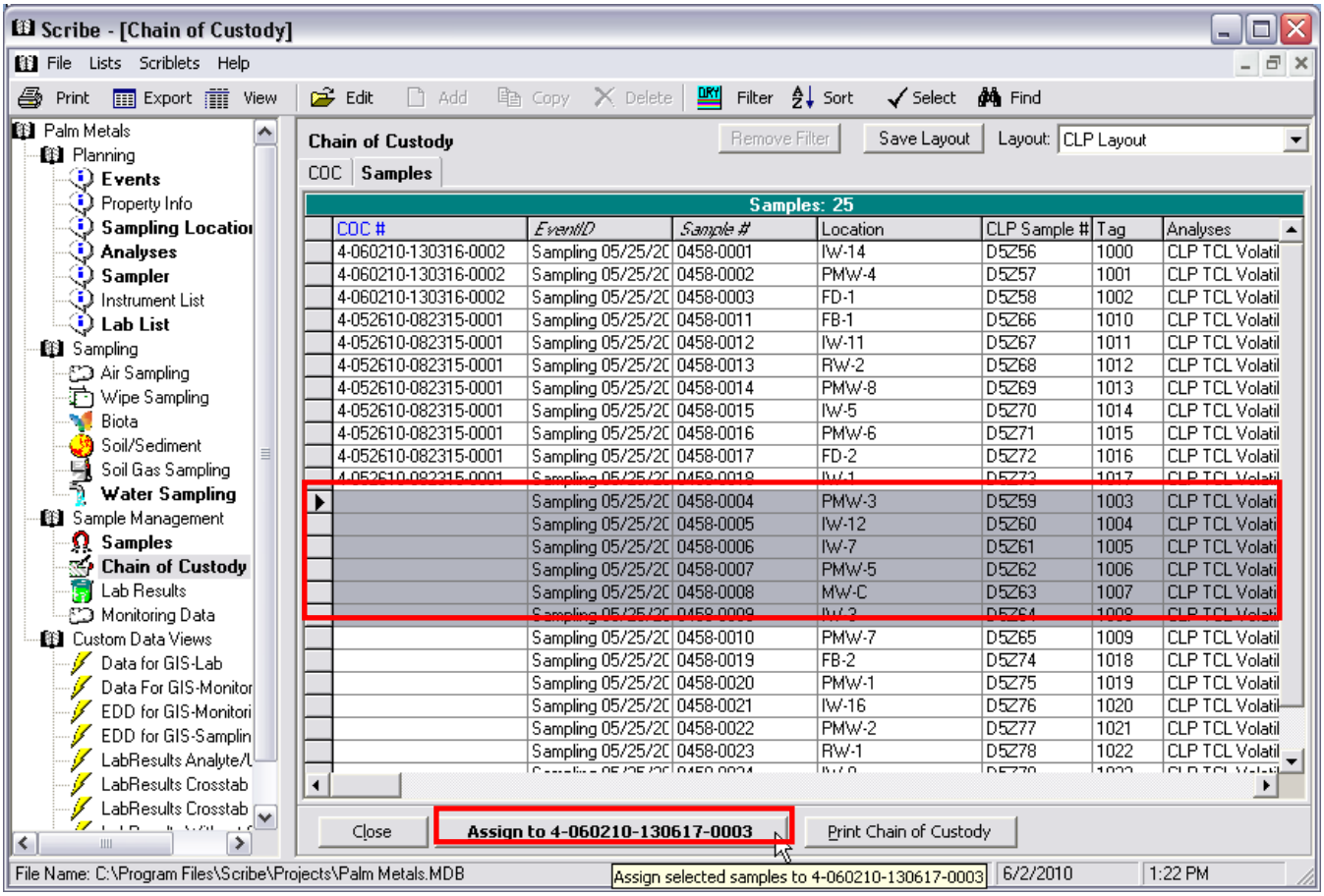
6. Click '**Assign Samples to the COC'** to continue.

7. The "**Chain of Custody Samples**" screen appears. Samples that have not been assigned to a chain are displayed at the bottom of the list.

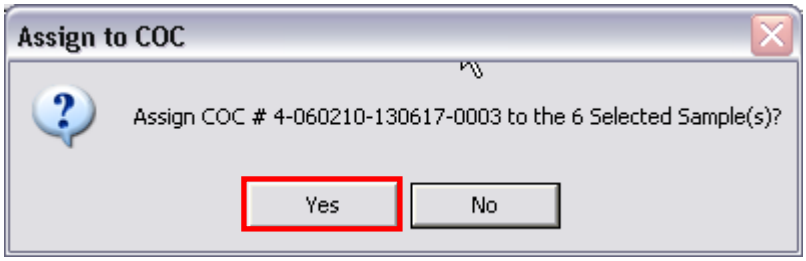


8. Highlight the samples to assign to the new Chain of Custody. Highlight multiple samples by holding down the Shift key or Ctrl key while clicking on the first column before COC# of the samples you wish to assign to the COC.

9. Click the '**Assign to...**' button on the bottom of the window to assign the samples to the Chain of Custody.



10. You will be prompted to confirm. Click '**Yes**' to assign the selected samples to the COC.

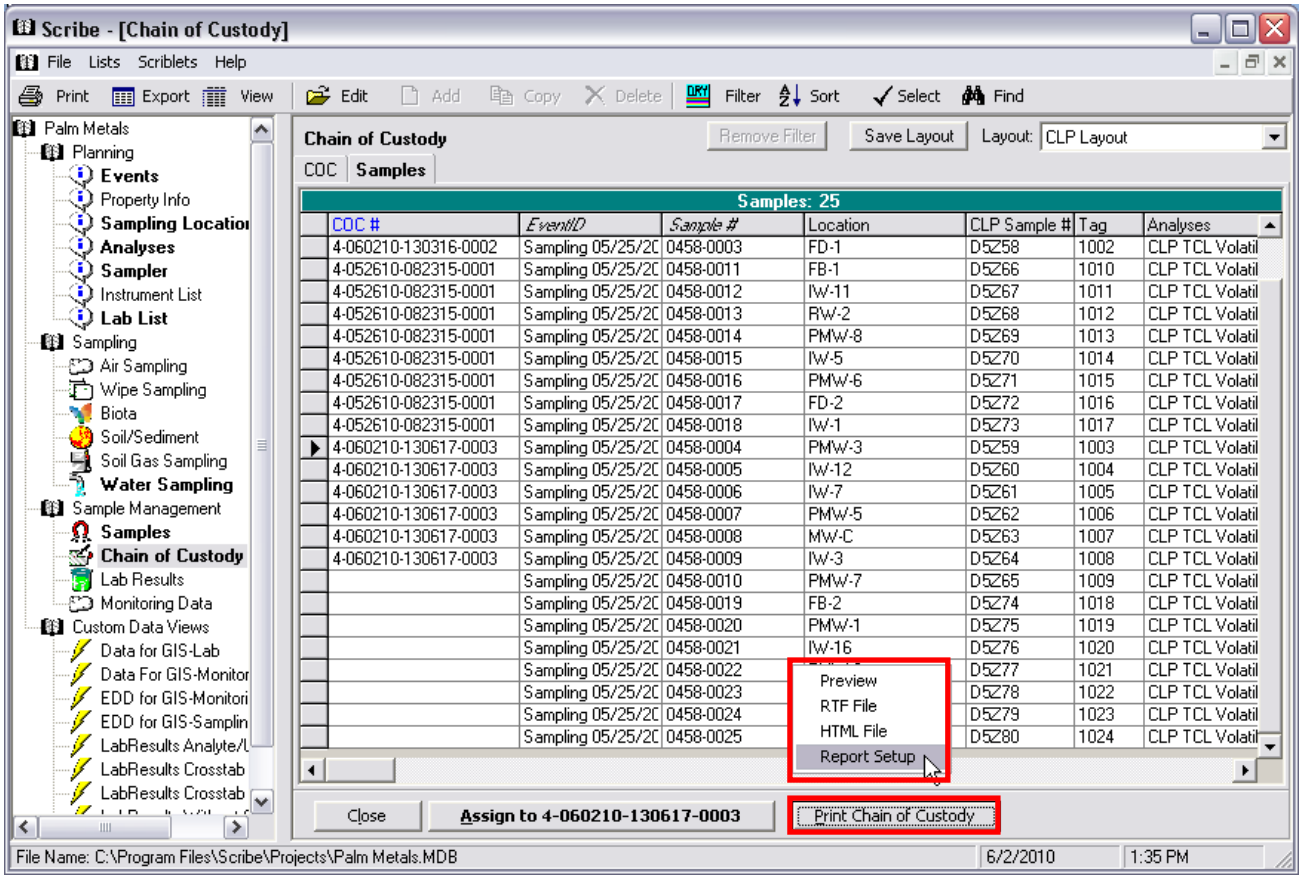


11. You are now ready to configure and print your COC.

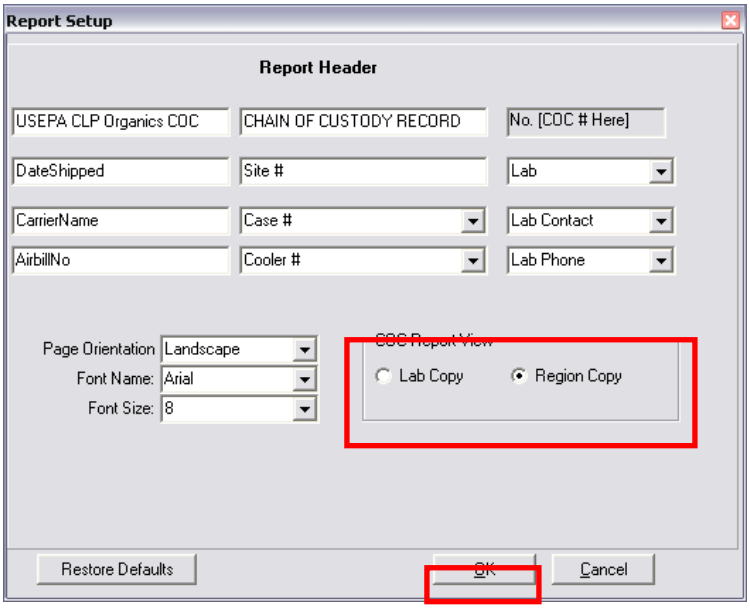
Configure and Print COC

To configure and print a COC:

