June 2019
Lower Passaic River Restoration Project

ANCHOR QEA

Current Conditions Monitoring Program Physical Water Column Monitoring Quality Assurance Project Plan/ Field Sampling Plan Addendum

Prepared in Conjunction with AECOM and Ocean Surveys, Inc.
Prepared for The Lower Passaic River Cooperating Parties Group

623691

June 2019
Lower Passaic River Restoration Project

Current Conditions Monitoring Program Physical Water Column Monitoring Quality Assurance Project Plan/ Field Sampling Plan Addendum

Prepared for
The Lower Passaic River Cooperating Parties Group

Prepared by
Anchor QEA, LLC
290 Elwood Davis Road
Liverpool, New York 13088

In conjunction with
AECOM
250 Apollo Drive
Chelmsford, Massachusetts 01824
and
Ocean Surveys, Inc.
129 Mill Rock Road East
Old Saybrook, Connecticut 06475

TABLE OF CONTENTS

APPENDICES

ABBREVIATIONS

ADCP	acoustic doppler current profiler
Ag	silver
Al	aluminum
As	arsenic
Be	beryllium
BOD	Biological Oxygen Demand
Br	bromine
CA	corrective action
CCMP	Current Conditions Monitoring Program
Cd	cadmium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
chlor-a	chlorophyll-a
Cl	chlorine
COC	chain-of-custody
CPG	Cooperating Parties Group
Cr	chromium
Cu	copper
CWCM	Chemical Water Column Monitoring
DMP	Data Management Plan
DOC	dissolved organic carbon
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objectives
EDD	electronic data deliverable
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
Hg	mercury
HOC	Hydrophobic Organic Compound
HSMVS	HOC Sampling Method Validation Study
HV CWCM	High Volume Chemical Water Column Monitoring
IR	Interim Remedy
LCS	Laboratory Control Sample
LDC	Laboratory Data Consultants, Inc.
LIMS	laboratory information management systems
LPR	Lower Passaic River

LPRRP	Lower Passaic River Restoration Project
LPRSA	Lower Passaic River Study Area
m	meter
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
Mn	manganese
MS	matrix spike
mS/cm	millisiemens per centimeter
MSD	matrix spike duplicate
N/A	Not Applicable
NBSA	Newark Bay Study Area
NGVD	National Geodetic Vertical Datum
NH_3	ammonia
Ni	nickel
NIST	National Institute for Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NS	no standard
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo(p)dioxins and furans
PE	performance evaluation
PM	Project Manager
POC	particulate organic carbon
ppt	parts per thousand
PREmis	Passaic River Estuary Management Information System
PWCM	Physical Water Column Monitoring
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	quantitation limit
QMP	Quality Management Plan
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

RM	River Mile
RPD	relative percent difference
RPM	Remedial Project Manager
Sb	antimony
SDG	Sample Delivery Group
Se	selenium
SOP	standard operating procedure
SSC	Suspended Solids Concentration
SSO	Site Safety Officer
SVCG	Small Volume Composite Grab
SV CWCM	Small Volume Chemical Water Column Monitoring
SVOC	semivolatile organic compounds
TBD	To be determined
TEPH	total extractable petroleum hydrocarbons
THA	Task Hazard Analyses
Tl	thallium
TOC	total organic carbon
TSS	total suspended solids
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U. S. Geological Survey
VOC	volatile organic compound
Zn	zinc

1 Introduction

This Quality Assurance Project Plan/Field Sampling Plan addendum (QAPP/FSP Addendum) has been developed on behalf of the Lower Passaic River Study Area (LPRSA) Cooperating Parties Group (CPG) to support the Current Conditions Monitoring Program (CCMP) in the upper 9 miles of the Lower Passaic River (LPR). The LPRSA encompasses the 17.4-mile tidal reach of the Passaic River from just below the Dundee Dam to the confluence with Newark Bay. The LPRSA also includes the main tributaries to this reach (e.g., Saddle River, Second River, and Third River) and the surrounding watershed that hydrologically drains below the Dundee Dam (see Figure 1 in Appendix A). The area for the data collection activities described in this QAPP/FSP Addendum is defined using the river mile (RM) [1] system developed for the Remedial Investigation (RI). The data collection activities described herein will begin near RM 8.0 (approximate U.S. Army Corps of Engineers [USACE] RM 8.3) and will extend upstream, approaching the Dundee Dam (discussed further in Section 1.2). The CCMP will consist of three primary data collection activities, including:

- Physical Water Column Monitoring (PWCM)
- Small Volume Chemical Water Colum Monitoring (SV CWCM)
- High Volume Chemical Water Colum Monitoring (HV CWCM)

This QAPP/FSP Addendum focuses on the PWCM component of the CCMP and is based on the Remedial Investigation Water Column Monitoring/Physical Data Collection QAPP/FSP Addendum (AECOM 2010). This document adopts U.S. Environmental Protection Agency (USEPA) applicable Uniform Federal Policy (UFP) QAPP worksheets (Publication Numbers: EPA: EPA-505-B-04-900A, DoD: DTIC ADA 427785) (USEPA 2005) and standard operating procedures (SOPs) for the field activities.

1.1 Approach

The PWCM will: 1) establish current conditions; and 2) support the development of refined models to facilitate the design, implementation, and long-term evaluation of an Interim Remedy (IR) in the upper 9 miles of the LPR. The IR approach is documented in a letter from USEPA dated October 10, 2018 (USEPA 2018). The data collected will include flow velocity, turbidity, conductivity (salinity), and temperature. These data will be collected continuously at fixed locations, as well as during discrete monitoring events at multiple locations. The discrete measurements will be collected along cross-channel transects (in the vicinity of the fixed monitoring locations), as well as along the river centerline in the vicinity of the salt front (to monitor the expected location of the estuarine turbidity maximum). In addition to the physical characteristics, water samples will be collected from transect

[1] The RI/FS RMs used in this QAPP differ from the USACE RMs of the LPR by approximately 0.3 mile due to the specification of the zero RM location. The USACE RM can be seen in Figures 1a and 1b of USACE (2010). In this QAPP, USACE RMs are designated by the prefix USACE, while the RI/FS RMs have no such prefix. An approximate conversion to RI/FS RMs is to subtract 0.3 from the USACE RMs; the exact conversion varies along the river.

locations several times during the long-term continuous monitoring equipment deployment for suspended sediment concentration (SSC), particulate organic carbon (POC), and dissolved organic carbon (DOC) analysis. Additional SSC, POC, and DOC data, as well as Chlorophyll-a (chlor-a) data, will be collected as part of the Chemical Water Column Monitoring (CWCM)

1.2 Summary of Lesson Learned from Remedial Investigation Physical Water Column Monitoring Program

During the RI sampling program, PWCM data were collected. Based on the RI PWCM program, the following modifications were made:

1. Instrumentation fouling and bio-fouling occurred during the RI program. To help prevent loss of data, newer probes are fitted with automated wipers to prevent bio-fouling, and the probes will be monitored on a biweekly basis for the first 2 months of the program, at a minimum. Additional probe servicing may occur if needed.
2. Field filtration of the samples was time-consuming, and with approximately 100 samples per event being filtered in triplicate, an alternate means to filter has been employed in the CCMP. A courier has been employed to pick up samples daily during the field sampling events, to bring the samples to a local ALS laboratory. Staff at the laboratory will filter the samples and ship filters and filtrate to laboratories within the ALS network that specialize in the analyses.
3. Tributary sampling during wet weather was conducted during the RI PWCM program. The 2009 data showed the tributaries to be minor sources of solids and the data collected in 2009 should be sufficient to support model refinement. No additional sampling is proposed for the tributaries or targeting wet weather.

1.3 Summary of Activities

The scope of the PWCM is summarized below and presented in detail in the FSP Addendum (Appendix A).

1.3.1 Continuous Fixed-Point Monitoring

Continuous fixed-point monitoring will be performed in the vicinity of RM 8.4, RM 10.2, RM 12.0, and RM 13.5, and at a location upstream of the confluence with the Saddle River in the vicinity of RM 15.8. At RM 8.4, RM 10.2, RM 12.0, and RM 13.5, continuous monitoring of vertical profiles of velocity, conductivity, turbidity, and temperature will be conducted near the center of the channel. The velocity data will be collected using bottom-mounted acoustic doppler current profilers (ADCPs) deployed at each station for approximately 6 months starting in the early summer of 2019. Conductivity, turbidity, and temperature will be measured using sondes at two depths (approximately 3 feet below the surface and 2 feet off the bottom). These sondes will be deployed from buoys located near the ADCPs.

At RM 15.8, continuous conductivity, turbidity, and temperature measurements will be obtained with a sonde deployed at the approximate mid-depth of the water column. An ADCP will not be deployed because velocity measurements are not required at this location. This location was selected as it is the furthest upstream location that is easily accessible by boat and has sufficient water depth to deploy a sonde without risk of exposing the instrument to air during low flow/low tide conditions. SSC, DOC, POC, and chlorophyll-a (chlor-a) data will only be collected as part of the SV CWCM at this location.

Initially, the ADCPs and sondes will be inspected every 2 weeks and cleaned/calibrated as appropriate. The frequency of inspections may be modified based as the program progresses. Logged data will be downloaded during these periodic inspections.

1.3.2 Cross-Channel Transect Monitoring Events

Flow velocity data will be collected during periodic monitoring events along four cross-channel transects in the vicinity of RM 8.4, RM 10.2, RM 12.0, and RM 13.5, near the fixed-point deployments. Vertical profiles of velocity will be obtained along each transect using a vessel-mounted ADCP. Turbidity, conductivity, and temperature will be collected in conjunction with the ADCP surveys along the four cross-channel transects. These data will be obtained at discrete locations along each transect. These locations will be sampled at 7 data collection points along each transect, based on the anticipated needs of future model calibration efforts. Data will be collected at approximately 1-foot intervals throughout the water column to provide a vertical profile. At points along each transect, grab surface water samples will be collected for analysis of SSC, POC, and DOC. Chlor-a data will be collected at center channel locations as part of the CWCM (overlapping of PWCM events with a portion of the CWCM events is anticipated).

Four transect monitoring events are planned in 2019. As described in Appendix A, a range of freshwater flow conditions[2] will be targeted, to the extent practicable. Two rounds of data will be collected at each station (one round during mid-flood and the other during mid-ebb tide) for each event. Data collection during the same approximate tidal condition at all transects is important for model calibration, but synoptic data collection at all four transects during the same tidal cycle is not critical and may not be feasible due to logistical concerns.

1.3.3 Along-River Transect Monitoring Events

Vertical profiles of velocity, conductivity, turbidity, and temperature will be obtained along a center channel transect. Prior to data collection, the water column will be screened for conductivity to identify the location of the salt front. This screening will be initiated near the predicted location of

[2] Flows from U.S. Geological Survey (USGS) Gage 01389890 Dundee Dam will be used to determine actual flow conditions during sampling. Since the gage at Dundee Dam does not have forecasts, the flow conditions will be monitored using the predictions from the USGS Gage 01389500 at Little Falls, located upstream of Dundee Dam.

the salt front based on flow conditions and previous investigations, and will be expanded as needed. The along-river transect will be located near the center of the channel, beginning approximately 2 miles downstream of the point where maximum salinity falls below 2 parts per thousand (ppt) and extending upstream to the point where maximum salinity falls below 0.5 ppt (minimum of approximately 1 mile upstream of the location of the 2 ppt threshold). A vessel-mounted ADCP will provide velocity and backscatter along the transect. Vertical profiles of conductivity, turbidity, and temperature will also be collected at 1-foot depth intervals every 0.25 mile along the transect. The along-river transect monitoring events will be performed under a range of flows during the same mobilization as cross-channel transects. Two rounds of data will be collected (one round during mid-flood and the other during mid-ebb tide) for each event.

2 QAPP Worksheet No. 1 (UFP-QAPP Manual Section 2.1) Title and Approval Page

Document Title: Current Conditions Monitoring – Physical Water Column Data Collection Quality Assurance Project Plan/Field Sampling Plan Addendum. Lower Passaic River Restoration Project.

Lead Organization: CPG and de maximis, inc.

Preparer's Name and Organizational Affiliation:

Mark LaRue, Anchor QEA, LLC
Kristen Durocher, AECOM
Ken Cadmus, Ocean Surveys, Inc.

Preparer's Address, Telephone Number, and E-mail Address:

Mark LaRue
Anchor QEA, LLC
290 Elwood Davis Road
Liverpool, New York 13088
mlarue@anchorQEA.com

Kristen Durocher
AECOM
250 Apollo Drive
Chelmsford, Massachusetts 01824
kristen.durocher@aecom.com

Ken Cadmus
Ocean Surveys, Inc.
129 Mill Rock Road East
Old Saybrook, Connecticut 06475
kac@oceansurveys.com

Preparation Date (Month/Day/Year): May 22, 2019

Investigative Organization's Project Manager	Jim Rhea, Anchor QEA, LLC
Investigative Organization's Project Quality Assurance Manager	Debra Simmons, AECOM
Lead Organization's Project Manager	Bill Potter/Robert Law, de maximis, inc.

3 QAPP Worksheet No. 2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Site Name/Project Name:	**Diamond Alkali Operable Unit (OU) 4 – Lower Passaic River Restoration Project (LPRRP) Current Conditions Monitoring**
Site Location:	**LPRSA**
Site Number/Code:	**Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Document No. 02-2007-2009**
Operable Unit:	**OU 4**
Contractor Name:	**Anchor QEA/AECOM**
Contractor Number:	**Not Applicable (N/A)**
Contract Title:	**N/A**
Work Assignment Number:	**N/A**

4. Identify guidance used to prepare QAPP: Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Final Version 1. March 2005. Intergovernmental Data Quality Task Force (USEPA, U.S. Department of Defense (DoD), U.S. Department of Energy). EPA 505-B-04-900A.
5. Identify regulatory program: CERCLA
6. Identify approval entity: USEPA Region 2
7. Indicate whether the QAPP is a generic or a **project-specific** QAPP. (circle one)
8. List dates of scoping sessions that were held: April 3, 2019, April 17, 2019
9. List dates and titles of QAPP and FSP documents written for previous site work, if applicable:

Title
CLH (Chemical Land Holdings), 1995. *Work Plan, Vol. 1 of Passaic River Study Area Remedial Investigation Work Plans.* Chemical Land Holdings (now Tierra Solutions, Inc.), Newark, New Jersey. January 1995.
MPI (Malcolm Pirnie, Inc.), 2005. *Lower Passaic River Restoration Project. Quality Assurance Project Plan.* Malcolm Pirnie, Inc., White Plains, New York. August 2005.
MPI, 2006. *Lower Passaic River Restoration Project. Field Sampling Plan. Volume 1.* Malcolm Pirnie, Inc., White Plains, New York. January 2006 (includes Rutgers 2004/05 sampling activities).
MPI, 2007. *QAPP/FSP Addendum for Lower Passaic River Restoration Project Empirical Mass Balance Evaluation.* Malcolm Pirnie, Inc., White Plains, New York. December 2007.

Title
ENSR, 2008. *Lower Passaic River Restoration Project RI/FS. Quality Assurance Project Plan. RI Low Resolution Coring/Sediment Sampling. Revision 4.* ENSR, Westford, Massachusetts. October 2008.
AECOM, 2008. *Lower Passaic River Restoration Project. Periodic Bathymetric Surveys. Quality Assurance Project Plan.* AECOM, Westford, Massachusetts. October 2008.
Sommerfield, C.K. and R.J. Chant, 2007. *Grant Proposal for Mechanisms of Sediment Trapping and Accumulation in Newark Bay. New Jersey: An Engineered Estuarine Basin,* Hudson River Foundation. March 2007.
AECOM, 2010. *Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring.* Lower Passaic River Restoration Project. March 2010.
AECOM, 2012. *Quality Assurance Project Plan.* Lower Passaic River Study Area. Quality Assurance Project Plan/Field Sampling Plan Addendum. RI Water Column Monitoring/Small Volume Chemical Data Collection. Revision 3. July 2012.
AECOM, 2012. *Quality Assurance Project Plan.* Lower Passaic River Restoration Project. RI Water Column Monitoring/High Volume Chemical Data Collection. Revision 2. Prepared for the Lower Passaic River Cooperating Parties Group. December 2012.

10. List organizational partners (stakeholders) and connection with lead organization: This work will be performed by the LPRSA CPG under the requirements of the Settlement Agreement and Statement of Work with oversight conducted by USEPA and its government partners. de maximis, inc. (acting as project coordinator for the CPG), Anchor QEA, AECOM and their subcontractors are conducting the work on behalf of the CPG.
11. List data users: CPG members, de maximis inc., Anchor QEA, AECOM, New Jersey Department of Environmental Protection (NJDEP), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), USEPA, U.S. Fish and Wildlife Service (USFWS), and Windward Environmental.
12. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below: N/A

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	• Title and Approval Page	• Worksheet No. 1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	• Table of Contents • QAPP Identifying Information	• Worksheet No. 2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	• Distribution List • Project Personnel Sign-Off Sheet	• Worksheet No. 3 • Worksheet No. 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	• Project Organizational Chart • Communication Pathways • Personnel Responsibilities and Qualifications Table • Special Personnel Training Requirements Table	• Worksheet No. 5 • Worksheet No. 6 • Worksheet No. 7 • Worksheet No. 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	• Project Planning Session Documentation (including Data Needs tables) • Project Scoping Session Participants Sheet • Problem Definition, Site History, and Background • Site Maps (historical and present)	• Worksheet No. 9 • Worksheet No. 9 • Worksheet No. 10 and Introduction • Appendix A
2.6 Data Quality Objectives (DQOs) and Measurement Performance Criteria 2.6.1 Development of DQOs Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	• Site-Specific DQOs • Measurement Performance Criteria Table	• Appendix B • Worksheet No. 12
2.7 Secondary Data Evaluation	• Sources of Secondary Data and Information • Secondary Data Criteria and Limitations Table	• Worksheet No. 13 • Worksheet No. 13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	• Summary of Project Tasks • Reference Limits and Evaluation Table • Project Schedule/Timeline Table	• Worksheet No. 14 • Worksheet No. 15 • Worksheet No. 16

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	• Sampling Design and Rationale • Sample Location Map • Sampling Locations and Methods/ Standard Operating Procedures (SOP) Requirements Table • Analytical Methods/SOP Requirements Table • Field Quality Control (QC) Sample Summary Table • Sampling SOPs • Project Sampling SOP References Table • Field Equipment Calibration, Maintenance, Testing, and Inspection Table	• Worksheet No. 17, Appendix A • Appendix A • Worksheet No. 18 • Worksheet No. 19 • Worksheet No. 20 • Worksheet No. 21 • Worksheet No. 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	• Analytical SOPs • Analytical SOP References Table • Analytical Instrument Calibration Table • Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	• Appendix D • Worksheet No. 23 • Worksheet No. 24 • Worksheet No. 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	• Sample Collection Documentation • Handling, Tracking, and Custody SOPs • Sample Container Identification • Sample Handling Flow • Example Chain-of-Custody (COC) Form and Seal	• Worksheet No. 26 • Appendix C • Worksheet No. 26 • Worksheet No. 27 • Worksheet No. 27

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
3.4 QC Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	• QC Samples Table	• Worksheet No. 28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	• Project Documents and Records Table • Analytical Survey Table • Data Management Procedures	• Worksheet No. 29 • Worksheet no. 30 • Data Management Plan (DMP) [ENSR 2007a]
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	• Planned Project Assessments Table • Assessment Findings and Corrective Action Responses Table	• Worksheet No. 31 • Worksheet No. 32
4.2 QA Management Reports	• QA Management Reports Table	• Worksheet No. 33
4.3 Final Project Report	To be completed following data collection	• (not applicable)
Data Review		
5.1 Overview 5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	• Verification (Step I) Process Table • Validation (Steps IIa and IIb) Process Table • Validation (Steps IIa and IIb) Summary Table • Usability Assessment	• Worksheet No.34 • Worksheet No. 35 • Worksheet No. 36 • Worksheet No. 37
5.3 Streamlining Data Review 5.3.1 Data Review Steps to be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	To be completed following data evaluation	• (not applicable)

4 QAPP Worksheet No. 3 (UFP-QAPP Manual Section 2.3.1) Distribution List

The following persons will receive a copy of the approved Final QAPP, subsequent QAPP revisions, addenda, and amendments:

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number*
Diane Salkie	Remedial Project Manager (RPM)	USEPA Region 2	212.637.4427	salkie.diane@epa.gov	N/A
William Sy	Project Quality Assurance (QA) Officer	USEPA Region 2	732.321.6648	sy.william@epa.gov	N/A
Jay Nickerson	Project Coordinator	NJDEP	609.633.1448	jay.nickerson@dep.nj.gov	N/A
Clay Stern	Assistant Supervisor of Environmental Contaminants	USFWS	609.382.5280	cstern@fws.gov	N/A
Lisa Baron	Project Manager (PM)	USACE-NY District	917.790.8306	lisa.A.Baron@usace.army.mil	N/A
Reyhan Mehran	Coastal Resource Coordinator	NOAA	212.637.3257	reyhan.mehran@noaa.gov	N/A
Bill Potter Robert Law	CPG Project Coordinators	de maximis, inc.	908.735.9315	otto@demaximis.com rlaw@demaximis.com	N/A
William Hyatt	Coordinating Counsel	K&L Gates	973.848.4045	william.hyatt@klgates.com	N/A
Jim Rhea	Anchor QEA Project Manager	Anchor QEA	315.453.9009	jrhea@anchorqea.com	N/A
Mark LaRue	Anchor QEA Field Task Leader	Anchor QEA	315.453.9009	mlarue@anchorqea.com	N/A
Kristen Durocher	AECOM Field Task Manager	AECOM	603.581.6608	Kristen.durocher@aecom.com	N/A
Cristopher Altman	Environmental Health and Safety (EHS)	AECOM	610.466.0821	cristopher.Altman@aecom.com	N/A
Debra Simmons	Project QA Manager	AECOM	978.905.2399	debbie.simmons@aecom.com	N/A
Mary O'Connell Kozik	Project Chemist	AECOM	978.905.2277	mary.oconnellkozik@aecom.com	N/A
James Herberich	Data Management Task Manager	AECOM	978.905.2243	jim.herberich@aecom.com	N/A

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number*
Sharon McKechnie	Data Validation Coordinator	AECOM	978.905.2317	sharon.mckechnie@aecom.com	N/A
Laura Soeten	Data Validation Subcontractor	Laboratory Data Consultants, Inc. (LDC)	760.827.1136	Lsoeten@lab-data.com	N/A
Wendy Hyatt	Laboratory Contact	ALS Environmental	520.623.3381	Wendy.hyatt@alsglobal.com	N/A
Ken Cadmus	Vessel/Mooring Subcontractor Lead	Ocean Surveys, Inc. (OSI)	860.388.4631	kac@oceansurveys.com	N/A
John Connolly	Modeling Team Manager	Anchor QEA	201.571.0919	jconnolly@anchorqea.com	N/A
Peter Israelsson	Modeling Team Task Leader	Anchor QEA	857.445.4980	pisraelsson@anchorqea.com	N/A

Note:
*Uncontrolled electronic copies will be available on www.ourpassaic.org.

5 QAPP Worksheet No. 4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization: A completed sign-off sheet will be maintained in the files for each organization represented below.

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read
Bill Potter Robert Law	CPG Project Coordinators	908.735.9315		
Jim Rhea	Anchor QEA Project Manager	315.453.9009		
Mark LaRue	Anchor QEA Field Task Leader	315.453.9009		
(TBD)	Anchor QEA Field Oversight/Site Safety Officer (SSO)	(TBD)		
Kristen Durocher	AECOM Field Task Manager	603.581.6608		
Cristopher Altman	AECOM Environmental Health and Safety	610.466.0821		
Debra Simmons	AECOM Project QA Manager	978.905.2399		
Mary O'Connell Kozik	AECOM Project Chemist	978.905.2277		
James Herberich	AECOM Data Management Task Manager	978.905.2243		
Sharon McKechnie	AECOM Data Validation Coordinator	978.905.2317		
Laura Soeten	LDC (Data Validation Subcontractor)	760.827.1136		
(TBD)	AECOM Field Lead/SSO	(TBD)		
Ralph Poulsen	ALS Laboratory Manager	520.623.8501		
Wendy Hyatt	ALS Laboratory Contact	520.623.3381		
Ken Cadmus	OSI Vessel/Mooring Subcontractor Lead	860.388.4631		

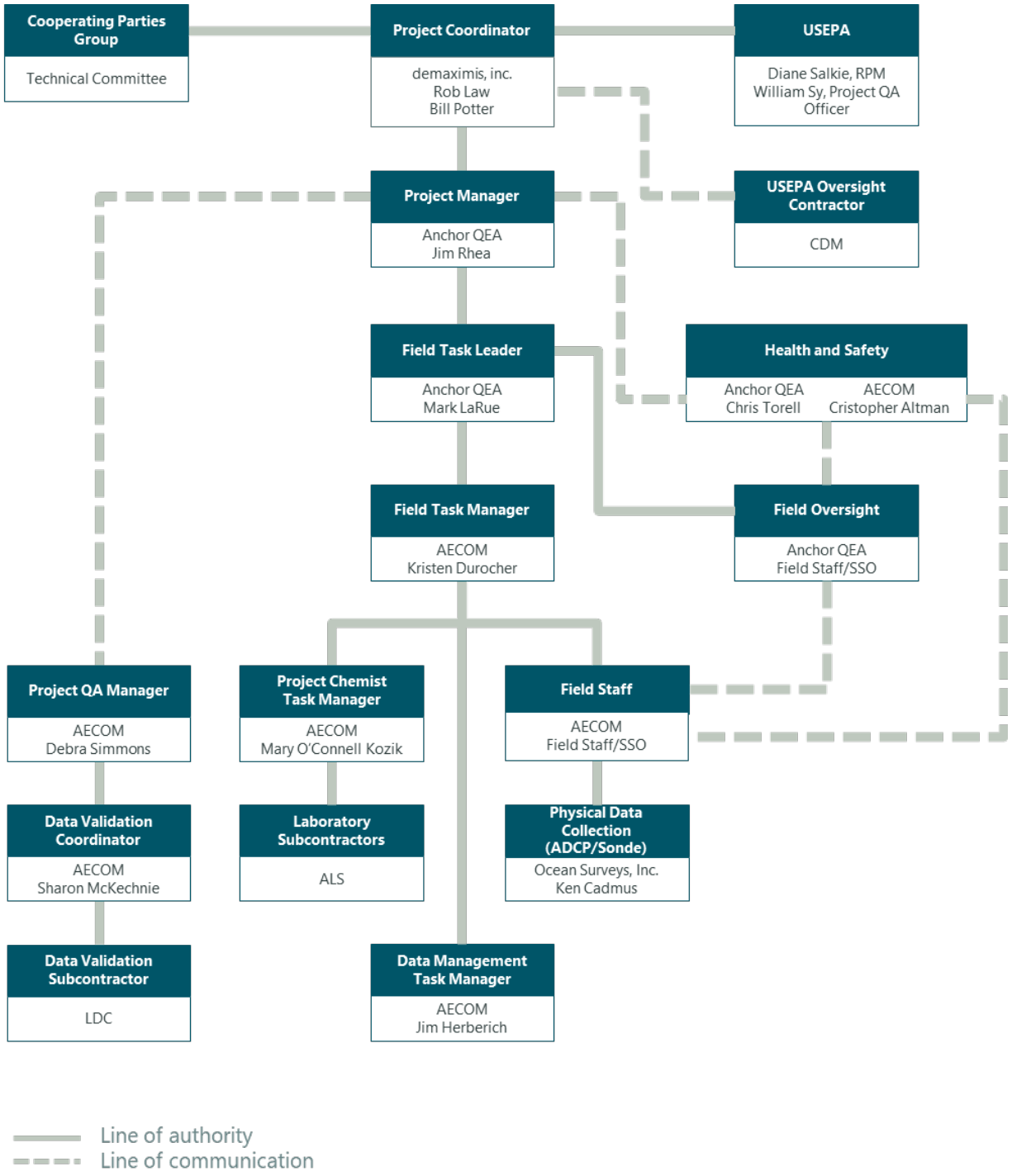
Note:
*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

Organization:

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read

Note:
*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

6 QAPP Worksheet No. 5 (UFP-QAPP Manual Section 2.4.1) Project Organizational Chart



7 QAPP Worksheet No. 6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Field activities status and issues	AECOM Field Coordinator	Kristen Durocher	603.581.6608	Communicate daily, or as needed, with AECOM field personnel, subcontractors, and Anchor QEA Field Task Leader directly, or via e-mail or telephone. Minor work plan deviations and/or proposed revisions will be documented and communicated in writing, with a copy sent to de maximis, inc. and copied to USEPA.
Sampling progress/laboratory coordination	AECOM Field Coordinator	Kristen Durocher	603.581.6608	Communicate daily, or as needed, with AECOM Project Chemist and Anchor QEA Field Task Leader via e-mail or telephone.
Health and safety briefings and updates	AECOM SSO	Kristen Durocher or designee	603.581.6608	Communicate daily, or as needed, with field personnel, boat operators, and Anchor QEA field oversight personnel directly, or via e-mail or telephone.
Significant health and safety concerns or incidents	AECOM SSO	Kristen Durocher or designee	603.581.6608	Communicate immediately with AECOM Regional EHS Manager, Anchor QEA HAS Manager, and Anchor QEA Project Manager.
Mooring/vessel operations	OSI Vessel/Mooring Subcontractor Lead	Ken Cadmus	860.388.4631	Communicate daily, or as needed, with AECOM Field Coordinator and Anchor QEA Field Task Leader directly. The sampling vessel captain has the ultimate authority for stopping work while working on water. The vessel captain, in consultation with the SSO, will follow guidelines documented in the site-specific Health and Safety Plan (HASP). In addition, standard safe boating practices related to weather conditions and vessel operations will also apply, even if not specifically addressed in the HASP.
Analytical laboratory issues, including coordination with field, schedule, and technical issues	AECOM Project Chemist	Mary O'Connell Kozik	978.905.2277	Communicate with AECOM Field Coordinator and Laboratory Contact as needed via telephone or e-mail.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Analytical data validation issues	AECOM Data Validation Coordinator	Sharon McKechnie	978.905.2317	Communicate with LDC and Laboratory Contact as needed via telephone or e-mail.
Audit findings (field and/or laboratory)	AECOM Project QA Manager	Debra Simmons	978.905.2399	Communicate findings to AECOM Field Coordinator, Anchor QEA Field Task Leader, or Laboratory Contact (as appropriate); transmit final audit reports, including corrective actions, to AECOM Field Coordinator, Anchor QEA Field Task Leader, Anchor QEA Project Manager, and CPG QA Coordinator.
Issues potentially affecting DQOs	OSI Vessel/Mooring Subcontractor Lead	Ken Cadmus	860.388.4631	Communicate findings to AECOM Field Coordinator, Anchor QEA Field Task Leader, AECOM QA Manager, via e-mail or telephone.
	AECOM Project Chemist	Mary Kozik	978.905.2277	
	AECOM Data Validation Coordinator	Sharon McKechnie	978.905.2317	
	AECOM Field Coordinator	Kristen Durocher	603.581.6608	Communicate with Anchor QEA Field Task Leader via e-mail or telephone. Notification of the CPG Project Coordinator as appropriate.
	Anchor QEA Field Task Leader	Mark LaRue	315.453.9009	Communicate with Anchor QEA Project Manager via e-mail or telephone. Notification of the CPG Project Coordinator as appropriate. Significant work plan modifications will be reported to de maximis, inc. and USEPA in writing prior to implementation.
Water sample collection task implementation, including sampling, analysis, and reporting	AECOM Field Coordinator	Kristen Durocher	603.581.6608	Communicate with Anchor QEA Project Manager, Anchor QEA Field Task Leader and Laboratory Contact (as appropriate), via e-mail or telephone.
Project status and issues (internal)	Anchor QEA Project Manager	Jim Rhea	315.453.9009	Communicate with CPG Project Coordinator daily, or as needed, via e-mail or telephone, and submit monthly progress reports.
Project status and issues (external)	CPG Project Coordinators	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	Communicate with USEPA RPM as needed, via e-mail or telephone.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
	CPG Coordinating Counsel	William Hyatt (K&L Gates)	973.848.4045 or 4054	In the event the CPG Project Coordinator is unavailable for communication with USEPA, the Anchor QEA PM will notify the Coordinating Counsel prior to contacting USEPA.
Data management	AECOM Data Management Task Manager	James Herberich	978.905.2243	Maintain comprehensive project technical database, communicate with AECOM Field Coordinator to receive data from the field; communicate with Laboratory Contact to receive analytical result data, communicate with AECOM Data Validation Coordinator to facilitate validation review and database update; communicate with AECOM Field Coordinator and Anchor QEA Field Task Leader to provide data for review; and provide data deliverables to USEPA.
	ALS Laboratory Contact	Wendy Hyatt	520.623.3381	Transmit electronic data deliverables (EDDs) to AECOM Data Management Task Manager, and data reports to AECOM Data Validation Coordinator.
	AECOM Data Validation Coordinator	Sharon McKechnie	978.905.2317	Communicate with AECOM Data Management Task Manager regarding final data qualifiers.
Stop Work (technical non-compliance)	AECOM, Anchor QEA, or Ocean Surveys personnel			Any personnel believing that a work stoppage is necessary shall stop work immediately, and then verbally notify their respective supervisor as soon as possible, who will in turn verbally notify de maximis, inc. and/or Anchor QEA Project Manager. Given the potential significance of such communications, this should occur as quickly as possible.