1. Click the '**Print Chain of Custody**' button.
2. Then select '**Report Setup**'.

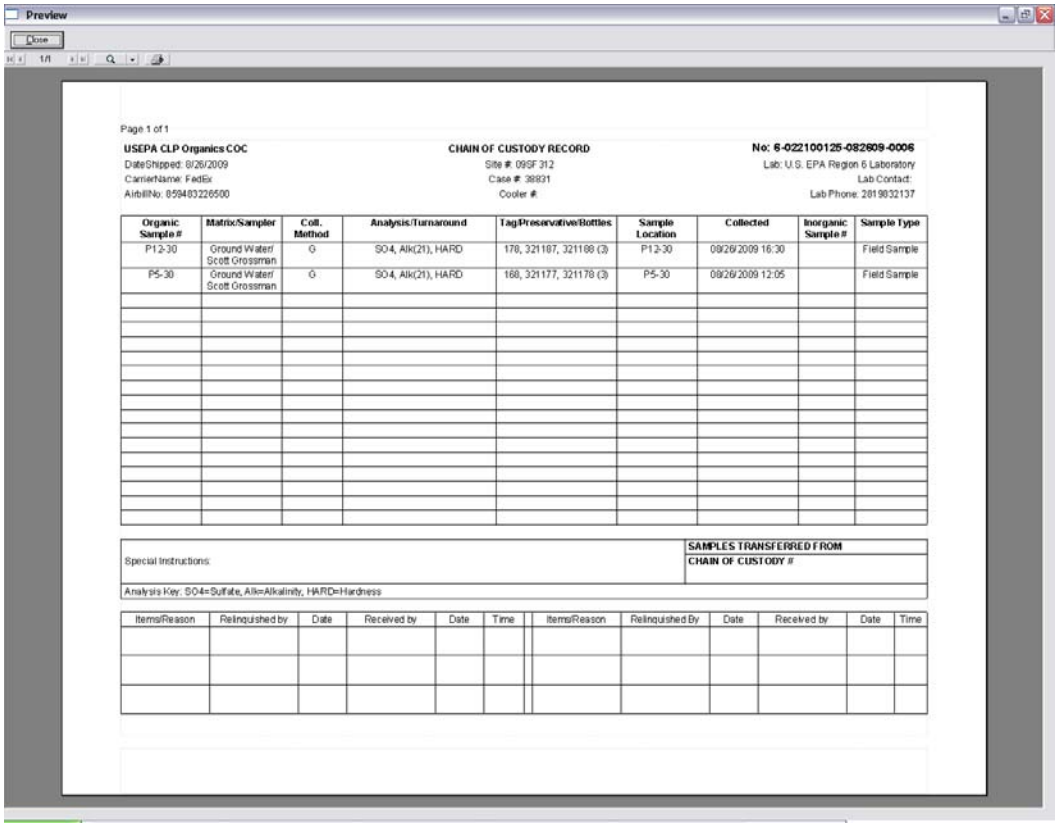


3. The Report Header settings are displayed.



4. The COC Report View (Lab or Region Copy) can also be selected.

5. Click '**OK**' to preview and print the Chain of Custody.

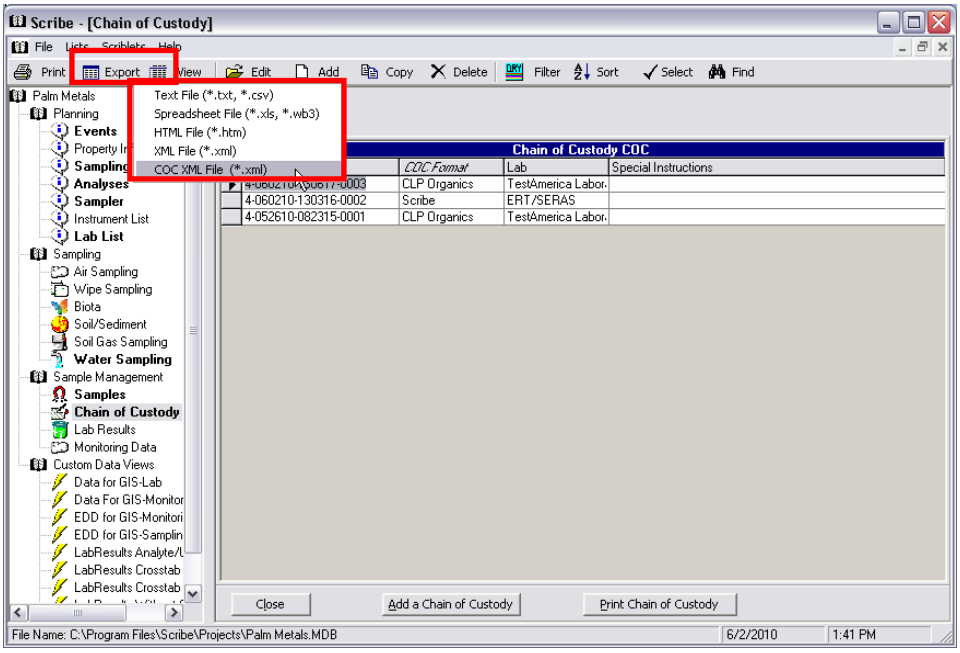


Export to XML File

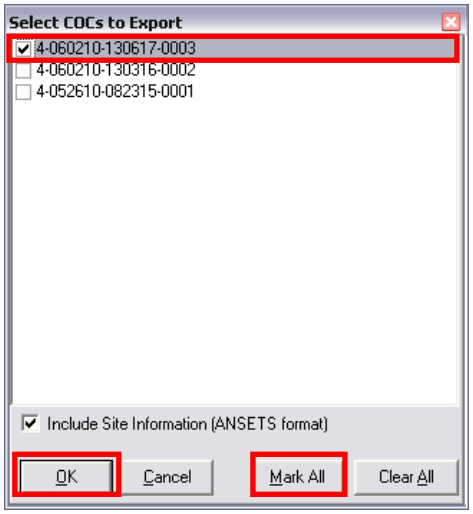
Export COC to XML

A new feature in Scribe is the ability to export the CLP COCs to an XML file. To export:

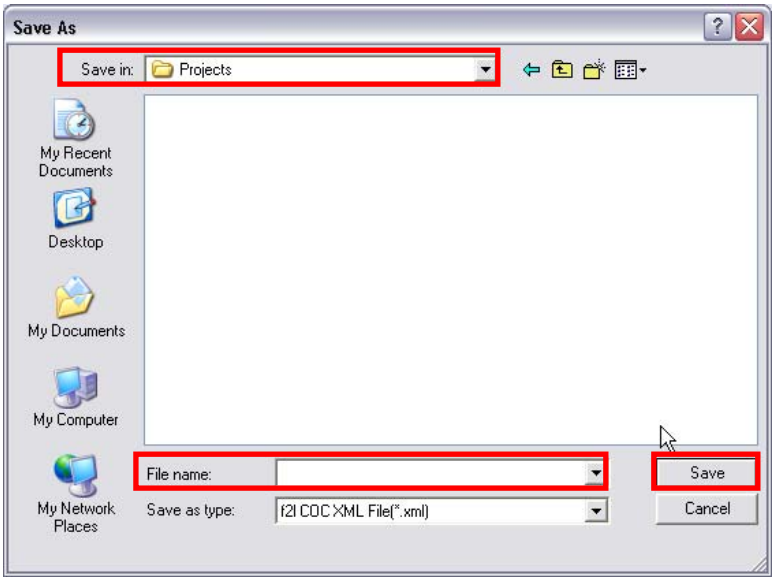
1. Click the '**Export'** button on the top menu bar.
2. Select '**COC XML File (*.xml)**' option.



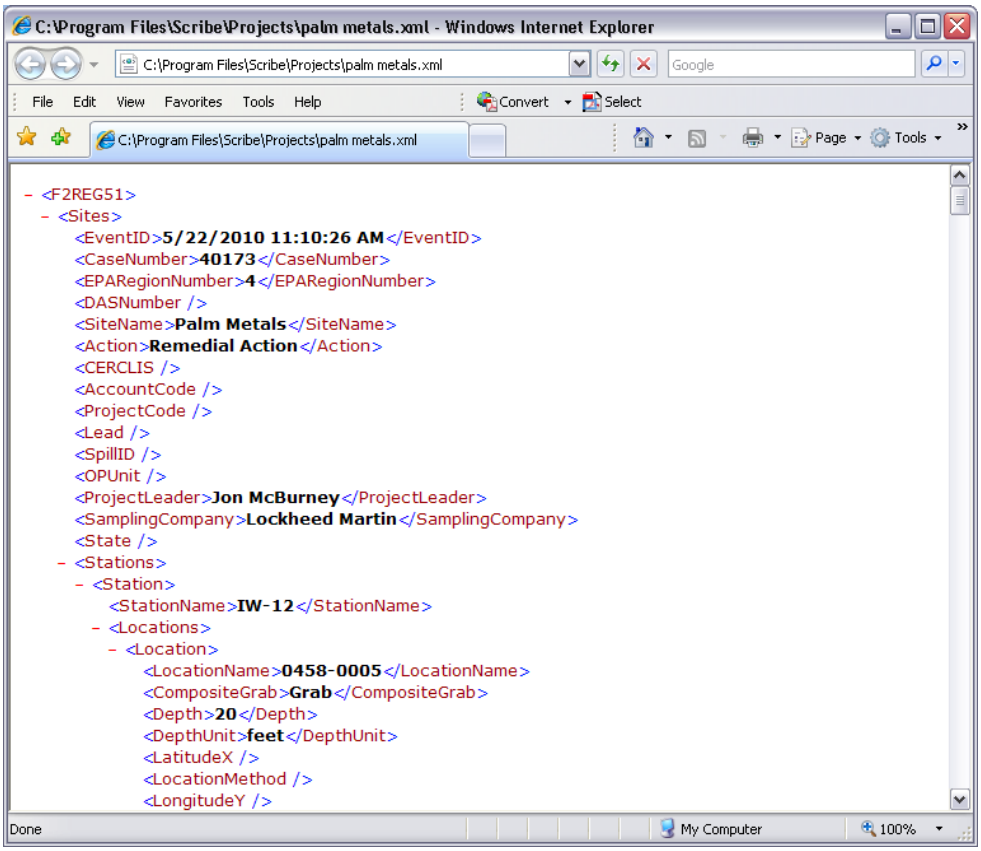
3. Select the Chain of Custody records to export by checking the individual records or click **'Mark All'** to select all COCs.



4. Select your location and provide a filename and click '**Save**'.



5. The XML file will open in Windows Internet Explorer while the file is created and saved.



REPORTING

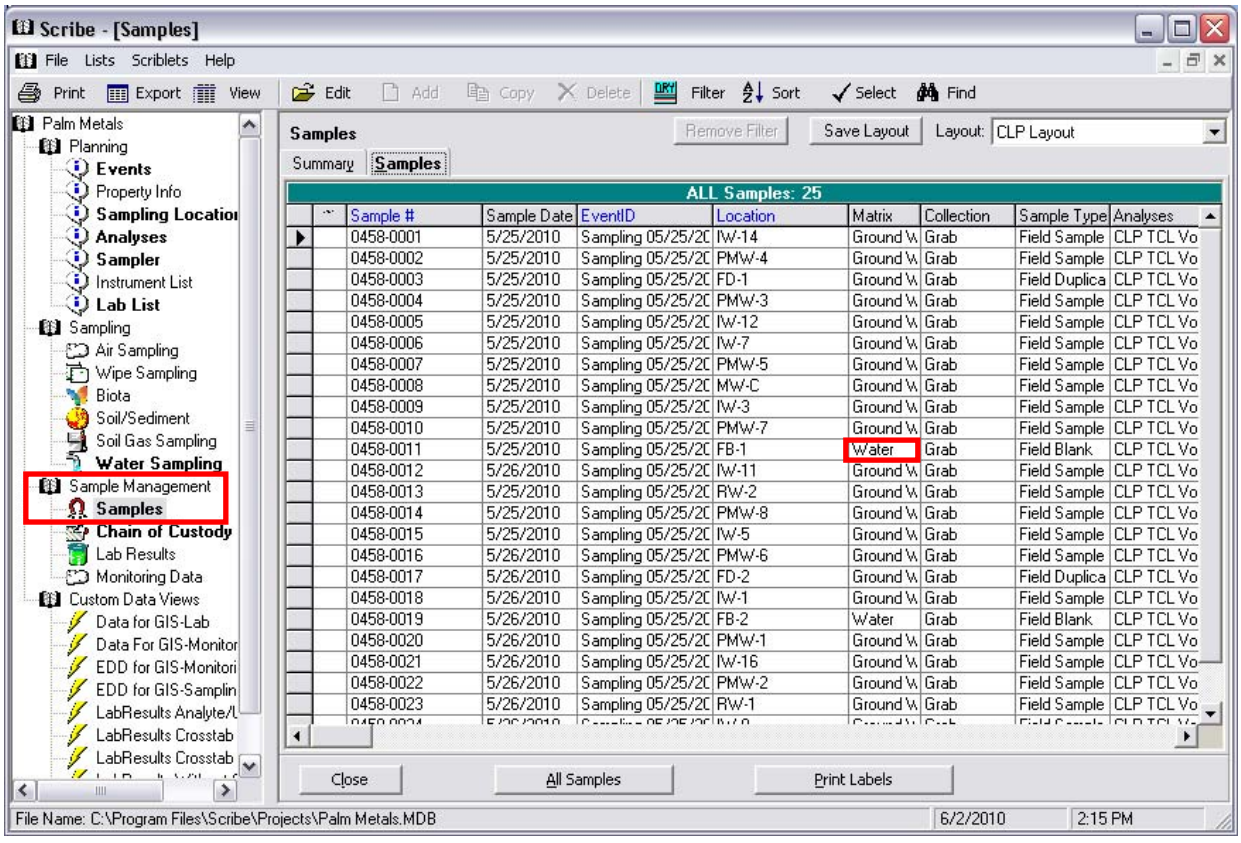
Scribe has flexible reporting options. The most popular way to report out from Scribe is to manipulate the grid view in the All Samples screen to display the data you wish to report. Then export the grid data to an file type that fits your reporting needs. File types include .txt, .csv, .xls, .htm, .xml, .kml, and .kmz.

Find, Filter and Sort

Scribe has built-in user-friendly querying functions such as Find, Filter and Sort. These functions are most useful when you are searching for a particular subset of data that meets one or more criteria.