8 QAPP Worksheet No. 7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Robert Law	CPG Project Coordinator	de maximis, inc.	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project quality assurance/quality control (QA/QC), Health and Safety including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor, and the LPRSA Partner Agencies.	PhD, Geology, 38 years' experience
Willard Potter	CPG Project Coordinator	de maximis, inc.	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project QA/QC, Health and Safety including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor, and the LPRSA Partner Agencies.	BS, Chemical Engineering, 48 years' experience
Jim Rhea	Project Manager	Anchor QEA	Overall responsibility for technical, financial, and scheduling concerns of the LPRSA Program. Primary point of contact with CPG Project Coordinator.	PhD, Environmental Engineering, 36 years' experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Mark LaRue	Field Task Leader	Anchor QEA	Responsible for the execution and completion of the PWCM, including reviewing task deliverables, and providing oversight for field and laboratory tasks. The Field Task Leader will keep the project manager apprised of the status of the field program as well as communicate any issues with schedule, budget, or achievement of the task objectives.	A.A.S., Civil Technology, 40 years' experience
Kristen Durocher	Field Task Manager	AECOM	Responsible for the procurement and supervision of subcontractors, reviewing task deliverables, and serving as the primary coordinator for field and laboratory tasks. The Field Task Manager will keep Anchor QEA apprised of the status of the survey as well as communicate any issues with schedule, budget, or achievement of the task objectives.	BA, Environmental Studies, 27 years' experience
Debra Simmons	Project QA Manager	AECOM	Responsible for reviewing and approving QA procedures, ensuring that planned QA assessments (e.g., technical surveillance audits, data validation) are conducted according to the QAPP/FSP Addendum and the AECOM Quality Management Plan (QMP), and reporting on the adequacy of the QA Program to the Project Manager.	BS, Biology, 37 years' experience
Chris Torell	Health and Safety Manager	Anchor QEA	Responsible for ensuring that the objectives of Anchor QEA's HASP are met, and for monitoring task activities for conformance to the HASP.	MS, Environmental Engineering, 28 years' experience
TBD	Site Safety Officer (SSO)	Anchor QEA	Responsible for implementing field sampling activities in accordance with the approved HASP. Primary responsibilities include holding safety meetings and ensuring adherence with all HASP requirements; and communicating daily with the Field Task Leader and Field Task Manager	TBD

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Cristopher Altman	Regional EHS Manager	AECOM	Responsible for ensuring that the objectives of AECOM's HASP are met, and for monitoring task activities for conformance to the HASP.	MS, Occupational Health and Safety, 30 years' experience
TBD	Site Safety Officer (SSO)	AECOM	Responsible for implementing field sampling activities in accordance with the approved HASP. Primary responsibilities include holding safety meetings and ensuring adherence with all HASP requirements; and communicating daily with the Field Task Manager	TBD
Mary O'Connell Kozik	Project Chemist	AECOM	Responsible for laboratory procurement and monitoring of progress and will be the primary point of contact with the laboratory(ies). The Project Chemist is also responsible for communicating any issues that could affect achievement of the DQOs to AECOM project management and the AECOM Project QA Manager.	MS, Chemistry, 41 years' experience
Sharon McKechnie	Data Validation Coordinator	AECOM	The Data Validation Coordinator reports to the Project QA Manager and is responsible for managing the validation task, including ensuring that validation is conducted and documented according to the requirements of this QAPP, and interacting with the laboratory(ies) to resolve any technical issues.	BS, Environmental Science, 19 years' experience
James Herberich	Data Management Task Manager	AECOM	Data management for project, including overall responsibility for database quality and structure, including graphical representation of data.	BA, Engineering Sciences, 31 years' experience
Ralph Poulsen	Laboratory Manager	ALS	Acts as the primary point of contact at the laboratory for AECOM Project Chemist on all technical issues related to the required analytical procedures.	BS, Business Administration, 43 years' experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Wendy Hyatt	Laboratory Contact	ALS	Acts as the primary point of contact at the laboratory for AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	BS, Chemistry, 18 years' experience
Ken Cadmus	Vessel/Mooring Subcontractor Lead	OSI	Responsible for vessel operation, providing crew and equipment, deployment and retrieval of equipment and data. Acts as the primary point of contact between Field Task Manager and vessel crew.	MS, Civil Engineering, 25 years' experience
TBD	Field Oversight	Anchor QEA	Responsible for review of field activities and methodology to ensure QAPP/FSP Addendum has been followed.	TBD
Polly Newbold	CPG QA Coordinator	ddms, inc.	Oversight of project QA/QC. Periodically review and audit operations to ensure that QAPP/FSP Addendum QA/QC procedures are being followed.	BS, Textile Science, 26 years' experience

Note:

1. Resumes of all individuals are available upon request.

9 QAPP Worksheet No. 8 (UFP-QAPP Manual Section 2.4.4) Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
SSO	40-hour HAZWOPER[1]	Varies	Various	AECOM SSO	AECOM	AECOM
	HAZWOPER 8-hour Refresher	Varies	Within 12 months of field program			
	HAZWOPER 8-hour Supervisor Training	Varies	Various			
Field Personnel	40-hour HAZWOPER	Varies	Various	Various	Anchor QEA or AECOM	Anchor QEA or AECOM
	HAZWOPER 8-hour Refresher	Varies	Within 12 months of field program			
	Hazmat awareness	Varies	Various			
Vessel Operators	State issued safe boating certificate (or equivalent)	Varies	Various	Various operators	OSI	OSI
	40-hour HAZWOPER	Varies	Various			
	HAZWOPER 8-hour Refresher	Varies	Within 12 months of field program			
	First Aid/CPR	Varies	Within 24 months of field program			

Notes:

1. Hazardous Waste Operations and Emergency Response

10 QAPP Worksheet No. 9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: Physical Water Column Monitoring **Projected Date(s) of Sampling:** Summer/Fall 2019 **Project Manager:** Bill Potter/Robert Law	**Site Name:** Diamond Alkali OU 4 – LPRRP RI/FS **Site Location:** LPRSA
Date of Session: 4/11/2019 **Scoping Session Purpose:** CPG presented their proposal for the Current Conditions Monitoring to USEPA/Partner Agencies	

Name	Affiliation	E-mail Address
USEPA Team		
Michael Sivak	USEPA	Sivak.michael@epa.gov
Diane Salkie	USEPA	salkie.diane@epa.gov
Chuck Nace	USEPA	Nace.Charles@epa.gov
Beth Franklin	USACE	Elizabeth.A.Franklin@usace.army.mil
Andrew Bullard	CDM Smith/USEPA Consultant	bullardak@cdmsmith.com
Jonathan Clough	Warren Pinnacle/USEPA Consultant	jclough@warrenpinnacle.com
Dan Cooke	CDM Smith/USEPA Consultant	cookedw@cdmsmith.com
Aaron Frantz	CDM Smith/USEPA Consultant	FrantzAR@cdmsmith.com
Ed Garland	HDR/USEPA Consultant	edward.garland@hdrinc.com
John Kern	Kern Statistical Services/USEPA Consultant	jkern@KernStat.com
Scott Kirchner	CDM Smith/USEPA Consultant	kirchnersf@cdmsmith.com
Keegan Roberts	CDM Smith/USEPA Consultant	robertsk@cdmsmith.com
James Wands	HDR/USEPA Consultant	james.wands@hdrinc.com
NJDEP Team		
Anne Hayton	NJDEP	Anne.hayton@dep.nj.gov
Jay Nickerson	NJDEP	jay.nickerson@dep.nj.gov
Myla Ramirez	NJDEP	Myla.Ramirez@dep.nj.gov
John Wolfe	LimnoTech/NJDEP Consultant	jwolfe@limno.com
CPG Team		
Robert Law	de maximis	rlaw@demaximis.com
Bill Potter	de maximis	otto@demaximis.com
Gary Fisher	CPG	gary.fisher@nokia.com
Doug Reid-Green	CPG	douglas.reid-green@basf.com
Kristen Durocher	AECOM	Kristen.Durocher@aecom.com
Sue Harden	AECOM	susan.harden@aecom.com
John Connolly	Anchor QEA	jconnolly@anchorqea.com
Jim Rhea	Anchor QEA	jrhea@anchorqea.com

Name	Affiliation	E-mail Address
Mark LaRue	Anchor QEA	mlarue@anchorqea.com
Peter Israelsson	Anchor QEA	pisraelsson@anchorqea.com
Mike Johns	Windward Environmental	MikeJ@windwardenv.com
Lisa Saban	Windward Environmental	lisas@windwardenv.com

Comments/Decisions: The CPG presented their proposal for the Current Conditions Monitoring Program to USEPA, NJDEP, and their consultants. USEPA and NJDEP were generally in agreement on the scope of the PWCM, and discussions focused on the scope of the chemical monitoring of water, sediment, and biota. A follow up meeting was scheduled for April 17, 2019.

Project Name: Physical Water Column Monitoring **Projected Date(s) of Sampling:** Summer/Fall 2019 **Project Manager:** Bill Potter/Robert Law	**Site Name:** Diamond Alkali OU 4 – LPRRP RI/FS **Site Location:** LPRSA
Date of Session: 4/17/2019 **Scoping Session Purpose:** Discuss the scope of the water monitoring component of the Current Conditions Monitoring Program	

Name	Affiliation	E-mail Address
EPA Team		
Michael Sivak	USEPA	Sivak.michael@epa.gov
Diane Salkie	USEPA	salkie.diane@epa.gov
Chuck Nace	USEPA	Nace.Charles@epa.gov
Beth Franklin	USACE	Elizabeth.A.Franklin@usace.army.mil
Andrew Bullard	CDM Smith/USEPA Consultant	bullardak@cdmsmith.com
Jonathan Clough	Warren Pinnacle/USEPA Consultant	jclough@warrenpinnacle.com
Dan Cooke	CDM Smith/USEPA Consultant	cookedw@cdmsmith.com
Aaron Frantz	CDM Smith/USEPA Consultant	FrantzAR@cdmsmith.com
Ed Garland	HDR/USEPA Consultant	edward.garland@hdrinc.com
John Kern	Kern Statistical Services/USEPA Consultant	jkern@KernStat.com
Scott Kirchner	CDM Smith/USEPA Consultant	kirchnersf@cdmsmith.com
Keegan Roberts	CDM Smith/USEPA Consultant	robertsk@cdmsmith.com
James Wands	HDR/USEPA Consultant	james.wands@hdrinc.com
NJDEP Team		
Anne Hayton	NJDEP	Anne.hayton@dep.nj.gov
Jay Nickerson	NJDEP	jay.nickerson@dep.nj.gov
Myla Ramirez	NJDEP	Myla.Ramirez@dep.nj.gov
John Wolfe	LimnoTech/NJDEP Consultant	jwolfe@limno.com
CPG Team		

Name	Affiliation	E-mail Address
Robert Law	de maximis	rlaw@demaximis.com
Bill Potter	de maximis	otto@demaximis.com
Gary Fisher	CPG	gary.fisher@nokia.com
Doug Reid-Green	CPG	douglas.reid-green@basf.com
Kristen Durocher	AECOM	Kristen.Durocher@aecom.com
Sue Harden	AECOM	susan.harden@aecom.com
John Connolly	Anchor QEA	jconnolly@anchorqea.com
Jim Rhea	Anchor QEA	jrhea@anchorqea.com
Mark LaRue	Anchor QEA	mlarue@anchorqea.com
Peter Israelsson	Anchor QEA	pisraelsson@anchorqea.com
Mike Johns	Windward Environmental	MikeJ@windwardenv.com
Lisa Saban	Windward Environmental	lisas@windwardenv.com

The CPG presented a more detailed proposal for the Current Conditions Monitoring Program to USEPA, NJDEP, and their consultants. USEPA and NJDEP were generally in agreement on the scope of the PWCM. USEPA recommended that the number of vertical casts for turbidity, conductivity, and temperature along the cross-channel transects be increased to seven from CPG's original proposal of three to five locations. CPG accepted this recommendation and indicated that the target for submittal of the PWCM QAPP/FSP would be in mid-May 2019.

11 QAPP Worksheet No. 10 (UFP-QAPP Manual Section 2.5.2) Problem Definition

The accumulation of new sediment, as well as the stability of existing sediment in the upper 9 miles of the LPR is driven by the dynamics of the system. These dynamics include the location of the tidal salt front, freshwater flow rates, and the effects of storm events on flow velocity, sediment deposition, resuspension, and redistribution. Understanding these dynamics is critical to predicting the long-term fate and transport of contaminants associated with sediment and to evaluating the effectiveness of remedial alternatives. Previous investigations have evaluated dynamics and solids transport in the LPR; however, additional data are needed: 1) to establish current conditions; and 2) to support model calibration associated with the Adaptive Management approach including the proposed interim remedial action and post-construction recovery. This investigation is designed to target the upper 9 miles of the LPR, refining hydrodynamic and suspended solids conditions within this area, including at the upstream and downstream boundaries. The study will be conducted over a range of tidal and freshwater flow conditions to better define system variability.

12 QAPP Worksheet No. 11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQOs are presented in Appendix B.

13 QAPP Worksheet No. 12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group	**Suspended Solids Concentration (SSC)**				
Concentration Level	**Low**				
Sampling Procedure[1]	**Analytical Method/ SOP[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-02	L-66	Contamination	<Quality Limit (QL)	Method Blank	A
	L-66	Contamination	<QL	Equipment Blanks	S & A
	L-66	Accuracy/ Sensitivity	Supplier Certified Limits	Performance Evaluation (PE) Sample[3]	Not Proposed[3]
	L-66	Precision	Relative Percent Difference (RPD) ≤ 50% if > 10 mg/L	Field Duplicate	S & A
	L-66	Completeness	≥ 95%	Data Completeness Check	S & A

Notes:

1. Refer to QAPP Worksheet No. 21.
2. Refer to QAPP Worksheet No. 23.
3. PE sample is not available for this analyte.

Matrix	Water				
Analytical Group	**POC**				
Concentration Level	**Low**				
Sampling Procedure[1]	**Analytical Method/ SOP[2]**	**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)**
LPR-FI-02	L-67	Contamination	<QL	Method Blank	A
	L-67	Contamination	<QL	Equipment Blanks	S & A
	L-67	Accuracy/ Sensitivity	85%–115%	Laboratory Control Sample (LCS)	A
	L-67	Accuracy/ Sensitivity	Supplier Certified Limits	PE Sample[3]	Not Proposed[3]
	L-67	Precision	RPD ≤ 20% if > 10x QL	Field Duplicate	S & A
	L-67	Completeness	≥ 95%	Data Completeness Check	S & A

Notes:

1. Refer to QAPP Worksheet No. 21.
2. Refer to QAPP Worksheet No. 23.
3. PE sample is not available for this analyte.

Matrix	Water				
Analytical Group	**DOC**				
Concentration Level	**Low**				
Sampling Procedure[1]	**Analytical Method/ SOP**[2]	**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)**
LPR-FI-02	L-68	Contamination	<QL	Method Blank	A
	L-68	Contamination	<QL	Equipment Blanks	S & A
	L-68	Accuracy/ Sensitivity	80%–120%	LCS	A
	L-68	Accuracy/ Sensitivity	80%–120%	MS	A
	L-68	Accuracy/ Sensitivity	Supplier Certified Limits	PE Sample[3]	Not Proposed[3]
	L-68	Precision	RPD ≤ 20% if > 10x QL	Field Duplicate	S & A
	L-68	Precision	RPD ≤ 20% if > 10x QL	MS/MSD	A
	L-68	Completeness	≥ 95%	Data Completeness Check	S & A

Notes:

1. Refer to QAPP Worksheet No. 21.
2. Refer to QAPP Worksheet No. 23.
3. If required and appropriate PE samples can be identified, and a PE study conducted during the course of the program.

14 QAPP Worksheet No. 13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by Tierra Solutions, Inc. in LPRSA				
Tide Gage Measurement	Tierra Solutions, Inc., 1995 to 1996, Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. June 2004.	Tierra Solutions, Inc., Water level fluctuations, April 14, 1995 to June 11, 1996 (partial), 3 gages RM: 0.9–7.8	Provides characterization of water level variation	Does not cover all flow conditions. Covers only a portion of the lower 8 river miles.
Current Cross-Section Measurement	Tierra Solutions, Inc., 1995 to 1996, Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., 8 Velocity cross-sections periodically surveyed between July 7, 1995 and May 22, 1996 during different tide phases RM: 0.5–7.9	Provides characterization under limited set of conditions	Does not cover all flow conditions. Covers only a portion of the lower 8 river miles. See Attachment 1 of AECOM (2010) for data quality review.
Moored Current Profile Measurement	Tierra Solutions, Inc., 1995 to 1996, Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., Point velocity meters, July 26, 1995 to May 22, 1996 (partial), 3 gages RM: 1.4–6.8	Provides characterization under limited set of conditions	Does not cover all flow conditions. Covers only a portion of the lower 8 river miles. See Attachment 1 of AECOM (2010) for data quality review.
Salinity Cross-Section Measurement	Tierra Solutions, Inc., 1995 to 1996, Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., 8 Salinity cross-sections periodically surveyed between July 20, 1995 and May 22, 1996, during different tide phases RM: 0.5–7.9	Provides characterization under limited set of conditions	Does not capture movement of salt wedge with flow conditions. See Attachment 1 of AECOM (2010) for data quality review.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by Malcolm Pirnie in LPRSA				
Moored Current Profile Measurement	MPI, 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008	MPI, Vertical velocity profile, November 2, 2004, to October 11, 2005 (partial), 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions	Dataset is incomplete with substantial time periods and spatial locations missing. See Attachment 1 of AECOM (2010) for data quality review.
Moored Salinity Measurement	MPI, 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008	MPI, surface and bottom salinity conditions, November 30, 2004 to September 20, 2005, 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions	Meters present only between RM 8.5 and RM 11.6. See Attachment 1 of AECOM (2010) for data quality review.
Moored Turbidity Measurement	MPI, 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008	MPI, surface and bottom suspended solids conditions, November 30, 2004 to September 20, 2005 (partial), 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions	Meters present only between RM 8.6 and RM 11.6. See Attachment 1 of AECOM (2010) for data quality review.
Dissolved/total metals, Dissolved/particulate Polychlorinated Biphenyls (PCBs,) pesticides, POC, DOC, Chlorine (Cl), Bromine (Br), total suspended solids (TSS)	MPI, Pilot Dredging Study Passaic River Estuary Management Information System (PREmis) database	Collected December 2005	Will not be used	For relevant parameters (TSS): very limited temporal or spatial coverage or limited/lacking corresponding hydrodynamic information. Other parameters not reviewed.
Dioxin, pesticides, PCBs, TSS	MPI, Hydrophobic Organic Compound (HOC) Sampling Method Validation Study (HSMVS) survey project PREmis database	Collected October/November 2005	Will not be used for physical characterization.	For relevant parameters (TSS): limited physical data available. Other parameters not reviewed.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Metals, pesticides, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), herbicides, nutrients, Biological Oxygen Demand (BOD), DOC, chlor-a, TSS	MPI Small Volume Composite Grab (SVCG) survey project PREmis database	Collected November 2005	Will not be used for physical characterization	For relevant parameters (TSS): limited physical data available. Other parameters not reviewed.
Work Performed by Rutgers University Coastal Ocean Observation Lab in LPRSA and/or NBSA				
Moored Salinity Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, surface and bottom salinity, August 18, 2004 to September 12, 2005, 5 moorings RM: 1.0–7.8	Provides characterization under limited set of conditions	Does not cover all flow conditions. See Attachment 1 of AECOM (2010) for data quality review.
Moored Current Profile Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, Vertical velocity profile, August 18, 2004 to September 3, 2005 RM: 2.8	Provides insight to appropriate mooring locations for future synoptic data	Available for single location at approximately RM 3. See Attachment 1 of AECOM (2010) for data quality review.
Salinity Profile Transect Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, 13 Salinity transects, June 23, 2004 to August 18, 2005. RM: 0.0–8.0	Provides characterization under limited set of conditions	Cover only lower 8 miles of river. Synoptic nature of data unconfirmed. See Attachment 1 of AECOM (2010) for data quality review.
Current Profile Transect Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, Velocity cross-section, September 23, 2004 to August 18, 2005, 13 transects RM: 0.0–8.0	Will not be used	Data not corrected for magnetic influence on instrumentation compass, or used to monitor dye study, therefore not synoptic. See Attachment 1 of AECOM (2010) for data quality review.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Moored Turbidity Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, surface and bottom suspended solids conditions, August 18, 2004 to September 12, 2005 (partial), 5 moorings RM: 1.0–6.7	Will not be used	Substantial instrumentation fouling due to debris in river. See Attachment 1 of AECOM (2010) for data quality review.
Moored Turbidity Measurement	Rutgers, 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, Vertical turbidity profile, August 18, 2004 – September 3, 2005 RM: 2.8	Provides characterization under limited set of conditions	Data available only for RM 3. See Attachment 1 of AECOM (2010) for data quality review.
Moored ADCP and Turbidity Measurements	Sommerfield and Chant, 2007. Data not yet available	Sommerfield and Chant, March 2008 – February 2009. 5 moorings: LPR, Hackensack River, mid-Newark Bay, Kill van Kull, Arthur Kill	Characterization of flows, salinity and solids movement in the Newark Bay Study Area (NBSA)	Data will be reviewed for quality, completeness and sufficiency for NBSA characterization when publicly available
Work performed by various investigators in LPRSA and/or NBSA				
Stream Flow	USGS Gage 01389500 – Passaic River at Little Falls, New Jersey No Formal Report http://waterdata.usgs.gov/nj/nwis/nwisman/?site_no=01389500&agency_cd=USGS	USGS Daily average stream flow August 1897 – present	Record of historical flows, development of flow frequency statistics, and evaluation of other water column measurements	No limitations
Stream flow	USGS Gage 01389890 – Passaic River at Dundee Dam at Clifton, New Jersey No Formal Report http://waterdata.usgs.gov/nj/nwis/inventory/?site_no=01389890&amp	USGS Daily average stream flow April 2007 – present	Evaluation of other water column measurements, compare with Little Falls data	Limited record

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Silver (Ag), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel (Ni), Lead (Pb), Zinc (Zn), and turbidity	Dredging Permit Applications (13): Newark Bay: USACE (1991b; 1997b) AK: USACE (1992a; 1992b; 1992c; 1993; 1997a; 1997d; 1997e) KVK: USACE (1997c; 1999) PR: USACE (1987; 1991a)	Same as data source	Will not be used for physical characterization	Limited physical data available
PCBs, polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated dibenzo(p)dioxins and furans (PCDD/Fs), inorganic chemicals, POC, DOC	NJDEP (2001)	Same as data source	Will not be used for physical characterization	Limited physical data available
Cr, Pb, Zn, TSS, fecal coliform, BOD	Rutgers (1976)	Same as data source	Will not be used for physical characterization	Limited physical data available
Ag, Arsenic (As), Beryllium (Be), Cd, Cr, Cu, Hg, Ni, Pb, Antimony (Sb), Selenium (Se), Thallium (Tl), Zn, total organic carbon (TOC), Ammonia (NH_3), organic carbon	Science Applications International Corporation (SAIC) (1993)	Same as data source	Will not be used for physical characterization	Limited physical data available
POC, DOC, suspended sediments	Stahl (1985)	Same as data source	Will not be used for physical characterization	Limited physical data available
PCDD/Fs, PCBs, Aluminum (Al), As, Cu, Manganese (Mn), Pb, Zn, POC, DOC, suspended sediments	Su et al. (2002)	Same as data source	Will not be used for physical characterization	Limited physical data available
PCDD/Fs, pesticides/herbicides, PCBs, total cyanide, Total Extractable Petroleum Hydrocarbons (TEPH), TSS, chlor-a, depth, velocity	Tierra Solutions, Inc. (1997)	Same as data source	Will not be used for physical characterization	Limited physical data available

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Inorganic chemicals, PCDD/Fs, PCBs, pesticides, herbicides, PAHs, VOCs, TEPH, TSS	Tierra Solutions, Inc. (1999)	Same as data source	Will not be used for physical characterization	Limited physical data available
HOCs, Metals, carbon, TSS and ancillary (loading) data	Harbor Estuary Program Contamination Assessment Reduction Project (NY/NJ HEP CARP) program. See NY/NJ HEP website http://www.carpweb.org/main.html.	Same as data source	May use HEP data for comparative purposes	Very limited temporal or spatial coverage or limited/lacking corresponding hydrodynamic information
Work performed by the Cooperating Parties Group in LPRSA				
Current Cross-Section Measurement	AECOM, 2009 to 2010. Physical Water Column Monitoring Sampling Program Characterization Summary. Lower Passaic River Study Area RI/FS. AECOM, May 2019.	Same as data source	Provides characterization under several conditions. Limited characterization of upper river.	None
Moored Current Profile Measurement	AECOM, 2009 to 2010. Physical Water Column Monitoring Sampling Program Characterization Summary. Lower Passaic River Study Area RI/FS. AECOM, May 2019.	Same as data source	Provides characterization under several conditions. Limited characterization of upper river.	None
POC, DOC, and SSC	AECOM, 2009 to 2010. Physical Water Column Monitoring Sampling Program Characterization Summary. Lower Passaic River Study Area RI/FS. AECOM, May 2019.	Same as data source	Provides characterization under several conditions. Limited characterization of upper river. Includes wet weather sampling.	None
Metals, pesticides, VOCs, SVOCs, herbicides, nutrients, DOC, POC, SSC, chlor-a, PCDD/Fs, PCBs	AECOM, 2011 to 2013. Small Volume Chemical Water Column Monitoring Sampling Program Characterization Summary. Lower Passaic River Study Area RI/FS. AECOM, May 2019.	Same as data source	Will not be used for physical characterization	None

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
PCDD/Fs, PCBs, SSC, POC, DOC	AECOM, 2011 to 2013. High Volume Chemical Water Column Monitoring Sampling Program Characterization Summary. Lower Passaic River Study Area RI/FS. AECOM, May 2019.	Same as data source	Will not be used for physical characterization	None

15 QAPP Worksheet No. 14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Field Tasks: The field tasks for the PWCM are summarized here and discussed in detail in the FSP (Appendix A).

The approach for the field collection of data involves a combination of deployed recording instrumentation for continuous measurements of water column physical parameters (flow velocity, turbidity, conductivity, and temperature) combined with periodic surveys to download data and service the moored instruments, and boat-based surveys to perform ADCP transects and to collect supplemental water samples for SSC, DOC, and POC. Field tasks to be conducted include the following:

- Continuous fixed-point monitoring of velocity, conductivity, turbidity, and temperature in vicinity of RM 8.4, RM 10.2, RM 12.0, and RM 13.5 for approximately 6 months
  - Bottom-mounted an ADCP deployed at each station
  - Water quality measured using sondes at two depths
    - Deployed from small buoys near ADCPs
    - Set at approximately 3 feet below surface and approximately 2 feet off bottom
  - ADCP and water quality data will be logged and downloaded every 2 weeks
    - Vertical profiles of conductivity, turbidity, and temperature collected at approximately 1-foot depth intervals each time data downloaded
    - Frequency may be modified as study progresses
- Continuous fixed-point monitoring of conductivity, turbidity, and temperature in vicinity of RM 15.8 for approximately 6 months to characterize upstream conditions
  - Water quality measured using a sonde
    - Deployed from a small buoy
    - Set at approximately mid-depth
    - Data logged and downloaded every 2 weeks
      - Vertical profiles of conductivity, turbidity, and temperature collected at approximately 1-foot depth intervals each time data downloaded
      - Frequency may be modified as study progresses
  - SSC, DOC, and POC data will only be collected as part of the CWCM at this location
- Cross-channel vertical profiles of velocity, conductivity, turbidity, temperature, SSC, DOC, and POC in vicinity of RM 8.4, RM 10.2, RM 12.0, and RM 13.5) near fixed deployments
  - Vessel-mounted ADCP to collect data
    - Data to be collected during four events in Year 1 (range of flow conditions)
    - Data collected at mid-flood and mid-ebb during each event

        - Data collected during same approximate tidal conditions but may not be collected at all four transects during the same tidal cycle due to limited time window due to travel time and low bridge clearances at high tide
    - Vertical profiles of conductivity, turbidity, and temperature collected at approximately 1-foot depth intervals at approximately 7 points along transect
        - Number of points along each transect based on the anticipated needs of future model calibration efforts.
    - Water samples for SSC, DOC, and POC collected at 3 points corresponding to locations 2, 4 and 6 of the vertical profiles (see Figure 2 in Appendix A)
        - Two depths at each point (approximately 3 feet below surface and 2 feet above the bottom)
        - Chlorophyll-a data will be collected at center channel locations as part of the CWCM (Coordination of PWCM events with a portion of the CWCM events is anticipated)
- Along-channel vertical profiles of velocity, conductivity, turbidity, temperature, SSC, DOC, and POC
    - Vessel-mounted ADCP to provide velocity and backscatter along center channel transect
    - Transect located near the center of the channel, beginning approximately 2 miles downstream of the point where maximum salinity falls below 2 parts per thousand (ppt) and extending upstream to the point where maximum salinity falls below 0.5 ppt (minimum of approximately 1 mile upstream of the location of the 2 ppt threshold)
        - Conductivity (salinity) identified by manual water quality profiles
        - Approximately 1-foot depth intervals in center channel every 0.25 mile in several-mile region where salt front expected
    - Water samples for SSC, DOC, and POC collected at two depths at each point (approximately 3 feet below surface and 2 feet above bottom)
    - Data collected under a range of flows during same mobilization as cross-channel transects
    - Four events planned
    - Data collected at mid-flood and mid-ebb during each event

Analysis Tasks: Project-related field and laboratory-based measurements will be performed as described below:

Field Measurements:

Instrumentation types include:

- ADCP – to provide water velocity and acoustic backscatter measurements throughout the water column
- YSI Sondes – to provide measurements of water conductivity (salinity), turbidity (optical backscatter), and temperature as a function of depth

Laboratory Measurements: Collected samples will be analyzed for SSC, POC, and DOC according to the methods listed in Worksheet No. 12.

Quality Control Tasks: QC samples have been defined for the field and laboratory efforts. Field QC samples are summarized in Worksheet No. 20; laboratory QC samples are summarized in Worksheet No. 28. During boat-based transects, newly acquired field data will be reviewed for reasonableness before moving off station. Moored sensor data will be reviewed as soon as practical after the data are downloaded to assess the dataset completeness and reasonableness. Duplicate (boat-based) ADCP data will be collected once per event, and will be reviewed to assess data variability.

Secondary Data: All relevant secondary/historical data are summarized in Worksheet No. 13.

Data Management Tasks: AECOM's DMP (ENSR 2007a) covers all field-collected and laboratory-generated records/data. The handling of records and data is summarized in Worksheet No. 29.

Documentation and Records: Project-related records (field, sample transfer/COC, and laboratory) are summarized in Worksheet No. 29.

Assessment/Audit Tasks: Field and laboratory audits are scheduled in accordance with Worksheet No. 31.

Data Review Tasks: Field data will be reviewed as described in Worksheet No. 34 and consistent with SOP LPR-G-01 Sections 6 and 7. Laboratories are contractually required to verify all laboratory data including EDDs as summarized in Worksheet No. 34. Data validation and usability assessments will be conducted per LDC SOP 14.0.0 (Appendix E), amended for project-specific needs as detailed in Worksheet Nos. 12, 28, 35, 36, and 37.

16 QAPP Worksheet No. 15 (UFP-QAPP Manual Section 2.8.1) Reference Limits and Evaluation Table

Matrix: Water

Analytical Group: General/Ancillary Parameters

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/L)[a]	Project QL Goal (mg/L)[b]	Analytical Method[c]		Achievable Laboratory Limits[d]	
				MDLs	Method QLs	MDLs	QLs
SSC	N/A	No Standard (NS)	5	2 mg/L	N/A	1 mg/L	1 mg/L
POC	N/A	NS	1,300 mg/Kg	500 mg/Kg	N/A	500 mg/Kg	1,300 mg/Kg
DOC	N/A	NS	0.5	0.1 mg/L	0.5 mg/L	0.1 mg/L	0.3 mg/L

Notes:

a. Project Action Limits are not specified for these physical/ancillary parameters.
a. The project quantitation limit (QL) goal is selected based on laboratory practical/achievable limits.
b. Analytical method detection limits (MDLs) and QLs are those documented in validated methods.
c. Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

17 QAPP Worksheet No. 16 (UFP-QAPP Manual Section 2.8.2) Project Schedule/Timeline Table

Activities	Organization	Timing		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Project Status	de maximis/ Anchor QEA	Monthly	Monthly	Progress report	15th of each month
Planning and Development of Study Objectives	de maximis/ Anchor QEA	March 2019	May 2019	QAPP	To be submitted in May 2019, revised as needed
Deployment of Fixed Point ADCPs and Sondes	Anchor QEA/ AECOM/OSI	June 2019	December 2019	(None)	(None)
Routine Servicing of Fixed-Point Instruments and Data Download	Anchor QEA/ AECOM/OSI	June 2019, initially every 2 weeks, frequency may be modified as program progresses	December 2019	Processed data and supporting files	Approximately 2 weeks after each field download
Cross-Channel Transect Surveys (ADCPs/Sondes)	Anchor QEA/ AECOM/OSI	June 2019*	December 2019*	Processed data and supporting files	Approximately 2 weeks after each survey
Cross-Channel Transect Surveys (Water Sampling)	Anchor QEA/ AECOM/OSI	June 2019*	December 2019*	SSC, DOC/POC data (Included in Data Summary Report	May 2020
Along-Channel Transect Surveys (ADCPs/Sondes)	Anchor QEA/ AECOM/OSI	June 2019*	December 2019*	Processed data and supporting files	Approximately 2 weeks after each survey
Along-Channel Transect Surveys (Water Sampling)	Anchor QEA/ AECOM/OSI	June 2019*	December 2019*	SSC, DOC/POC data (Included in Data Summary Report)	May 2020
Quality Review and Evaluation of Sample Data	de maximis/ Anchor QEA/ AECOM	February 2020	March 2020	(Included in Summary Report)	May 2020
Preparation and Delivery of Year 1 Summary Report	de maximis/ Anchor QEA/ AECOM	April 2020	May 2020	Data Summary Report	May 2020

Note:
* Timing for surveys is dependent on weather and flow conditions occurring that meet criteria specified in the FSP.

18 QAPP Worksheet No. 17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

The sampling approach has been developed to satisfy specific data needs identified by entities developing, calibrating, and implementing hydrodynamic and sediment and organic carbon transport models. These models will be used to select and evaluate an intermediate remedy in the upper 9 miles of the LPR. This investigation is designed to refine hydrodynamic and suspended solids conditions within this area, including at the upstream and downstream boundaries. The study will be conducted over a range of tidal and freshwater flow conditions to better define system variability.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

Field Data Collection

Instrumentation will be used to collect temperature, conductivity, turbidity, and acoustic backscatter (to be converted to flow velocity data) over approximately 6 months. Two types of monitoring will be conducted, including continuous measurements at fixed moorings, and event-based surveys performed from vessels. The event-based surveys will be timed (to the extent practicable) to correspond with different flow conditions, as specified in the FSP Addendum (Appendix A).

Fixed moorings will be established at five locations in the LPR (described below), including one upstream location. At the four fixed moorings located between RM 8.4 to RM 13.5, ADCPs will be bottom mounted, and will collect data continuously throughout the deployment period. Data will be obtained throughout the water column, from just above the instrument to near the surface. Temperature, conductivity, and turbidity data will also be collected continuously with a sonde from moorings adjacent to the ADCPs. These data will be collected at two depths, one approximately 2 feet off the bottom, and the other approximately 3 feet below the surface. At the shallow upstream location (RM 15.8), a single sonde will be deployed approximately mid-depth to measure temperature, conductivity, and turbidity. An ADCP will not be deployed at RM 15.8 since velocity data is not needed for a model input at this station. Initially, the fixed moorings will be serviced and data downloaded from the instrumentation every 2 weeks. This frequency may be modified later in the deployment period. Calibrations will be performed as described in Worksheet No. 22.

To supplement the fixed moorings, data will be collected from vessels traveling along transects during four events. The transects will be run both cross-channel and along-channel, and data will be obtained twice during each event (once during mid-flood tide and once during mid-ebb tide). Vessel-mounted ADCPs will be used to collect acoustic backscatter data throughout the water column along the full extent of each transect. The cross-channel transects will be located adjacent to the fixed moorings, while the location of the along-channel transect will be determined in the field based on the location of the salt front in the LPR at the time of the survey. Vertical profiles of temperature, conductivity, and turbidity data will be collected at discrete points along each transect. These measurements will be obtained at approximately seven discrete points on the cross-channel transects (based on anticipated model calibration needs), and approximately every 0.25 mile on the along-river transects.

Sampling Locations

Sampling locations are illustrated in the FSP addendum (Appendix A). Sampling will be conducted along cross-channel transects located at the fixed-point moorings at RM 8.4, RM 10.2, RM 12.0, and RM13.5. No water sampling will be performed at RM 15.8 as part of the PWCM because samples for SSC, DOC, POC, and chlorophyll-a will be collected at that location during the CWCM. The approximate spatial resolution of these locations was selected to provide a resolution appropriate for use in the models. The final locations were selected based on a review of the 2019 hydrologic survey performed by the CPG and institutional knowledge of river conditions provided by OSI. The location of the along-channel transect will be determined in the field based on the location of the salt front in the LPR at the time of the survey. The along-river transect will be located near the center of the channel, beginning approximately 2 miles downstream of the point where maximum salinity falls below 2 ppt and extending upstream to the point where maximum salinity falls below 0.5 ppt (minimum of approximately 1 mile upstream of the location of the 2 ppt threshold). The location of the salt front identified by measuring vertical profiles of conductivity using a manually deployed sonde.

Water Sample Collection

During each of the four events, water samples will be collected along the cross-channel transects for SSC, DOC, and POC at three of the discrete points corresponding to locations 2, 4 and 6 of the vertical profiles (see Figure 2 in Appendix A). These samples will be collected at two depths, one approximately 2 feet off the bottom, and the other approximately 3 feet below the surface. Samples will not be collected for chlorophyll-a from the transects because these samples will be collected from center channel locations during the CWCM. Samples will be collected twice during each event at the transect stations (once during mid-flood tide and once during mid-ebb tide). Approximately 384 environmental samples will be collected and submitted to a laboratory for SSC, DOC, and POC analysis, not including QA/QC samples. QA/QC samples will be collected and submitted for analysis in accordance with the requirements specified in Worksheet No. 20.

19 QAPP Worksheet No. 18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Survey Type	Sampling Location	Matrix	Measurement Type	Sampling or Deployment Depth	Sampling Frequency	Sampling SOP Reference	Rationale for Sampling Location
Fixed-Point Deployments	RM 15.8	Water	Sonde	Mid-Depth	Continuous	LPR-FI-02	Establish upstream conditions for temperature, conductivity, and turbidity for model calibration.
Fixed-Point Deployments	RM 13.5, 12, 10.2, 8.4	Water	ADCP	Bottom-Mounted	Continuous	LPR-F1-03	Spatial resolution selected to support model calibration
			Sonde	2 feet above bottom and 3 feet below surface	Continuous	LPR-F1-02	
Cross-Channel Transects	RM 13.5, 12, 10.2, 8.4	Water	ADCP	Surface (Vessel-Mounted)	4 Events (Timing Based on Criteria in FSP); Data collected twice during each event (mid-flood and mid-ebb tide)	LPR-F1-03	Flow conditions and spatial resolution selected to supplement fixed-point monitoring, supporting model calibration
			Sonde	Manual vertical profile at 7 discrete points across channel		LPR-F1-02	
			Water Sampling for SSC, DOC, POC	2 feet above bottom and 3 feet below surface, 3 discrete points across channel	4 transects/ event 2 tides/ event 3 points/ transect 2 depths/ point 4 events 192 samples total	LPR-F1-02	

Survey Type	Sampling Location	Matrix	Measurement Type	Sampling or Deployment Depth	Sampling Frequency	Sampling SOP Reference	Rationale for Sampling Location
Along-Channel Transect	~1 Mile Upstream to ~2 Miles Downstream of Salt Front	Water	ADCP	Surface (Vessel-Mounted)	4 Events (Timing Based on Criteria in FSP); Data collected twice during each event (mid-flood and mid-ebb tide)	LPR-F1-03	Flow conditions and spatial resolution selected to supplement fixed-point monitoring, supporting model calibration
			Sonde	Manual vertical profile at discrete points 0.25 mile apart		LPR-F1-02	
			Water Sampling for SSC, DOC, POC	2 feet above bottom and 3 feet below surface, discrete points 0.25 mile apart	1 transect/ event 2 tides/event 12 points/ transect 2 depths/ point 4 events 192 samples total	LPR-F1-02	

20 QAPP Worksheet No. 19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Size[2]	Containers (number, size, and type)[3]	Preservation Requirements	Maximum Holding Time[4] (Preparation/ Analysis)
Water	SSC	Low to High	L-66	1-L minimum	One tared 1-L plastic	0–≤6°C; store in the dark; weigh entire sample bottle to nearest 0.1 g and record weight upon receipt at laboratory	28 days
Water	POC/DOC	Low to High	L-66 LPR-FI-02 Attachment 1	0.2-L minimum	Three 0.2-L plastic[5]	0–≤6 °C; store in the dark	Samples will be shipped to the laboratory and filtered within 48 hours of collection[6]
Particulate	POC	Low to High	L-66	0.2-L minimum	Three 25-mm GF/F	0–≤6 °C; store in the dark	28 days
Dissolved Fraction	DOC	Low to High	L-68	0.04-L minimum	Three 0.04-L amber glass with Teflon lined lids	0–≤6 °C; store in the dark	28 days

Notes:

1. Refer to Worksheet No. 23 for SOP titles.
2. Sample size is the minimum requested by the laboratory to perform the requested analysis and may vary based on river flow/suspended load conditions.
3. Alternative containers may be provided by the laboratory under the condition that method or project-specific requirements are met.
4. Begins at time of sample collection.
5. Three replicate filters are prepared for each sample by filtering each sample volume collected. Three separate bottles are used so that each replicate analysis uses the entire sample rather than mixing a larger bottle and subaliquoting. Samples with large amounts of suspended solids tend to settle out too quickly creating aliquots with less suspended solid material in the initial subsample and increasingly more with each successive subaliquot.
6. Sample filtration will be performed at the ALS laboratory in Middletown, PA in order to meet the 48-hour holding time. ALS Middletown will then ship the filters and filtrate to the ALS laboratories in Tucson, AZ, and Kelso, WA, for the analysis of POC and DOC, respectively.

21 QAPP Worksheet No. 20 (UFP-QAPP Manual Section 3.1.1) Field Quality Control Sample Summary Table

Matrix	Parameter	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations (No. of Samples[2])	No. of Field Replicates[3]	No. of Rinsate Blanks[4]	No. of PE Samples[5]	Total No. of Samples to Lab[6]
Water	SSC	Low to High	L-66	384	20	4	0	404
Water	POC	Low to High	L-67	384	20	4	0	404
Water	DOC	Low to High	L-68	384	20	4	0	404

Notes:

1. Refer to Worksheet No. 23 for SOP title.
2. Based on four sampling events.
3. Field replicates will be collected at a minimum frequency of 1 per 20 samples, accounting for number of servicing and sampling events. Field replicates will be collected by filling the sample and replicate jars simultaneously. The collected water sample will be distributed to each of the jars alternately until both jars are filled.
4. Equipment rinsate blanks will be collected at a rate of one per event.
5. PE sample analysis is not included. NELAP certification requires ongoing PE studies; additional PE studies may be included during the sampling program.
6. Note that these numbers are estimated and may change based on field conditions.

22 QAPP Worksheet No. 21 (UFP-QAPP Manual Section 3.1.2) Project Sampling SOP References Table

The following is a list of all SOPs associated with project sampling including, but not limited to, sample collection, sample preservation, equipment cleaning and decontamination, equipment use, testing, inspection and maintenance, supply inspection and acceptance, and sample handling and custody.

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
LPR-G-01	Field Records, Rev. 4	AECOM	N/A	No	Appendix C
LPR-G-02	Navigation/Positioning, Rev. 6	AECOM	Differential	No	Appendix C
LPR-G-03	Equipment Decontamination, Rev. 6	AECOM	N/A	No	Appendix C
LPR-G-04	Investigative Derived Waste (IDW) Handling and Disposal, Rev. 6	AECOM	N/A	No	Appendix C
LPR-G-05	Sample Custody, Rev. 7	AECOM	N/A	No	Appendix C
LPR-G-06	Sample Packaging and Shipping,	AECOM	N/A	No	Appendix C
LPR-FI-02	CTD/Turbidity Data Collection and Water Sampling, Rev. 4	AECOM	CTD/OBS Sensors/ pump	No	Appendix C
LPR-FI-03	ADCP Data Collection, Rev. 1	AECOM	ADCP Sensors	No	Appendix C

Procedural modifications to these documents may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification will be approved in advance by the Project QA Manager, Anchor QEA Field Task Leader, and the AECOM Field Task Manager, and communicated to the CPG Project Coordinator and to the USEPA RPM. Deviations will be documented in the field records.

23 QAPP Worksheet No. 22 (UFP-QAPP Manual Section 3.1.2.4) Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
YSI-CT/OBS	Temperature sensors are factory calibrated. Conductivity and turbidity probes calibrated against fixed calibration solutions.	Battery and anti-fouling checks performed at every mooring service date. Clean all probes with soft plastic brush.	Test the turbidity and conductivity sensors against CTD-OBS Vertical Profiler data.	Before each use, check for biological fouling of conductivity and turbidity probe. Check wiper for proper operation.	Calibrate prior to first deployment. Conduct maintenance, testing and inspection at each servicing and upon final recovery.	If meter cannot achieve or maintain calibration, corrective action will be warranted.	Recalibrate/ repeat with alternate standard set. Replace instrument if calibration not achievable or instrument otherwise damaged.	Vessel/Mooring Subcontractor Lead for boat based programs.	LPR-FI-02 (refer to Worksheet No. 21)
Seabird CTD/OBS Vertical Profiler	Temperature and conductivity sensors factory calibrated. Turbidity probe calibrated against fixed calibration solutions.	Periodical checks and refill of mineral oil in pressure sensor. All other sensors relatively maintenance free.	Test cast prior to use to verify proper operation.	Off-site inspection of calibration before servicing and recovery.	Calibration of turbidity probe prior to first deployment.	If meter cannot achieve or maintain calibration, corrective action will be warranted.	Recalibrate turbidity probe if necessary.	Vessel/Mooring Subcontractor Lead	LPR-FI-02 (refer to Worksheet No. 21)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ADCP	Transducer beam angles and frequency factory calibrated. Compass calibration conducted in the field.	Maintenance is required before deployment and in preparation of storage or shipment.	Internal systems, boards, sensors, and memory tests. Results logged digitally on field computer.	Check for biological fouling, clean as necessary.	Test before initial deployment and at each service date thereafter.	N/A (factory calibration).	Recalibrate compass. Replace instrument if calibration not achievable or instrument otherwise damaged.	Vessel/Mooring Subcontractor Lead	LPR-FI-03 (refer to Worksheet No. 21)
Teledyne/RDI Workhorse Sentinel ADCP Wave Gage	Transducer beam angles and frequency factory calibrated. Compass and pressure sensor calibration conducted in the field.	Maintenance is required before deployment and in preparation of storage or shipment.	Internal systems, boards, sensors, and memory tests. Results logged digitally on field computer.	Check for biological fouling, clean as necessary.	Test before initial deployment and at each service date thereafter.	N/A (factory calibration)	Recalibrate compass. Replace instrument if calibration not achievable or instrument otherwise damaged.	Vessel/Mooring Subcontractor Lead	LPR-FI-03 (refer to Worksheet No. 21)

24 QAPP Worksheet No. 23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP Reference Table

SOP Reference Number[1,2]	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-66	Sample Preparation for Sediment, Particulate Carbon and Nitrogen, and Particulate Organic Carbon in Water, GEN-POC PC, PN SSC PREP, Rev. 3. 0	Definitive	General Chemistry	Analytical Balance	ALS	N
L-67	Total Carbon and Sulfur by Combustion/Infrared Detection, CHM-SC832 Rev. 00.0	Definitive	General Chemistry	LECO Model SC832 Sulfur Carbon Analyzer	ALS	N
L-68	Total and Dissolved Organic Carbon (TOC, DOC), Total Inorganic Carbon (TIC), and Total Carbon (TC) in Water, GEN-TOC, Rev. 15	Definitive	General Chemistry	Teledyne-Tekmar Model TOC Fusion Analyzer	ALS	N

Notes:

1. All SOPs are contained in Appendix D.
2. It is expected that the procedures outlined in these SOPs will be followed. Procedural modifications to individual SOPs may be warranted depending upon an individual sample matrix, interferences encountered, or limitations imposed by the procedure. Deviations from individual SOPs will be documented in the laboratory records. Substantive modification to any SOP will be approved in advance by the Project QA Manager, Anchor QEA Field Task Leader, and AECOM Field Task Manager, and communicated to the CPG Project Coordinator and to the USEPA RPM. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

25 QAPP Worksheet No. 24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[a]
Balance	Weigh and record National Institute for Standards and Technology (NIST) traceable standard weight in range of interest	Daily	± 5% of certified weight	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-66
CHN Analyzer	Certified material	Daily	± 0.3% of expected value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-67
TOC Analyzer	Single point calibration	Daily	± 10% of expected value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	L-68

Note:

a. Refer to the Analytical SOP References table (Worksheet No. 23). All SOPs are contained in Appendix D.

26 QAPP Worksheet No. 25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[a]
Analytical Balance	Annual service	Check balance against NIST traceable weights	Balance performance and sensitivity	Once per year or as needed	Within NIST specified tolerances	Correct and recalibrate	Analyst	L-66
CHN Analyzer	Replace combustion and reduction tubes; Replace nickel vial receptacle	Initial calibration standard results	Instrument performance and sensitivity	Replace combustion tube after ~ 1000 analyses; replace reduction tube after ~ 400 analyses; replace nickel vial receptacle after ~ 450 analyses or whenever combustion tube is replaced	See SOP	Correct and recalibrate	Analyst	L-67
TOC Analyzer	Check chlorine scrubber; check that gas/liquid separator is properly filled; empty mist trap; inspect permeation dryer for damage or water accumulation	Initial calibration standard results	Instrument performance and sensitivity	Daily or as needed	See SOP	Correct and recalibrate	Analyst	L-68

Note:

a. Refer to the Analytical SOP References table (Worksheet No. 23). All SOPs are contained in Appendix D.

27 QAPP Worksheet No. 26 (UFP-QAPP Manual Appendix A) Sample Handling System

Sample Collection, Packaging, and Shipment
Sample Collection (Personnel/Organization): AECOM Field Team (see Worksheet No. 21 for a list of the sample collection methods)
Sample Packaging (Personnel/Organization): AECOM Field Team
Coordination of Shipment (Personnel/Organization): AECOM Field Team
Type of Shipment/Carrier: Commercial carrier (Federal Express or equivalent) for overnight delivery or laboratory courier
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Assigned laboratory personnel (see Worksheet No. 30 for laboratories providing analytical services)
Sample Custody and Storage (Personnel/Organization): Assigned laboratory personnel (see Worksheet No. 30 for laboratories providing analytical services)
Sample Preparation (Personnel/Organization): Assigned laboratory personnel (see Worksheet No. 30 for laboratories providing analytical services)
Sample Determinative Analysis (Personnel/Organization): Assigned laboratory personnel (see Worksheet No. 30 for laboratories providing analytical services)
Sample Archiving
Field Sample Storage (number of days from sample collection): Samples will not be stored in the field but will be shipped to the designated laboratory within 24 hours of collection or processing. If circumstances require that the samples be stored in the field, they will be maintained under the specifications listed in Worksheet No. 19.
Sample Disposal
Personnel/Organization: Assigned laboratory personnel (see Worksheet No. 30 for laboratories providing analytical services)
Number of Days from Analysis: Varies by laboratory; laboratory is required to give AECOM 30 days' notice prior to intent to discard any project samples.

Sample Handling and Custody

Sample custody procedures ensure the timely, correct, and complete analysis of each sample for all parameters requested. A sample is considered to be in someone's custody if it:

- Is in his/her possession
- Is in his/her view, after being in his/her possession
- Is in his/her possession and has been placed in a secured location
- Is in a designated secure area

Sample custody documentation provides a written record of sample collection and analysis. The sample custody procedures require the specific identification of samples associated with an exact location and the recording of pertinent information associated with the sample, including time of

collection and any preservation techniques, and a COC record that serves as physical evidence of sample custody. Custody procedures will be similar to the procedures outlined in USACE's *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001) and the USEPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2007). The COC documentation system provides the means to individually identify, track, and monitor each sample from the time of collection through final data reporting. Sample custody procedures are developed for three areas: sample collection, laboratory analysis, and final evidence files, which are described in Worksheet No. 27 and SOP LPR-G-05.

Field Sample Handling and Custody

Field records provide a means of recording information for each field activity performed at the site. COC procedures document pertinent sampling data and all transfers of custody until the samples reach the analytical laboratory. The sample packaging and shipment procedures summarized in Worksheet No. 27 are designed to ensure that the samples arrive at the laboratory with the COC intact. Specific preservation procedures required for each analytical method are described in Worksheet No. 19.

28 QAPP Worksheet No. 27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): The field sample custody procedures are discussed in Worksheet No. 26 and sample packing, shipment, and delivery requirements are below. Sample management information is also provided in **SOPs LPR-G-05 and LPR-G-06.**

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Each laboratory has a sample custodian who accepts custody of the samples and verifies that the information on the sample labels matches the information on the COC. The sample custodian will document any discrepancies, document sample condition upon receipt at the laboratory, and will sign and date all appropriate receiving documents. Additional information on laboratory sample receiving procedures is provided in the text below this summary table.

Sample Identification Procedures: Each sample will be assigned a unique sample identification number using the Lower Passaic River Data Management System. This identification nomenclature will consist of an alphanumeric code that identifies the program, sample location (including depth interval if needed), and sample type. Details of sample identification are provided below.

Electronic Sensor Data File Naming Procedures: The unique naming of sensor data collection/storage configuration files will aid in data management and will fall into two categories: 1) boat-based file naming; and 2) moored instrument file naming. This identification nomenclature will consist of an alphanumeric code that identifies the program, event, and for moored sensors, the location. Details are provided below.

COC Procedures: A COC will accompany all samples from the time of sampling through all custody transfers. A sample COC form is provided in LPR-G-05; the COC procedures are summarized below and in SOP LPR-G-05 provided in Appendix C.

Sample Identification

Samples will be uniquely identified at the time of collection. The sample identifiers will be assigned according to the following pattern:

- Program-Event-Transect-Station-Depth-Type

Where:

Program	Two-digit year plus sequence letter to distinguish sampling programs: "19A" for first deployment or sampling event in 2019.
Event	"CE" plus two-digit sequence number: Event will define the tide stage period for the sample were CE02 is flood tide and CE04 is ebb tide.
Transect	"T" plus three-digit representation of RM by tenths for LPR: "T120" for transect at RM 12.0.
Station	"P" plus single-digit sequence for position along transect from left bank looking upstream: "P2" for second station
Depth	Single character sequence letter for depth interval, with "X" reserved to indicate no depth interval: "A" for the depth interval nearest the water surface, "B", etc. for intervals of increasing depth.
Type	Single character for sample type: "S" for normal sample, "T" for field duplicate, "R" for rinsate blank

For example:

- A sample labeled 19C-CE02-T102-P1AS identifies the third program (19C) sample collected at the transect from RM 10.2 (T102). The sample was collected during the flood tide (Event = CE02) and consisted of the first profile station (P1) from left bank looking upstream, at the uppermost depth (Depth A) and is identified as a normal sample (S).
- A sample labeled 19B-CE02-T120-P2BT is the field duplicate for a sample collected at depth (Depth B = second in sequence from the surface) from the second station point along a transect (P2) at RM 12.0. The sample was collected during the second survey conducted for the program (19B), and during a flood tide (the event code is CE02).
- A sample labeled 19C-CE04-T120-P1XR identifies a rinsate blank done prior to sampling transect at RM 12.0 during the third event (19C) on an ebb tide (CE04). Note that although equipment rinsate blanks are assigned an ID related to a sample recently processed or collected, this is for identification purposes only. Equipment rinsate blanks are collected periodically and are considered reflective of decontamination procedures for the period. They are therefore applicable to all samples collected that period of the survey using a particular type of equipment.
- A sample labeled 19B-CE02-T084-P1AS identifies a sample collected during the second event (19B) at a monitoring location from RM 8.4 (T084) during a flood tide (CE02), from the left location along the transect (P1) at the shallowest depth (AS).

Electronic Sensor Data File Naming

The unique naming of sensor data storage and/or configuration files will be assigned similar to the scheme for sample identification, and based on whether the contents are associated with a boat-based survey or a moored instrument:

- Boat-based CTD/OBS files will be named with the program and event code (i.e., 19A-CE04, 19A-CE02, 19C-CE04, etc.) plus the specific collection software-assigned file extension.
- Boat-based ADCP files will be named with the program and event code, plus collection software-assigned sequence number and file extension (i.e., 19A-CE02-001p.000, 19A-CE04-013p.000, etc.).
- Moored instrument configuration files will be named with the program, event, and transect codes to capture position information related to the deployment (i.e., 19A-CE04-T084, 19D-CE04-T102, etc.) plus the specific collection software-assigned file extension.

COC Procedure

The COC form serves as an official communication to the laboratory detailing the specific analyses required for each sample. The COC record is prepared by the field sample custodian and accompanies samples from the time of sampling through all transfers of custody. The COC will be retained by the laboratory that analyzes and archives the samples. Three copies of the COC are created: one copy is retained in the field, one is provided to the project chemist, and one is provided to the laboratory.

Transfer of Custody and Shipment

Sample custody must be maintained from the time of sampling through shipment and receipt at the laboratory. The procedures for custody transfer are outlined in SOP LPR-G-05 (Appendix C).

Sample Packaging and Shipping Requirements

Samples will be packaged and shipped at the end of each day unless other arrangements have been made with the laboratory. Samples will be shipped by commercial carrier (Federal Express or equivalent) for overnight delivery using the procedures outlined in SOP LPR-G-06 (Appendix C) or will be delivered directly to the laboratory by laboratory courier. Field samples will initially be delivered by courier to the ALS Laboratory in Middletown, PA, for filtration for POC/DOC within the 48-hour holding time. Once filtration is complete, ALS Middletown will ship the filters to be analyzed for POC and the SSC samples to ALS Tucson, AZ, and the filtrate to be analyzed for DOC to Kelso, WA, via commercial carrier.

Laboratory Custody Procedures

Each contracted laboratory will have a SOP that details the procedures used to document sample receipt and custody within the laboratory. The following procedures must be addressed in the laboratory custody SOP:

- Each laboratory must have a designated sample custodian who accepts custody of the samples at the time of delivery to the laboratory and verifies that the information on the sample labels matches the information on the COC. The sample custodian must sign and date all appropriate receiving documents and note any discrepancies in sample documentation as well as the condition of the samples at the time of receipt.
- Once the samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with laboratory custody and security requirements as outlined in the laboratory QMP.
- To ensure traceability of samples during the analytical process, the laboratory will assign a sample ID number based on procedures outlined in the laboratory QMP or laboratory SOP.

- The following procedures, at a minimum, must be documented by the laboratory:
  - Sample extraction/preparation
  - Sample analysis
  - Data reduction
  - Data reporting
- The ALS Middletown laboratory will generate a COC for both the filter (POC) and filtrate (DOC) samples generated from the filtration process and attach the original field COC with samples shipped to ALS Tucson for analysis and include a copy of the original field-generated COC with filtrate samples shipped to ALS Kelso for analysis.
- Laboratory personnel are responsible for sample custody until the samples are returned to the sample custodian.
- When sample analysis and QC procedures are completed, any remaining sample must be stored in accordance with contractual terms. A minimum of 30 days' notice must be provided to AECOM before disposal of any sample. Data sheets, custody documents, and all other laboratory records must be retained in accordance with contractual agreements.

Final Evidence Files

Laboratory records including COCs and other sample receiving records, sample preparation and analysis records, and the final data package become part of the laboratory final evidence file and must be retained as required by the contractual agreement. An electronic original copy of the data package in portable document format (pdf) and associated EDD must be provided to AECOM in accordance with the contractual agreement and will be retained by AECOM along with associated field records and other related correspondence.

Final evidence files as retained by Anchor QEA and/or AECOM will include, but not be limited to, correspondence (paper and e-mail), plans, contractual documents, maps and drawings, field data, calculations, assessment reports, laboratory deliverables, and progress and data reports. This information will be maintained in a secure area according to the procedures outlined in the LPR QMP (ENSR 2007b).

29 QAPP Worksheet No. 28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group	SSC
Concentration Level	Low to High
Sampling SOP	LPR-FI-02
Analytical Method/SOP Reference	L-66
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	ALS
Number of Sample Locations	Refer to Worksheet No. 18

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1/Batch (20 samples)	No target compounds > QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
Rinsate Blank	1/Event (4)	No target compounds > QL	Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
Laboratory Duplicates	1/Batch (20 samples)	RPD 20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤ 20%
PE Sample	Not available	N/A	N/A	N/A	N/A	N/A

Matrix Water

Analytical Group POC

Concentration Level Low to High

Sampling SOP LPR-FI-02

Analytical Method/ SOP Reference L-67

Sampler's Name AECOM Field Staff

Field Sampling Organization AECOM

Analytical Organization ALS

Number of Sample Locations Refer to Worksheet No. 18

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1/Batch (20 samples)	No target compounds > QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
Rinsate Blank	1/Event (4)	No target compounds > QL	Qualify data as needed. Assess field procedures.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
Laboratory Control Sample	1 per 20 samples	85%–115%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	85%–115%
Laboratory Duplicates	1 per 20 samples	RPD 20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤ 20%
PE Sample	N/A	N/A	N/A	N/A	N/A	N/A

Matrix	Water
Analytical Group	DOC
Concentration Level	Low to High
Sampling SOP	LPR-FI-02
Analytical Method/ SOP Reference	L-68
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	ALS
Number of Sample Locations	Refer to Worksheet No. 18

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1/Batch (20 samples)	No target compounds > QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
Rinsate Blank	1/Event (4)	No target compounds > QL	Qualify data as needed. Assess field procedures.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds > QL
LCS	1 per 10 samples	80%–120%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	80%–120%
Laboratory Duplicates	1 per 10 samples	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤ 20%
MS/MSD	1 per 10 samples	80%–120% RPD ≤ 20%	Flag data, discuss in narrative	Analyst/Section Supervisor	Accuracy/Bias Precision	80%–120% RPD ≤ 20%
PE Sample (if available)	Not currently proposed	Supplier certified limits	N/A	N/A	N/A	N/A

30 QAPP Worksheet No. 29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field notes, field data sheets, field logbooks	Field notes, field data sheets, field logbooks	Custody records and copies of air bills	Reports of field sampling audits	Progress reports
Custody records and air bills	Field instrument calibration records	Analytical data packages and EDDs	Reports of laboratory audits	Processed data and supporting files
Communication logs, records or copies of pertinent e-mails	Field measurement data	Communication logs	Validation reports	Final report - prepared and submitted to clients and USEPA
QAPP/FSP Addendum and HASP (including Task Hazard Analyses [THAs])	QAPP/FSP Addendum and HASP (including THAs)	Laboratory notebooks and bench sheets documenting sample preparation and analysis	QA reports to management	
CA reports and results	CA reports and results	Instrument maintenance and calibration records, standard preparation and traceability records	CA reports and results	
Documentation of field modifications	Documentation of field modifications	Laboratory SOPs and documentation of method modifications	Internal laboratory assessments, third-party audit reports	
		CA logs and documentation of CA results		

Regular reporting on the progress of the Physical Water Column Data Collection project will be performed as part of the overall monthly progress reporting and will include the following:

- Brief summary of any field surveys performed during the previous month (type of survey, dates, number of samples collected, issues of note, and deviations from the QAPP/FSP Addendum).
- Delivery of validated data, processed data, and raw data (as applicable) as prescribed by the Region 2 guidance on multimedia EDDs.
- Following completion of the PWCM, a Data Summary Report will be prepared. The report will include the following:

- Summary of the overall monitoring effort including a full description of any deviations from this QAPP/FSP Addendum
- Presentation of a data quality review and summary of data usability
- Summary graphics of monitoring data
- Discussion on achievement of the DQOs and any recommended follow-up investigations

This section describes the project data management process tracing data from generation through final use and/or storage. All project data, communications, and other information must be documented in a format useable to project personnel.

Project Document Control System

Project documents are controlled by AECOM's PM who will ensure that hard copies and/or electronic copies of project-related documents are managed according to the LPR QMP (ENSR 2007b). Electronic copies of information relating to this project are maintained on the project network files and are backed up daily; file access is limited to authorized project personnel. Project data/information must be documented in a standard format that is usable by all project personnel.

Data Recording

Data generated during this project will be captured electronically or entered by hand into bound field or laboratory logbooks or preprinted forms (refer to SOP LPR-G-01 in Appendix C). Computer-generated laboratory data will be managed using the laboratory information management systems (LIMS); the LIMS used by the subcontracted laboratory is described in their QMP.

Data Analysis

Data generated during this project will initially be evaluated for reasonableness and consistency with field notes soon after collection/download. Boat-based CTD/turbidity and ADCP data will be reviewed during shipboard operations, and ADCP transect data will be collected in duplicate and averaged as appropriate; moored sensor data downloads will be evaluated on board as conditions allow and/or soon after transfers occur to the Data Management Task Manager to ensure completeness and consistency.

Data analyses and presentation will include time series plots of water velocity, salinity and suspended sediments (as derived from the correlation between backscatter and SSC samples) for each mooring location, along with flows recorded at Dundee Dam and water levels. These data will be analyzed to characterize salt wedge movement and the variation of solids spatially along the river and temporally with changing river flow and tidal water elevations. Boat-based ADCP data will be presented as vector plots of vertically averaged data and backscatter data converted to SSC values presented as

color cross sections. CTD-OBS profiles will be shown as vertical profiles of temperature, salinity, density, turbidity, and SSC. The fraction of suspended matter that is organic in nature (under various flow conditions) will be calculated from the POC/SSC dataset.

Data QA Procedures

AECOM will monitor the progress of sample collection to verify that samples are collected as planned. The progress of sample collection and processing will be monitored through the documentation of samples collected and shipped. The participating laboratory must maintain a formal QMP to which they adhere, and which addresses data-generating aspects of daily operations. A policy of continuous improvement will allow data-generation processes to be reviewed and modified as needed to meet project objectives. Periodic audits of field and laboratory operations will ensure that data collection, documentation, and QC procedures are being followed.

Laboratory Data Transmittal

Laboratory data are managed by each laboratory's LIMS beginning with the sample receiving process. Laboratories are required to provide validated data reports (sample results, QC summary information, and supporting raw data) including EDDs within the turnaround time specified in Worksheet No. 30. Oceanographic data streams (ADCPs, CTDs, etc.) will be transferred directly in native file formats for transformation and uploading to the project database. EDDs related to suspended solids, and carbon (DOC/POC) measurements will be provided to AECOM in the four-file EQuIS® format specified by AECOM's Data Management Task Manager. Data will be handled in accordance with the Data Management Plan (ENSR 2007a).