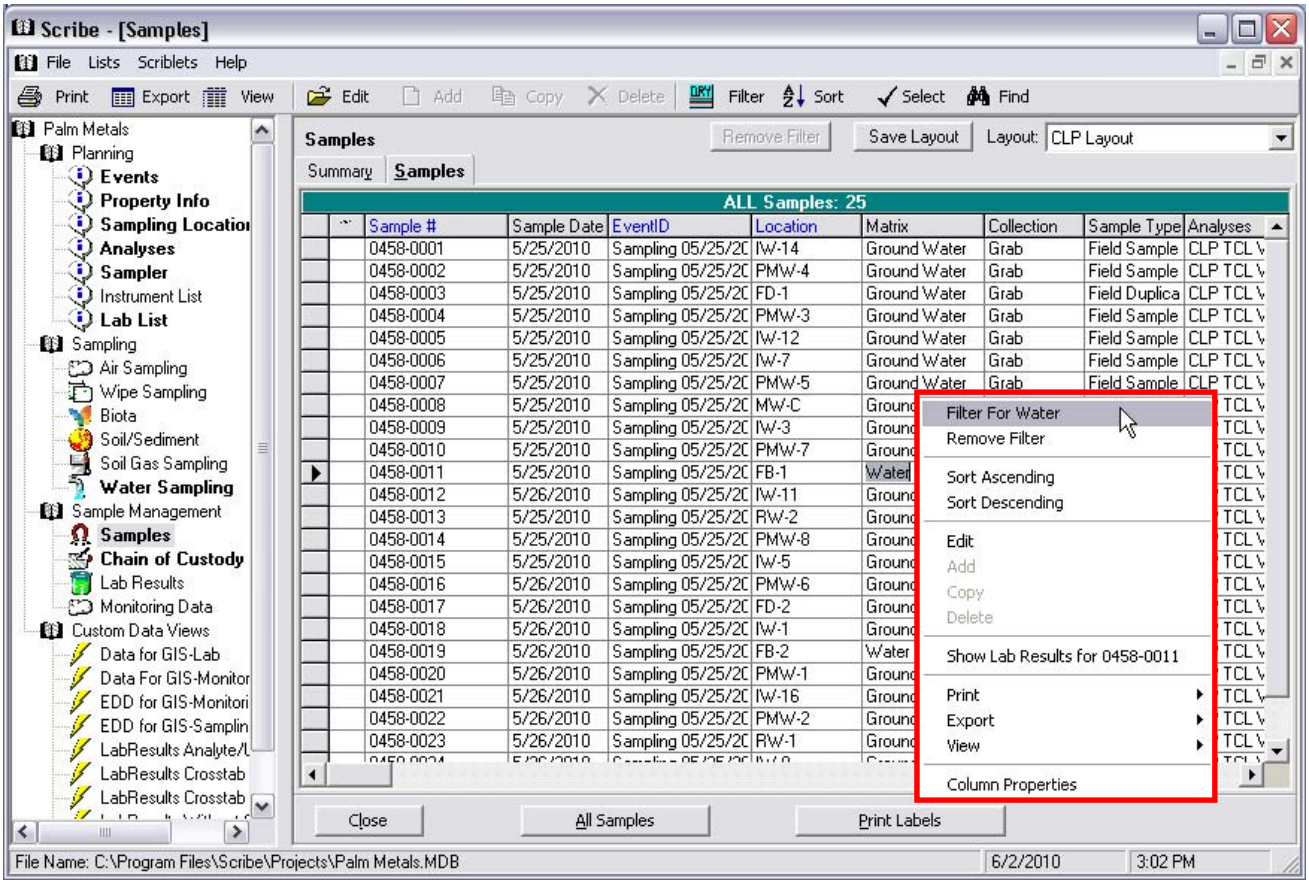
For example, to find and filter for all samples with a Water matrix or Sort ascending/descending:

1. Click on **'Samples'** under Sample Management in the left Navigation bar.



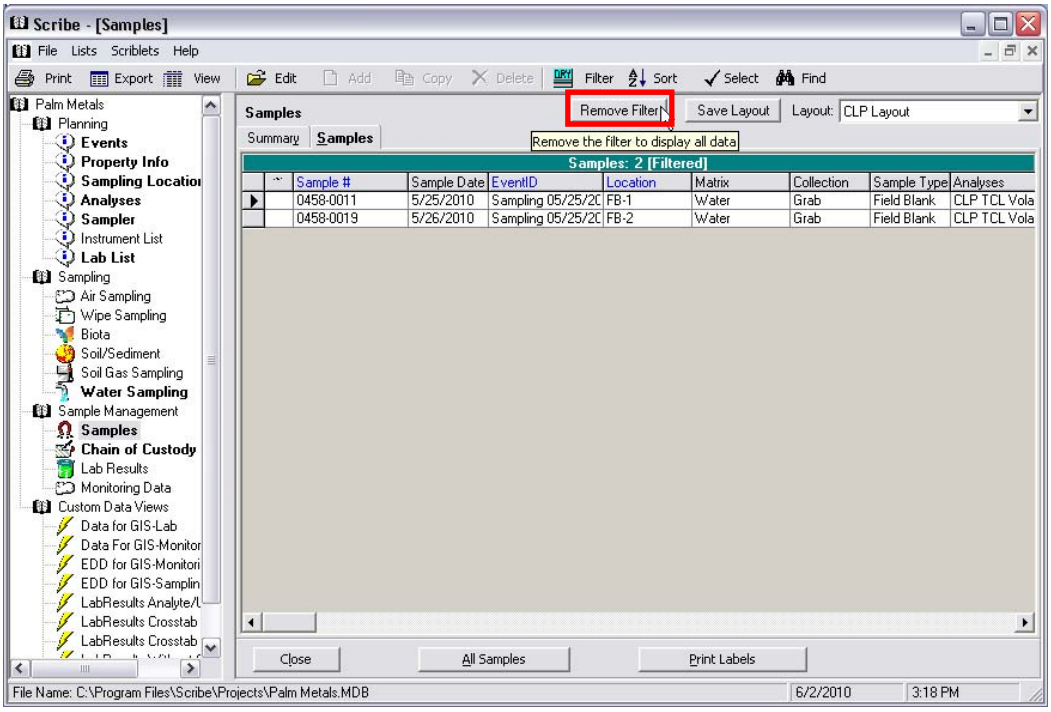
2. To filter or sort on ONE criteria, RT-click on Water value in the Matrix column.

3. Select '**Filter for Water'** in the pop-up menu or select Sort.

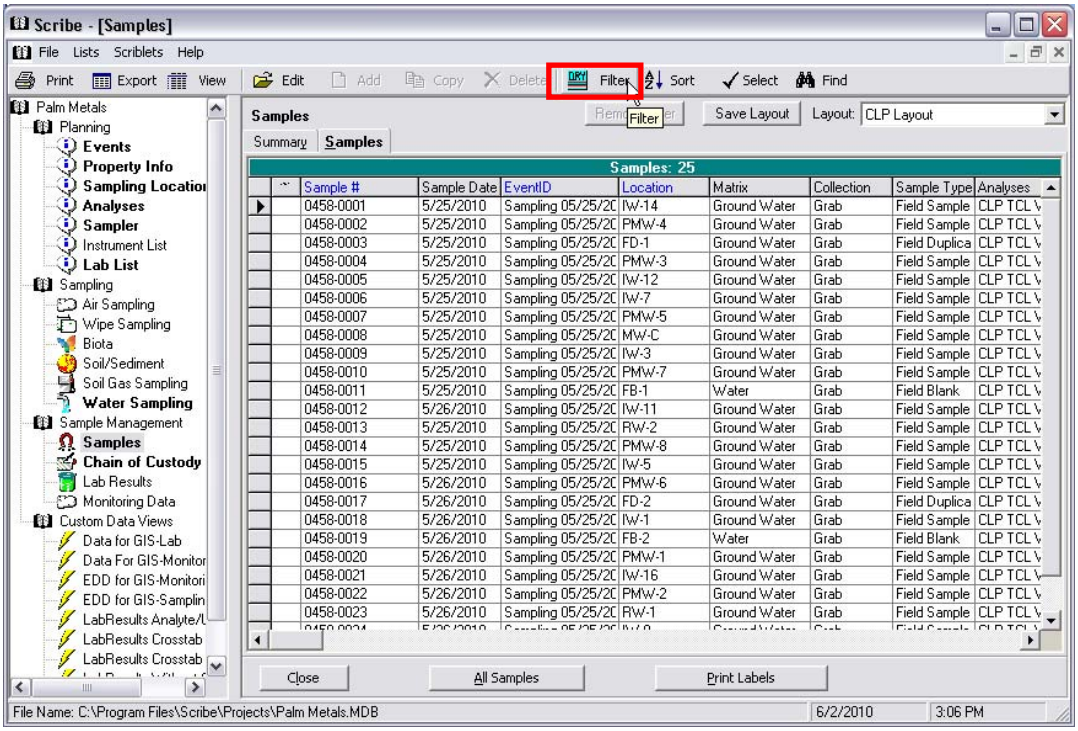


All records that have Water in the Matrix field are displayed.

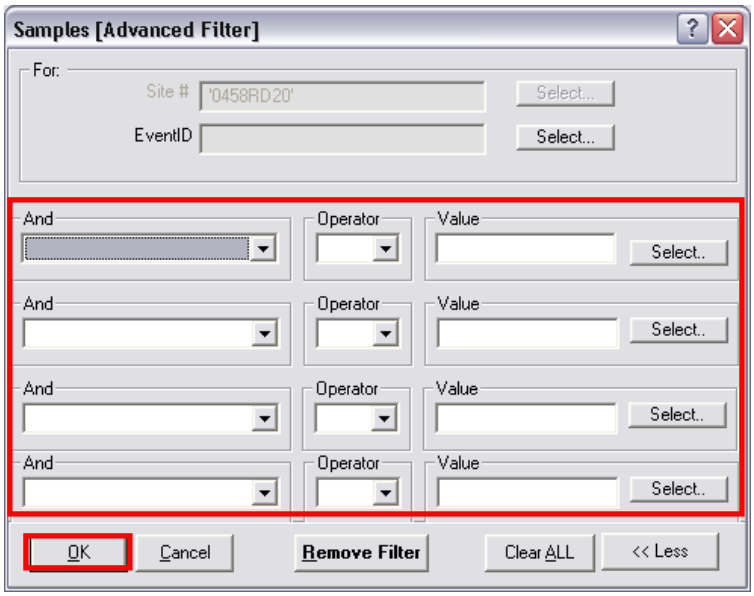
4. To remove the applied filter, click the **'Remove Filter'** button at the top of the screen.



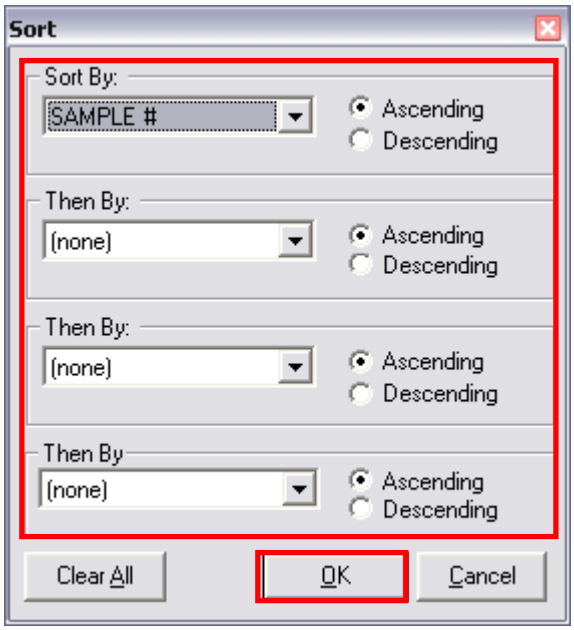
5. To filter on multiple criteria, select the **'Filter'** button on the top menu bar.



6. The Advanced Filter window is displayed. Input the criteria that for your search and click **'OK'** to apply the filter.