Data Storage and Retrieval

Completed forms, logbooks, photographs, data packages, and electronic files will be transmitted regularly to the Project Document Control Manager. Each laboratory will maintain copies of all documents that it generates as well as backup files of all electronic data relating to sample measurements. Raw data and electronic files of field samples, QC analyses, and blanks must be archived from the date of generation and maintained by each laboratory in accordance with the terms of the contract between AECOM and the laboratory. Project closeout will be conducted in accordance with contractual guidance. As required by the Settlement Agreement (USEPA 2007), data and other project records will be made available to the USEPA.

31 QAPP Worksheet No. 30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory/ Organization [1,2]	Backup Laboratory/ Organization
Water	SSC	Low to High	All Locations	L-66	45 Days	ALS 4208 S. Santa Rita Avenue Tucson, AZ 85714 Wendy Hyatt 520-623 3381	GeoTesting Express 125 Nagog Park Acton, MA 01720 (Subcontracted by Alpha Analytical) Elizabeth Porta 508.844.4124
Water	POC/DOC Filtration	Low to High	All Locations	L-66	48 hours	ALS 301 Fulling Mill Road Middletown, PA 17057 Fiona Adamsky 717.514.0564	Alpha Analytical, Inc. 8 Walkup Drive Westborough, MA 01581 Elizabeth Porta 508.844.4124
Water	POC	Low to High	All Locations	L-67	45 Days	ALS 4208 S. Santa Rita Avenue Tucson, AZ 85714 Wendy Hyatt 520-623 3381	Alpha Analytical, Inc. 320 Forbes Boulevard Mansfield, MA 02048 Elizabeth Porta 508.844.4124
Water	DOC	Low to High	All Locations	L-68	45 Days	ALS Environmental, 1317 S. 13th Ave., Kelso, WA 98626 85714 Howard Holmes 360.501.3364	Alpha Analytical, Inc. 8 Walkup Drive Westborough, MA 01581 Elizabeth Porta 508.844.4124

Notes:

a. ALS-Tucson is the primary laboratory and will provide technical oversight of all analyses. ALS-Middletown, PA, will receive the SSC/DOC/POC samples from the field, filter the samples within 48 hours, and send the DOC samples to ALS-Kelso and the SSC/POC samples to ALS-Tuscon for analysis.

b. ALS acquired the former Columbia Analytical Services laboratories which performed the analyses in the previous sampling program.

32 QAPP Worksheet No. 31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CAs	Person(s) Responsible for Monitoring Effectiveness of CA
Safety Audit	Once, during the November 2019 servicing event	Internal	AECOM	AECOM Regional EHS Manager	AECOM SSO, AECOM Field Task Manager	AECOM SSO, AECOM Field Task Manager	AECOM Project SSO
Technical Audit of Field Activities	Once during the first few days of field operations; follow-up audits as necessary	Internal	AECOM	Project QA Manager or designee	AECOM Field Lead, AECOM Field Task Manager	AECOM Field Lead, AECOM Field Task Manager	AECOM Project QA Manager
Internal Lab Audits	Per laboratory QMP; at least annually	Internal	Laboratory	Laboratory QA Officer or designee	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer
External Lab Audits	Per certification requirements	External	State or national certifying authority	State or national certifying authority auditor	Laboratory management and staff	Laboratory management and staff	Laboratory management and staff

33 QAPP Worksheet No. 32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field System Audit	Written audit report	Anchor QEA PM, AECOM Field Task Manager, CPG QA Coordinator	Verbal summary of major findings within 24 hours; written report within one month	Memo with possible reaudit	Project QA Manager, AECOM Field Task Manager, Anchor QEA PM, CPG QA Coordinator	One week
Internal Laboratory Audits	Written audit report	Laboratory Manager/Laboratory Contact	As required by laboratory QMP	Memo or as required by laboratory QMP	Laboratory Manager, Laboratory PM AECOM Project Chemist and Project QA Manager (if project DQOs are impacted)	As required by laboratory QMP
External Laboratory Audits by Third-Party Entities	Written audit report	Laboratory Manager	Major deficiencies communicated orally at exit meeting; written report based on policy of external auditing organization	Letter or as required by external auditing organization with possible reaudit	External auditing organization; AECOM Project Chemist and AECOM Project QA Manager (if project DQOs are impacted)	As required by external auditing organization

Non-Conformance/QC Reporting

A non-conformance is defined as an identified or suspected deficiency in, or deviation from, procedures described in an approved document (e.g., improper sampling procedures, improper instrument calibration, errors in calculations, or errors in computer algorithms); an item where the quality of the end product itself or subsequent activities conducted using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with established plans or procedures. Any project staff member that discovers or suspects a non-conformance is responsible for initiating a non-conformance report to the Project QA Manager and AECOM Field Task Manager. The AECOM Field Task Manager will provide a response describing the actions to be taken and assigning responsibility for the CA. The AECOM Field Task Manager will verify that the non-conforming item or procedure is not used until the CA has been performed and

found to produce acceptable results. If the non-conformance involves instrumentation or equipment, the device must be tagged to indicate it is defective and not to be used.

A copy of each non-conformance report will be added to the project file.

Assessment

Assessment activities will measure the effectiveness of the project implementation and associated QA/QC activities. Audits are used as a means of monitoring the performance of field and laboratory activities and are conducted by the Project QA Manager or another member of the QA staff. Audits will include systems audits, which are more qualitative in nature and will be made at appropriate intervals to ensure that all aspects of the QA program are operative. Performance audits are quantitative audits that are conducted to assess the accuracy of measurement systems.

Systems audits will be conducted for field and laboratory operations to assess implementation of QA/QC requirements and determine if the systems under review are capable of meeting project DQOs. Any minor deficiencies noted during an audit will be corrected immediately. If a major deficiency is noted during an audit, a stop-work order will be issued until the deficiency can be corrected and the effectiveness of the CA measured and documented. A stop-work order may be issued by the Project QA Manager who will notify the AECOM Field Task Manager and the Anchor QEA PM. The conditions leading to a stop-work order must be documented in sufficient detail to clearly define the problem and identify possible corrective measures. Communications among project staff that address evaluation of the problem and appropriate solutions must be attached to the stop work order. The Project QA Manager, the AECOM Field Task Manager, and Anchor QEA Project PM must agree in writing to resume work after review of the data supporting correction of the deficiency. The Project QA Manager will maintain a CA log that lists deficiencies that were noted, the individual(s) responsible for follow-up, documentation of the effectiveness of the CAs taken, and implementation of procedures to prevent recurrence of the problem.

A written report will be prepared for all audits regardless of the outcome and submitted to the AECOM Field Task Manager, and the Anchor QEA PM. Any modifications to the existing program, CAs required, or the need for additional audits will be documented.

In addition to participation in any audits conducted by AECOM QA personnel, participating laboratories are required to take part in regularly scheduled performance evaluations and audits required by state and federal agencies as part of ongoing certification or participation in specific contracts, and to provide copies of the results of these performance evaluations and audits to the Project Chemist upon request. Any change in laboratory ownership, management, or certification status must be immediately reported to the Project Chemist. If any laboratory analysis is found to be outside control limits, the laboratory must immediately implement CA and notify the Project Chemist

if the project DQOs will be affected. The Project Chemist will be responsible for notifying the appropriate members of the Project Team. The Laboratory Contact will be responsible for documenting the effectiveness of the CA measures before continuing analysis of project samples.

34 QAPP Worksheet No. 33 (UFP-QAPP Manual Section 4.2) QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Progress Reports	Monthly	Due the 15th of each month	Anchor QEA PM and CPG Project Coordinator	USEPA RPM
Audit Reports	Per Worksheet No. 31	Within one month after field work begins and at least annually or as required during program	AECOM Project QA Manager	AECOM Field Task Manager, Anchor QEA PM, and CPG QA Coordinator
Data Validation Reports	After laboratory data are received and validated	See Worksheet No. 16	LDC/AECOM Data Validation Task Manager	AECOM Project QA Manager, AECOM Field Task Manager, and Anchor QEA PM
Non-conformance Report	As needed	When a non-conformance is identified	AECOM staff	AECOM Project QA Manager, AECOM Field Task Manager, Anchor QEA PM, CPG QA Coordinator, and USEPA RPM
Corrective Action	When CA is required	Within 30 days of resolution of CA.	AECOM Project QA Manager or designated Task Manager	Anchor QEA PM, AECOM Field Task Manager, and Project Team Members. If project objectives are impacted, CPG QA Coordinator, CPG Project Coordinator, and USEPA RPM will be notified

The monthly management report will address the results of any CAs or audits that took place during the reporting period as well as any trends noted during the data validation process. Problems or issues that arise between regular reporting periods may be identified to management at any time. Information included in the monthly progress report will include:

- Results of audits conducted during the reporting period
- Discussion of problems with measurement data including issues related to precision, accuracy, completeness, representativeness, and comparability that could affect achievement of the DQOs
- A listing of any non-conformance reports or stop-work orders, the associated CAs taken, and the outcome of these CAs

35 QAPP Worksheet No. 34 (UFP-QAPP Manual Section 5.2.1) Verification (Step I) Process Table

Verification Input	Description	Internal/External	Responsible for Verification
Field Data	Field data will be reviewed for completeness, accuracy, and agreement with SOP LPR-G-01 (Field Records).	Internal	AECOM Field Task Manager or designee
	Sensor data will be reviewed and evaluated for completeness, reasonableness/trends before data are transferred to the Data Management Task Manager.	Internal	AECOM Field Task Manager or designee
COC	The COC will be reviewed initially in the field for complete and correct information.	Internal	AECOM Field Task Manager or designee
	Upon receipt at the laboratory, the COC will be compared to sample containers and any discrepancies will be resolved.	External	Laboratory Sample Custodian
	During validation the COC will be verified against laboratory receipt and reporting information per SOP LDC 14.0.0 (Appendix E).	Internal	LDC Data Validator
Laboratory Data Packages and EDDs	Laboratory data reports and EDDs will be verified by the laboratory performing the work for completeness and technical accuracy prior to release.	External	Laboratory
	Laboratory data will be assessed using the validation procedures described in Worksheet Nos. 35 and 36.	Internal	LDC Data Validator
Audit Reports	Audit reports will be reviewed to confirm that specified corrective actions have been taken, the CA has been effective and all documentation of CA is attached to the audit report.	Internal	AECOM Project QA Manager
Assessment Actions and Reports	QA/QC process will be reviewed for agreement with QAPP/FSP Addendum.	Internal	CPG Project QA Coordinator

36 QAPP Worksheet No. 35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIa	Field SOPs, field records	Verify conformance to approved sampling and field measurement procedures, ensure that activities met performance criteria, and verify that deviations from procedures or criteria were documented.	Debra Simmons, Project QA Manager/AECOM
IIa	Analytical data deliverables, contractual documents	Verify the required deliverables, analyte lists, method holding times, analytical procedures, laboratory qualifiers, measurement criteria, and project quantitation limits conform to specifications. Verify that deviations from procedures or criteria were documented.	Sharon McKechnie, Validation Coordinator/AECOM
IIa	Field records, database output	Verify transcription of field data from field forms to database.	James Herberich, Data Management Task Manager/AECOM
IIa	Custody records, analytical data reports	Review traceability from sample collection through reporting.	Sharon McKechnie, Validation Coordinator/AECOM
IIa	Laboratory EDDs, analytical data reports, database output	Verify EDDs against data reports.	James Herberich, Data Management Task Manager/AECOM
IIa	Data validation reports, database output	Verify that entry of qualifiers was correct and complete.	Sharon McKechnie, Validation Coordinator/AECOM
IIb	Analytical data reports	Verify that reported analytes, holding times, analytical procedures, measurement criteria, and project quantitation limits conform to the QAPP. Verify that deviations from procedures or criteria were documented.	Sharon McKechnie, Validation Coordinator/AECOM
IIb	Analytical data reports, validation guidance	Combination full/limited data validation (see details below).	Sharon McKechnie, Validation Coordinator/AECOM
IIb	QAPP, analytical data reports, validation guidance	Verify that the qualifiers applied during validation were in conformance with the QAPP and specified validation guidance.	Sharon McKechnie, Validation Coordinator/AECOM
IIb	QAPP, data validation reports	Verify that data validation was performed in accordance with the QAPP specifications and that all required peer reviews were conducted. If validation actions deviated from the QAPP specifications and/or regional validation guidance based on professional judgment, verify that rationale was documented.	Debra Simmons, Project QA Manager/AECOM

Data Validation

Data validation will be performed by LDC, Carlsbad, California. At a minimum, 100% full validation will be performed on the first two Sample Delivery Groups (SDGs). The remaining SDGs will be subject to full validation for every 10 SDGs, and limited validation for the remaining SDGs.

Limited validation will be based on information provided by the laboratory on their QC forms, and will include no or minimal raw data review. At a minimum, limited validation will include the following data elements:

- Agreement of analyses conducted with COC requests
- Holding times and sample preservation
- Initial and continuing calibrations and analytical sequence
- Laboratory blanks/equipment blanks/field blanks
- LCS
- Laboratory duplicate results
- Field duplicate results
- Quantitation limits and sample results (limited to evaluating dilutions and reanalyses)

If significant issues (e.g., those affecting achievement of the DQOs) are noted during full validation, the limited validation will be expanded to include this issue.

Qualifiers will be applied based on the criteria in the QAPP, guidance from Region 2 validation SOPs, or professional judgment.

Reports summarizing data qualification as a result of the validation effort will be prepared.

37 QAPP Worksheet No. 36 (UFP-QAPP Manual Section 5.2.2) Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)
IIb	Water	SSC	Low to High	QAPP Worksheet Nos. 12, 15, 19, 24, and 28	Sharon McKechnie, Validation Coordinator/AECOM (or designate)
IIb	Water	POC	Low to High	QAPP Worksheet Nos. 12, 15, 19, 24, and 28	
IIb	Water	DOC	Low to High	QAPP Worksheet Nos. 12, 15, 19, 24, and 28	

Note:

a. Includes professional judgment where appropriate and necessary.

38 QAPP Worksheet No. 37 (UFP-QAPP Manual Section 5.2.3) Usability Assessment

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

AECOM's field team will review in situ data for completeness/reasonableness during profiling/transect activities to ensure data collection is complete and reasonable. Data will be viewed graphically during monitoring surveys and time series and vertical profile plots will be developed from the data. The data will be reviewed for spurious or unreasonable values, based on expected range of values from prior LPR data collection efforts.

LDC will validate all laboratory data in accordance with the protocols described in Worksheet No. 36. The Project QA Manager, in conjunction with the project team, will determine whether the analytical data meet the requirements for use in making decisions related to further actions at the site. The results of field and laboratory measurements will be compared to the DQOs described in Appendix B of this document.

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

In situ sensor variability will be examined for noise/variability and the usability of data identified based on the level of spurious points and/or interference. Boat-based measured data will be reviewed in real time for assessment of the need for repetition of a given profile.

Discrete sample data (SSC, POC, DOC) will be validated. During the data validation process the validator will use information confirming sample identification, sample preparation, analysis within holding time, instrument calibration data, and results of QC samples designed to assess blank contamination, analytical precision, and accuracy to identify any limitations in data use and, if known, data bias. The validator will apply qualifiers as needed to reflect any limitations on the use of specific data points and will prepare a report detailing the information reviewed, data limitations, and overall usability. Patterns of data use limitations or anomalies that become apparent during the validation process or as the data are used will be reviewed with the Project QA Manager and the appropriate laboratory. Data that do not meet the stated DQOs will be clearly identified in the database so that data users are aware of any limitations associated with data usability. Details of the problems identified during data validation and the bias in the data will be provided in the associated validation memorandum.

Identify the personnel responsible for performing the usability assessment:

Instrument sensor data usability will be assessed by the field team during boat-based collection or soon after moored sensor data are downloaded. Usability of the samples collected will be assessed by LDC under the supervision of the AECOM Validation Coordinator. The usability assessment will be performed jointly by the Anchor QEA, AECOM, and de maximis, inc. project teams and will include input by field personnel, QA staff, and project management.

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

In situ sensor data issues will be recorded on the data log established to document sensor data collections (refer to SOP LPR-FI-02 and SOP LPR-FI-03). The documentation generated during data validation will include a memorandum that describes the information reviewed, the results of this review, and will provide a recommendation on overall data usability and limitations on specific data points. As a result of this review, standard qualifiers are entered into the database so that data users can readily identify any limitations associated with a specific data point.

Assessment of data usability will be performed by AECOM's staff. The results of the Data Usability Assessment will be summarized in the final project report. The following items will be assessed and conclusions drawn based on their results:

Holding Time: Discrete (SSC, POC, DOC) sample data will be checked to verify that both sample preparation and analysis were performed within the required holding time for the method.

Calibration: Field and laboratory data associated with instrument calibration and verification of calibration will be reviewed to confirm that all data were generated using properly calibrated instrumentation.

Accuracy/Bias Contamination: Results for field blanks, laboratory method blanks, and instrument calibration blanks will be checked against performance criteria specified in Worksheet No. 28; results for analytes that exceed criteria will be identified and the impact on field sample data will be assessed.

Accuracy/Bias Overall: Suspended material will be measured using two separate filter types to evaluate potential bias in the measurement. Reported values of LCS and performance samples will be evaluated against the spiked or certified concentration and the percent recovery will be calculated and compared to the criteria specified in Worksheet No. 28. The percent recovery information will be used to assess the bias associated with the analysis. Average recoveries will be calculated and reported by analyte for each type of QC sample.

Precision: CTD/turbidity instrument precision specifications are well within project requirements and boat-based ADCP duplicate measurements across transects will be evaluated by the field team for precision. The temperature sensor has a resolution of 0.01 ºC and an accuracy of ±0.15 ºC. The conductivity sensor has a resolution of 0.001 to 0.1 millisiemens per centimeter (mS/cm) (depending on water column turbidity) and an accuracy of ±5% of the reading plus 0.001 mS/cm. The water level sensor has a resolution of 0.0003 meters (m) and an accuracy of ±0.02 m. The ADCP sensors have an accuracy of 0.3% to 0.5% of the water velocity. RPD statistics will be calculated for SSC, POC, DOC, and in laboratory and field duplicates to evaluate the precision associated with these measurements. These RPDs will be checked against measurement performance criteria presented on Worksheet No. 28; RPDs exceeding the stated criteria will be identified. This information will be used to draw conclusions about the precision of the analyses and, for field duplicates, the precision of sampling and analysis. Any limitations on the use of the data will also be described.

Sensitivity: The in situ measurements (CTD/turbidity, etc.) are made with highly sensitive instruments that will fully meet the associated program goals. The temperature sensor has a range of -5 to 60 ºC. The conductivity sensor has a range of 0 to 100 mS/cm. The water level sensor has a range of 0 to 9 m. The ADCP sensors have a range of ±20 m/s. The SSC, POC, and DOC reporting limits will be checked against the criteria presented in Worksheet No. 15. Limitations on the use of the data and conclusions about the sensitivity of the analysis will be reported.

Representativeness: A review of field records will be made to confirm that data/sample collection and handling was performed in a manner that conformed to the designated SOP. Similarly, laboratory preparation procedures will be reviewed during validation to ensure that a representative sample was selected for analysis. Any deviations or modifications to field or laboratory procedures that might impact the representativeness of the sample will be discussed in the final report for the project.

Comparability: The sampling and analytical procedures to be used in this program have been selected such that the resulting data will be comparable to data from similar programs conducted previously or in the future. Any modifications or deviations from stated procedures that might impact data comparability will be addressed in the final report for the project.

Completeness: Completeness for the analytical program will be calculated as the number of data points that are accepted as usable based on the validation process divided by the total number of data points for each analysis. Completeness will be reported for each analytical category and an overall value will be reported. As shown in Worksheet No. 12, the analytical completeness goal is ≥95%. Completeness for the field program will be calculated as the number of samples successfully collected compared to the total number proposed. The completeness goal for the field sampling program is ≥95%.

Each of the project QLs presented on Worksheet No. 15 will be reviewed to determine if the stated objective was met. The results and observations from data validation and measurement performance criteria assessments will be used to assess the overall data quality and whether DQOs were achieved. The final report will summarize the information used to reconcile each objective and overall conclusions regarding data quality.

39 References

AECOM, 2010. *Quality Assurance Project Plan/Field Sampling Plan Addendum*. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring. Lower Passaic River Restoration Project. March 2010.

ENSR, 2007a. *Lower Passaic River Restoration Project Data Management Plan*. ENSR Corporation. November 2007, including all revisions.

ENSR, 2007b. *Quality Management Plan*. Lower Passaic River Restoration Project, CERCLA Docket No.02-2007-2009. ENSR Corporation. May 2007, Revised July 2007.

USEPA (U.S. Environmental Protection Agency), 2005. *Uniform Federal Policy for Quality Assurance Project Plans*. Intergovernmental Data Quality Task Force. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual Publication Numbers: EPA: EPA-505-B-04-900A DOD: DTIC ADA 427785 Final Version 1. March 2005.

USEPA, 2007. Administrative Settlement Agreement and Order on Consent for Remedial Investigation/ Feasibility Study. CERCL Docket No. 02-2007-2009. May 2007.

USEPA, 2018. Letter to Robert Law. Administrative Order on Consent, No. CERCLA 02-2007-2009. Diamond Alkali Superfund Site, Operable Unit 4, Lower Passaic River Study Area - Preparation of Feasibility Study Evaluating Interim Remedy Alternatives. October 10, 2018.

USACE (U.S. Army Corps of Engineers), 1987. Public Notice of Maintenance Dredging with Upland Disposal by Essex Chemical Corporation. Public Notice #12714-86-776-J2, Issued on 8/29/1986, Expired 9/29/1986.

USACE, 1991a. Public Notice of Maintenance Dredging with Ocean Disposal and Barge Overflow by Celanese Chemical Company, Inc. Public Notice # 14516-86-939-OD, Issued 12/3/1991, Expired 1/2/1992.

USACE, 1991b. Public Notice of Maintenance Dredging with Barge Overflow and Ocean Disposal by the Port Authority of New York and New Jersey. Public Notice # 14515-91-1028-OD, Issued 11/25/1991, Expired 12/31/1991.

USACE, 1992a. Public Notice of Maintenance Dredging with Barge Overflow and Ocean Disposal by the Port Authority of New York and New Jersey. Public Notice #91-0116-OD, Issued 10/19/1992, Expired 11/30/1992.

USACE, 1992b. Public Notice of Maintenance Dredging with Ocean Disposal by Northville Linden Terminal Corporation. Public Notice #14670-92-0446-OD, Issued on 6/10/1992, Expired 7/10/1992.

USACE, 1992c. Public Notice of Maintenance Dredging with Barge Overflow and Ocean Disposal by Consolidated Edison of New York. Public Notice #14702-92-0762-OD, Issued on 8/4/1992, Expired 9/4/92.

USACE, 1993. Public Notice of Maintenance Dredging and Ocean Disposal without Barge Overflow by Bayway Refining Company. Public Notice #92-07650-OD, Issued on 4/9/1993, Expired on 5/7/1993.

USACE, 1997a. Public Notice of Maintenance Dredging with Barge Overflow and Subsequent Disposal of the Dredged Material at the Mud Dump Disposal Site off of Sandy Hook, New Jersey by CITGO Petroleum Corporation. Public Notice #96-09100-OD, Issued on 3/25/1997, Expired on 4/25/1997.

USACE, 1997b. Public Notice of Newark Bay, Hackensack and Passaic Rivers, NJ Federal Navigation Project Maintenance Dredging with Capping in the Ocean by U.S. Army Engineer District, NY. Public Notice #96/97 NWK, Issued on 3/17/1997, Expired 4/17/1997.

USACE, 1997c. Public Notice of Maintenance Dredge with Subsequent Ocean Disposal and Barge Overflow by Exxon Company, USA. Public Notice #92-09020-OD, Issued on 4/3/1997, Expired on 5/3/1997.

USACE, 1997d. Public Notice of Maintenance Dredging NY and NJ Channels (Raritan Bay Reach) mile 0 to 11. Federal Navigation Project. Public Notice #96/97 RBR, Issued on 4/2/1997, Expired 5/2/1997.

USACE, 1997e. Public Notice of Maintenance Dredge with Barge Overflow and Subsequent Disposal of the Dredge Material at the Mud Dump Site off of Sandy Hook, NJ by Mobil Oil Corporation. Public Notice #92-08990-OD, Issued on 4/2/1997, Expired 4/30/1997.

USACE, 1999. Public Notice of Dredging by the New York District, USACE. Public Notice # FP63-1234CC, Issued 1/25/99, Expired 2/22/1999.

USACE, 2001. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. February 2001.

USACE, 2010. *Lower Passaic River Commercial Navigation Analysis.* Revised July 2010.

USACE, 2013. Engineering and Design - Hydrographic Surveying. EM 1110-2-1003. Modified November 2013. Available at: https://www.publications.usace.army.mil/usace-publications/engineer-manuals/?udt_43544_param_page=4

Appendix A
Field Sampling Plan Addendum

Appendix A
Field Sampling Plan Addendum

1 Introduction

This appendix presents the Field Sampling Plan (FSP) Addendum for the Physical Water Column Monitoring (PWCM), which is part of the Current Conditions Monitoring Program, as described in Section 1 of the Quality Assurance Project Plan (QAPP) Addendum (main text). This FSP addendum is based on the Remedial Investigation Water Column Monitoring/Physical Data Collection QAPP/FSP Addendum (AECOM 2010).

This FSP Addendum presents the detailed approach and procedures that will be implemented to perform the PWCM field investigation. The work described in this FSP Addendum will be performed to establish current physical conditions in the upper 9 miles of the Lower Passaic River (LPR). The PWCM, in conjunction with other programs (small volume chemical water column monitoring and high-volume chemical water column monitoring), will provide data to support the development of refined models of the LPR, establish baseline conditions prior to the Interim Remedy (IR) and evaluate changes in the river system since 2013. The site background and objectives for the PWCM are presented in Section 1 of the main text. Standard operating procedures (SOPs) covering the field elements of the proposed investigation are included as Appendix C to the QAPP. Related laboratory SOPs are included as Appendix D to the QAPP. Health and safety documentation (based on the overall Lower Passaic River Restoration Project Health and Safety Plan [HASP; MPI 2005]) addressing the work elements specific to this investigation will be submitted under a separate cover.

This physical data collection effort will be used to compare the results of future surveys to identify changes (if any) that occur in the LPR within the areas specified herein. The primary data collected will include flow velocity, turbidity, salinity (conductivity), and temperature. These data will be supplemented with sampling and analysis for suspended sediment concentration (SSC), dissolved organic carbon (DOC), and particulate organic carbon (POC). The velocity, turbidity, conductivity, and temperature data will be collected continuously at fixed locations, as well as during discrete monitoring events at multiple locations. The discrete measurements will be collected along cross-channel transects (in the vicinity of the fixed monitoring locations), as well as along the river centerline in the vicinity of the salt front (to monitor the estuarine turbidity maximum). Sampling for SSC, DOC, and POC will be performed during the discrete monitoring events.

2 Field Activities

The PWCM will include continuous fixed-point monitoring, cross-channel transect monitoring, and along-river transect monitoring events further described in Sections 2.1, 2.2, and 2.3, respectively.

2.1 Continuous Fixed-Point Monitoring

Continuous monitoring of vertical profiles of velocity, conductivity, turbidity, and temperature will be conducted near the center of the channel in the vicinity of river mile (RM) 8.4, RM 10.2, RM 12.0, and RM 13.5. Due to limited bridge clearances and shallow water depths, the background location planned in the vicinity of RM16 will be placed at RM 15.8 upstream of the confluence with the Saddle River.

Instrumentation will be deployed at each station for approximately 6 months starting in the early summer of 2019. The velocity data will be collected using bottom-mounted acoustic doppler current profilers (ADCPs). Conductivity, turbidity, and temperature will be measured using data sondes with a conductivity, temperature and depth (CTD), and optical backscatter (OBS) nephelometer sensors. The equipment will be deployed at two depths (approximately 3 feet below the surface and 2 feet off the bottom). Due to lack of water depth at the upstream location at RM 15.8, only one sensor will be deployed at mid-depth in the water column. No continuous ADCP will be deployed.

Initially, the deployed meters will be serviced every 2 weeks, with the timing dependent on field conditions (weather, flow) and the history of sensor fouling and debris interference at a given location. The frequency of servicing may be modified as the program progresses. The servicing vessel will be equipped with a CTD/OBS and a pump/tubing sampling system. Data downloading and mooring servicing will be performed with the following approach:

- A water column profile will be obtained using boat-based CTD/OBS at the deployed meter location prior to recovering meters. These data will be immediately downloaded and viewed on the survey vessel.
- The deployed meter(s) will be retrieved, data will be downloaded, and an initial inspection of the data will be performed. The CTD/OBS data will be compared with the water column profile data to evaluate the reproducibility and status of each deployed CTD/OBS. There will be no field verification of the moored ADCP data. If there are no obvious data quality issues, the instrument will be cleaned, batteries checked, and redeployed. If there are issues with the mooring setup, the meters, or downloaded data, the meter may either be replaced at that time (if a replacement is available), pulled for repair, or a replacement survey scheduled.

2.1.1 Equipment

Each continuous fixed-point monitoring locations will include the following equipment:

- Water Quality Sonde, equipped with the following probes:
  - OBS Nephelometer. This probe provides point measurements of optical turbidity. It will be used in recording mode for the mooring deployments. The probe will be outfitted with a wiper to periodically remove fouling from the sensor optics.
  - CTD (integrated within the nephelometer). This meter provides point measurements of salinity (calculated from conductivity), temperature, and relative water depth over the meter (calculated from pressure).
- ADCP: This meter provides multiple binned measurements of water velocity and acoustic backscatter over the water column. The ADCP will be deployed on the bottom facing upwards to provide data over the entire water column.

At each location, two sondes will be deployed adjacent to the ADCP sensor. One meter will be deployed 2 feet above the river bottom and the second 3 feet below the surface. The upper meter will be attached to a floating surface buoy and will move with the water surface elevation.

2.1.2 Locations

The locations for the fixed-point monitoring are at RM 15.8, RM 13.5, RM 12, RM 10.2, and RM 8.4 as shown in Figure 1. Locations at RM 13.5 and RM 10.2 correspond with data collected as part of the 2010 Physical Data Collection effort (AECOM 2010). Final locations will be determined in the field for suitability for deployment, vessel access, and safety concerns. Initial target coordinates for the fixed-point moorings are provided in Table 1.

Table 1
Target Fixed-Point Monitoring Coordinates and Equipment Specification

Station ID	NJ State Plane (NAD83, ft)		Water Quality Monitoring Equipment Location	ADCP Monitoring
	Easting	Northing		
RM 15.8	600075	740067	Mid-Depth	No
RM 13.5	597194	734261	Near Bottom/Near Surface	Yes – On bottom
RM 12.0	596821	726685	Near Bottom/Near Surface	Yes – On bottom
RM 10.2	592220	719791	Near Bottom/Near Surface	Yes – On bottom
RM 8.4	589536	711207	Near Bottom/Near Surface	Yes – On bottom

2.2 Cross-Channel Transect Monitoring Events

Flow velocity and CTD/OBS data will be collected during periodic monitoring events along four cross-channel transects in the vicinity of RM 8.4, RM 10.2, RM 12, and RM 13.5, near the fixed-point deployments following the SOP described in Section 2.4. Vertical profiles of velocity will be obtained along each transect using a vessel-mounted ADCP. A minimum of four transect monitoring events are planned in 2019. As described below, a range of freshwater flow conditions will be targeted, to the extent practicable. Two rounds of data will be collected at each station (one round during mid-flood and the other during mid-ebb tide) for each event. For the purposes of the PWCM, mid-flood and mid-ebb are defined to be +/- 1.5 hours from the mid-point of each tidal cycle. Data collection during the same approximate tidal condition at all transects is important for model calibration, but synoptic data collection at all four transects during the same tidal cycle is not critical and may not be feasible due to logistical concerns.

Water quality (CTD/OBS) will be collected in conjunction with the ADCP surveys along the four cross-river transects. These data will be obtained at seven discrete locations along each transect. The number of points along each transect is based on the anticipated needs of future model calibration efforts. Data will be collected at approximately 1-foot intervals throughout the water column to provide a vertical profile of water quality parameters. The transects and data collection points are presented in Table 2 and shown in Figure 2.

Table 2
Target Coordinates for Cross-Channel Monitoring Points

Location	Sampling Point	Northing	Easting	Sampling Type
RM 13.5	1	734242.16	597253.09	Vertical Water Quality Profile Point
	2	734254.36	597214.34	Vertical Water Quality Profile and Water Sampling Point
	3	734266.56	597175.58	Vertical Water Quality Profile Point
	4	734278.76	597136.83	Vertical Water Quality Profile and Water Sampling Point
	5	734290.96	597098.08	Vertical Water Quality Profile Point
	6	734303.16	597059.32	Vertical Water Quality Profile and Water Sampling Point
	7	734315.36	597020.57	Vertical Water Quality Profile Point
RM 12	1	726712.85	596702.11	Vertical Water Quality Profile Point
	2	726705.11	596735.83	Vertical Water Quality Profile and Water Sampling Point
	3	726697.37	596769.55	Vertical Water Quality Profile Point
	4	726689.63	596803.27	Vertical Water Quality Profile and Water Sampling Point
	5	726681.88	596836.99	Vertical Water Quality Profile Point
	6	726674.14	596870.71	Vertical Water Quality Profile and Water Sampling Point
	7	726666.40	596904.43	Vertical Water Quality Profile Point

Location	Sampling Point	Northing	Easting	Sampling Type
RM 10.2	1	719801.63	592026.73	Vertical Water Quality Profile Point
	2	719799.56	592066.83	Vertical Water Quality Profile and Water Sampling Point
	3	719797.48	592106.93	Vertical Water Quality Profile Point
	4	719795.41	592147.03	Vertical Water Quality Profile and Water Sampling Point
	5	719793.34	592187.13	Vertical Water Quality Profile Point
	6	719791.26	592227.23	Vertical Water Quality Profile and Water Sampling Point
	7	719789.19	592267.33	Vertical Water Quality Profile Point
RM 8.4	1	711253.29	589442.90	Vertical Water Quality Profile Point
	2	711232.39	589485.74	Vertical Water Quality Profile and Water Sampling Point
	3	711211.49	589528.58	Vertical Water Quality Profile Point
	4	711190.59	589571.43	Vertical Water Quality Profile and Water Sampling Point
	5	711169.69	589614.27	Vertical Water Quality Profile Point
	6	711148.79	589657.11	Vertical Water Quality Profile and Water Sampling Point
	7	711127.89	589699.95	Vertical Water Quality Profile Point

Water samples will be collected for suspended solids concentration (SSC), particulate organic carbon (POC), and dissolved organic carbon (DOC) at three locations along each transect following the SOP described in Section 2.4. The sampling points will correspond to locations 2, 4, and 6 of the seven vertical CTD/OBS vertical profiles (Figure 2). Samples will be collected from two depths: three 3 feet below surface and two 2 feet from the bottom of the river. The samples will be submitted to the analytical laboratory for filtering and analysis. Laboratory analytical procedures are specified in Appendix D.

Surveys will be conducted approximately monthly for 4 months; however, the schedule will be flexible so that a range of flow conditions expected in the LPR can be targeted. Three rounds will capture the low, medium low, and medium high ranges of routine flows experienced most of the year. One event will target a high flow on the LPR. The USGS gage 01389890 Passaic River at Dundee Dam at Clifton, New Jersey will be monitored for determine the survey schedule. The four flow ranges targeted for survey are:

- <300 cubic feet per second (cfs)
- >300 and <600 cfs
- >600 cfs
- >5000 cfs (high flow sampling)

The river flows should be in the targeted range for 7 days antecedent to the survey. The high flow sampling will be opportunistic and does not have an antecedent requirement. Each survey round will

include the collection of ADCP data, CTD/OBS profiles, and SSC/DOC/POC sampling and analysis during the mid-flood and mid-ebb tidal cycles.

2.2.1 Equipment

The cross-river transect monitoring will use a boat based ADCP. The ADCP will be mounted facing downward on the survey vessel (with surface connection and real-time readout and recording). An OBS/CTD meter with real-time readout and recording will be used to conduct vertical profiling at 1-foot intervals through the water column. The ADCP and CTD/OBS meters will be similar to the equipment installed at the fixed-point moorings.

2.2.2 Locations

The cross-channel surveys will be conducted at the fixed-point monitoring locations at RM 13.5, RM 12, RM 10.2 and RM 8.4 as shown in Figure 1 and described in Section 2.1.2.

2.3 Along-River Transect Monitoring Events

Vertical profiles of velocity, conductivity, turbidity, and temperature will be obtained along a center channel transect following the SOP described in Section 2.4. Four surveys will be conducted during the same mobilizations as the cross-channel surveys described in Section 2.2. The surveys will be performed approximately monthly targeting the same flow regimes as the cross transect monitoring events (see Section 2.2). Each survey round will include the collection of ADCP data, CTD/OBS profiles, and SSC/DOC/POC sampling and analysis during the approximate mid-flood and mid-ebb tidal cycles.

Prior to data collection, the water column will be screened for salinity to identify the approximate location of the salt front. This screening will be initiated near the predicted location of the salt front based on flow conditions and previous investigations and will be expanded as needed. The along-river transect will be located near the center of the channel, beginning approximately 2 miles downstream of the point where the maximum salinity falls below 2 parts per thousand (ppt) and extending upstream to the point where maximum salinity falls below 0.5 ppt (minimum of approximately 1 mile upstream of the location of the 2 ppt threshold). A vessel mounted ADCP will provide velocity and backscatter along the transect. Vertical profiles of conductivity, turbidity, and temperature will also be collected at 1-foot depth intervals every 0.25 mile along the transect. The along-river transect monitoring events will be performed under a range of flows during same mobilization as cross-channel transects. Two rounds of data will be collected (one round during mid-flood and the other during mid-ebb tide) for each event.

Water samples will be collected for SSC), POC, and DOC at each 0.25-mile point along each transect following the SOP described in Section 2.4. Samples will be collected from two depths: 3 feet below surface and 2 feet from the bottom of the river. The samples will be submitted to the analytical

laboratory for filtering and analysis. Laboratory analytical procedures are specified in Appendix D of the main text.

2.3.1 Equipment

The along-river transect monitoring will use a boat based ADCP. The ADCP will be mounted facing downward on the survey vessel (with surface connection and real-time readout and recording). A CTD/OBS meter with real-time readout and recording will be used to conduct vertical profiling at 1-foot intervals through the water column every 0.25 mile along the transect. The ADCP and CTD/OBS meters will be similar to the equipment installed at the fixed-point moorings.

2.3.2 Locations

The along-river transect will be located near the center of the channel, beginning approximately 2 miles downstream of the point where maximum salinity falls below 2 ppt and extending upstream to the point where maximum salinity falls below 0.5 ppt (minimum of approximately 1 mile upstream of the location of the 2 ppt threshold). Depending on the river flows, the salt front may be in the Lower 8 miles at higher flows or up towards RM 10 during low flows. An initial transect will determine the location of the salt front and the subsequent starting and end points for the along river transect. An example location of the transects are shown in Figure 3.

2.4 Standard Operating Procedures

The SOPs for the PWCM are based on the SOPs presented in the Remedial Investigation Water Column Monitoring/Physical Data Collection QAPP/FSP Addendum (AECOM 2010). These field SOPs are provided as Appendix C to the QAPP and include the following:

SOP No.	Revision No./Date	Title
LPR-G-01	Rev. 4, May 2019	Field Records
LPR-G-02	Rev. 6, May 2019	Navigation/Positioning
LPR-G-03	Rev. 6, May 2019	Equipment Decontamination
LPR-G-04	Rev. 6, May 2019	Investigative Derived Waste Handling and Disposal
LPR-G-05	Rev. 7, May 2019	Sample Custody
LPR-G-06	Rev. , May 2019	Sample Packaging and Shipping
LPR-FI-02	Rev. 4, May 2019	CTD/Turbidity Data Collection and Water Sampling
LPR-FI-03	Rev. 1, May 2019	ADCP/ADC Data Collection

2.5 Site facilities

A field trailer will be located at the Kelways Industrial Park in East Rutherford (at approximately RM 13.5) and will serve as the base of operations for this effort. The field trailer will be used for

storage; assembling and testing instrument arrays; staging surveys; and packaging samples for shipment to the laboratory for analysis. The floating dock located at the field facility will be used for vessel mobilization for survey operations in the middle and upper sections of the study area.

2.6 Health and Safety

The tasks described within this FSP Addendum will be conducted in accordance with the overall project HASP (MPI 2005), and addenda developed for the PWCM under separate cover.

2.7 Data management

The data collected during the tasks described within this FSP Addendum will be handled and managed in accordance with the Data Management Plan (DMP; ENSR 2007). The DMP specifies data formats, data deliverables, and data archiving procedures.

3 Reporting

Regular reporting on the progress of the PWCM will be performed as part of the overall monthly progress reporting for the LPR remedial investigation and feasibility study and will include the following:

- Brief summary of any field surveys performed during the previous month (type of survey, dates, number of samples collected, issues of note, and deviations from the program QAPP/FSP Addendum).
- Delivery of validated data, processed data, and raw data (as applicable) as prescribed by the Region 2 guidance on multimedia electronic data deliverables.
- Following completion of the PWCM, a data summary report will be prepared that will include the following:
  - Summary of the overall monitoring effort including a description of any deviations from this FSP Addendum or the QAPP Addendum
  - Presentation of a data quality review and summary of data usability
  - Summary graphics of monitoring data
  - Discussion on achievement of the data quality objectives and any recommended follow-up investigations

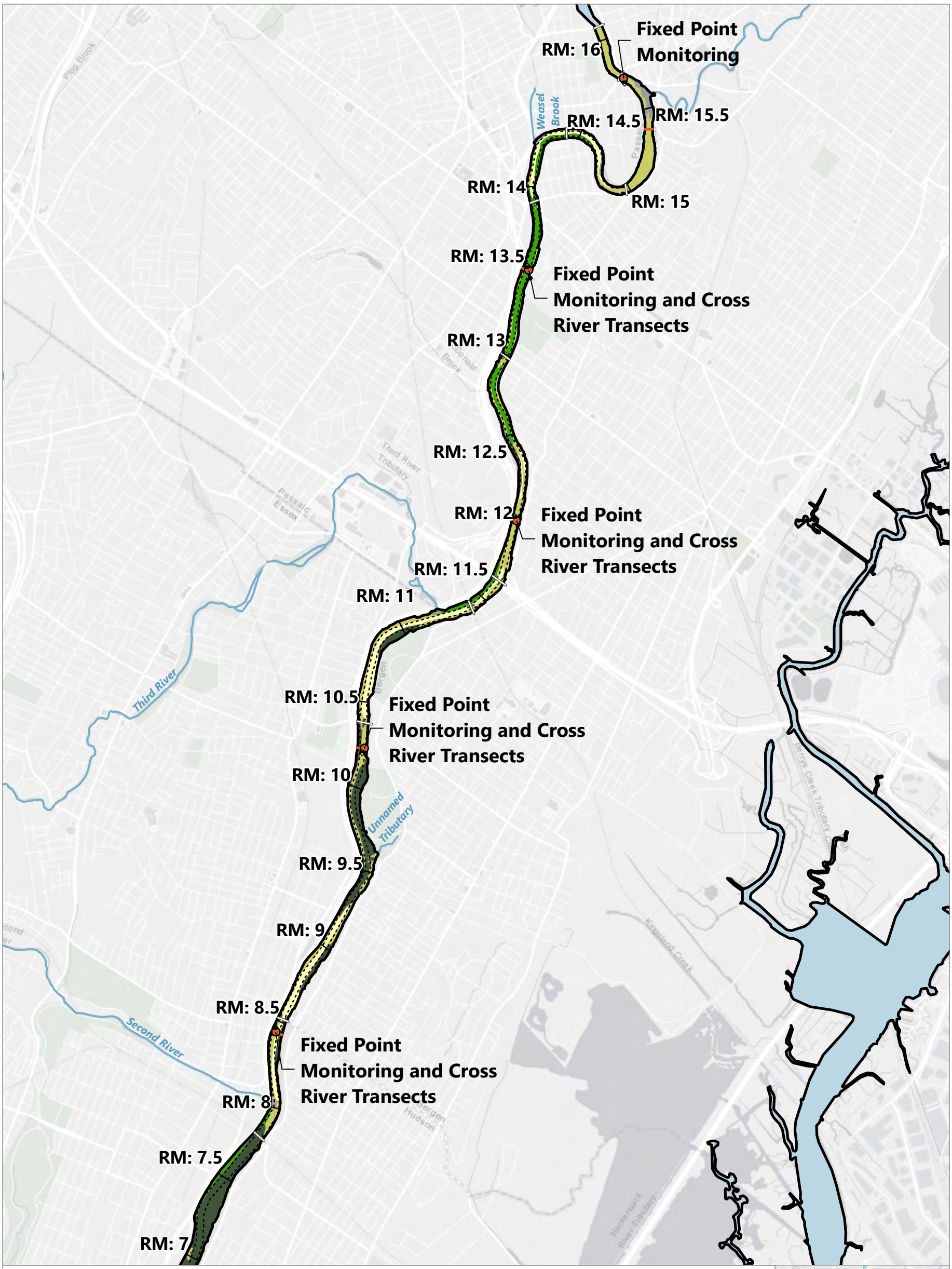
4 References

AECOM, 2010. *Quality Assurance Project Plan/Field Sampling Plan Addendum*. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring. Lower Passaic River Restoration Project. March 2010.

ENSR, 2007. *Lower Passaic River Restoration Project Data Management Plan*. ENSR Corporation. November 2007, including all revisions.

MPI (Malcolm Pirnie, Inc.), 2005. *Lower Passaic River Restoration Project Health and Safety Plan*. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, New York. August 2005.

Figures

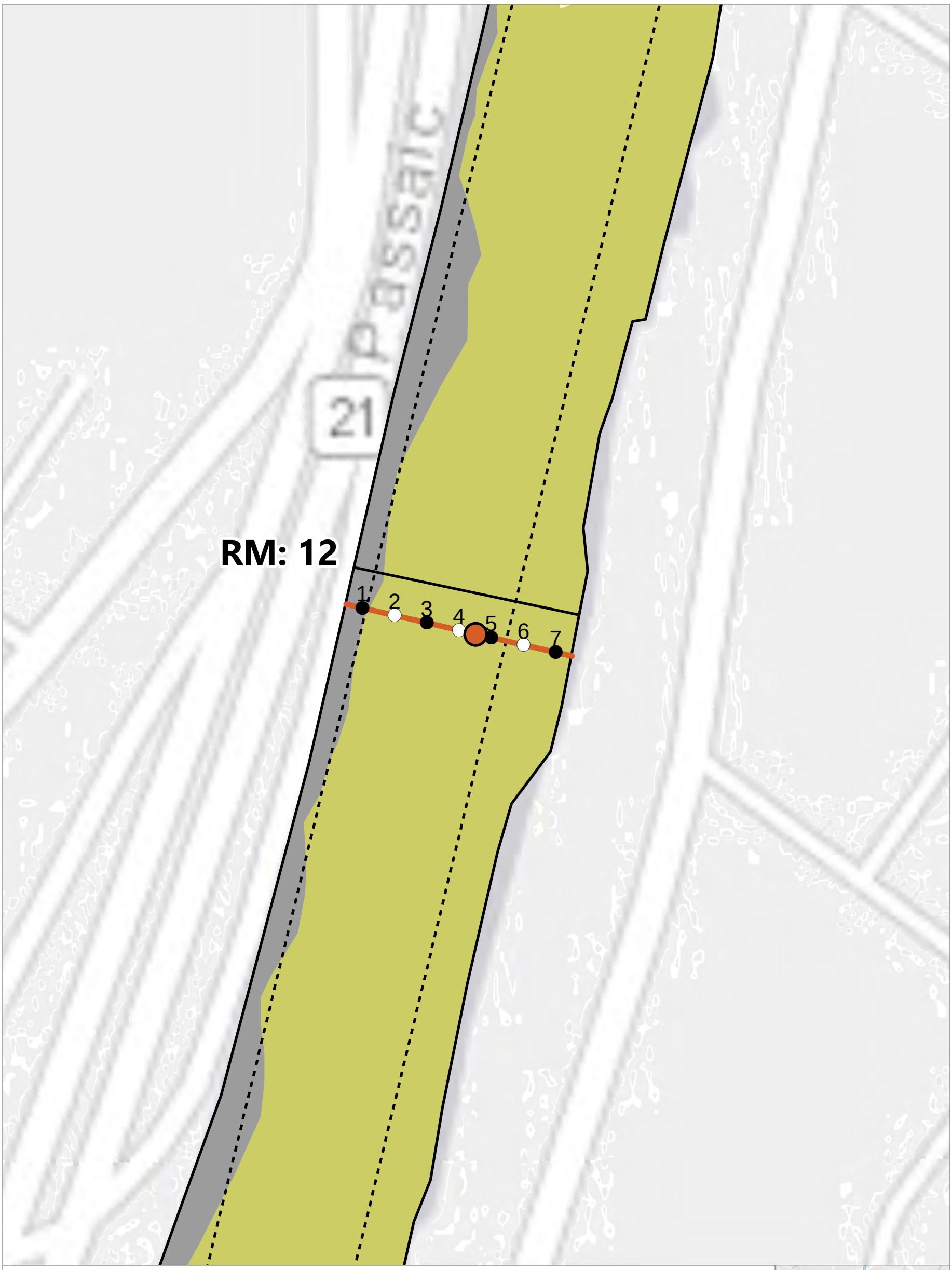


Publish Date: 2019/05/21, 10:59 AM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_FullExtent.mxd

Figure 1
Current Conditions Monitoring Locations
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project

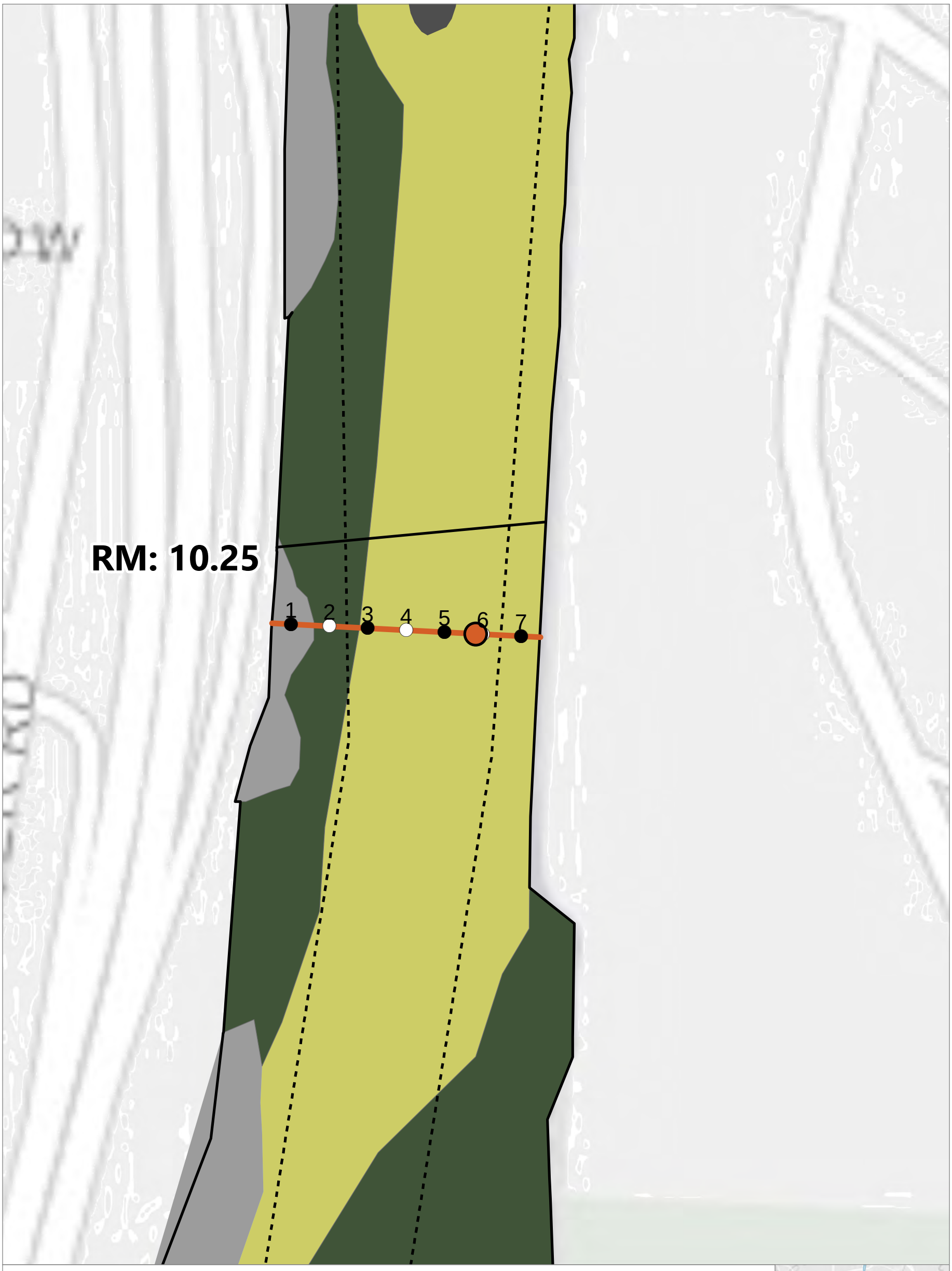
Publish Date: 2019/06/24, 1:46 PM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_ByRMExtent.mxd

Figure 2a
Cross-Channel Monitoring Transects: RM 13.5
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project



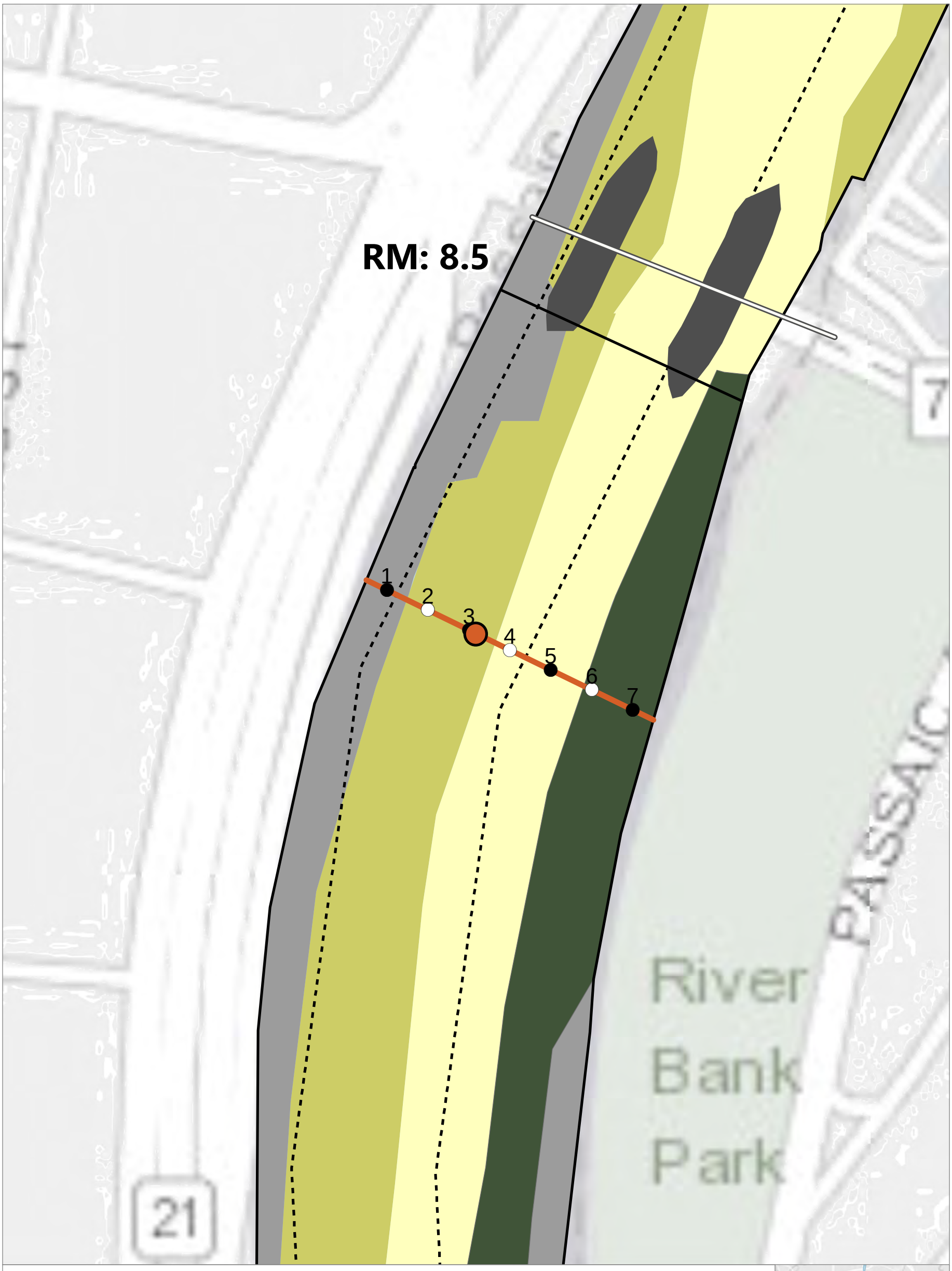
Publish Date: 2019/06/24, 1:46 PM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_ByRMExtent.mxd

Figure 2b
Cross-Channel Monitoring Transects: RM 12
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project



Publish Date: 2019/06/24, 1:47 PM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_ByRMExtent.mxd

Figure 2c
Cross-Channel Monitoring Transects: RM 10.25
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project



Publish Date: 2019/06/24, 1:47 PM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_ByRMExtent.mxd

Figure 2d
Cross-Channel Monitoring Transects: RM 8.5
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project

Publish Date: 2019/05/29, 6:12 PM | User: dbaker
Filepath: \\Boston1\jobs\Passaic_CPG\DOCUMENTS\2019\Current_Conditions_Physical_WC_QAPP\source\RM7.8_to_DD_Map_monitoring_locations_RiverCenter.mxd

Figure 3
Example Along River Transect
Field Sampling Plan Addendum
Current Conditions Monitoring Program - Physical Water Column Monitoring
Lower Passaic River Restoration Project

Appendix B
Data Quality Objectives

Appendix B
Data Quality Objectives

Data Quality Objective 1 (DQO 1): Provide data to calibrate hydrodynamic and sediment transport models	
DQO Step	**Description**
Step 1 **State the Problem**	The accumulation of new sediment, as well as the stability of existing sediment in the upper 9 miles of the Lower Passaic River (LPR) is driven by the dynamics of the system. These dynamics include the location of the tidal salt front, freshwater flow rates, and the effects of storm events on flow velocity, sediment deposition, resuspension, and redistribution. Understanding these dynamics is critical to predicting the long-term fate and transport of contaminants associated with sediment and to evaluating the effectiveness of remedial alternatives. Previous investigations have evaluated dynamics and solids transport in the LPR; however, additional data are needed: 1) to establish current conditions; and 2) to support model calibration associated with the Adaptive Management approach including the proposed interim remedial action and post-construction recovery period. The proposed investigation is designed to target the upper 9 miles of the LPR, refining hydrodynamic and suspended solids conditions within this area, including at the upstream and downstream boundaries. The proposed study will be conducted over a range of tidal and freshwater flow conditions to better define system variability.
Step 2 **Identify the Goals of the Study**	The goals of the study associated with Data Quality Objective (DQO) 1 are to provide data: 1) to establish current condtions; and 2) to support calibration and refinement of the hydrodynamic and sediment transport models.
Step 3 **Identify the Information Inputs**	**New Data Needed**: Specific study questions and the information inputs needed to address them are as follows: • How variable are the physical characteristics of the upper 9 miles of the LPR? – Quantify along-river and cross-channel variability in velocity, turbidity, suspended solids, salinity, and temperature • Where is the maximum turbidity in the estuarine portion of the LPR and what are its characteristics? – Quantify along-river gradients in suspended solids concentrations and vertical stratification to identify and characterize the estuarine turbidity maximum • How does variation in freshwater flow affect suspended solids concentrations in the upper 9 miles of the LPR? – Quantify relationship between flow dynamics at Dundee Dam and input of suspended solids to the LPR **Existing Data** (see Quality Assurance Project Plan [QAPP] Worksheet No.13 for more detail) • Remedial Investigation Water Column Monitoring Program/Physical Data Collection (2009–2010)

Data Quality Objective 1 (DQO 1): Provide data to calibrate hydrodynamic and sediment transport models	
DQO Step	**Description**
Step 4 **Define the Boundaries of the Study**	**Geographic Area.** The geographic area includes the upper 9 miles of the LPR. **Time Frame.** Monitoring is proposed for approximately 6 months during the second half of 2019.
Step 5 **Develop the Analytical Approaches**	**Field Approach.** The approach for the collection of data involves a combination of continuous and instantaneous measurements of physical parameters (temperature, conductivity, current velocity, and turbidity). The continuous measurements will be obtained by deploying instrumentation at several fixed locations in the LPR. Instrumentation types include: • Acoustic Doppler Current Profiler (ADCP) – provides water velocity measurements throughout the water column as well as acoustic backscatter. • Water Quality Sonde – provides point measurement of water conductivity (salinity), temperature, turbidity, and depth of deployment. Instanteous measurements will be performed during periodic boat-based surveys. These surveys will be performed in a manner designed to quantify both cross-channel and along-channel variability in temperature, conductivity, velocity, and turbidity. These data will be supplemented by the collection and analysis of water samples for suspended sediment concentration (SSC), dissolved organic carbon (DOC), and particulate organic carbon (POC). The boat-based surveys will be coordinated with periodic servicing of the instruments at the fixed deployment locations. Servicing will include cleaning, calibration, and downloading of data collected since the last service interval.
Step 6 **Specify Performance or Acceptance Criteria**	Data will be obtained by instrumentation that will be calibrated and checked according to the manufacturer's specifications to confirm accuracy.
Step 7 **Develop The Detailed Plan For Obtaining Data**	Details of the plan for obtaining, analyzing, and reporting the data for this investigation can be found in the main body of the QAPP and in the Field Sampling Plan Addendum included as Appendix A. In summary, the proposed plan includes the following elements: • Continuous fixed point monitoring of velocity, conductivity, turbidity, and temperature in vicinity of river mile (RM) 8.4, RM 10.2, RM 12.0, and RM 13.5 for approximately 6 months – Bottom-mounted ADCP deployed at each station – Water quality measured using sondes at two depths • Deployed from small buoys near ADCPs • Set at approximately 3 feet below surface and approximately 2 feet off bottom – ADCP and water quality data will be logged and downloaded monthly • More frequently early on to confirm data quality over a

Data Quality Objective 1 (DQO 1): Provide data to calibrate hydrodynamic and sediment transport models	
DQO Step	**Description**
	month • Continuous fixed point monitoring of conductivity, turbidity, and temperature in vicinity of RM 15.8 for approximately 6 months – Water quality measured using a sonde • Deployed from small buoys • Set at approximately mid-depth – Water quality data will be logged and downloaded monthly • More frequently early on to confirm data quality over a month • Cross-channel vertical profiles of velocity, conductivity, turbidity, temperature, SSC and DOC/POC in vicinity of RM 8.4, RM 10.2, RM 12.0, and RM 13.5) near fixed deployments – Vessel-mounted ADCP to collect data – Data to be collected during four events in Year 1 (range of flow conditions) – Data collected at mid-flood and mid-ebb during each event – Data collected during same approximate tidal conditions but may not be collected at all four transects during the same tidal cycle due to limited time window due to travel time and low bridge clearances at high tide – Manual water quality profiles and water samples collected along each transect • Vertical profiles of conductivity, turbidity, and temperature collected at approximately 1-foot depth intervals at approximately seven points along transect • Water samples for SSC and DOC/POC collected at three points (center channel and near each shore), two depths at each point (approximately 3 feet below surface and 2 feet above bottom) • Along-channel vertical profiles of velocity, salinity, turbidity, temperature, SSC, and DOC/POC – Vessel-mounted ADCP to provide velocity and backscatter along center channel transect • Approximately 1 mile upstream to approximately 2 miles downstream of salt front – Salt front identified by manual water quality profiles – Approximately 1-foot depth intervals in center channel every 0.25 mile in several-mile region where salt front expected – Water samples for SSC and DOC/POC collected at two depths at each point (approximately 3 feet below surface and 2 feet above bottom) – Data collected under a range of flows during same mobilization as cross-channel transects – Four events in Year 1 – Data collected at mid-flood and mid-ebb during each event

Appendix C
Field Standard Operating Procedures

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

CTD/Turbidity Data Collection and Water Sampling

Procedure Number: LPR-FI-02

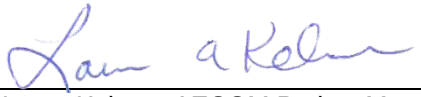
Revision No.: 5

Revision Date: June 2019

Prepared by

Dion Lewis
Don Boye
Don Kretchmer

Kristen Durocher, AECOM Task Manager — Date: June 24, 2019



Laura Kelmar, AECOM Project Manager — Date: June 24, 2019

Debra L. Simmons, AECOM Project QA Manager — Date: June 24, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
CTD/Turbidity Data Collection and Water Sampling

Contents

Standard Operating Procedure
Lower Passaic River Restoration Project
CTD/Turbidity Data Collection and Water Sampling

1.0 Scope and applicability

1.1 This project Standard Operating Procedure (SOP) defines the procedures for the collection of water samples and physical water property data associated with the Lower Passaic River Restoration Project (LPRRP) using conductivity, temperature and depth (CTD)/turbidity sensors from a boat, other sampling platform, or shore based station during sample/data collection activities. This SOP also provides for the moored deployment of CTD/turbidity instrument sensors. Specialized handling of trace metal or trace organic samples is beyond the scope of this SOP.

1.2 The collection of water samples is limited to suspended solids concentrations (SSC), particulate organic carbon (POC), and dissolved organic carbon (DOC).

1.3 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; ENSR 2008; AECOM 2011; AECOM 2019). The major health and safety considerations for the work associated with water and CTD/turbidity data collections are the marine safety aspects of the program.