7. The Advanced **Sort** button also provides multi-tiered sorting options for sorting on more than one criteria.



Export

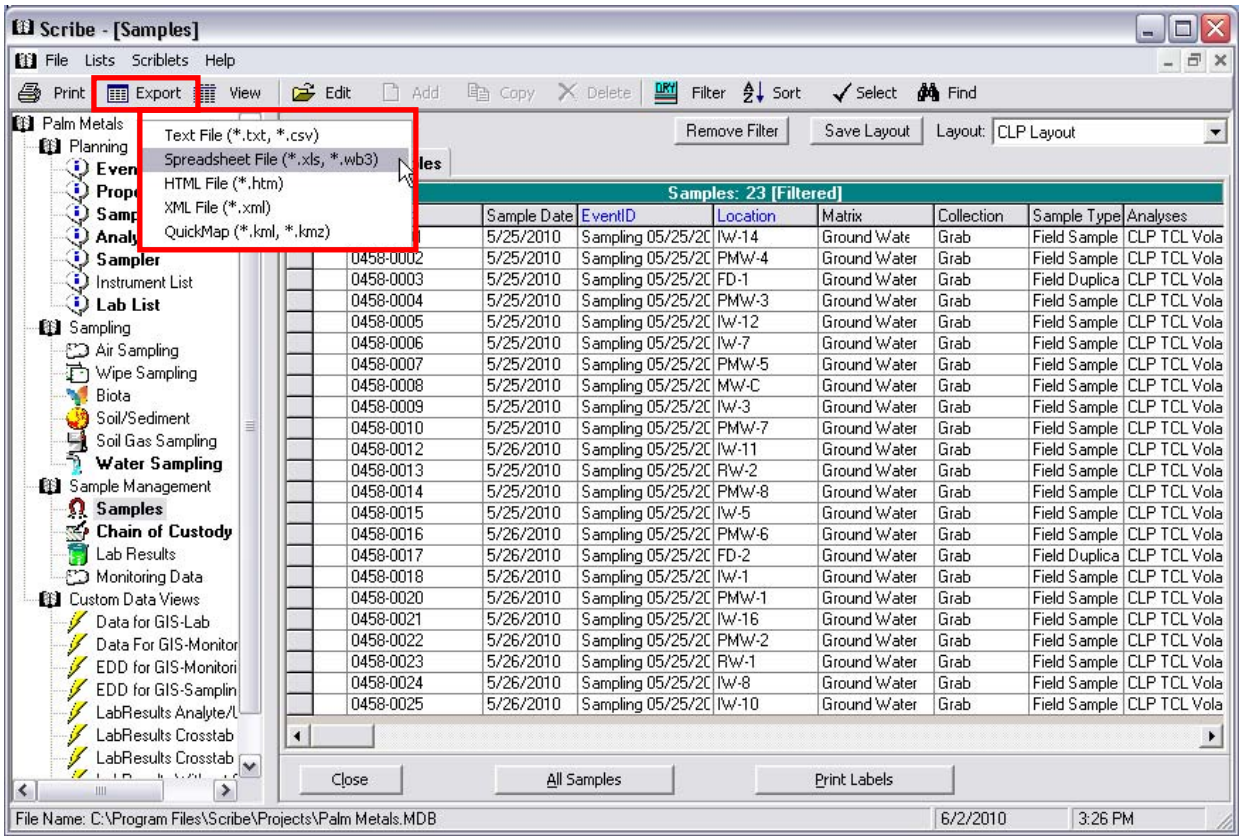
The Scribe grid view does not display every field in Scribe. Select fields are displayed by default and the user can turn on/off the columns. Turn on/off columns as described in the Sample Management section of this document to manipulate the data that is displayed.

After your grid view contains the data necessary for reporting purposes, the user can export the grid view to a third-party file type.

To export the grid view:

1. Click on **'Export'** button on the top menu bar.

2. Select the file type to which you wish to save the data. For example, Spreadsheet (.xls).



3. You will be prompted to select the destination and name the file.

4. The file will open in the external application if it is installed on your computer. For example, if you selected Spreadsheet, Excel will open with the grid data.

Worksheet Reports

Scribe provides a generic worksheet report that allows the user to customize the Header of the report to suit their needs. This option can be used to customize a Samples Report that could be used as a Receipt for Samples on residential sampling tasks.

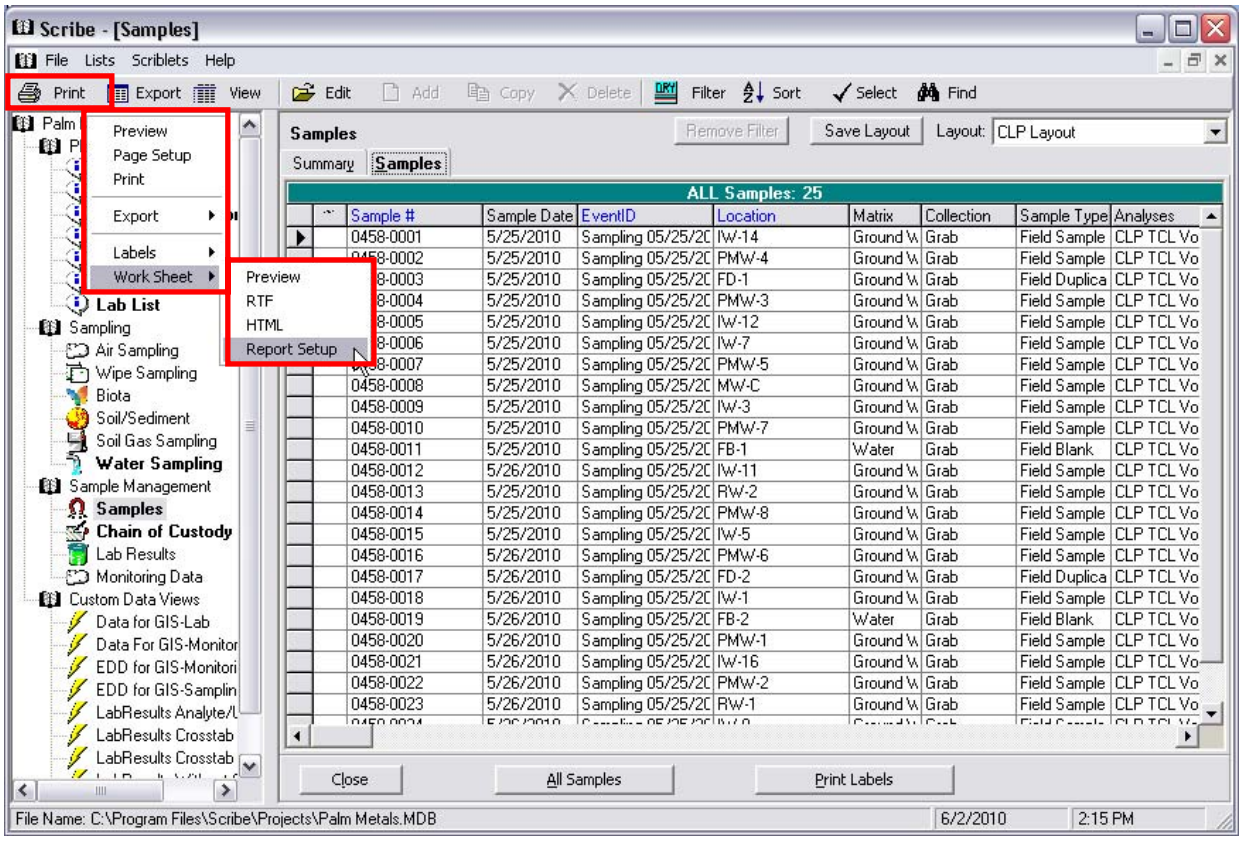
To generate the worksheet report:

1. Use the Find, Filter and Sort options and Column Views to display the data you want to report.

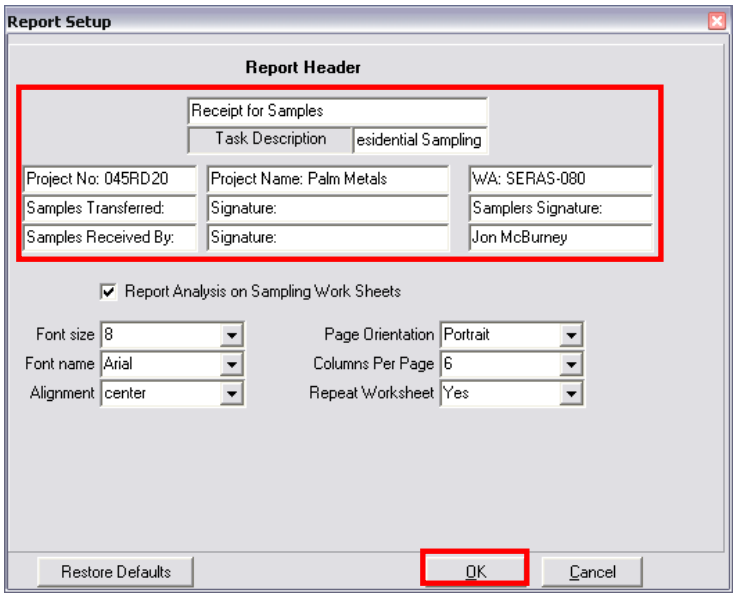
2. Click on the **'Print'** button on the top menu bar.

3. Select the **'Worksheet'** option.

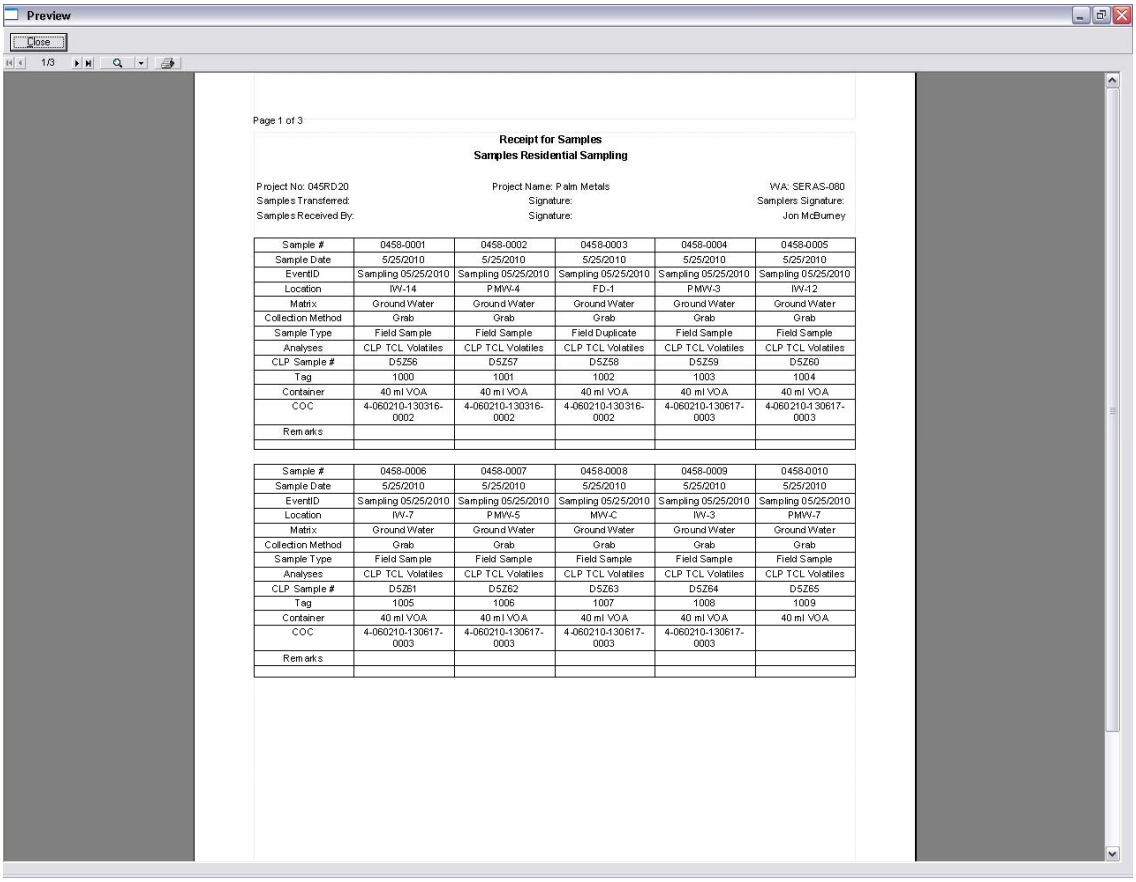
4. Select the **'Report Setup'** option to customize the Header. RTF and HTML will print the worksheet data to the selected format.