2.2 Daily safety briefings are to be conducted at the start of each working day before any work commences. These daily briefings are to be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Ensuring that the in situ sensors are maintained properly will help reduce interference risks related to these data collection efforts. Bio-fouling is generally the greatest concern related to moored systems, particularly when sensing turbidity. Data bias can arise related to suspended solids if the entire sample is not used during sample processing (USGS 2000) and special handling is required to

minimize sea salt bias when processing seawater. However, these handling concerns should be addressed in laboratory SOPs.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Water pump (peristatlic pump)
- CFLEX™ or equivalent polymer tubing (typical configuration requires 3/8 inch ID), a 50-foot length will be required for the deepest portion of the Lower Passaic River (LPR)
- Water sample containers per Quality Assurance Project Plan (QAPP)
- CTD/turbidity instrument package (OBS3A or equivalent) with display and 100' cable
- Connective (serial) cabling
- Weight bearing line/cable and anchor weight
- Acrylic Horizontal Alpha Bottle (or equivalent) with messenger and 50 feet of line
- Field laptop computer, equipped with Intelligent Data Entry Forms (IDEF)® from EarthSoft , or equivalent
- Sample collection forms
- Field logbook
- Chemical-free wipes
- Tap water supply
- Manufacturer's operating manual
- Replacement batteries
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment (SOP LPR-G-02)
- Safety gear (work vests, HASP specified personal protective equipment [PPE])
- Y-fitting for CFLEX™ or equivalent tubing to facilitate split sampling

Moored operations:

- Buoy, instrument caging, and connector deployment cable/chain
- Sufficient battery and memory capacity for the deployment period
- If station requirements are limited to turbidity, or pressure, then individual turbidity or pressure sensing systems (e.g., HOBO™ or equivalent) will be needed

Water sample processing for POC/DOC

- Glass fiber filters (GF/Fs), generally (pre-combusted) 25mm for POC
- Filter supports/holders
- Vacuum pump
- Forceps
- Aluminum foil
- Pre-cleaned Wheaton-33™ low extractable borosilicate glass vials (40-mL) or equivalent

5.0 Procedures

5.1 CTD/Turbidity Instrument Set-Up

If collecting profiles from a boat:

Fasten the pump tubing to the CTD/turbidity sensor package avoiding any obstruction to the turbidity sensor. Attach the CTD instrument and the tubing inlet to the weighted deployment line at approximately 3 feet above the anchor weight. The tubing and the sensor cable should then be fastened (with plastic tape) to the weighted deployment line at regular intervals over the entire length. Sensors should be inspected for cleanliness and to ensure they are free of corrosion.Install the instrument batteries and operating software according to instrument-specific operating manual. A new configuration file should be named for each (multi-day) survey or mooring event to aid in data tracking. Refer to the QAPP for the survey/mooring naming conventions.

If taking spot measurements from a bridge or shore point:

Ensure that instrument has screened protective housing over sensors avoiding any damage to the sensors. Attach the CTD to the weighted deployment line approximately 1 foot above an anchor weight if current velocity is too high to submerge the instrument without weight. The sensor cable should then be fastened (with plastic tape) to the weighted deployment line at regular intervals over the entire length. Sensors should be inspected for cleanliness and to ensure they are free of corrosion. Note Step 5.4 is not required for bridge or shore deployment.

5.2 System Testing

Test the turbidity, temperature and conductivity sensors as outlined in the operating manual.

5.3 Calibration

The CTD and turbidity sensors are factory calibrated. CTD sensors should be returned to the manufacturer if they are not operating within the specified accuracy/precision limits. Initial checking can be accomplished in a calibration cup full of water with known conductivity/salinity, temperature, and turbidity. Conductivity and turbidity/optical backscatter (OBS) sensor calibration should be calibrated against fixed calibration solutions once/at the start of each (multi-day) survey/mooring deployment according to instrument-specific operating manual. Barometric correction procedures are to be completed daily on survey operations and during each deployed instrument servicing period.

5.4 Water Pump

Connect the pump to a 12-volt battery or directly to the vessel's 12-volt electrical system using appropriate electrical connections. The tubing should be new and dedicated to the project. Between-station (or between sampling depth) rinsing is not generally required for major component (POC/DOC, SSC) sampling/analysis, however, the internal volume of water carried through the tubing in the system should be purged with a least one volume of water to ensure that a representative sample is collected. Attachment 1 provides additional water sample collection handling requirements for discrete water sample handling.

5.5 Deployment/Field Data Collection

5.5.1 Navigate to the station of interest using the navigational procedures outlined in SOP LPR-G-02 – Navigational Positioning.

5.5.2 If collecting profiles from a boat:

Deploy the instrument group and attached sampling tube and begin CTD/turbidity data profiling as outlined in the QAPP/FSP Addendum. If a vessel is equipped with a fathometer and real time CTD readout, vertical positioning can be determined electronically to avoid potential disturbance of bottom sediments.

At the station of interest, the instruments (and sampling tubing) should be lowered through the water column until it is 3 feet off the bottom as determined by the shipboard fathometer. If the operator "feels" the bottom with the weight, the instrument should be raised and sample collection delayed to allow any resuspended sediment to dissipate. Throughout the procedure, the readout of turbidity should be monitored for any spikes in signal as the sensors approach the boom. Should any signal spikes in turbidity beseen, notes will be made in the field records that describe time and duration of spike, as well as measures taken to ensure the spike does not impact data quality (i.e., stop pumping, purge tubing, etc.).

Based on the water depth provided by the CTD, field technicians will determine the water column structure and define the desired depths for data and sample collection. Water collections are then generally made upon instrument recovery (near-bottom water first, then intermediate depths as needed, and surface water last).

Once fixed at a given sampling point, the sampling tubing should be flushed with at least one system volume prior to the collection of any water samples. Given the small (typically 3/8-inch ID) tube diameter, tube flushing will be complete for a 25-50 foot tube well within 10 seconds, with a flow rate of 10 liter (L)/min or better. After flushing the tubing, the requisite volume of water can be collected for the parameter set of interest.

Moored CTD/turbidity instruments should be serviced at a frequency outlined in the QAPP/FSP and will often correspond with other program data collection activities.

If taking spot measurements from a bridge or shore point:

Lower the instrument group into the stream channel at least 3 inches below the water surface and begin CTD/turbidity data collection. The instrument sensors should be completely

submerged and readings stable. Record temperature, salinity (as conductivity) and turbidity on field sheets, or electronically with field computer and associated software.

5.5.3 If collecting SSC or POC/DOC water samples from a boat:

SSC and POC/DOC water samples should be collected directly in pre-labeled plastic bottles and stored on ice in the dark (refer to the QAPP for containerization and storage specifications).

5.5.4 If collecting SSC and POC/DOC water samples from a bridge or shore point:

If collecting a sample from a bridge: 1) Set the trigger mechanism on the horizontal Alpha Bottle to hold the bottle open. 2) Lower the horizontal Alpha bottle until it is submerged below the surface, taking care to keep the bottle off the bottom and not stir up sediments. Should the bottle hit the bottom, retrieve the bottle and redeploy out of any turbidity plume generated by the bottle hitting the bottom or wait for the turbidity to clear (a minimum of 5 minutes). Let water flow over and through the open bottle. Submerge and empty the bottle at the station without triggering the closing mechanism three times prior to sampling. 3) Return the bottle into the flow and send the messenger down the line to trigger the bottle to close. 4) SSC and POC/DOC water samples should be collected directly from the Alpha Bottle outlet into pre-labeled plastic bottles and stored on ice in the dark (refer to the QAPP for containerization and storage specifications).

If collecting samples from a shore point: 1) Use a dipper to collect sample from the main portion of the river flow out of eddies or slow moving water near shore. Rinse dipper three times with river water at the point of collection then collect sample. 2) SSC and POC/DOC water samples should be collected directly from the dipper into pre-labeled plastic bottles and stored on ice in the dark (refer to the QAPP for containerization and storage specifications). Alternatively, peristaltic pumps and tubing may be used as described for sampling from a vessel.

5.5.5 POC/DOC water samples should be processed within hours if possible. This can be performed either on deck, at the dock, at the field facility, or at the laboratory (see Attachment 1).

5.5.6 Sample collection information will be recorded at the time of collection using either IDEFs, standardized forms, the field logbook, or a combination. This information will include, but not be limited to, the station ID, sample ID, time and date of sample collection, sample collection depth, the sampler's name, vessel, description of any sample processing, and any pertinent observations. An example of the IDEF is provided as Attachment 2.

5.5.7 All discrete water samples should be collected and stored/transferred to laboratories according to the procedures described in SOPs LPR-G-05 – Sample Custody, and LPR-G-06 – Packaging and Shipping.

6.0 Quality assurance / quality control

6.1 It is the responsibility of the Field Task Manager (FTM) or designee to check the instrument calibration/test information, to spot check adherence to the procedural requirements of this SOP, and to review the associated documentation for accuracy and completeness.

6.2 During boat-based transects or shore based surveys, newly acquired data should be reviewed for reasonableness by the FTM or designee before moving off station.

6.3 Quality control (QC) samples will be collected in the field (i.e., duplicates) to assess field handling precision and in the laboratory (i.e. laboratory control sample, lab blanks) to assess measurement accuracy and precision at a frequency outlined in the QAPP.

6.4 Equipment rinsate blanks will be collected at the frequency specified in the QAPP, and from every set of sampling gear: tubing, filter (if applicable), or bottle sampler. Rinsate blanks of the bottle sampler will be collected by filling the decontaminated bottle sampler with laboratory-supplied de-ionized water, then filling the appropriate sample containers. Blanks will be collected for a bottle sampler will be done after the sampling gear is decontaminated. Tubing rinsate blanks will be collected by pumping laboratory-supplied de-ionized water through a new length of tubing (and filter, if applicable, for dissolved samples). Blanks for tubing and filters only (if applicable) will be collected after purging the tubing with de-ionized water. Then new de-ionized water will be to fill the appropriate sample containers. Laboratory-specific de-ionized water will be used to prepare the rinsate blanks for each laboratory performing rinsate blank analysis. and blanks collected by filling bottles per the QAPP.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP LPR-G-01 – Field Records and in the LPR Data Management Plan (DMP) [ENSR 2007a, or current version]. These documents cover all aspects of collection including chronology of events, station locations, time/date, sampler name, and data collected.

Instrument check/test records including turbidity sensor calibration records will be maintained in the field logbook. If filtration is performed in the field, POC sample filtration volumes will be recorded on POC sample processing sheets (Attachment 1). Sample collection information will be recorded on IDEF (or equivalent) or manually, on standardized forms. The following naming convention will be followed for the IDEF EDD files: “idef_{yyyymmdd}_{crew or boat identifier}.xls[x].” For example, “idef_20190716_boat2.xlsx” for data recorded on July 16,2019 by boat #2.

7.2 During boat-based surveys in situ CTD/turbidity data will be captured on a laptop PC using a data acquisition system that integrates instrument software and Hypack navigation software. Furthermore, acquired data should be downloaded on a daily basis to the AECOM Data Management Task Manager for permanent storage as specified in the DMP (ENSR 2007a, or current version). Data collected from moored systems will be downloaded at regular intervals (during servicing surveys) and again transferred to the AECOM Data Management Task Manager for final upload/storage.

Data files recorded by the instrument may be tracked by date/time stamp and associated navigational data. Furthermore, sensor data files should be logged to track transect, start and end time, and the

associated file sequence (Attachment 3). Note: as indicated in Section 5, each boat-based survey or mooring should provide a new configuration file name to aid data file tracking. The field laptop time/clock should be checked at the start of the survey against an accurate source (e.g., cell phone or DGPS time stamp) to ensure accurate time synchronization for these tidally sensitive data.

During wet-weather surveys, data will be recorded on field sheets (Attachment 4) and delivered, after the survey, to the AECOM Data Management Task Manager for entry into the database and permanent storage as specified in the DMP (ENSR 2007a, or current version).

7.3 Field data will be maintained and distributed to the appropriate personnel as described in the LPR DMP (ENSR 2007a, or current revision).

7.4 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence, summarized on a non-conformance report, and communicated to the AECOM Task Manager and the Project QA Manager no later than the end of the day.

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, and FSP). Water quality data collection is a relatively simple procedure requiring minimal training. However, initial instrument calibration and sample/data collections should be supervised by the FTM or designee.

9.0 References

AECOM, 2019 AECOM, 2019. Health and Safety Plan. Lower Passiac River Restoration Project Current Conditions Study. [in prep]

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

ENSR 2008. Health and Safety Plan Addendum. USEPA Lower Passaic River Restoration Project Remedial Investigation/Feasibility Study. Spring 2008 Field Programs

ENSR 2007a. Lower Passaic River Data Management Plan. November 5, 2007, including all revisions.

ENSR 2007b. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

USGS 2000. Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data. Water-Resources Investigations Report 00-4191, Reston, VA. 20 pp.

10.0 Revision history

Revision	Date	Changes
0	June 2009	NA
2	December 2009	Modified to include bridge/shore-based monitoring/sampling
3	February 2010	Added Y-fitting to equipment list to facilitate split sampling and additional information on the sample collection form
4	May 2019	Minor editorial changes; updates to reflect sampling for Current Conditions.
5	June 2019	Added equipment blank collection.

Attachment 1

Suspended Solids Sample Handling

Samples collected for SSC can be either filtered in the field or simply containerized and transferred to a fixed laboratory for filtration and analysis. To simplify logistics on the LPRRP program, SSC samples will be containerized as specified in the QAPP and transferred to a fixed laboratory.

Further, if total volatile solids are to be determined, no added sample is required as this measurement can be obtained from the same SSC filter after initial gravimetric analysis.

POC/DOC Sample Filtration

POC samples should be collected in triplicate for analysis. Whenever possible, POC/DOC water samples should be filtered immediately following sample collection in the following manner[1,2]:

i. Place a pre-combusted filter on fritted filter base of the filtration apparatus and attach the filtration tower (store filters covered if not immediately used).
ii. Thoroughly shake the sample container to suspend the particulate matter.
iii. Measure and record the required sample volume using a graduated cylinder. Pour the measured sample into the filtration tower, no more than 50-mL at a time.
iv. Filter the sample using a vacuum pulling no more than 10 inches of mercury.
v. Transfer an aliquot of the filtrate to a small (~ 40-mL) borosilicate glass vial[3] and freeze without delay for DOC determination/storage.
vi. If less than the measured volume of sample can be practically filtered due to clogging, measure and record the actual volume filtered.

Important: Do not rinse the filter following filtration

vii. Air dry the filter after the sample has passed through by continuing the vacuum for 30 s.
viii. Using Teflon™-coated flat-tipped forceps, fold the filters in half while still on the fritted glass base of the filter apparatus.
ix. Transfer the filter pads to aluminum “packets”, seal completely, and either freeze or dry at 103-105°C (24 hr) and place in a desiccator for long-term storage.

[1]If storage of the water sample is necessary, place the sample into a clean amber glass or plastic bottle and store at 4°C until filtration is done.

[2]Before the program commences, obtain pre-combusted GF/F filters for the purpose of DOC filtration/POC collection or prepare a batch by pre-combusting GF/F glass fiber filters at 500 °C for 1.5 hr.

[3]Before the program commences, obtain pre-cleaned glass vials for DOC sample storage or prepare a batch by rinsing with 10% hydrochloric acid (reagent grade) and then deionized water (DIW). Approximately 30-mL are needed for the analysis; use Wheaton-33™ low (40-mL) extractable borosilicate glass vials or equivalent.

Particulate samples should have some coloration following filtration to ensure sample detectability. Under most circumstances, filtering 500 mL will be sufficient under low flow/low particulate conditions in the LPR and 100 mL will be sufficient under high flow conditions when using a 25-mm diameter GF/F filter pad. Corresponding larger volumes will be required when using a 47-mm filter; smaller volumes when using a 13-mm filter. Refer to USEPA Method 440 for additional details.

Reference:

USEPA Method 440. Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis. Rev 1.4, 1997. National Exposure Research Laboratory, Office of Research and Development, USEPA Cincinnati, OH. 10 pp.

POC Sample Processing Form

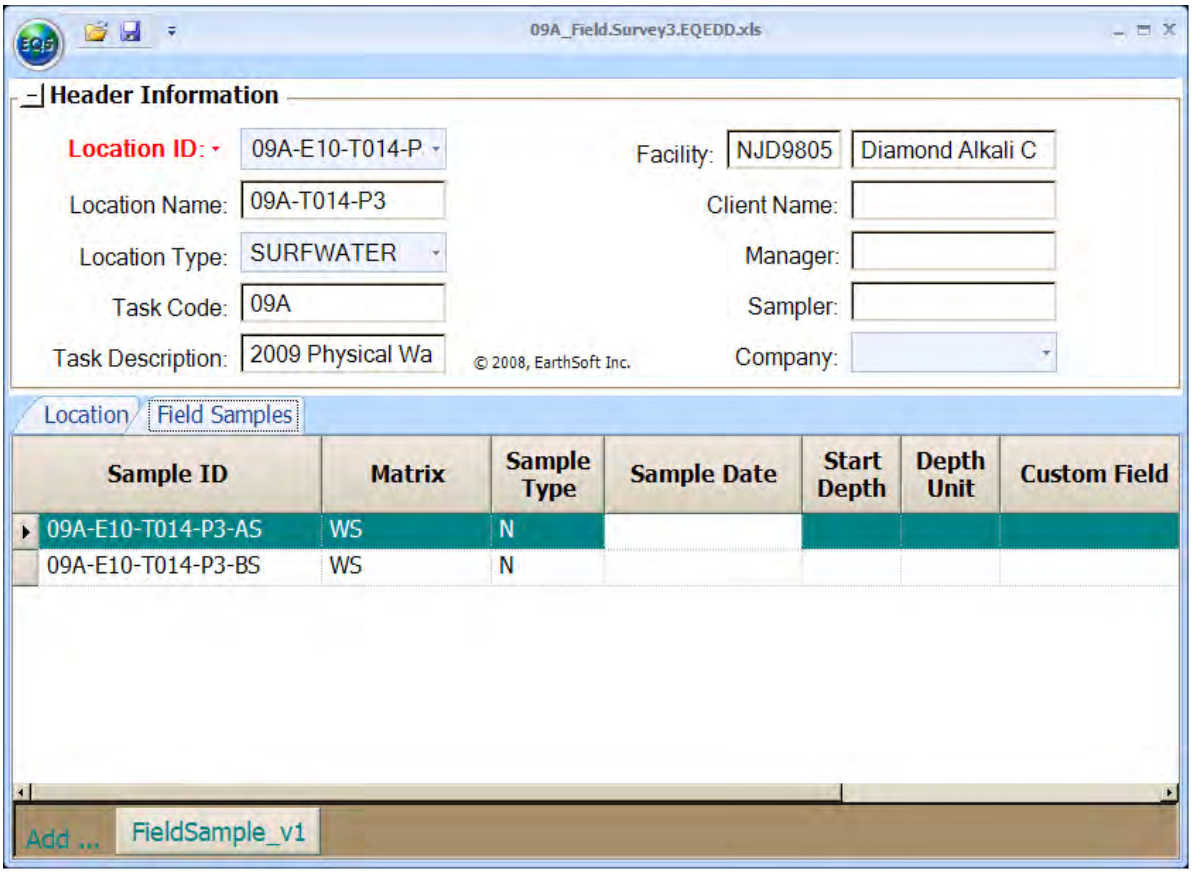
Program: _____

Recorded By: _____ ***Date***_____

Sample ID	Date/Time (filtered)	Volume (filtered)	Filtered By	Storage/Time*

*Stored in freezer/on dry ice without delay

Attachment 2 Example of IDEF



Attachment 3. In Situ Data Log

Program: _____ ***Survey Name***_____

Recorded By: _____ ***Survey Date***_____

Transect Name/Location	**Time* EST__EDT__UTC__**		**File Name(s)**	**Comment**
	Start	**End**		

*Record as 24-hour; Check Eastern Standard Time, Eastern Daylight Time, or Coordinated Universal Time (EST/EDT/UTC).

Standard Operating Procedure
Lower Passaic River Restoration Project
CTD/Turbidity Data Collection and Water Sampling

Attachment 4. Wet Weather Field Sheet

Program: _____ ***Station:*** _____ ***Survey Name:*** _____

Recorded By: _____ ***Survey Date:*** _____

Sampling Round	Time* EST__EDT__UTC__		Rain Gage (in)	Staff Gage (ft)	Temperature (C)	Specific Conductance (µS/cm)	Turbidity (NTU)	SSC Sample Collected (Y or N)	Comment
	Start	End							

*Record as 24-hour; Check Eastern Standard Time, Eastern Daylight Time, or Coordinated Universal Time (EST/EDT/UTC).

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

ADCP/ADC Data Collection

Procedure Number: LPR-FI-03

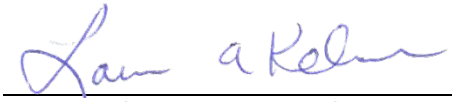
Revision No.: 1

Revision Date: May 2019

Prepared by

Dion Lewis
Ken Heim

Kristen Durocher, AECOM Task Manager — Date: May 14, 2019



Laura Kelmar, AECOM Project Manager — Date: May 14, 2019

Debra L. Simmons, AECOM Project QA Manager — Date: May 14, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and applicability

1.1 The purpose of this document is to define the Standard Operating Procedure (SOP) for the collection of physical water property data associated with the Lower Passaic River Restoration Project (LPRRP) using Acoustic Doppler Current Profile (ADCP) and Acoustic Doppler Current (ADC) or electromagnetic current sensing from a boat or from a deployed mooring.

1.2 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project QA Manager and the AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; ENSR 2008; AECOM, 2011; AECOM, 2019). The major health and safety considerations for the work associated with current meter data collections are the marine safety aspects of the program.

2.2 Daily safety briefings are to be conducted at the start of each working day before any work commences. These daily briefings are to be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Ensuring that the in situ sensors are maintained properly and clean will ensure will reduce interference risks. Floating debris that may foul the instrumentation and regular checking is needed to ensure that sensors are not blocked. In some cases precautions may be undertaken (e.g., deflectors installed) but care should be exercised so that the natural current/particle field are not altered.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Broadband ADCP (e.g., TRDI™ or equivalent)
- ADC or electromagnetic current meter (e.g., InterOcean Systems, Inc. S4™ or equivalent)
- Manufacturers' operating manuals
- Spare parts
- CTD or stand alone conductivity sensor (Operation and Maintenance per LPR-FI-02)

Boat-based operations:

- Boat-based mounting system (ADCP only)
- Field computer
- Chemical-free wipes
- Deionized water (DIW)
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment (SOP LPR-G-02)
- Safety gear (work vests, HASP specified personal protective equipment [PPE])

Moored operations:

- Buoy, instrument caging, and connector deployment cable/chain
- Sufficient battery and memory capacity for the deployment period

5.0 Procedures

5.1 Instrument Handling

5.1.1 Current profile/ADCP instruments: Refer to Section 1.5.1 of the instrument manual (Teledyne RDI 2007) for proper handling of the ADCP instrument (e.g., never set the transducer on a hard or rough surface, I/O decoupling precautions, etc.). Refer to Section 1.5.2 of the manual (Teledyne RDI 2007) for assembly guidelines.

5.1.2 Point current instruments: Refer to Section 2 of the instrument manual for proper handling and set-up of the S4™ instrument (InterOcean Systems, Inc. 1994).

5.2 Maintenance

Maintenance is required before deployment and in preparation of storage or shipment. Refer to Section 3 of the ADCP instrument manual (Teledyne RDI 2007) for a full discussion of instrument

inspection and maintenance procedures and spare parts list or Section 5 of the S4™ instrument manual (S4 1994) for related maintenance.

5.3 Mounting

Boat-based ADCP profiling will be accomplished in the LPR using an over-the-side mounting arrangement. Refer to Section 2.3 of the manual for mounting instructions/considerations. Section 2.4 (Teledyne RDI 2007) addresses in-hull mounting options and mooring considerations for the ADCP. Mooring of the S4™ is addressed in Section 3 of the S4™ manual (InterOcean Systems, Inc.1994).

5.4 Computer Set-Up.

Refer to the ADCP manual Section 2.5 (Teledyne RDI 2007) for minimum computer/software requirements or, for S4™ requirements, Section 1 of the S4™ manual (InterOcean Systems, Inc.1994). A new configuration file should be named for each (multi-day) survey or mooring event (using the survey or mooring name) to aid in data tracking. Refer to the QAPP for the survey/mooring naming conventions.

5.5 System Testing

5.5.1 ADCP: Use software diagnostic programs to test the system as described in Section 4 of the corresponding ADCP manual (Teledyne RDI 2007). ADCP instrumentation should be tested initially upon arrival from factory/leasing agency, before and after each deployment or every six months, or when problems are suspected. Dock side and related tests are addressed in Sections 4.4 and 4.5 of the manual (Teledyne RDI 2007).

5.5.2 S4™ test procedures are described in Section 9 of the S4™ manual (InterOcean Systems, Inc.1994).

5.6 Troubleshooting

5.6.1 ADCP: Potential malfunctions generally relate either to a communication failure, a built-in test failure, a beam failure or a sensor failure (ADCP Manual Section 5.2 (Teledyne RDI 2007)). Refer to Section 5 (Teledyne RDI 2007) of the instrument manual for a discussion on instrument troubleshooting.

5.6.2 S4™: Refer to Section 9 of the S4™ instrument manual (InterOcean Systems, Inc.1994) for a discussion on instrument troubleshooting.

5.7 Deployment/Field Data Collection

5.7.1 Navigate to the station using the navigational procedures outlined in SOP LPR-G-02 – Navigational Positioning, and obtain a salinity/conductivity measurement at the current instrument deployment location as needed for velocity calculations. Record the water salinity on the data log (Attachment 1).

5.7.2 Deploy the ADCP and/or S4™ and commence data collection as outlined in the FSP Addendum. For boat-based transect data collections, the data collection software will prompt the user to enter the start point as either left or right (river) bank. Note: directional left or right commands assume that the investigator faces the river mouth. Failure to input this information correctly/consistently may result in confusing results during data synthesis. For boat-based transects, positional data should be included in the ADCP data file. Sensor data

collection efforts should be logged on the in situ data log established for that purpose (Attachment 1). Initial data checks should be performed as outlined in Attachment 2.

5.7.3 For boat-based (ADCP) surveys, average boat speed should not exceed the average water speed unless impractical/unsafe to do so and pitch/roll should not be excessive (USGS, 2005). Duplicate transects may be performed to assess variability, but is dependent on timing (i.e., need to capture tide phase). Retrieve the instrument when the necessary data have been collected, inspect the instrument and secure the instrument/mount between transects. Copy/backup data files between transects.

Moored instruments should be serviced at a frequency outlined in the FSP, whichmay correspond with other program data collection activities.

6.0 Quality assurance / quality control

6.1 It is the responsibility of the Field Task Manager (FTM) or designee to oversee instrument testing, deployment, retrieval and maintenance operations, and to review the documentation for accuracy and completeness.

6.2 Configuration files should be checked for errors, appropriateness for the hydrologic conditions, and for consistency with field notes as soon after the data are collected/downloaded as feasible.

6.3 During boat-based transects, newly acquired data should be reviewed for reasonableness by the FTM or designee without delay.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP LPR-G-01 – Field Records, and in the Data Management Plan (DMP) [ENSR 2007a]. These documents cover all aspects of collection including chronology of events, station locations, time/date, data collector/sampler name, and data collected.

7.2 During boat-based surveys ADCP data will be captured on a laptop PC using instrument/vendor software with backup after each transect. Further, acquired data should be downloaded on a daily basis to the AECOM Data Management Task Manager for permanent storage as specified in the DMP (ENSR 2007a). Current meter data collected from moored systems will be downloaded at regular intervals (servicing surveys) and again transferred to the AECOM Data Management Task Manager for final upload/storage.

Data files will be generated by the instrument/vendor software and may be tracked by date/time stamp. Data files should also be logged to track transect, start and end time, and the associated file sequence (Attachment 1). Note: as indicated in Section 5, each boat-based survey or mooring should provide a new configuration file name to aid data file tracking. The field laptop time/clock should be checked at the start of the survey against an accurate source (e.g. cell phone) to ensure accurate time synchronization for these tidally sensitive data.

7.3 Field data will be maintained and distributed to the appropriate personnel as described in the LPR DMP (ENSR 2007a).

7.4 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence, summarized on a nonconformance report, and communicated to the AECOM Task Manager and the Project QA Manager at the end of the day/without delay.

8.0 Personnel qualifications and training

The individuals executing these procedures must be trained in the proper testing, use and maintenance of ADCP and ADC or electromagnetic (S4™) instrumentation. Individuals performing these procedures must have worked alongside/under the supervision of experienced staff before testing, deploying, or maintaining these instruments.

9.0 References

AECOM, 2019. Health and Safety Plan. Lower Passiac River Restoration Project Current Conditions Study. [in prep]

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

ENSR 2008. Health and Safety Plan Addendum. USEPA Lower Passaic River Restoration Project Remedial Investigation/Feasibility Study. Spring 2008 Field Programs.

ENSR 2007a. Lower Passaic River Data Management Plan. November 5, 2007, or current revision.

ENSR 2007b. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

InterOcean Systems, Inc. 1994. S4 Current Meter Users Manual. Fourth Edition, August 1994.

Teledyne RDI 2007. WorkHorse Monitor, Sentinel, Mariner Acoustic Doppler Current Profiler Technical Manual. November 2007.

USGS 2005. QA Plan for Discharge Measurements using Acoustic Doppler Current Profilers. Science Investigations Report 2005-5183.

10.0 Revision history

Revision	Date	Changes
0	June 2009	NA
1	May 2019	Minor editorial changes; updates to reflect Current Conditions program.

Attachment 1. In Situ Data Log

Program: _____ ***Survey Name***_____

Recorded By: _____ ***Survey Date***_____

Transect Name/Location	**Time* EST__EDT__ UTC__**		**File Name(s)**	**Salinity, Direction (L/R), Max Depth, Current Velocity**
	Start	**End**		

*Record as 24-hour; Check Eastern Standard Time, Eastern Daylight Time, or Coordinated Universal Time (EST/EDT/UTC).

Attachment 2. ADCP Initial Data Checks[1]

The following eight data checks can be made by viewing the acquisition software and will help ensure that the data are complete/of reasonable quality:

- Check the ensembles lost due to communication problems. This number is usually very small.
- Check the ensembles that did not meet quality guidelines and did not return a discharge. If this number is large by comparison to the total then a setup change may be required.
- Check the percentage of bad bins that have returned a discharge measurement over number of bins.
- Verify the correct ADCP Date and Time.
- Check to ensure that ancillary data are reasonable.
- Ensure that the boat/float speed is lower than the water speed. Observe the maximum water speed during the transect. This will be used to determine the best configuration.
- Observe the maximum water depth during the transect. This will also be used to determine the best configuration.
- Verify that the "Distance Made Good" matches actual distance. If the "Distance Made Good" is much greater than actual then a compass problem or a river with a moving bed may exist. Check to determine if the boat path is going upstream on some parts of the transect to detect moving bed.

[1]Initial data checks should be performed shipboard soon after data are acquired or uploaded; from WinRiver™ Software Help Files (WinRiver II, Version 2.20, Teledyne RD Instruments).

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Field Records

Procedure Number: LPR-G-01

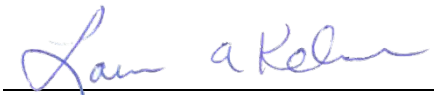
Revision No.: 8

Revision Date: June 2019

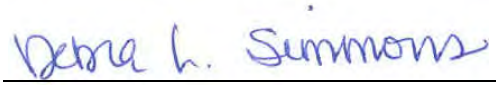
Prepared by

Kristen Durocher
Dion Lewis

Kristen Durocher, AECOM Task Manager — Date: June 24, 2019



Laura Kelmar, AECOM Project Manager — Date: June 24, 2019



Debra L. Simmons, AECOM Project QA Manager — Date: June 24, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Field Records

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Lower Passaic River Restoration Project (LPRRP), including sample collection events, field measurements, and site visits. Appropriate documentation of field activities provides an accurate and comprehensive record of the work performed, sufficient for a technical peer to reconstruct the day's activities and determine that necessary requirements were met. Field records also provide evidence and support technical interpretations and judgments. The procedures and systems defined in this SOP help ensure that the records are identifiable (reference the project task/activity), legible, retrievable, and protected from loss or damage.

1.2 LPRRP field data may be recorded electronically or in field logbooks, standardized forms, annotated maps, or photos. This SOP provides general guidance on field recordkeeping; additional details for specific procedures (for example, chain of custody, sample collection) are provided in the SOPs for the individual task.

1.3 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although record keeping itself does not generally pose significant health and safety risks, the tasks being implemented in the vicinity of individuals keeping records may require attention to safety practices. Project related physical, chemical and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI, 2005a; MPI 2005b; ENSR, 2008; AECOM 2011; AECOM 2019).

2.2 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not Applicable

4.0 Equipment and Materials

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Bound field logbook
- Standardized field data sheets (refer to Section 5.3)
- Black ballpoint pen, Rite-in-Rain® pen, or black Sharpie® (or equivalent)
- Site maps
- Clipboard
- Three-ring binder or equivalent
- Camera (optional)
- Time piece
- Hand-held electronic recording device (optional) with EQuIS Data Gathering Engine (EDGE)™ software from Earthsoft, Intelligent Data Entry Form® (IDEF) software or equivalent

5.0 Procedures

5.1 General Requirements

5.1.1 The field records will contain sufficient detail so that the collection effort can be reconstructed without reliance on the collector's memory.

5.1.2 Pertinent field information will be recorded legibly in a logbook and/or an appropriate standardized form (as described herein) in black ballpoint pen.

5.1.3 Entries will be signed and dated. No erasures or obliterations will be made. A single line will be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

5.1.4 If a ballpoint pen cannot be used because of adverse weather conditions (rain or freezing temperatures), a fine-point Sharpie® or Rite-in-Rain® pens are acceptable substitutes. If conditions are such that only pencil can be used, an explanation will be included in the logbook and the affected data will be photocopied, signed as verified copy, and maintained in the project files as documentation that the information has not been changed.

5.1.5 Entries will be factual and observational (i.e., no speculation or opinion), and will not contain any personal information or non-project-related entries. Abbreviations and acronyms will be defined.

5.1.6 Field information will be recorded without delay – information recorded significantly after the fact will be dated as such.

5.1.7 Field activities and other events pertinent to the field activities will be documented in chronological order. Times will be recorded using Eastern Standard Time (EST) or Eastern Daylight Savings Time (EDT) notation for each entry. Electronic data logging systems that will overlap time changes may use Coordinated Univeral Time (UTC). This will be noted in the log books upon deployment, servicing and retrieval.