5. Configure the Report Header fields to reflect the information that will be displayed at the top of the report.



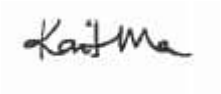
6. Click **'OK'** and the report is generated.



Sample #	0458-0001	0458-0002	0458-0003	0458-0004	0458-0005
Sample Date	5/25/2010	5/25/2010	5/25/2010	5/25/2010	5/25/2010
EventID	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010
Location	IW-14	PMW-4	FD-1	PMW-3	IW-12
Matrix	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Collection Method	Grab	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Duplicate	Field Sample	Field Sample
Analyses	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles
CLP Sample #	D5Z56	D5Z57	D5Z58	D5Z59	D5Z60
Tag	1000	1001	1002	1003	1004
Container	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA
COC	4-060210-130316-0002	4-060210-130316-0002	4-060210-130316-0002	4-060210-130617-0003	4-060210-130617-0003
Remarks					

Sample #	0458-0006	0458-0007	0458-0008	0458-0009	0458-0010
Sample Date	5/25/2010	5/25/2010	5/25/2010	5/25/2010	5/25/2010
EventID	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010
Location	IW-7	PMW-5	MW-C	IW-3	PMW-7
Matrix	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Collection Method	Grab	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Analyses	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles
CLP Sample #	D5Z61	D5Z62	D5Z63	D5Z64	D5Z65
Tag	1005	1006	1007	1008	1009
Container	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA
COC	4-060210-130617-0003	4-060210-130617-0003	4-060210-130617-0003	4-060210-130617-0003	
Remarks					

Field Operating Procedure-08
Packing and Shipping of Environmental Samples

Author: Kaitlin Ma 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE 08

Packing and Shipping of Environmental Samples

1.1 Purpose

This Field Operating Procedure (FOP) presents general guidelines for the packing and shipping of samples to the laboratory for analysis.

1.2 Scope

This is a general description of how to pack and ship samples collected and prepared for analysis at an offsite laboratory. Refer project-specific requirements for material or equipment substitutions, as applicable.

1.3 Equipment and Materials

- Waterproof hard plastic coolers
- Resealable plastic bags
- Plastic garbage bags
- Absorbent packing material (not vermiculite)
- Inert cushioning material (not vermiculite)
- Ice
- Scribe software
- Laptop and printer
- Adhesive labels (generated by Scribe software)
- Chain-of-custody forms (generated by Scribe software)
- EPA Regional custody seals, as applicable
- Air bills and shipping pouches (for example, FedEx)
- Clear tape
- Strapping tape
- Mailing labels

1.4 Procedures and Guidelines

1.4.1 Prepare Sample Bottles for Shipment

1. Arrange sample containers in groups by sample number.
2. Check that sample container lids are tight.
3. Arrange containers on ice in assigned coolers.
4. Affix appropriate adhesive labels to each container.
5. Enclose each sample in a clear, resealable plastic bag, making sure that sample labels are visible.

1.4.2 Prepare Evacuated Canisters Shipment

1. Arrange sample canisters in groups by sample number.
2. Check that the canisters were fully closed upon completion of sampling.
3. Secure laboratory-provided sample tags on canister with string or wire, if applicable
4. Arrange canisters in assigned boxes for shipment. Note that canisters are not shipped with ice.
5. Place flow controllers used for sampling within the box for shipment.
6. Affix appropriate adhesive labels to each box.

1.4.3 Prepare Coolers or Boxes (Evacuated Canisters only) for Shipment

1. Tape drains shut, inside and out.
2. Place inert cushioning material (for example, bubble wrap, preformed poly-foam liner) in the bottom of each package. Do not use vermiculite.
3. Put an absorbent pad in the bottom of the cooler and fill the cooler with enough packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped (offsite sample shipment only). Absorbent material is not required for shipment of evacuated canisters.
4. Double-bag and seal loose ice in resealable, plastic, zip-top bags to prevent melting ice from leaking and soaking the packing material. Place the ice outside the garbage bags containing the samples. Place sufficient ice in cooler to maintain the internal temperature at 4±2 degrees Celsius during transport. Evacuated canisters are not shipped on ice.
5. Place appropriate chain-of-custody records with corresponding custody seals on top of each package.
6. Record the EPA Regional custody seal numbers, as applicable, on the chain-of-custody forms if package is being shipped. Sign each chain-of-custody form (or obtain signature) and indicate the time and date the cooler was custody sealed.
7. Seal the laboratory copies of the chain-of-custody forms in a large resealable plastic bag and tape to the inside lid of the package. Retain copies of the chain-of-custody forms for return to EPA, if requested (required for Region 5). Each cooler must contain a chain-of-custody form (or forms) that corresponds to the contents of the package.
8. Close lid and latch.
9. Peel custody seals carefully from backings and place intact over lid openings (right front and left back) for shipping. Cover seals with clear protection tape. When shipping evacuated canisters, verify that custody seals are placed so that if the box was opened they would break.
10. Place mailing label with laboratory address on top of each package.
11. Affix applicable laboratory-provided shipping labels on the outside of the package being shipped.
12. Tape package shut on both ends, making several complete revolutions with strapping tape for shipping. Do not cover custody seals with strapping tape.
13. Relinquish to carrier (for example, Federal Express). Place air bill receipt inside the mailing envelope and send to sample documentation coordinator, along with the other documentation.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Verify each cooler contains a chain-of-custody form (or forms) that corresponds to the contents of the package.
- Verify forms are complete before sealing inside the cooler.
- Verify EPA Regional copies of the chain-of-custody forms are retained for return to EPA, as applicable.
- Inspect the cooler for leaks prior to relinquishing to the carrier.

1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-10
Investigation and Remediation-derived Waste Management

Author: Steve Chumney	5/4/2022	
	Date	Project Manager
Approver: Kimberly Amley	5/4/2022	
		Program Quality Manager

FIELD OPERATING PROCEDURE-10

Investigation and Remediation-derived Waste Management

1.1 Purpose

The purpose of this field operating procedure (FOP) is to provide general guidelines for the handling and disposal of investigation-derived waste (IDW) or remediation-derived waste (RDW). Refer to the project-specific Waste Management Plan (WMP) for additional details.

1.2 Scope

This FOP covers the handling and disposal of IDW/RDW, which are the waste materials generated during a field investigation and remediation activities, respectively. Some of the waste materials may be classified as hazardous waste. All IDW/RDW must be disposed of in accordance with local, state, and federal regulations.

1.3 Equipment and Materials

- Log book
- Indelible pen
- Container labels
- Approved waste container

1.4 Procedures and Guidelines

All IDW/RDW will be handled in accordance with federal and state regulations, as well as any site-specific requirements. If IDW/RDW is identified as potentially hazardous waste based on analytical data, it must be segregated from IDW/RDW that will be treated as nonhazardous for further characterization.

The following IDW/RDW will be placed in United Nations (UN)-approved 55-gallon steel drums or other container approved by the project-specific Environmental Manager:

- Disposable equipment, such as plastic ground and equipment covers, aluminum foil, Teflon tubing, broken or unused sample containers, sample container boxes, and tape
- Used personal protective equipment (PPE), such as disposable coveralls, gloves, booties, and respirator canisters identified as potentially hazardous waste
- Excessive soil brought to the surface during sampling activities not used for laboratory analysis Groundwater obtained through well development, purging, and/or sampling
- Development water
- Decontamination fluids

IDW/RDW not identified as potentially hazardous waste will be managed as follows:

- Used PPE will be placed in a UN-approved 55-gallon drum, trash bag, or project-specific approved container and disposed of as a solid waste in an appropriate licensed landfill.

1.4.1 Labeling

All IDW/RDW containers will be labeled to identify their waste status.

- Type of waste (for example, groundwater or decontamination fluids)
- Location from which the waste was generated
- Accumulation start date
- Generator point of contact (POC)

Containers used to accumulate waste will include one of the following labels:

- "Analysis Pending" – This is a temporary label used until analytical results are received and reviewed, and the waste characterized as hazardous or nonhazardous. Once the waste is characterized, this label will be replaced with one of the following labels. Include the accumulation start date on this label.
- "Hazardous Waste" labels with the following information:
  - Accumulation start date
  - Generator name, address, contact, and phone number
  - U.S. Environmental Protection Agency (EPA) identification (ID) number
  - Why the waste is hazardous (toxic, ignitable, corrosive, reactive)
  - RCRA waste code(s)
  - Proper Department of Transportation shipping name
  - Prior to transport, the manifest number must be added (for containers of less than 110-gallon capacity)
  - Manifest tracking number will be entered when pickup occurs
- "Nonhazardous Waste" labels with the following information:
  - Generator name
  - POC name and phone number
  - Waste-specific information (for example, petroleum-contaminated soil or petroleum-contaminated water)

For hazardous waste, the DOT labels (for example, flammable or oxidizer) will be included on the container prior to shipment.

1.4.2 Waste Accumulation Area Management

All IDW/RDW identified as potentially hazardous will be transferred as soon as practical to a temporary storage area identified by the field team leader. The following requirements apply to the waste storage areas:

- Hazardous wastes and waste awaiting designation will be stored separately in the waste accumulation area.
- Store containers in rows based on the waste stream designators.
- When possible, store UN-approved 55-gallon drums with solids on concrete, wooden pallets, or project-specific secondary containment system.
- Drums or other containers containing liquid waste will be placed in secondary containment.
- Drums will remain completely closed with lids, covers, bolts, and locking mechanisms engaged, as though ready for immediate transport, except when removing or adding waste to the drum.
- No waste container will be placed within 50 feet of a water course or storm drain.

1.4.3 Offsite Disposal

Arrangements will be made immediately upon completion of sampling activities to have the contracted waste handling firm remove the waste from the site. The need for waste disposal analysis will be determined as discussed with the contract waste handler before the onset of field events. IDW/RDW sampling, if required, will be completed in accordance with project-specific requirements.

1.5 Records Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-16
GPS Coordinate Data Collection Procedures

Author: Ryan Sleeper 5/4/2022 

Author

Approver: Kimberly Amley 5/4/2022 

Program Quality Manager

FIELD OPERATING PROCEDURE-16

GPS Coordinate Data Collection Procedures

1.1 Purpose

This field operating procedure (FOP) provides guidelines for the collection of horizontal coordinates during field activities using a Global Positioning System (GPS) unit.

1.2 Scope

This method described for the collection of horizontal coordinates is applicable to a Trimble® Pathfinder Pro XR, Pro XRS, or comparable GPS receivers. The level of accuracy following this procedure is submeter. Refer to specific requirements of the project in the Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) or project plan(s) when using this FOP during field activities.

1.3 Equipment and Materials

- Trimble® Pathfinder Pro XR, Pro XRS, or comparable GPS receiver and compatible data-logger
- Field Logbook
- Pin Flags
- Aerial Photograph or map of Sampling Area
- Measuring Wheel

1.4 Procedures and Guidelines

- Assemble and turn on the unit in accordance to manufacturer's instructions.
- Verify that GPS readouts are in the units specified in the UFP-QAPP or project plan(s).
- Place the GPS antenna over the location where coordinates are to be collected, and record coordinates in field logbook, the GPS receiver, or both. If locations are to be logged into the receiver, readings must be collected every 5 seconds for a period of 1 minute (see manufacturer instructions on position logging). The data files recorded for each position must be named including both the sample location identification and date recorded.
- The data from the GPS unit must be downloaded to a personal computer every 2 hours or at each new sampling site. If neither option for downloading data is available (i.e., collecting samples from a boat), then a real-time reading of coordinates must also be recorded in the field log book or appropriate field form.
- The program precision and accuracy requirements for location coordinates are ± 1 meter (3.3 feet). To achieve real-time data with a submeter accuracy level with no post-processing of data using GPS Pathfinder Office, the following criteria must be met:
    - Minimum number of satellites = 4
    - Maximum Position Dilution of Precision (PDOP) = 6

  - Minimum (Signal to Noise Ration) SNR = 4
  - Minimum elevation = 15 degrees

- If any of the above criteria cannot be met due to weather conditions, time of day, or obstructions of the sky, such as buildings or foliage resulting in a less than submeter accuracy:
  - Mark the location using a pin flag and measure the distance from two known points for future triangulation calculations. Come back and take a reading when conditions are optimal, if the location coordinate accuracy requirements cannot be met because of either weather conditions or time of day.
  - Mark the location on an applicable aerial photograph or map for coordinate extrapolation in GIS and measure the distance from two known points if the location coordinate accuracy requirements cannot be met because of heavy foliage or other physical obstruction.
  - Mark the location on the applicable aerial photograph or map if the location cannot be marked using a pin flag (over water), no matter the obstruction. Also, estimate the distance from two known locations and note in the field logbook so that, at a minimum, a general location position can be obtained.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Verify the coordinate units meet the project plan(s).
- Charge battery to GPS unit when not in use.
- The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

1.7 Attachments

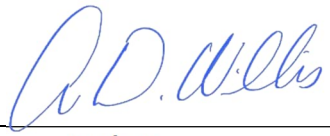
None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-47
Global Navigation Satellite System Survey Procedures

Author: Aaron Willis, PLS 6/14/2023



Author

Approver: Kimberly Amley 6/14/2023

Program Quality Manager

FIELD OPERATING PROCEDURE-47

Global Navigation Satellite System Survey Procedures

1.1 Purpose

This field operating procedure (FOP) provides general guidelines for conducting land surveying using Global Navigation Satellite System (GNSS) equipment.