5.2 Field logbooks

5.2.1 Field logbooks will be bound waterproof field books. LPRRP logbooks will be dedicated to the project and will not be used for any other project or purpose. Separate and dedicated logbooks will be kept for different operations running concurrently (e.g., one per vessel or field team); individual tasks making up each operation will be maintained in the same logbook, if possible.

5.2.2 The cover and binding of each logbook will be labeled to identify the operation and dates included with the logbook; each page in the logbook will be consecutively numbered. Pages will not be removed or torn out of the logbook.

5.2.3 The title page of each logbook will contain the following:

- AECOM contact, AECOM office location, and phone number;
- The logbook number (assigned at the time the logbook is signed out)
- Project name and number (LPRRP/Task Name, No. XXXXXXXX-XXXX); and
- Start and end dates of work covered by the logbook.

5.2.4 To assist in the return of a field logbook in the event it is lost, the following will also be included on the title page: “$25 Reward if found and returned to AECOM, 250 Apollo Drive, Chelmsford, Massachusetts 01824”.

5.2.5 At the front of each logbook will be a page cross-referencing each author’s printed name, signature, and initials.

5.2.6 A page header will appear on the first page of each day’s notes in the logbook, and activities for each day will be recorded on a new page. The page header will include:

- name of author and other personnel on site (and affiliated organization if applicable);
- date;
- time of arrival (military time; EDT or EST);
- proposed activity (task); and
- current weather and tidal conditions, and weather forecast for the day.

5.2.7 An abbreviated header, containing at least the date, will appear at the top of each additional page for the active date. Field forms require similar header information.

5.2.8 The field logbook will provide a chronology of events. At a minimum, documentation in a logbook will include the following (unless documented on a standard form):

- names of visitor(s), including time of arrival and departure, the visitor’s affiliation, and reason for visit;

- summary of project-related communications, including names of people involved and time;
- time daily work commences and ceases;
- start and stop times of new tasks;
- start and stop times of significant stand-by time (work interruptions);
- safety or other monitoring data, including units with each measurement;
- deviations from approved scope of work, including the necessary approvals;
- progress updates;
- problems/delays encountered;
- unusual events; and
- signature or initials of author on every page.

Additional detail on the contents of the field logbook is provided in Table 1.

5.2.9 The logbook will cross-reference the field forms if necessary; however, whenever possible, details recorded on the standardized forms will not be replicated in the logbook.

5.2.10 If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, and initialed and dated, leaving no room for additional entries.

5.3 Standardized forms

5.3.1 Standard forms for field data are provided with each SOP. The Daily Activity Log is attached to this SOP (Attachment 1). This form will be completed each day of active work and transmitted to the AECOM Task Manager or his/her designee. Refer to the appropriate SOP (e.g., core processing) for the forms specific to that task.

5.3.2 The information collected on any field form may alternately be collected electronically by PC/handheld as appropriate.

5.3.3 The following rules apply to the standardized forms:

- Each form will be signed and dated by the person completing the form.
- There will be no blank spaces on the form – unused spaces will have "not applicable" or "not available" explanations.

5.4 Maps and drawings

5.4.1 Pre-existing maps and drawings that include notations made in the field (for example, relocating of sample locations) will be referenced in the logbook and, like all field records, include the project/task name and number, site identification, and be signed/dated by the person that prepared them.

5.4.2 Maps and drawings will include compass orientation and scale. Sketches will include points of reference and distances to the reference points.

5.5 Photographs and other photo documentation

Photographs or videos may be taken by the field team to help document site conditions, sample locations, or sample characteristics. Photographs and videos will be identified in the logbook or on the standard form by a unique numbering system. If photographs are collected by a digital camera, the file number as well as the photograph number will accompany the description of the photograph in the logbook. At a minimum, the date/time the photograph was taken, the general location, a brief description, and the photographer's name will be recorded. Additional information may include Differential Global Positioning System (DGPS) coordinates, direction the photographer was facing, and/or weather conditions. If necessary, an object will be included to indicate the scale of the object in the photograph.

5.6 Electronic files

5.6.1 Electronically recording devices may include data logging systems, cellular telephones, laptops, or tablets.

5.6.2 Sufficient backup systems will be in place to protect against electronic data loss. Information will be backed up immediately upon completion. The backup media (CD, flash drive) will then be stored in a secure location separate from the laptop or tablet

5.6.3 Files will be uniquely identified and will be stored in the project files on the network in accordance with the Lower Passaic River Project Quality Management Plan (ENSR, 2007a; AECOM 2009). Files will be labeled per Worksheet #27 of the QAPP and should include the date, a description of the file contents or a unique title, and a version number. For example, "YYYYMMDD_Name of documentV#". An unedited version of the file will be maintained and all subsequent manipulations tracked.

6.0 Quality Assurance/Quality Control

6.1 Entries in the field forms will be double-checked by the samplers to verify the information is correct.

6.2 Completed field forms will be reviewed periodically by the AECOM Field Task Manager and/or Project QA Manager or their designees to verify that the requirements are being met. At a minimum, this should occur at the end of each day. When the review is complete, the reviewer will append his/her initials and date to the pages reviewed for documentation purposes.

6.3 If information recorded in the field is transcribed to another format, the original record will be retained for comparison purposes.

7.0 Data and Records Management

7.1 Deviations to the procedures detailed in the SOP or approved plans will be noted in the field logbook or other appropriate field form at the time of occurrence. These changes will be summarized on the Daily Activity Log. Significant deviations will be documented on a Nonconformance Form (Attachment 2) and maintained in the project file.

7.2 Proposed modifications to the SOPs or approved plans will be documented on a Field Modification form and submitted to USEPA. An example Field Modification form is presented as Attachment 3.

7.3 Logbooks, field forms, chain of custody forms, and all other records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Project Quality Management Plan (ENSR, 2007a; AECOM 2009).

7.4 Logbooks that are taken offsite from the field facility will be photocopied, scanned, or photgraphed and filed at the end of each day to mitigate against the loss of historical entries should the logbook be lost in the field.

7.5 Field data forms and chain of custody will be filed in the field facility once they have been completed and distributed (if necessary), or at the end of each field day. These documents will be maintained in labeled three-ring binders or contained in some other organized manner that prevents loss.

7.6 Distribution of daily forms will be performed according to the needs of the project team and at the direction of the Field Task Manager or designee. Refer to the Lower Passaic River Data Management Plan (ENSR, 2007b; AECOM, 2010) for the frequency and distribution of field data and chain-of-custody transmittal information.

8.0 Personnel Qualifications and Training

8.1 Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, FSP). No specialized training is required. Nonetheless, these activities should be reviewed by the Field Task Manager, as described below.

8.2 The Field Task Manager is responsible for reviewing and approving the field records for accuracy, completeness, and conformance to the procedures in this SOP. The Field Task Manager is also responsible for ensuring that the field records are distributed to the appropriate personnel during field activities, ensuring that records are maintained properly on site, and for archiving the records upon completion of field activities.

9.0 References

AECOM, 2019. Health and Safety Plan. Lower Passiac River Restoration Project Current Conditions Study.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

ENSR, 2008. Health and Safety Plan Addendum. USEPA Lower Passaic River Restoration Project Remedial Investigation/Feasibility Study. Spring 2008 Field Programs

ENSR, 2007a. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009.

ENSR, 2007b. Lower Passaic River Data Management Plan. November 2007.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

10.0 Revision History

Revision	Date	Changes
0	May 2008	NA
1	July 2008	Added cross-reference as Section 5.2.5; updated Table 1; added unique file ID scheme to Section 5.6.3
2	September 2009	Included Field Modification and Nonconformance forms; “ENSR” to “AECOM”; minor editorial changes
3	February 2010	Modify to include IDEF option; Table 1 footnote update; addition of Attachment 2-3 names on Contents page
4	June 2010	Updated text to reflect general sampling procedures where sediment specific wording was used.
5	September 2010	Minor revisions throughout document
6	June 2011	Minor revisions throughout document
7	July 2011	Minor revisions throughout document
8	May 2019	Minor editorial changes; updates to reflect Current Conditions program.

Table 1 LPR Summary of Field Information

General Information	Applicable Record[1]
Project/task name/general location	All
Personnel on site (AECOM, clients, site contacts, regulators, oversight personnel, subcontractors, general public)	A, B, K
Results of phone calls, conversations (See QAPP Worksheet #3 for project contact information)	B
Chronology of activities, including mobilization, investigatory activities, and demobilization	B
Weather conditions (initial and any changes; temperature, barometric pressure, wind conditions, precipitation)	B, D
Tidal and atmospheric information (if applicable)	B, G
Subcontractors, description of services to be provided, and any issues (equipment problems, corrective action, stand by time)	A, B
Health and safety (H&S) tailgate meetings, H&S monitoring	Refer to HASP
Description of major equipment (survey vessels, sampling platforms, sampling devices) and any problems or conditions that might impact performance or data quality	A, B, J
Equipment decontamination	B, D, E
Any pertinent field observations such as difficulties in sampling or conducting measurements or unusual circumstances that could affect data quality (instrument problems, contamination sources)	B, D, J
Deviations from approved plan (schedule, relocation/elimination of locations, change orders), including rationale and approval	A, B, J
Sample collection and transfer summary, custody information from collection through analysis, to final disposal	C, D, E, H
Investigation-derived waste (IDW) types, volumes, storage, and disposal	F
Field measurements	
Description of Instruments (make, model, serial number) and inspection	B, G
Instrument calibration (date, time, personnel, standard, standards used/expiration date, and results)	B, G
Measurement date, time, location/station, results (units, any correction factors applied, calculations (if applicable)	D, E, G, L
Identity of person performing the measurements	D, E, G, L
Sampling information	
Equipment description and inspection	B, D
Sample selection criteria/rationale (if different from plan)	A, B, D, J
Sample location (GPS coordinates, depth, compass/distance from fixed points)	D
Sample description (recovery, moisture, color, odor, texture, general sediment profile/stratigraphy, PID screening results, artifacts)	D, I
Sample manipulations (homogenization, compositing, filtering, preservation)	D, E
Sample ID, segment/interval, date, time, and sampler identity	D, E, H
Sample parameters, containers (size/type), preservation	
Field and QC sample ID, storage container and conditions for each (sub)sample/parameter set	D, C, E

[1] Locations for this information may include but are not limited to: A: Daily Activity Log; B: Field Notebook; C: COC Form; D: Sample Collection Form; E: Sample Processing Form; F: IDW Logs; G: Water Quality Data Log; H: Sample Transfer and Custody Form; I: Core Logging Form; J: Nonconformance Form; K: Site Log-in Record; L: In-Situ Data Log

Attachment 1 Example of Daily Activity Log

AECOM

Daily Activity Log
Lower Passaic River Restoration Project
Project No.: 60145884
Task: _____
Date: _____

Vessel/Sampling Platform:
Personnel (Name/Affiliation/Role)
Sampling Performed/Equipment Used:
Stations Sampled:
Health and Safety Issues:
Deviations from Approved Plan:
Dock Departure Time:
Dock Return Time:
Recorded by:

Revision 2, June 2011

Attachment 2 Example of Field Modification Form

AECOM

Field Modification Form
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

Field Modification Number:	
Document (plan or SOP title and date)	
Activity:	
Proposed Modification:	
Effective Date:	
Rationale:	
Submitted by	**Date:**
FTM Approval:	**Date:**
Project QA Manager Approval:	**Date:**
Task Manager Approval:	**Date**

Revision 2, June 2011

Attachment 3 Example of Nonconformance Form

AECOM

Nonconformance Report
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

Nonconformance Number:	
Document (plan or SOP title and date)	
Activity:	
Nonconformance:	
Date of Nonconformance:	
Ramifications/Corrective Action:	
Submitted by	Date:
Project QA Manager Review:	Date:
Task Manager Review:	Date:
Other Approval:	Date

Revision 2, June 2011

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Navigation/Positioning

Procedure Number: LPR-G-02

Revision No.: 7

Revision Date: June 2019

Prepared by

Kristen Durocher

Kristen Durocher, AECOM Task Manager — Date: June 24, 2019

Laura Kelmar, AECOM Project Manager — Date: June 24, 2019

Debra L. Simmons, AECOM Project QA Manager — Date: June 24, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for positioning vessels for the Lower Passaic River Restoration Project (LPRRP). Positioning will be conducted to locate the vessel(s) with sufficient accuracy and precision to meet project objectives during sampling or measurement activities.

1.2 This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to position vessels. Specific information regarding proposed sampling and/or measurement locations is provided in the LPRRP Quality Assurance Project Plan (QAPP).

1.3 It is fully expected that the procedures outlined in this SOP will be followed by the field team. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety (H&S) considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI, 2005a; MPI 2005b; AECOM 2011, AECOM 2019). The major health and safety considerations for the work associated with navigating/positioning the vessel are the marine safety aspects of the program

2.2 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Differential global positioning system (DGPS) signal interferences/blockage can occur from time to time by bridges or other structures. These interferences can prevent system function until satellite signals are re-established. If insufficient satellite coverage occurs for proper function, the user will be alerted by the HYPACK system. In these cases the vessel will be repositioned to obtain better satellite coverage.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- sampling vessel(s) adequately sized and equipped for the task and expected conditions on the Passaic River, including high frequency (VHF) radio, ground tackle, and required U.S. Coast Guard safety gear;
- navigation charts and sampling/measurement locations figure;
- electronic navigation charts with pre-loaded waypoints for all sampling and measurement locations - refer to the corresponding LPRRP QAPP;
- DGPS Receivers (x2) with an accuracy of $\pm$1 foot;
- DGPS External Antennas (x2);
- field laptop computer with HYPACK survey software;
- equipment user manuals;
- table of target sampling/measurement location coordinates;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices);
- logbook and ballpoint pen;
- sample collection forms; and

5.0 Procedures

Sampling and measurement activities will be conducted from a vessel. In accordance with procedures outlined below, these vessels must be properly positioned and their position recorded before each activity can begin. The following describes the procedures that will be performed to accurately position sampling vessels at a designated sampling location, and the pertinent observations that will be recorded in the appropriate field notebook and/or data sheet.

Positioning will be achieved by using a DGPS integrated with HYPACK survey software in order to obtain the real time position of the vessel, in relation to planned sampling stations, displayed on an electronic nautical chart. Survey personnel will follow the appropriate sections of equipment user's manuals to ensure proper equipment operation and system performance.

5.1 Positioning the vessel

This section gives the step-by-step procedures for vessel positioning. Observations made during vessel positioning will be recorded on the sample collection forms, other standardized forms, and/or logbook, as appropriate.

A DGPS will be used to establish locations during implementation of activities specified in the LPRRP QAPP. One DGPS unit will be required on board the vessel with a receiving antenna to be aligned with the deployment of the sampling apparatus. This unit will utilize position correctors generated from the USCG transmitted from Sandy Hook, NY.

While this SOP provides general guidance and procedural steps, personnel performing positioning activities also will follow the appropriate sections of equipment user's manuals and have the manuals available for reference while operating the equipment.

The following procedures describe the steps to establish position at a location, as well as the steps to adjust the positioning for collection of additional samples.

5.1.1 Obtain the appropriate form(s). Initiate the Daily Activity Log provided in SOP LPR-G-01 (Field Records).

5.1.2 Obtain the target sampling/measurement locations. These locations will have been selected prior to commencement of field activities, as described in the QAPP. The location of each target sampling location will be established in the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83).

5.1.3 Enter the coordinates for each sampling location as a waypoint into the HYPACK software package. Confirm accuracy of each entry against the coordinates established in the corresponding LPRRP QAPP.

5.1.4 Configure the HYPACK system for the survey, including setting the survey grid to the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83 - feet), and, if applicable, setting the "target ring" or maximum allowable offset based on task specific requirements listed in the corresponding LPRRP QAPP.

5.1.5 If less than sub-meter accuracy is required, a DGPS base station will be established over a shore-based marker prior to sampling or measurement operations. The operation and horizontal/vertical (if needed) accuracy of the vessel mounted DGPS will be verified at another shore-based marker by recording observed horizontal (X,Y) and vertical (Z, if needed) data and comparing these data to the published XY data for a given point. After initial DGPS system verification, a temporary benchmark may be established at a location convenient to the vessel to facilitate daily DGPS system performance verification. DGPS system performance verification will be conducted twice per day and documented in the logbook and vessel data logger. The horizontal and vertical (if needed) accuracy will be compared to shore-based markers to verify performance. Elevations will be recorded in North American Vertical Datum of 1988 (NAVD88) with an accuracy of +/- one foot, if applicable.

5.1.6 Install the DGPS antennae in a safe location which accurately represents the actual sample or measurement collection point; (e.g., immediately adjacent to a coring well, or mounted to the A-frame).

5.1.7 Identify and approach actual sampling/measurement locations by using data from the DGPS/HYPACK system in the navigation mode. The navigation mode provides information on heading, distance remaining, and time remaining. This information is based on the selected waypoint location and the present location of the vessel.

5.1.8 For sediment sampling, the vessel will be secured by lowering spud poles once in position within the station "target radius". In water depths that preclude the use of spud poles, maneuver the vessel approximately 60 feet up-current (or up-wind in slack conditions) of the target, drop the anchor, and pay out anchor line until the vessel drifts within the "target radius". A second anchor set may be required to increase lateral stability under certain conditions.

5.1.9 For water column sampling, the vessel will be positioned over each sampling/measurement location with no contact with the bottom. The operator will utilize the onboard navigation system to maintain positioning of the vessel within 10 feet of the sampling/measurement location. The water sampling apparatus will be secured to a CTD-OBS vertical profile unit or YSI datasonde which will be viewed on the vessel in real time. As the field crew conducts the vertical profile, the unit will be stopped at various depths to collect the water samples while making no contact with the riverbed.

5.1.10 Once the vessel is on location (and secured, for sediment sampling), note the coordinates from the DGPS unit and check the coordinates to verify that the vessel is within the pre-determined range of the target location as defined in QAPP, if defined. If not acceptable, adjust the vessel's location, and recheck the position. Repeat this process until the vessel's position is within acceptable range of the target. Record the final coordinates on the appropriate form. Record the actual sampling coordinates electronically (using HYPACK).

5.1.11 Once the coordinates are acceptable, perform the sampling or measurement activity at the location. Record final location coordinates on the appropriate form. For sediment sampling, final location coordinates will be recorded once the sampling device has penetrated the sediment to the target depth or refusal and prior to retrieval. Plot locations onto a master chart or use computer-based, real-time software to verify location.

5.1.12 To adjust the vessel's position to repeat an attempt at sediment sampling, the vessel will be moved by allowing it to rotate around the spud pole or by adjusting an anchor line until the new position for the sampling device has been established. Record the new position.

5.1.13 At the end of the sampling day, check the data loaded onto the DGPS units to verify the existence of locations where data were collected. Download HYPACK navigation files to a portable data storage device and transfer data to an applicable secure project directory (AECOM 2010).

5.2

5.2.1 In order to establish the elevation of the sediment surface at locations within the river, a system will be established whereby the water level of the river is continuously monitored and recorded for use as a local reference. This system will consist of a number of

transducer/data loggers (tide gauges) for measuring and recording the water level at approximately one-mile intervals (or more closely spaced, as necessary) along the Lower Passaic River. The benchmark elevation of each water level recorder will be surveyed to the North American Vertical Datum of 1988 (NAVD88) with an accuracy of 0.01 foot. Once the benchmark elevation for a station is established it can be re-located as necessary for coverage of the active work area. The water level at each tide station will be recorded approximately every 15 minutes, and the data downloaded weekly.

5.2.2 At each sampling point on the river where elevation data is required, the depth from the water level to the sediment surface will be determined as specified in the SOP for the activity being performed. The time of the measurement will be recorded. The water surface elevation at the time of the measurement will be determined by comparison to the closest water level recorders, with interpolation between measuring points as necessary.

5.3 Calibration, maintenance, and use of field instruments

5.3.1 Poor DGPS Reception or System Failure

If insufficient satellite coverage occurs for proper function, the user will be alerted by the HYPACK® system. In these cases the Field Task Manager will be notified that verification of the field position of the vessel at the target location cannot be performed. The Field Task Manager will review the situation with respect to available reference resources and may provide the field team with alternate locations, as required by the QAPP. The selection of alternate sampling locations will be made jointly through discussions with the Field Task Manager and the boat personnel.

When satellite reception is insufficient to meet system accuracy requirements, system error codes will appear on the output screen. Nonetheless, proper operation of the DGPS / HYPACK navigation system can be verified by checking the displayed vessel position on the electronic base map against surrounding geographic features. This activity will be undertaken at the start of each day after start-up as a quick check to verify proper system function. Note: system function errors will be obvious and rigorous checking of the system is not necessary.

5.3.2 Maintenance

Prior to use, the DGPS units will be inspected for functionality. Maintenance and use of DGPS units will follow the appropriate sections of the equipment user's manual. Field personnel will have the manual available for reference. Equipment maintenance will be recorded in the field logbook, including the reason for the maintenance (routine or because of a problem), actions taken, and final resolution (e.g., correction of the problem, replacement of the instrument).

6.0 Quality Assurance/Quality Control

6.1 The QAPP-specified radius/tolerance surrounding the target coordinates, if specified in the corresponding LPRRP QAPP, will be used to verify actual sampling/measurement locations. Using a HYPACK navigation system allows the user to see the real time position of the sampling vessel in relation to the designated position of the sampling/measurement station and the user defined “target

radius" surrounding each station. This visual confirmation on the electronic chart is also complimented by a HYPACK data display that indicates the actual distance to target. Using these two features ensures proper vessel positioning.

6.2 DGPS system performance will be verified by confirming the accuracy of the initial HYPACK configuration (i.e., geographic reference) and by regular system checks during the course of the day.

6.3 The quality of the data provided by the DGPS unit is monitored by HYPACK as another control feature built into the system. In the event there is degradation in DGPS signal quality, either by a reduced number of available satellites or satellite geometry, the HYPACK system will alert the operator of the reduced quality of horizontal and vertical (if needed) precision levels.

6.4 Data recorded manually and electronically (see Section 7.2) will be cross-checked for accuracy

7.0 Data and Records Management

7.1 Field records will be generated as outlined in SOP LPR-G-01 (Field Records). This document provides specifics on recording data for field activities. At a minimum, sample position information (x, y, and z [if needed]), verification of DGPS system performance, and any positioning-related problems encountered will be recorded. Additional information may be required for sample collection or measurement activities and are outlined in the relevant SOPs.

7.2 Position data will be saved electronically at the time of sampling within HYPACK and recorded manually on the sample collection/measurement forms. Although the electronic record represents the primary record, the sample collection/measurement form information will serve as a backup to the electronic file.

7.3 Position data (actual sample locations) will be downloaded and transmitted to the AECOM Data Management Task Manager at the frequency stated in the Data Management Plan (AECOM, 2010).

7.4 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.5 All records (electronic and hard copy) associated with the activities described in this SOP will be maintained in accordance with the LPRRP Quality Management Plan (AECOM, 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read, and be familiar with, the requirements of this SOP. Vessel navigation and positioning will only be performed by experienced DGPS / HYPACK operators.

9.0 References

AECOM, 2019. Health and Safety Plan. Lower Passaiac River Restoration Project Current Conditions Study. [in prep]

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011..

AECOM 2010. Lower Passaic River Data Management Plan. September 2010 or current revision.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

10.0 Revision History

Revision	Date	Changes
0	May 2008	NA
1	July 2008	Minor revisions to all sections; added elevation measurements as Section 5.2
2	September 2009	Minor revisions to expand procedures to include water column sampling and measurements
3	September 2010	Minor revisions throughout document
4	June 2011	Minor revisions throughout document
5	July 2011	Included Newark Bay Study Area
6	May 2019	Review for updates. Changes to make consistent with Current Conditions program
7	June 2019	Minor modifications for “target” coordinate applicability.

Standard Operating Procedure
Lower Passaic River Restoration Project

Equipment Decontamination

Procedure Number: LPR-G-03

Revision No.: 6

Revision Date: May 2019

Prepared by

Kristen Durocher

Kristen Durocher, AECOM Task Manager — Date: May 14, 2019

Laura Kelmar, AECOM Project Manager — Date: May 14, 2019

Debra L. Simmons, AECOM Project QA Manager — Date: May 14, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

The purpose of this document is to define the standard operating procedure (SOP) for decontamination of equipment, instruments, and other materials used during implementation of field tasks for the Lower Passaic River Restoration Project (LPRRP) and sampling in the Newark Bay Study Area. Decontamination is the process of neutralizing, washing, and rinsing exposed surfaces of equipment to minimize the potential for contaminant migration and/or cross-contamination. This procedure does not apply to personnel decontamination which is described in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011, AECOM 2019).

It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications to this SOP may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and to the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical and biological hazards, are addressed in the HASP and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011. AECOM 2019).

2.2 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Equipment decontamination should be performed in an area that does not interfere with sampling activities, but sufficiently close to maintain an efficient working environment. Whenever possible, decontamination activities will be performed in a location that is not subject to potential sources of contamination (for example, generators and other combustion engines). Where decontamination is required on a boat, the vessel's engines must be turned off during decontamination (and collection of equipment rinsate blanks).

3.2 Equipment that is improperly or inadequately decontaminated may result in biased sample results. To avoid sample contamination, the procedures and equipment specified in this SOP are to be followed. Specifically:

- The decontamination materials, including detergent, water, solvents, and acids, will meet the specifications of the SOP;
- Buckets and other containers holding decontamination solutions will be labeled to segregate containers holding “dirty” from “clean” solutions, and brushes will be dedicated to a particular step in the decontamination process; and
- Decontaminated equipment that is not immediately reused will be covered/wrapped in plastic or aluminum foil (shiny side out) and marked to indicate it is clean.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- bristle brushes;
- plastic wash/rinse buckets or tubs;
- phosphate-free biodegradable detergent (e.g. Liquinox®, Alconox®);
- Joy® (or equivalent) detergent (for oily residues);
- 10% nitric acid, reagent grade;
- methanol (pesticide grade or better in separate Teflon bottles);
- hexane (pesticide grade or better in separate Teflon bottles);
- deionized "analyte-free" water (DIW);
- stainless steel bowls or pans (labeled as needed);
- squeeze bottles (Teflon® for solvent)
- aluminum foil;
- plastic sheeting;
- zipper-lock bags;
- tap water (from any treated municipal water supply);
- high-pressure/steam cleaner;
- sample container(s) for equipment rinsate blank, if collected;
- investigation-derived waste (IDW) storage containers (refer to SOP LPR-G-04); and
- field logbook and standardized forms as needed.

5.0 Procedures

Sampling equipment (including newly purchased equipment) that comes into contact with the media to be sampled will be decontaminated prior to use in the field to eliminate or minimize cross-contamination. The frequency of decontamination is provided in the task-specific SOPs (for example, surface water sampling, grab sampling, sediment collection via vibracore, core processing). Sufficient decontaminated equipment will be available to be dedicated to the sampling locations planned for each day, where feasible. Equipment will be decontaminated in the area designated for decontamination.

For the LPRRP Program, surface water and sediment samples may be submitted for chemical, radiochemical, biological, and geotechnical analyses as described in the Quality Assurance Project Plan (QAPP) (Anchor QEA and AECOM, 2019). Sampling equipment will be decontaminated as described in Section 5.0 below. Decontamination of the sampling equipment will be commensurate with the analyses to be performed.

Solvents used during decontamination activities will be collected and handled in accordance with residuals management procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

Not all sampling equipment will require full decontamination procedures. Three levels of decontamination (i.e., solvent, soap and water, or ambient water decontamination) will be performed based on the usage of the sampling equipment as defined below.

5.1 General preparation

Inspect equipment needed for sample collection to ensure that it is in good working order and establish an equipment decontamination area that includes a collection basin that can be placed beneath the equipment to collect decontamination fluids, brushes, and a series of wash bottles for each of the solutions specified in the following section. An IDW container and storage system will also be established as outlined SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.2 Level I (Decontamination with Ambient Water): The following steps will be used to decontaminate sampling and support vessels, vessel anchors, lines, ropes, vibracoring head, and buoy marker weights:

5.2.1 Personnel will dress in suitable PPE to reduce exposure to contaminants (refer to the HASP).

5.2.2 Equipment will be rinsed with river water onboard the sampling vessel.

5.2.3 Rinse water will not be contained.

5.2.4 Daily decontamination of the decks of the vessels will consist of a river water washing as soon as possible after concluding work. Further wash-down with tap water at the marina is at the discretion of the boat's captain.

5.3 Level II (Decontamination with Soap and Water): The following steps will be used to decontaminate equipment that is not intended to collect samples for chemical analysis (e.g., sample storage coolers):

5.3.1 Personnel will dress in suitable PPE to reduce exposure to contaminants (refer to the HASP).

5.3.2 Residual sediment will be scraped off and the equipment rinsed with site/river water (on the sampling vessel while on site).

5.3.3 Residual sediment on equipment that is decontaminated at the field facility will be collected according to IDW procedures outlined in SOP LPR-G-04 – IDW Handling and Disposal.

5.3.4 Equipment may be rinsed with tap water if needed to further remove gross contamination.

5.3.5 Equipment will be placed in a wash tub or bucket (if size allows) containing Alconox® (or other phosphate-free detergent) along with tap water, and scrubbed with a bristle brush or similar utensil.

5.3.6 Equipment will be rinsed twice with tap water over a bucket using a squeeze bottle or pressure washer.

5.3.7 Following decontamination, equipment will be placed in a dedicated clean area or will be protected from re-contamination by covering with plastic or wrapping in foil.

5.3.8 Rinse water and detergent water will be replaced frequently. Residual decontamination water used on the boat will be held in 5-gallon buckets, labeled, and transferred to the field facility for collection and ultimate disposal in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigation Derived Waste (IDW) Handling and Disposal.

5.4 Level III (Decontamination with Solvents): The following decontamination procedure is based on a modification of the Region 2 procedure (USEPA, 1989). The following steps will be used to decontaminate small sampling equipment that will come into contact with sediment or surface water designated for chemical analysis. This sampling equipment includes stainless steel trowels, spoons and bowls, core tubes, stainless steel core cutters and catchers, plastic caps for the core tubes, trigger-activated bottle samples, and CFLEX tubing (if not pre-cleaned by the laboratory). Sampling devices will be decontaminated between collection of samples at different depths and different times at the same sampling location.

5.4.1 Personnel will dress in suitable PPE to reduce exposure to chemicals and contaminants (refer to the HASP).

5.4.2 Any residual sediment will be scraped off and the equipment rinsed with site/river water (on the vessel while on site).

5.4.3 Residual sediment on equipment that is decontaminated at the field facility will be collected according to IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.4.4 Equipment may be brushed and rinsed with tap water if needed to further remove gross contamination.

5.4.5 Equipment will be placed in a wash tub or bucket containing Alconox (or other phosphate-free detergent) along with tap water, and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water over a second wash tub or bucket, using a squeeze bottle or pressure sprayer, followed by a 10% nitric acid rinse (for metals analyses), a DIW rinse, a methanol rinse, a hexane rinse (for organic analyses), and lastly with a DIW rinse. Rinses shall utilize sufficient amounts of solvent/water to flush rather than just wet the surface. The volume of DIW used during the rinse must be at least five times the volume of solvent used.

5.4.6 Core liners will be decontaminated by pouring a small amount of detergent and tap water into each core, capping the ends, and agitating the core liner so that all surface areas are flushed with the liquid. The detergent and tap water will be containerized as IDW and the process repeated with tap water, 10% nitric acid, DIW, methanol, hexane, and DIW. All decontamination solutions will be containerized as IDW and handled as described in Section 5.4.8.

5.4.7 Following decontamination, equipment will be placed in a clean area on clean aluminum foil or plastic sheeting and allowed to air dry. Following air drying, the equipment will be wrapped in aluminum foil, shiny side out, or placed in a zipper-lock bag, if not immediately re-used for sample collection. Larger equipment may be wrapped in clean plastic sheeting. Equipment that may be used immediately (i.e., before fully air dried) may be reused providing obvious deionized water has been shaken off. Core liners will be capped with clean caps, and the caps taped in place. The core liners will then be placed back into their original packaging for storage. Clean equipment should be marked in some way to indicate that it is clean. Core liners will not be marked; instead, caps taped in place on both ends of a liner will indicate that it has been decontaminated.

5.4.8 Used decontamination solutions and associated materials will be collected for ultimate disposal in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal. Equipment decontamination waste materials generated on the vessel will be collected in 5-gallon buckets, labeled, and transferred to the field facility for disposal.

5.5 Field instrumentation should be cleaned according to the manufacturer's instructions. Care will be taken to prevent damage to equipment. Field instruments such as water quality meters will be rinsed daily during field operations at the end of each workday with DIW at a minimum, or more rigorously according to the manufacturer's instructions. When possible, instruments which are difficult to decontaminate, such as cameras and data logging instruments, may be protectively wrapped to reduce or eliminate the need for decontamination.

5.6 Pumps used for surface water sampling will be rinsed with tap water prior to and following each day of use. Decontamination of the peristaltic pumps between stations or between depths is not required. Tubing will be received from the laboratory pre-cleaned and in dedicated packaging and will not require decontamination in the field.

5.7 Other sampling equipment that might be used and that has had direct contact with sediments or wastes will be decontaminated at a designated area prior to leaving the Site. If the above decontamination procedures are not applicable or feasible, the decontamination procedure will be as follows:

5.7.1 Equipment will be wrapped or draped in plastic or placed in the plastic-lined cargo area of a truck for transport to the area designated for decontamination.

5.7.2 Equipment will first be washed with a hot water, high-pressure spray or steam-cleaned.

5.7.3 Equipment will then be rinsed, by hose or high pressure spray, with tap water.

5.7.4 Wash and rinse water will be collected and handled in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.8 Equipment leaving the Site upon the completion of on-site investigation activities will be decontaminated according to Sections 5.2, 5.3, 5.4, 5.5, or 5.6, above.