1.2 Scope

The FOP covers the topic of GNSS survey and ensures consistency, accuracy, and safety during GNSS surveys. This document should be reviewed by the field project team prior to working in the field.

1.3 Equipment and Materials

- Log book and indelible pen.
- GNSS Receiver: Use a high-precision GNSS receiver capable of tracking multiple satellite constellations (e.g., GPS, GLONASS, Galileo, BeiDou).
- Surveying Rod: Use a surveying rod with precise height markings for accurate measurements.
- Data Collector: Utilize a data collector device or tablet equipped with software capable of recording GNSS data.

1.4 Procedures and Guidelines

1.4.1 Pre-survey Preparation

- Review Project Requirements: Understand the project scope, objectives, and client requirements for the GNSS survey.
- Check Equipment: Ensure the GNSS receiver, surveying rod, and data collector are in good working condition. Calibrate and update the firmware, if necessary.
- Verify Control Points and/or Reference Stations: Confirm the availability and suitability of control points or reference stations for real-time corrections or post-processing.
- Check Satellite Visibility: Check the satellite visibility int eh area of interest to ensure sufficient satellite coverage for accurate positioning.

1.4.2 Field Survey Procedure

- Establish Control Points: Establish or locate existing control points in the survey area with known coordinates. Ensure that these control points are marked clearly and can be easily identified.

- Set-up the GNSS Receiver: Set up the GNSS receiver on a stable tripod mount. Ensure it is level and provide clear sky visibility.
- Connect to Reference Station: Connect the GNSS receiver to the available reference station for real-time corrections, if applicable. Follow the manufacturer's instructions for establishing a reliable connection.
- Check Control Points: Move the GNSS receiver to each control point and occupy it for a sufficient duration to collect accurate GNSS data. Maintain stability and avoid disturbances during data collection.
- Field Checks: Perform field checks to identify and address potential errors.
- Document Field Observations: Using a field logbook, document field observations, environmental conditions, equipment issues, equipment calibration, or other factors that may impact data quality.

1.4.3 Post Processing

- Data Transfer: Transfer the collected GNSS data from the data collector to a secure storage medium for further processing.
- Quality Control: Perform quality control checks on the collected data, including validating data integrity, signal quality, and positional accuracy.
- Post-Processing Software: Utilize post-processing software to process the raw GNSS data. If required, apply appropriate correction models, such as differential correction, to enhance accuracy.
- Adjustments and Georeferencing: Using Computer-Aided Drafting (CAD) Software, generate the required maps, reports, and digital datasets, according to project specifications.

1.5 Records Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Conduct quality control checks as outlined in the procedural steps in Section 1.4.
- Implement Safety Precautions outlined in the project-specific safety plan, including but not limited to:
    - Personal Safety: Prioritize personal safety during the survey. Follow local safety guidelines and wear appropriate personal protective equipment (PPE), such as hard hats, high-visibility vests, and safety boots.
    - Hazard Identification: Identify and assess potential hazards in the survey area, such as uneven terrain, traffic, underground utilities, or environmental risks. Take necessary precautions to mitigate risks and ensure the safety of survey personnel and others in the vicinity.

- Environmental Awareness: Be aware of the surroundings, including potential hazards such as uneven terrain, traffic, wildlife, or inclement weather conditions. Take necessary precautions and adapt surveying procedures accordingly.
- Traffic Control: Implement appropriate traffic control measures if the survey involves working near roadways or areas with vehicular traffic. Comply with local regulations and ensure the safety of survey personnel and motorists.
- Communication: Maintain clear communication among survey team members to coordinate activities, share information, and address any safety concerns that may arise during the survey.
- Equipment Safety: Handle the GNSS receiver and associated equipment with care to prevent damage. Secure equipment during transportation and store properly when not in use. Equipment should be checked by a manufacturer-approved vendor, as needed.
- Emergency Preparedness: Be prepared for emergencies by carrying necessary safety equipment, such as first aid kits, communication devices, and emergency contact information.
- Site Access and Permissions: Obtain permissions and access permits before conducting surveys on private property, government land, or restricted areas. Respect property boundaries and comply with applicable regulations.
- Data Privacy and Confidentiality: All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer. Protect the privacy and confidentiality of collected survey data, adhering to legal and ethical obligations. Store and handle data securely to prevent unauthorized access or disclosure.

1.7 Attachments

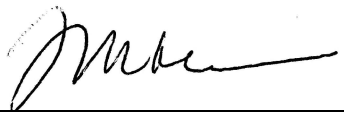
None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-50
Sediment Sampling Procedures

Author: Theresa Himmer 09/18/2023



Author

Approver: Kimberly Amley 09/18/2023

Program Quality Manager

FIELD OPERATING PROCEDURE 50

Sediment Sampling Procedures

1.1 Purpose

The purpose of this field operating procedure (FOP) is to describe general and specific procedures, methods, and considerations to be used and observed when collecting sediment samples for field screening or laboratory analysis.

1.2 Scope

The procedures contained in this document are to be used by field investigators when collecting and handling sediment samples in the field. On the occasion that field investigators determine that any of the procedures described herein are inappropriate, inadequate, or impractical and that another procedure must be used to obtain a sediment sample, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Equipment and Materials

The physical characteristics of the sediment sampling location and surface water body depth may dictate the equipment to be used. Wading may be a viable method for reaching the sampling location if that can be safely performed. The samples shall be collected facing upstream because wading may disrupt sediments and bias results. If the stream is too deep to wade, the sediment sample may be collected from a vessel or platform such as bridge.

- Global Positioning System (GPS) (tablet, mobile device, etc. with accuracy specified in the site-specific plan(s))
- Preassembled sampling containers
- Field logbook and pens with indelible ink
- Stainless-steel bowl(s)
- Stainless-steel spatula/spoon(s)
- Spade or shovel
- Sediment sampler (e.g., Ponar or Ekman grab)
- Sediment coring device (outer tubes, drive head, drop hammer, check valve devices, catchers, and core liners)
- Nylon rope or steel cable
- Bucket auger
- Large plastic tub or disposable food-grade aluminum pans
- Peristaltic pump
- Camera

- Dry erase board and marker
- Personal protective equipment identified in the project-specific plan(s) (disposable gloves, boots, hip/chest waders, etc.)
- Decontamination solution and equipment, as specified in project-specific plan(s)

Special considerations for projects that involve per- and polyfluoroalkyl substances (PFAS) shall be implemented in accordance with the project-specific plan(s).

1.4 Procedures and Guidelines

The sediment sampling techniques and equipment described in this procedure are designed to minimize effects on the chemical and physical integrity of the sample. If the procedures in this section are followed, a representative sample of the sediment should be obtained. The field team will determine which of the following procedures will be used to collect the sediment samples given the various site conditions including sediment depth to refusal. Operator manuals, if available, should be consulted for specific details.

1.4.1 Sample Collection

Suites of sample bottles will be preassembled. The volatile organic compound (VOC) bottles will be the first samples collected to minimize the loss of volatile compounds from the sample.

Surface sediment is to be collected either using a hand-held device such as a shovel or trowel or using a grab sampling device (such as Eckman, Ponar, VanVeen, etc). The surface interval can vary in thickness and will be defined in the project plan(s). Following collection, the sediment sample is placed into a decontaminated container such as a stainless-steel bowl or food grade aluminum pan, homogenized, and placed into appropriate sample containers. Sediment samples should be homogenized only after the portion for VOC analysis has been collected to avoid the loss of VOC contaminants during the homogenization process.

Before sub-samples of the surficial sediments are taken, the overlying water must be removed. The preferred method of removing this water is by slowly siphoning it off near one side of the sampler. This can be done using a peristaltic pump or similar siphoning or suction device (for example, turkey basters or large disposable plastic syringes). Methods such as decanting the water or slightly cracking the grab to let the water run out are not recommended, as they may result in unacceptable disturbance or loss of fine-grained surficial sediment and organic matter.

1.4.2 Hand Trowel, Shovel, Scoops, and/or Spoons

If the stream is dry, the sediment is accessed directly and is collected using either the hand trowel, shovel, stainless steel scoop or spoon.

- If the surface water body is a wade-able, wade into the surface water body and while facing upstream (into the current).
- If the surface water body is too deep to wade, the sediment sample will be collected from the bank, if the surface water body is narrow, or bridge or vessel. Attach a stainless-steel scoop or spoon to a piece of conduit or a handle.
- Remove the desired thickness of the sample along the bottom of the surface water body in the upstream direction.

- Remove/drain excess water from the scoop or spoon. However, this may result in the loss of some fine-grained particle size material associated with the substrate being sampled. Care should be taken to minimize the loss of fine-grained material.
- Collect VOC and gasoline range organics (GRO) samples if specified in the project plan(s). For VOCs and GRO, a dedicated micro-coring device (such as the laboratory provided plunger) should be used to transfer a predetermined amount of sediment into a pre-weighed sample container containing preservative, if possible. If pre-preserved vials are not provided, sediment should be placed in a small jar with no headspace for the VOC aliquot. After the VOC fraction of sediment is collected, place the remaining sediment sample in a stainless-steel bowl and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. A dedicated sampling scoop or trowel will be used to collect the sample material and place it into the appropriate sample container. Where possible, dedicated scoops or trowels are used to prevent the possibility of cross-contamination between sample stations as well as eliminating the need for any decontamination procedures between samples. The container cap will then be secured, and the sample will be preserved by immediately placing containers in a cooler with ice.

1.4.3 Grabs or Dredges

Grab samplers (also known as dredges) provide a means of collecting sediment from surface water bodies that are too deep to access by wading or too deep to collect from shore. This technique consists of lowering a sampling device to the sediment by use of a rope, cable, or extended handle. The mechanism is triggered, and the device entraps sediment in spring-loaded jaws, or within lever-operated jaws. The following procedures are used for collecting sediment samples with a sediment sampler such as an Ekman Bottom Grab Sampler or Ponar Grab:

- Attach a sturdy nylon or steel cable to the hook provided on top of the dredge or grab sampler.
- Arrange sampler in the open position.
- Lower the sampler to a point just above the sediment surface.
- Drop the sampler sharply onto the sediment.
- Trigger the release mechanism to close the sampler.
- Raise the sampler and slowly remove any free liquid through the top of the sampler. Be careful to retain fine sediments.
- Inspect the grab for acceptability. If the surface shows signs of disturbance (channeling, loss of surface integrity), discard the sample. Sediment samples are considered acceptable if they meet the following criteria:
    - Sampler is not overfilled with sediment; the jaws are fully closed and the top of the sediment is below the level of the opening doors.
    - Overlying water is present and not excessively turbid.
    - In certain locations slight over-penetration may be accepted at the discretion of the field team leader. Mild over-penetration may be accepted according to the following standards:
        - Sediment surface is intact on at least one side of the grab
        - Little or no evidence of surface sediment pushing through the grid surface of the grab (i.e., no visible imprint from the screening outside of that grid).

- Illustrations of acceptable grabs are shown on Figure 1.

- Gently siphon off overlying water, taking care to not disturb the sediment sample.
- Upon removal of the overlying water, take a photograph of the grab, so that the sediment type is observable. A dry erase board should be utilized to include the Station ID, grab number, and date in the photo. The description of the sediment should be recorded in the field logbook.
- Transfer the sediment into a stainless steel or high-density polyethylene bucket or a single use aluminum pan. Sediment in contact with the sides of the grab sampler should not be included in analytical samples. Continue to collect additional sediment until sufficient material has been obtained.
- Collect samples for VOC and GRO samples by inserting the coring device directly into undisturbed sediment in the central part of the grab. The remaining sample will then be placed into a stainless-steel bowl (or disposable pan) and homogenized using a dedicated stainless-steel scoop. Any extraneous material not considered to be relevant for analysis (for example, large debris or rocks) may be removed from the sample during homogenization and any water present will be decanted. The sample is then placed into the appropriate size, pre-labeled sample containers for each analysis to be performed. The container lid(s) will then be secured, and the samples will be preserved by immediately placing the containers in a cooler on ice.

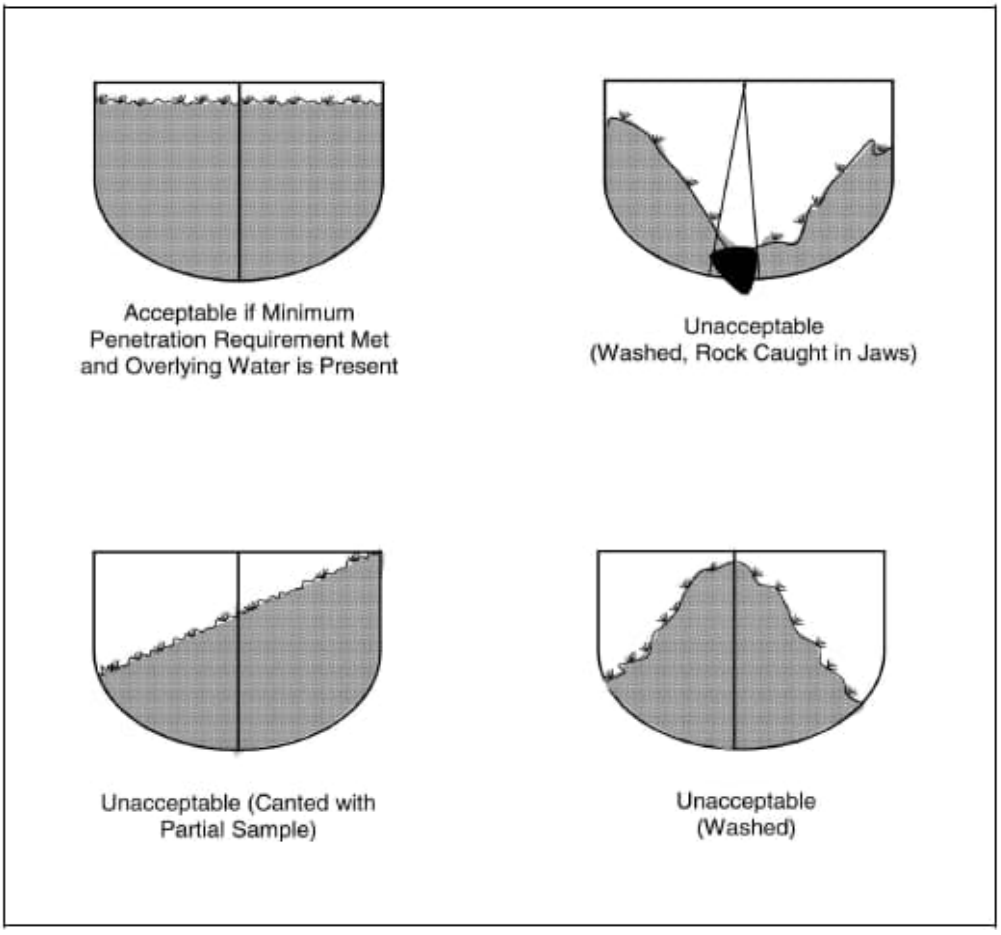


Figure 1. Depictions of Acceptable and Unacceptable Sediment Grab Samples

1.4.4 Hand Coring Device

A hand coring device consists of a coring device, handle, and core tub (which may be acetate, polycarbonate, or other material appropriate for the chemical testing planned). The following procedures are used for collecting sediment samples with a hand coring device. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas.

- Assemble the coring device by inserting the core liner into the sampling tube.
- Insert the "eggshell" core catcher into the leading end of the sampling tube with the convex surface positioned inside the core liner; if a water check valve is part of the device, verify that it moves freely.
- Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
- Place the sampler in a perpendicular position on the material to be sampled.
- This sampler may be used with either a drive hammer for firm consolidated sediments, or a "T" handle for soft sediments. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. Rotate the sampler to help release the sediment at the bottom of the core tube and retrieve the device.
- Slide the core liner out of the sampler tube and either process the sample immediately or seal the core tube for storage and transport..
- Cores may be processed by extruding the sediment or splitting the core liner longitudinally and bisecting the core for characterization. VOC and GRO samples should be collected immediately upon opening the core; the project plan(s) will specify how the location for VOC or GRO aliquot will be selected (for example, the mid-point of an interval, based on visual observations, or informed by PID readings). . The remaining sample that was not in contact with the core liner will then be placed into a stainless-steel bowl (or disposable pan) and homogenized using a dedicated stainless-steel or high density polyethylene scoop (the project plan(s) will specify what materials may or may not be used for sample processing). Any extraneous material not considered to be relevant for analysis (for example, large debris or rocks) is removed from the sample during homogenization and any water present will be decanted. The sample is then placed into the pre-labeled sample containers for each analysis to be performed. The container lid(s) will then be secured, and the samples will be preserved by immediately placing the containers in a cooler on ice.

1.4.5 Drive Hammer

If the drive hammer is selected, use the following procedures for collecting a sediment sample:

- Insert the tapered handle (drive head) of the drive hammer through the drive head.
- With left hand holding the tube, drive the sampler into the material to the desired depth. Do not drive the tube further than the tip of the hammer's guide.
- Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.
- Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

- Rotate the sampler at least two revolutions to shear off the sample at the bottom.
- Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head and rotate about 90-degrees.
- Withdraw the sampler by pulling the handle (hammer) upwards and dislodging the hammer from the sampler.
- Slide the core liner out of the sampler tube and either process the sample immediately or seal the core tube for storage and transport.Cores may be processed by extruding the sediment or splitting the core liner longitudinally and bisecting the core for characterization. VOC and GRO samples should be collected immediately upon opening the core; the project plan(s) will specify how the location for VOC or GRO aliquot will be selected (for example, the mid-point of an interval, based on visual observations, or informed by PID readings). . The remaining sample that was not in contact with the core liner will then be placed into a stainless-steel bowl (or disposable pan) and homogenized using a dedicated stainless-steel or high density polyethylene scoop (the project plan(s) will specify what materials may or may not be used for sample processing). Any extraneous material not considered to be relevant for analysis (for example, large debris or rocks) is removed from the sample during homogenization and any water present will be decanted. The sample is then placed into the pre-labeled sample containers for each analysis to be performed. The container lid(s) will then be secured, and the samples will be preserved by immediately placing the containers in a cooler on ice.
-

1.4.6 Sediment Characterization

This section provides the typical process followed for sediment characterization; the project plan(s) may specify additional observations that must be recorded to meet specific objectives. The sediment will be visually characterized for sediment type, color, moisture content, texture, grain size and shape, consistency, visible evidence of staining, and any other observations. The observations recorded must not contain any subjective conclusions about product type (i.e., nonaqueous phase liquid [NAPL] observations will consist of a description of the physical properties of the material including a description of odor as standardized below).

The sediment will be described using the Unified Soil Classification System (modified slightly for sediment characterization) based visual-manual identification in accordance with) ASTM-2488 standard practice.

The colors will be designated using a Munsell color chart. The information will be recorded in a field logbook or on a field form.

- Odor: Olfactory observations (odors) or positive responses to an organic vapor detector will be recorded on the sediment core log.
- Use the descriptors *none, strong, moderate, or faint to characterize odor.*
- Examples of odors may include, but not be limited to sulfur/sulfide, petroleum, and fuel type odors.
- Evidence of contamination: The following descriptors should be used to characterize any visible evidence of NAPL impact:
    - None Visible – Visible NAPL is not observed in the sediment sample.
    - Odor – Petroleum odor or positive response to an organic vapor detector

  - NAPL Sheen – NAPL is not visible but a distinct film is evident
  - NAPL Impregnated – NAPL is visible in the spaces between the sediment grains by NAPL does not flow from the sample.
  - Free NAPL – Sediment is NAPL impregnated and NAPL flows from the soil grains to the surface of the sample.
- Viscosity of Free-Phase Product – If free-phase product is present, a qualitative description of viscosity should be made. The following descriptors should be used:
  - Highly viscous (e.g., taffy-like)
  - Viscous (e.g., No. 6 fuel oil or bunker crude like)
  - Low viscosity (e.g., No. 2 fuel oil like)

1.4.7 Sediment Sample Documentation

Information to be recorded specific to this procedure includes the following:

- Sample location and number
- Date and time of collection
- Station coordinates (as-sampled)
- Water depth
- Make note of any debris in area
- Any other information (i.e., odor or sheen produced when grab brought to surface or sectioned).
- Grab penetration
- Collection method used
- Sediment color, texture, odor, organic content, and grain size distribution
- Photoionization detector readings, if required by project
- Number of attempts needed or other issues with sediment recovery
- Sample Identification and analytical samples collected
- Designation of quality control samples, including any blanks, duplicates, or laboratory matrix spikes/matrix spike duplicates
- Any other pertinent observations

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Wear personal protective equipment outlined in the site-specific plan(s), including gloves.
- Start at downstream locations and work upstream to the extent practicable.
- Beware of hidden stream hazards.
- Make sure the samples are kept at a temperature of 4°C before and after they are processed for delivery to the laboratory.
- Determine if a QC sample will be required at a sampling location. If a MS/MSD or duplicate sample will be needed, then additional sample volume will be required. Additional sample volume may be acquired by collection of additional samples using the procedures outlined in this FOP.
- Ensure that all tools that may come in contact with the sample are properly decontaminated.
- The field notes will be reviewed by the Site Quality Control Manager at the end of each work day performed.

1.7 Attachments

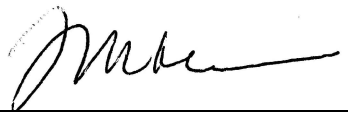
None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Field Operating Procedure-58
Vibracore Sediment Sample Collection

Author: Theresa Himmer 7/09/2024



Author

Approver: Kimberly Amley 7/09/2024

Quality Assurance Manager

FIELD OPERATING PROCEDURE 58

Vibracore Sediment Sample Collection

1.1 Purpose

The purpose of this field operating procedure (FOP) is to describe the collection and handling of sediment samples using a vibracore over water during field operations.

1.2 Scope

This procedure is applicable for the collection of representative sediment from a vibracore sample over water.

1.3 Equipment and Materials

- Verify the sampling vessel is appropriate for anticipated sampling conditions (mooring, core deployment and recovery system, vessel draft)
- Nautical charts and tide tables
- Marine very high frequency radio and cellular telephone
- US Coast Guard required vessel safety device, including personal flotation device
- Appropriate vessel navigation and position recording equipment, including shore side reference station beacon and tide staff gauge installed onsite
- Fathometer and bar gauge or equivalents for recording depth to sediment
- Vibratory core barrel of appropriate sampling length, and polycarbonate core liner material, if required
- Decontaminated core cutter (nose cone) and sample retainer (catcher) assemblies
- Decontaminated core cutting and sample processing equipment
- Decontamination supplies, including wash down pump and hoses
- Steel tape measure
- Sample coolers and ice
- Logbook
- Personal protective equipment (nitrile gloves, rubber boots, rain gear, etc.)

1.4 Procedures and Guidelines

1. Inspect decontaminated core cutter and core retainer assemblies prior to vessel departure.
2. Review day's planned sampling activities to ensure that all required equipment is onboard the vessel, and that the planned sampling order is appropriate. Program sample location

coordinates into onboard navigation system and confirm that they were determined in the proper coordinate system and datum for the site.

3. Sampling will begin downstream and work upstream to prevent contamination of unsampled areas. For tidally influenced sites, sampling will be scheduled to coincide with low tide and under low flow conditions, when possible, to minimize the dilution of possible contaminants.
4. Confirm that land-based reference beacon (if used) and differential global positioning system (DGPS) links have been established, global positioning system (GPS) antenna is over sample location, and antenna offsets have been measured to correct for the actual sampling location.
5. Inspect tide staff gauge and record water surface level to the nearest 0.1 foot.
6. Navigate to sampling location and anchor in position, securing the mooring to minimize the effects of current and wind. Follow all vessel crew instructions, remaining clear of equipment and moorage rigging.
7. Once vessel is in position; at the direction of the vessel crew, record sampling station ID, depth to sediment from the vessel decking using a bar gauge and fathometer, depth to water from vessel deck, position coordinates, position relative to fixed reference points, weather, and water surface conditions.
8. Prior to the advancement of the core, ensure that winch cable, push rod, or vibracore barrel have been measured and clearly marked in order to record penetration depth and note changes in drilling advancement or effort.
9. Lower the Core assembly or push until penetrative depth or refusal is encountered. Record depth of penetration, vessel position, time, and apparent sampling conditions. As soon as is practicable following sampling, record water surface level reading from the staff gauge. In the event of sample refusal relocate within 5 feet and repeat procedure from Step 6.
10. Observe vessel crew instructions and clear the sampling portal or boom area as core is retrieved. Perform breathing zone monitoring in accordance with the site-specific plan(s).
11. Once vessel crew has secured the core barrel inspect the barrel cutter head. Provide qualitative description of cutter head catch condition, or soil if retained.
12. Ensure that external sampling equipment is decontaminated using site water and a decontaminated brush, while not disturbing the open end of the core barrel.
13. Label sample end cap for base of sample, remove cutter head assembly, affix end cap, and decontaminate cutter head assembly.
14. Once suspended sediment has had adequate time to settle following sample staging (15-30 minutes), measure total recovery, using a decontaminated tape, calculate and record recovered percentage.
15. Cut or drill a small drain slit above the water-sediment interface, above the depth of recovered sediment and decant supernatant water. Once water has been decanted cut excess sample barrel or liner approximately 1” above the water-sediment interface, label end cap and affix to barrel. Dry barrel and label with an indelible marker. Sample labeling should include up and down designations with the sample number on the end caps, and directional arrows on the barrel or liner body. Cut barrel sections to fit staging coolers, transfer labeled samples to coolers immediately post-processing.

1.5 Records Retention and Management

Project records will be managed in accordance with the DES CLIN 3 Quality Management Plan. Project documents and records will be retained for 10 years after the closing date of the prime contract. All information generated under this program is considered to be confidential and shall not be released to others without the written consent of the Contract Officer.

1.6 Quality Control and Quality Assurance

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

1.7 Attachments

None.

1.8 References

CH2M HILL, INC. *Quality Management Plan for U.S. Environmental Protection Agency Remedial Acquisition Framework (RAF) Design and Engineering Services (DES) Contract CLIN 3*. May 2022.

Standard Operating Procedure (SOP) 2.1.1.3

By Revital Katznelson and Arleen Feng

Construction and use of a syringe pump apparatus for water sampling

1.0 Application:

Collection of water samples at defined depths below the water surface without contact with air, for analyses of dissolved oxygen, sulfides, or any other water quality parameter. This apparatus can be used to monitor depth profiles in lakes, to sample groundwater monitoring wells, to sample pools in creeks, etc. The apparatus as specified below is useful for depths/heads of up to 3 meters. It is recommended to use shorter tubing where appropriate.

2.0 Components:

Disclaimer: The information provided below does not construe endorsement of these products by the Clean Water Team or the SWRCB. The list below contains information from 1998. Readers are encouraged to check the latest information with vendors.

Item C1. 60 ml disposable syringe with Luer-Lok* tip (without needle):
Fisher Catalog Number: 14-823-2D (30 pack) $30.66 (Becton-Dickinson No.309663)

Item C2. Three-way stopcock with male Luer lock:
Cole-Parmer Catalog Number: E-30600-02 (10 pack) $16.25

Item C3. Plastic tubing for the “long tubing” (diameter 1/8" (3.2 mm) inside, 1/4" (6.4 mm) outside) should be flexible, but rigid enough to resist collapsing under vacuum or kinking under water. Clear PVC Nalgene* 180 works well; here are the Fisher Catalog Numbers:

14-176-12 (50 ft pack) $31.80 (Nalge Nunc No.8000-0020)
14-176-12 (10 ft pack) $7.99 (Nalge Nunc No.8000-1020)

Item C4. One ml disposable syringe with Luer slip tip (Tuberculin without needle):
Fisher Catalog Number: 14-823-2F (100 pack) $15 (Becton-Dickinson No.309602)

Item C5. Plastic tubing for the “side tube” (diameter 3/32" (2.4 mm) inside, 5/32" (4 mm) outside) should be flexible but does not have to be rigid.

Fisher Catalog Numbers: 14-176-192 (50 ft pack) $20 (Nalge Nunc No.8000-0006)

Fisher and other vendors have their own brands of PVC tubing in the same sizes, but we have not tested performance or compatibility.

3.0 Assembly notes: (see diagram)

Step 1: Push the top (wide fitting end) of the three-way stopcock, Item C2, onto the 60 ml syringe (Item C1) tip and screw into lock.

Step 2: Prepare 9-10 ft length of "long tubing" (Item C3) and push onto the bottom, narrow tip ("male lock") of the three-way stopcock (Item C2). For more strength, wrap joint with Parafilm or tape..

Step 3: Prepare 1 foot length of "side tube" (Item C5). Insert into the 1 ml syringe (Item C4) without the plunger; you may first cut this syringe about 1/2" from the tip if needed. Then push the tip of the 1 ml syringe into the side arm of the three-way stopcock. **Options**: Items C4 and C5 may be replaced by any other creative way to connect the side tube. Example: Prepare 1 ft tube (Item C3), cutting the end squarely; fit an insert piece (e.g. cut-off spare syringe tip, maybe aquarium connectors or a piece of ball-point pen tube?) into joint with side arm of stopcock, then wrap joint with Parafilm or tape (point 3 in the diagram).

4.0 Deployment Options:

Option 1: hold the end of the long tubing (farthest from the stopcock) in the creek or other sample source. Collect the sample as instructed below.

Option 2: Mark long tubing at 10 cm intervals, beginning from furthest end; attach a small weight to that end, deploy from above and collect sample. Caution: tubing will stretch, depth measurements may be inaccurate.

Option 3: Attach a non-stretching rope to a medium or heavy weight. Mark the rope at 10 cm intervals, beginning near the weight. Attach the end of the long tubing of the syringe apparatus to the weight or the rope, with the opening at zero cm, deploy from above and collect samples.

Option 4: Mark a "sampling pole" at 10 cm intervals, beginning from bottom tip, attach end of long tubing of the apparatus to tip of sampling pole with the opening at zero cm (see point 4 on the diagram), deploy from above or from the side (e.g. the bank of a creek). If the intake point of the syringe sampling apparatus is deployed at an angle, record the angle and the depth mark on the pole to calculate/estimate sampling depth.

5.0 Sample Collection: Preparation and priming

1. Assemble the apparatus: Connect the stopcock attached to the long tube to the 60-ml syringe. Connect the short tube to the side arm of the three-way stopcock. **(Be sure to hold the three-way stopcock in its center when you turn the selector. It is not strong enough to be held only by the syringe and will break if you attempt to turn the selector without support)**

2. Attach the end of the long tube to a rope or pole and dip in lake (or creek, or monitoring well) water.

3. Hold the stopcock and turn the selector so the "OFF" lever is in the direction of the short tube, and pull the plunger backwards slowly. This will fill the syringe with lake water (The volume of air in the tube should be about 30 ml, and then water will start coming in).

4. Hold the stopcock and turn the selector so the "OFF" lever is in the direction of the long tube, and push the plunger forward; this will push the water out through the short tube.

5. Hold the stopcock and turn the selector so the "OFF" lever is in the direction of the short tube, and pull the plunger backwards slowly. This will refill the syringe with lake water.

6. Hold the stopcock and turn the selector so the "OFF" lever is in the direction of the long tube, and push the plunger forward; this will push the water out through the short tube.

For most Water Quality parameters: After flushing 2-3 syringe-volumes through the system, take your sample for pH (and/or other water quality parameters) by placing the end of the short tube inside the sample container. Repeat steps 5 and 6 until the sample volume, in increments of 60 ml, is sufficient.

For Dissolved Oxygen (DO) or Sulfide: Make sure there are no air bubbles in the entire apparatus after step 6. Then place the short tube inside the DO bottle, and repeat steps 5 and 6 several times, flushing several bottle-volumes with sample water without contact with air. Then take the short tube out of the DO bottle and add to the bottle the reagents for the Winkler titration as instructed by the kit manufacturers.

6.0 Maintenance and Storage:

To clean the syringe and tubes, repeat steps 5 and 6 twice with tap water or deionized water. Clean the system immediately, or as soon as possible, after sampling. **Avoid drying of unwashed tubes.** Store syringe in partially opened position so you can push it forward in case rubber plunger sticks to the shaft. Store in a ziplock bag.

7.0 Sources and Resources

This SOP, as provided in the clean Water Team (CWT) Guidance Compendium, is identical to the following document (with slight revisions) and should be referenced as follows:

"Katznelson, R, and A. Feng 1998 Application, purchasing information, and use instruction of a syringe pump apparatus. Standard Operating Procedure submitted to the Alameda Countywide Clean Water Program, Hayward, CA. "

For an electronic copy, to find many more CWT guidance documents, or to find the contact information for your Regional CWT Coordinator, visit the CWT website at
www.swrcb.ca.gov/nps/volunteer.html

SYRINGE-PUMP APPARATUS

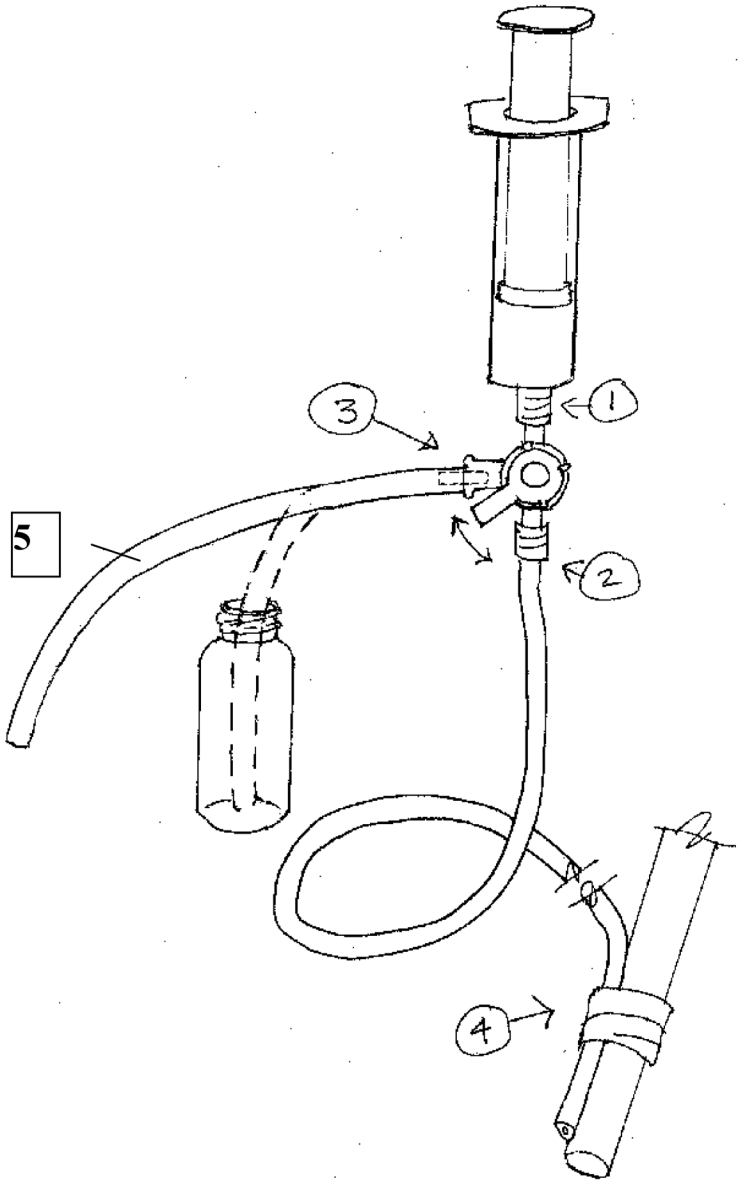


Diagram by Arleen Feng, Alameda County FCWCD, April 1998

Appendix B
Laboratory Standard Operating Procedures (to be provided later)