5.9 Equipment rinsate blanks will be collected to assess the adequacy of equipment decontamination procedures. Equipment rinsate blanks will be submitted for testing at the frequency specified in the QAPP. The equipment rinsate blank collection procedures are included in the SOPs for the individual tasks (surface water sampling, sediment sampling, core processing, etc.).

6.0 Quality Assurance/Quality Control

6.1 Decontamination QA/QC procedures described in Section 5.0 will be performed to assess the adequacy of equipment decontamination procedures. Equipment rinsate blanks will be collected at the frequency specified in the QAPP (QAPP Worksheet #20).

6.2 It is the responsibility of the Field Task Manager to periodically check/ensure that the equipment decontamination procedures are in conformance with those stated in this SOP.

7.0 Data and Records Management

7.1 Documentation of decontamination procedures will be contained in the field logbook or recorded on the appropriate task-specific standardized form and should include:

- a list of equipment being decontaminated along with the date and time;
- a brief description of the procedure and materials used during the process (e.g., Level I/ambient water rinse; Level II/soap and water rinse; Level III/acid and solvent rinse);
- the names of the project staff performing the decontamination;
- documentation of equipment rinsate blanks including sample ID, date and time, the equipment rinsed, collector, and parameters; and
- IDW storage and disposal.

7.2 Field data will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP). Decontamination of field

equipment is a relatively simple procedure; no specialized training is needed. However, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

Anchor AEA and AECOM, 2019. Current Conditions Physical Water Column Data Collection Quality Assurance Project Plan/Field Sampling Plan Addendum. May 2019.

AECOM 2019. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. [in prep].

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

AECOM 2010. Lower Passaic River Data Management Plan. August 2010 or current version.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

USEPA 1989. Region II CERCL Quality Assurance Manual. Revision 1. October 1989.

10.0 Revision History

Revision	Date	Changes
0	April 2008	NA
1	July 2008	Added Section 5.4.6 to discuss decontamination of core lines; reworded Section 5.3.8; corrected minor typos
2	June 2010	Added information specific to surface water sampling; logo change.
3	September 2010	Minor changes throughout the document
4	June 2011	Minor changes throughout the document
5	July 2011	Minor changes throughout the document
6	May 2019	Minor changes for Current Conditions program

Standard Operating Procedure
Lower Passaic River Restoration Project

Investigative Derived Waste (IDW) Handling and Disposal

Procedure Number: LPR-G-04

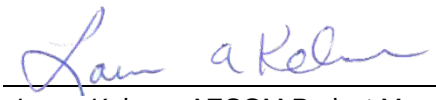
Revision No.: 6

Revision Date: May 2019

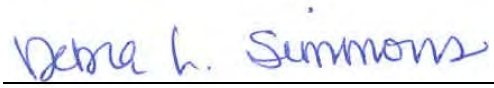
Prepared by

Kristen Durocher

Kristen Durocher , AECOM Task Manager — Date: May 14, 2019



Laura Kelmar, AECOM Project Manager — Date: May 14, 2019



Debra L. Simmons, AECOM Project QA Manager — Date: May 14, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Investigative Derived Waste (IDW) Handling and Disposal

Contents

Standard Operating Procedure
Lower Passaic River Restoration Project
Investigative Derived Waste (IDW) Handling and Disposal

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for disposal of sediment, water, personal protective equipment (PPE), and other potentially contaminated materials generated during Lower Passaic River Restoration Project (LPRRP) operations.

1.2 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications to this SOP may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modifications to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the AECOM Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011, AECOM 2019) as well as the DCS Americas Hazardous Materials Shipping Procedure S3AM-116-PR1.

2.2 Daily Tailgate Safety Meetings will be conducted at the start of each working day before any work commences. These daily meetings will be facilitated by the Site Safety Officer (SSO) or his/her designee prior to starting any site activities to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Equipment decontamination and Investigative Derived Waste (IDW) handling are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not applicable.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) or other safety equipment, as required by the HASP;

- 55-gallon open-top drums (Department of Transportation [DOT] approved) with lid;
- 55-gallon closed-top drums (DOT approved) for collection of liquids;
- 30-gallon (minimum) garbage bags;
- 5-10 gallon carboys to be used as satellite waste collection containers;
- Type I or II UL approved galvanized steel can(s) to be used for solvent waste collection;
- 5-gallon buckets with lids;
- permanent marking pens and/or paint pens;
- labels and tags;
- duct tape;
- storage racks;
- small (cooler-size) storage containers;
- walk-in cooler;
- chemical storage cabinet (meeting Occupational Safety and Health Administration [OSHA] and National Fire Protection Association [NFPA] Code 30 specifications/Factory Manual [FM] approved);
- field logbook and IDW log form (see Attachment 1); and
- Acid and solvent spill kits.

5.0 Procedures

Potentially contaminated sediment, water, PPE, and other materials will be classified into three categories: (1) solid materials consisting of sediments, sediment samples returned from the laboratory, used polybutyrate core tubes, used PPE, and other materials used in the handling, processing, and storage of sediment (addressed in Section 5.1); (2) liquid wastes such as waste water, river water and decontamination water (addressed in Section 5.2.1); and (3) spent and residual chemicals (liquids) from decontamination (addressed in Section 5.2.2). Sediment from cores that are not processed for chemical, biological, or radiochemical analysis may be either archived or disposed of, and will be segregated and handled separately according to its classification. To the extent practical, liquids generated during coring and core processing operations will be separated from the solid material. Each type of material will be handled in the manner described in this SOP.

As discussed in the HASP, solid and liquid IDW handling will be performed in a well ventilated area (in the field) or in the vacuum hood when working in the field facility, if available. Furthermore, skin and eyes will be protected from accidental exposure. Liquid IDW transfers will also take place in a well-ventilated storage location and may require respirators as specified in the HASP.

5.1 Solid waste

Solid residuals generated during field activities will be characterized for appropriate offsite disposal. Solid residuals consist of two types of materials: non-sediment solid materials generated during the collection and processing of cores, including items such as used polybutyrate core tubes, aluminum foil from clean core tubes, PPE (e.g., gloves, Tyvek® suits, boot covers), and sediment not used for analyses (e.g., waste sediment such as that collected from the core "smear zone" and residual sediment). Non-sediment and sediment wastes will be segregated and temporarily stored in separate containers pending disposal. Loose sediment will be removed from non-sediment waste items prior to disposal and stored with other sediment wastes.

If recovered sediment is determined to be unusable after a core has been cut open, the sediment will be removed from the core tube and stored in an appropriate container for disposal as waste sediment. The used core tube will be stored and disposed of with the non-sediment solid wastes. Sediment residuals will be placed in 55-gallon drums, labeled, and stored temporarily until disposal.

Non-sediment solid materials will be placed in 55-gallon drums, bulk bags and/or a roll-off container, and stored temporarily pending characterization and off site disposal. PPE and equipment used for surface water sampling that do not have sediment residual may be placed in a bulk trash bag and disposed of in the facility dumpster. All drums and bags containing solids residuals will be labeled and handled as described in Section 5.1.1 of this SOP.

5.1.1 Handling and tracking

As they are generated during field activities, waste sediment and other solid waste materials will be placed in DOT-approved 55-gallon drums or 30-gallon bags. Solid waste materials which are initially placed in bags may be bulked into 55-gallon drums for storage. The following procedures will be followed for storing sediment and other solid waste in these drums:

- A unique drum number (consisting of the program ID and the sequential number) will be assigned to each drum by the Field Task Manager or designee. The drum number will be clearly marked on multiple places on the drum;
- A label indicating that the drum contains IDW pending characterization and a Class 9 Hazardous Solid Waste label will be placed on each drum;
- A log will be kept for each drum, listing the materials placed in that drum. All solid materials will be segregated based on the type of material (e.g., sediment, coring tubes, PPE, waste plastic, paper, or foil) and, to the extent practicable, by where they were generated (e.g., location within the river, station number, etc.);
- Drums will be kept closed at all times except when material is being added to them. Drums will be sealed (bungs or lid bands tightened) when not in active use.
- Collection drums may be reused at the processing facility after emptying; and
- Drums containing solid materials will be stored in a secured area within the field facility until proper offsite disposal can be coordinated. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste

generator status (large quantity generator, small quantity generator, or very small quantity generator).

5.2 Liquid waste

5.2.1 Waste water

Waste water will be generated during sediment core processing and decontamination activities. Sediment recovered during this process will be handled according to Section 5.1 of this SOP. Waste water will be collected in the large on-site storage tank (which is connected to the sink outlet) until the material is characterized and transferred off site for disposal.

5.2.2 River water

River water will be generated during the collection of surface water samples including purging the pump tubing and excess water retained in the trigger-activated grab sampler. River water is not considered IDW. During sampling activities, river water that is collected during the sampling but is not needed to fill the required sample containers will be temporarily containerized in 5-gallon plastic buckets, and will be returned to the river upon completion of sampling at a station.

5.2.3 Chemical liquid wastes

Chemical liquid wastes will include the spent solvents and acids and other residual chemicals generated during the decontamination process (refer to SOP LPR-G-03 – Equipment Decontamination).

Waste acids and solvents will be collected in (dedicated) satellite containers as follows:

- Waste acids (e.g., HCl, HNO_3) will be collected in a plastic storage carboy (20-L) SEPARATE FROM WASTE SOLVENTS, labeled with a Class 8 Corrosive Liquid label and containing a tag that indicates acid name, concentration, and volume along with users initials, date/time.
- Waste solvents (e.g., acetone, methanol and hexane) will be collected in Type I or II UL approved galvanized steel disposal can, SEPARATE FROM WASTE ACIDS, labeled with a Class 3 Flammable Liquid label and containing a tag that indicates solvent name, concentration, and volume along with users' initials, date/time.

If chemical liquid waste volumes increase beyond limited satellite storage container capacity, they will be placed in separate DOT-approved 55-gallon drums as follows:

<u>Acid Waste (HCl, HNO_3):</u>

- Assign a unique identification number to the (plastic lined) acid drum (clearly marked on the top and sides).
- Place a label indicating that the drum contains IDW pending characterization and a Class 8 Corrosive Liquid label on the drum
- Prepare a log for the drum, listing the volume and concentration of each acid transferred to the drum along with date/time.
- Close the drum after each transfer

- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the applicable hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

Solvent Waste (Acetone, Methanol, Hexane):

- Assign a unique identification number to the Type I or II UL approved steel disposal can (clearly marked on the top and sides);
- Prepare a log for the drum, listing the volume and concentration of each solvent transferred to the drum along with date/time.
- Place a label indicating that the drum contains IDW pending characterization and a Class 3 Flammable Liquid label on the drum.
- Close the drum after each transfer.
- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

5.3 Samples returned from offsite laboratories

Upon completion of the required chemical, biological, and/or radiochemical analyses, remaining sample material and sample containers from the laboratory may be returned to the field facility. Returned sample material/containers will be transported under chain of custody procedures, and remain in custody until disposal. Upon receipt, the chain of custody form will be signed and the samples will be logged in by a project staff member. The approximate volume of sample material and the condition of the containers in which the samples are returned will be checked and recorded in the IDW logbook.

The labels will then be removed from the sample containers, and the containers with their contents will be placed in a DOT-approved 55-gallon drum and will be characterized and disposed of off-site.

5.4 Materials returned from sampling locations

Both solid and liquid IDW will be generated at each sediment sampling location. These materials will be containerized in closed 5-gallon buckets on the sampling vessel, labeled, and secured for transport to the CPG field facility. The containers will be carried by hand to a truck with a plastic-lined cargo area and then transported to the field facility for consolidation in 55-gallon drums for subsequent testing and disposal.

IDW associated with surface water sampling may include liquid wastes (equipment decontamination solutions) and solid waste such as used PPE, aluminum foil, and tubing. These materials will be containerized as described above and returned to the CPG field facility for disposal. As discussed

in Section 5.2, river water is not considered IDW and will be returned to the river upon departure from a sampling location.

6.0 Quality Assurance/Quality Control

6.1 Disposal procedures will be documented in a logbook to ensure that disposal activities are conducted in accordance with the procedures outlined in the SOPs. Waste manifests will be obtained for solid and aqueous waste disposal to verify that proper transportation and disposal of these materials has occurred.

6.2 It is the responsibility of the Field Task Manager to periodically check/ensure that the IDW procedures are in conformance with those stated in this SOP and that records are complete and accurate.

7.0 Data and Records Management

7.1 The Field Task Manager or designee is responsible for documenting the handling and/or disposal of containers filled with solids or liquids generated during the LPRRP investigation in accordance with SOP LPR-G-01 (Field Records). In addition, the following information will be included in the logbook (at a minimum):

- Name of person performing residual management or disposal activities;
- Date and time of activity;
- Information coordinating container numbers for drums or bags containing solid materials with sample numbers, core boring numbers, or origin; and
- Information coordinating origin of waste liquid (water or chemical[s]) with specific waste drum or tank.

7.2 The IDW logbook will be kept at the CPG field facility for the duration of the field program. The logbook will be divided into 3 sections. Section 1 will provide a summary of each drum number, the date that filling commenced, date filled, pickup date, and manifest identifier. Individual drum/container logs (Attachment 2) will be inserted into Section 2 of the logbook when complete (when each container is filled and closed for shipping). All shipping manifest documentation and Land Disposal Restriction forms (if applicable) will be inserted into Section 3 of the logbook when available.

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of the occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

8.1 The individual executing these procedures will have read, and be familiar with, the requirements of this SOP. Execution of these activities will initially be supervised by more experienced personnel.

8.2 Personnel will also be health and safety trained and certified as specified by the HASP and Section 4.4 of the AECOM (2017) Hazardous Materials Shipping Procedure (S3AM-116-PR1).

9.0 References

AECOM 2019. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. [in prep].

AECOM 2017. Hazardous Materials Shipping (S3AM-116-PR1) Revision 2 June 26, 2017

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

10.0 Revision History

Revision	Date	Changes
0	April 2008	NA
1	July 2008	Remove “acid” from solvent waste procedures in Section 5.2.2; add destruction of labels to Section 5.3
2	June 2010	Added information specific to surface water sampling; logo change.
3	September 2010	Minor revisions throughout the document.
4	June 2011	Minor revisions throughout the document.
5	July 2011	Included Newark Bay Study Area
6	May 2019	Minor revisions for Current Conditions program. Remove reference to Newark Bay Study Area

Attachment 1 – Example of IDW Log

IDW Log
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

Task: ________

Drum No.	Volume	Description/Content	Manifest No.	Date	
				Full	Shipped

Standard Operating Procedure
Lower Passaic River Restoration Project

Sample Custody

Procedure Number: LPR-G-05

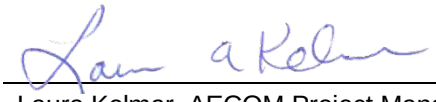
Revision No.: 7

Revision Date: May 2019

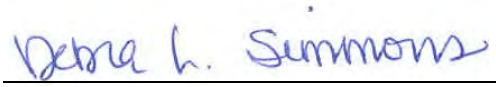
Prepared by

Kristen Durocher
Dion Lewis

Kristen Durocher, AECOM Task Manager — Date: May 14, 2019



Laura Kelmar, AECOM Project Manager — Date: May 14, 2019



Debra L. Simmons, AECOM Project QA Manager — Date: May 14, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for the chain-of-custody (COC) procedures associated with samples collected as part of the Lower Passaic River Restoration Project (LPRRP). The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements. Samples may include sediment or water collected or generated for chemical, radiochemical, biological, and/or physical analyses, and associated quality assurance (QA) analysis. This SOP is intended to be complete enough so that: 1) the steps which could affect tracking, documentation, or integrity of samples are explained in sufficient detail and 2) different sampling personnel following these procedures will deliver samples to the laboratory which are equally reliable and consistent, and in compliance with regulatory agency requirements.

1.2 It is expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the AECOM Task Manager and the Project QA Manager and will be communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although COC activities do not generally pose significant health and safety risks, sample exposure via external container residues may occur and much of the work going on in the vicinity of sample custodians requires attention to safety practices. Project-related physical, chemical and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011; AECOM, 2019).

2.2 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not applicable.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- sample containers as specified in the QAPP (Worksheet #19);
- sample labels;
- chain of custody forms;
- custody tape or seals;
- field logbook;
- ballpoint pen or fine-tipped marked (e.g., Sharpie®); and
- clear plastic sealing tape.

5.0 Procedures

5.1 General requirements

5.1.1 As few people as possible should handle the samples.

5.1.2 Sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge.

5.2 Sample identification

Each sample, including field samples and quality control (QC) samples (e.g., trip blanks, equipment rinsate blanks, field duplicates) will be assigned a unique identification. Refer to the corresponding QAPP (Worksheet #27) for the sample identification protocol.

5.3 Sample labeling

5.3.1 A label will be attached to each bottle used for sampling. Waterproof, adhesive labels are preferred. Labels will be applied to the container, not the lid, whenever possible.

5.3.2 When practical, the project identification, sample matrix, laboratory designation/analyses requested, field sample identification code, and preservation will be typed or printed onto the label before sampling. The label will be protected from water and solvents with clear packing tape, except in cases where not appropriate (for example, pre-weighed VOA vials).

5.3.3 Completion of the sample labels (including the sampler's initials and the date and time of sample collection) will occur at the time of sample collection. Labels will be completed in waterproof, indelible ink.

5.4 Sample tracking

5.4.1 From the time of collection through transportation, the handling of samples will follow COC procedures. A representative from each sampling team (e.g., from each vessel) will be assigned as the field sample custodian. This individual will be responsible for the custody of the samples from collection until release to CPG field facility Sample Management Officer (SMO) for processing or shipment to the laboratories, as appropriate. The field sample custodian will provide a sample transfer/custody form and the completed and electronic versions of the sample collection forms (refer to SOPs LPR-S-01 – Grab Sampling, LPR-S-02 – Sediment Coring Using a Piston Push Core, and LPR-S-03 – Sediment Sampling Using a Vibracorer) to the CPG Field SMO when relinquishing the collected samples for sample processing or shipment. The CPG Field SMO will verify the samples against the sample transfer/custody form and then sign the form accepting custody of the samples. An example sample transfer/custody form for field to CPG facility transfer of sediment cores is provided as Attachment 1; a similar form or a standard chain of custody (COC) form (Attachment 2) may be utilized for other types of samples.

5.4.2 A sample is considered under a person's custody if one or more of the criteria are met:

- sample is in the person's possession;
- sample is in the person's view after being in person's possession;
- sample was in the person's possession and then was locked up to prevent tampering; or
- sample is in a designated secure area.

5.4.3 Samples collected for analysis will be continuously tracked while in custody of AECOM staff and while in transit to the laboratory by use of the following procedures below. If samples are left in a locked building or vehicle, with limited and controlled access, the samples are considered to be a secure area.

5.4.4 Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory.

5.4.5 Pertinent information will be entered on the COC form (Attachment 2) and will include

- project identification (project and task number, LPRRP sampling program);
- signatures of samplers;
- sample identification code. This code should be unique to the sampling event and to the program and must agree exactly with the field sample identification code recorded on the bottle label;
- date and time of sample collection,
- sample matrix (sediment, water, etc.);
- analyses requested;
- number of sample containers;
- preservative;
- grab or composite sample designation (if applicable);

- sampler's remarks (optional). These comments may serve to alert the laboratory to highly contaminated samples or identify QC sample requirements.
- signatures of individuals involved in sample transfer;
- destination (e.g., laboratory name and location);
- page number (for example: 1 of 2, 2 of 2);
- if applicable, COC tape numbers; and
- if applicable, the air bill or other shipping number.

This information is consistent with guidance in SW 846, Test Methods for Evaluating Solid Waste (USEPA, 1993).

5.4.6 The COC will be manually filled out completely and legibly in indelible ink, or may be reproduced from electronic sample forms produced directly from software such as EQuIS Data Gathering Engine (EDGE)™ software from Earthsoft. COCs may be pre-printed with known information (project identification, parameters to be analyzed, etc.). Corrections will be made, if necessary, by drawing a single line through and initialing and dating the error. The correct information will then be recorded with indelible ink. There should be no unexplained blank spaces. Blank lines will be lined out and initialed and dated.

5.4.7 Each COC will be cooler-specific (i.e., list only the samples packed in the cooler). Information on the COC must agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

5.4.8 The completed COC form will be signed, dated, enclosed in a sealable plastic bag, and placed in the container prior to shipment. A copy of the COC will be retained by field personnel and stored in a dedicated binder or file. Additional copies will be distributed via email or fax as follows:

- Project Chemist or his/her designee;
- Data Management Task Manager or his/her designee;
- CPG QA coordinator, and
- laboratory project manager at each laboratory being used.

5.4.9 Samples will be considered in the custody of the field sample custodian or CPG Field SMO while in his/her possession or within sight, or maintained in a secure area prior to shipment. If the person packing the container and verifying the sample list (i.e., the CPG Field SMO) is different than the sampler, and the sample transfer/custody form (see Attachment 1 or equivalent) has been completed, the CPG Field SMO will sign the COC form to relinquish custody. The field sample custodian will sign each COC as the sampler.

5.4.10 If samples are to be shipped by commercial overnight carrier, COC seals must be used and the COC seal numbers recorded on the COC form. See Attachment 3 for an example COC seal. Refer to SOP LPR-G-06 – Packaging and Shipment of Environmental Samples for specific packaging procedures. Representatives of commercial carriers are not required to sign the COC form.

5.4.11 If samples are hand carried to a laboratory, custody will be maintained and documented on the COC form through the process (e.g., from the person packing the cooler to the person transporting the samples to the laboratory).

5.4.12 If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.4.10 or 5.4.11 will be followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

5.4.13 Upon receipt at the laboratory, the designated laboratory sample custodian will sign the COC form indicating receipt of the incoming field samples. The samples will be checked against the COC form upon arrival at the laboratory. The receiving personnel will enter all arriving samples into the laboratory system. Any discrepancies between the samples and the COC form(s), or any evidence of tampering with the shipping container or the custody seal will be immediately reported to the Project Chemist. The laboratory sample custodian will check the temperature of the cooler upon arrival at the laboratory and record the measured temperature on the COC and/or appropriate sample/cooler receipt forms. The Project Chemist will be immediately notified of any sample preservation issues, including temperature exceedances.

5.4.14 A completed copy of the COC form will be distributed via email or fax to the Project Chemist within 24 hours of sample receipt at the laboratory. The original will be retained by the laboratory.

6.0 Quality Assurance/Quality Control

6.1 Completed COCs will be reviewed by the individuals preparing the samples for shipment for completeness, accuracy, and legibility. Specifically, the samples and COC record will be compared to ensure agreement between the sample labels and the COC, and to verify the number of sample containers.

6.2 These records are subjected to periodic review by the Field Task Manager to verify adherence to the procedures outlined in this SOP.

7.0 Data and Records Management

7.1 The records associated with the custody process (transfer forms, COC records, airbills, etc.) will be maintained at the CPG field facility in an organized and contained manner (e.g., 3-ring binder or file folder) for the duration of the sampling event.

7.2 COC records will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP). No specialized training is required; however, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

AECOM, 2019. Health and Safety Plan. Lower Passiac River Restoration Project Current Conditions Study. [in prep]

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

AECOM 2010. Lower Passaic River Data Management Plan. August 2010, or current version.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-207-2009. September 2009 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

United States Environmental Protection Agency. 1997. SW 846, Test Methods for Evaluating Solid Waste.

10.0 Revision History

Revision	Date	Changes
0	May 2008	NA
1	July 2008	Changes to Sections 5.3, 5.4.1 and 5.4.8
2	September 2009	Minor changes to address non-sediment samples
3	June 2010	Minor changes to address surface water sampling; organizational changes; update logo
4	September 2010	Minor revisions throughout document
5	June 2011	Minor revisions throughout document
6	July 2011	Added Newark Bay Study Area
7	May 2019	Remove Newark Bay Study Area. Changes for Current Conditions program.

Attachment 1 Example Grab/Core Field Custody and Transfer Form

Grab/Core Field Custody and Transfer Form

Lower Passaic River Restoration Project, Remedial Investigation

Project No: 60145884

Grab/Core ID	Segment (Cores only)	Length (in)	Collection		Storage Conditions[1]		Comments
			Date	Time	Transit	Facility	

[1]Freeze (F) or chill on ice (C)

Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:
Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:
Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:

Attachment 2 Example Chain-of-Custody Form

AECOM

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name: **CPG/LPRRP RI LRC/Sediment Sampling**	Project Location: **Lower Passaic River, NJ**	Analysis Requested
Project Number: **60145884**	Field Logbook No.:	
Sampler (Print Name)/(Affiliation):	Chain of Custody Tape Nos.:	
Signature:	Send Results/Report to: **Marie Wojtas/ENSR** — TAT: **see QAPP**	

Container Type
P – Plastic
G – Glass
V – VOA Vial
O – Other
E – Encore

Preservative
1 – HCl
2 – H2SO4
3 – HNO3
4 – NaOH
5 – NaOH/ZnAc
6 – Na2S2O3
7 – Ice
8 – MeOH/DI water/ice

Matrix Codes:
DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water
S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

Field Sample No./Identification	Date*	Time*	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered											Lab I.D.	Remarks
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																
				√																

Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Analytical Laboratory (Destination):
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	
Relinquished by: (Print Name)/(Affiliation) Signature:	Date: Time:	Received by: (Print Name)/(Affiliation) Signature:	Date: Time:	Sample Shipped Via: UPS FedEx Courier Other — Temp blank: Yes No

*For sediments, represents the date and time of core/grab collection, not processing

Serial No. ____________

Attachment 3 Example Chain-of-Custody Seal

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Sample Packaging and Shipping

Procedure Number: LPR-G-06

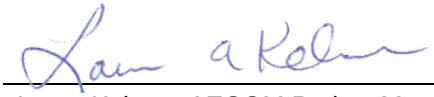
Revision No.: 6

Revision Date: May 2019

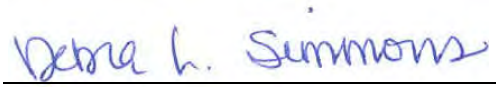
Prepared by

Kristen Durocher
Dion Lewis

Kristen Durocher, AECOM Task Manager — Date: May 14, 2019



Laura Kelmar, AECOM Project Manager — Date: May 14, 2019



Debra L. Simmons, AECOM Project QA Manager — Date: May 14, 2019

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for packaging and shipping samples collected as part of the Lower Passaic River Restoration Project (LPPRP). Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

1.2 It is expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the AECOM Task Manager and the Project Quality Assurance (QA) Manager and will be communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although packaging activities do not generally pose significant health and safety risks, sample exposure via external container residues may occur and much of the work going on in the vicinity of sample custodians/shippers require attention to safety practices. Project related physical, chemical, and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011; AECOM, 2019).

2.2 Sample packaging and shipping involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate precautions will be taken, including minimizing the weight of individual coolers, using hand carts to transport coolers, and using the buddy system to lift coolers into and out of vehicles.

2.3 Daily safety briefings will be conducted at the start of each working day before any work commences. These daily briefings will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Improper sample storage or inadequate protection against breakage and cross-contamination could potentially affect sample results. The field team will follow the details of this SOP to minimize these effects.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- inert packing material (e.g., foam peanuts, vermiculite, cardboard, bubblewrap, etc.);
- pre-preserved sample containers as specified in the QAPP (Worksheet #19);
- sample labels;
- chain of custody (COC) forms;
- insulated coolers;
- custody tape or seals;
- indelible marking pens;
- shipping tape;
- sealable plastic bags;
- temperature blanks (provided by the laboratory);
- field logbook;
- ice or similar chilling source;
- ballpoint pen or fine-tipped marked (e.g., Sharpie®); and
- clear plastic sealing tape.

5.0 Procedures

5.1 General requirements

5.1.1 Vehicular sample transport will adhere to normal/applicable Department of Transportation (DOT) regulations and air transport should follow applicable International Air Transport Association (IATA) regulations. DOT and IATA regulations/guidelines related to sample shipments can be viewed on AECOM's SH&E intranet web page.

5.1.2 An area for storing unused sample containers/coolers and a clean area for sample handling, packaging, and shipment will be designated at the CPG field trailer to avoid cross contamination concerns.

5.1.3 Laboratories will often re-use coolers. The interior and exterior of each cooler received at a project location should be inspected for cleanliness before using it. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) cannot be fashioned in the field.

5.1.4 Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with LPR-G-03 – Equipment Decontamination (Level II) prior to use.

5.1.5 The Field Task Manager or designee will notify the laboratory(ies) of the number, type and approximate collection and shipment dates for the samples in advance of any sample transfers and communicate any delays in sample shipment. The laboratory will be alerted when shipments are scheduled for weekend delivery, so that personnel are available to receive the samples.

5.2 Sample packaging and shipping will be done in accordance with applicable regulations, as described below:

5.2.1 After filling a sample container, affix cap and securely seal with clear tape **(except for samples to be analyzed for volatile organic compounds [VOCs])** and complete the sample label. Apply the label to the sample container and cover with clear tape.

5.2.2 Clean the outside of each sample container by wiping it off with a clean paper towel. Verify that residual sediment has been removed from the outside of the container, and from the area under and around the cap.

5.2.3 Place each glass sample bottle into an individual bubble bag sleeve provided by the lab or wrap each glass bottle/jar individually using bubble wrap secured with tape or rubber bands

5.2.4 Seal each sample container inside a sealable plastic bag. Samples for VOC analysis will be packaged together in a sealed plastic bag.

5.2.5 For those samples that require thermal preservation, place on ice or similar chilling source immediately after collection.

5.2.6 Place plastic bubble wrap matting in the bottom of each cooler or shipping container as needed. Insert a clean trash bag into the cooler to serve as a liner.

5.2.7 Transfer the samples to the plastic-lined cooler. Place bottles upright into the cooler. If a combination of plastic and glass sample containers are to be packed, alternate them within the cooler to further protect the glass. Use inert packaging material (e.g., cardboard, vermiculite, etc.) to cushion the samples and minimize the potential for breakage by placing additional packing material throughout the voids between sample containers and between any layers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling. Seal the drains on the ice chest (if present) with shipping tape or plug the drains with silicone sealant or a similar inert substance.

5.2.8 Place a trip blank in each cooler containing field samples for VOCs and/or TPH Purgeables analyses. It is suggested that sample containers used for VOC or TPH Purgeables analyses should be grouped together into a single individual cooler to limit the number of trip blanks required for transportation and analysis. Note that trip blanks are not required for aqueous QC samples such as equipment rinsate blanks.

5.2.9 Conduct an inventory of sample numbers, fractions and containers when placing samples into the coolers, and check the inventory against the corresponding COC form before sealing the cooler.

5.2.10 For those samples requiring thermal preservation, ice or similar chilling sources sufficient to maintain a temperature of 4° ± 2° Celsius (°C) will be placed inside the cooler during transport. Double bag cubed ice in heavy duty Ziploc type plastic bags to prevent leakage, close the bags, and distribute the packages in a layer over the top of the samples. If sample bottles are bubble wrapped, it is also permissible to insert double bagged ice packages between the sample bottles. Never place un-bagged loose ice directly into a cooler. Use sufficient ice to accommodate reasonable delays in shipment. A temperature blank provided by the analytical laboratory with each cooler will be included in the shipment.

5.2.11 Obtain two custody seals and enter the seal numbers on the COC form. Complete sample tracking documentation as described in SOP LPR-G-05 (Sample Custody), and place the documents in a sealable plastic bag inside the ice chest, taped to the inside of the lid.

5.2.12 Close the trash bag liner to prevent materials from spilling out. Secure chest lid with shipping tape by covering the entire seal with tape. Sign and date the two custody seals, affix the custody seals on opposing corners of the cooler lid and cover the seals with clear plastic tape. An example of a custody seal is attached to SOP LPR-G-05 (Sample Custody).

5.2.13 Shipping containers should be marked “THIS END UP”, along with arrow labels which indicate the proper position of the container. Labels used in the shipment of hazardous materials (e.g. Cargo Only Air Craft, Flammable Solids, etc.) are NOT permitted to be on the outside of containers used to transport environmental samples.

5.2.14 Repeat the above steps for each cooler or shipping container. If more than one cooler is being delivered to a laboratory, mark each cooler as “1 of 2”, “2 of 2”, etc.

5.2.15 Transport the shipping container directly to the laboratory, the laboratory courier, or to the overnight carrier for overnight delivery. Samples will be shipped by close of the same day, whenever possible.

6.0 Quality Assurance/Quality Control

6.1 Completed COCs will be reviewed by the individuals preparing the samples for shipment for completeness, accuracy, and legibility. Specifically, the samples and COC record will be compared to ensure agreement between the sample labels and the COC, and to verify the number of sample containers.

6.2 The laboratory will notify the Project Chemist within 24 hours of receipt in the event that samples are received broken, that there are sample preservation or holding time exceedances, or there are discrepancies between the custody paperwork and the sample containers.

6.3 The procedures and records associated with sample packaging and shipping are subjected to periodic inspection and review by the Field Task Manager to verify adherence to the procedures outlined in this SOP.

7.0 Data and Records Management

7.1 The records associated with the shipment process (COC records, airbills, etc.) will be maintained in the CPG field facility in an organized and contained manner (e.g., 3-ring binder or file folder) for the duration of the sampling event.

7.2 COC records will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Quality Management Plan (AECOM, 2009).

8.0 Personnel qualifications and training

Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, FSP). No specialized training is required; however, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

AECOM, 2019. Health and Safety Plan. Lower Passiac River Restoration Project Current Conditions Study. [in prep]

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011.

AECOM 2010. Lower Passaic River Data Management Plan. August 2010 or current version.

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

10.0 Revision History

Revision	Date	Changes
0	April 2008	NA
1	July 2008	Minor changes to Sections 5.1.5, 5.2.7, and 5.2.12
2	September 2009	Minor changes to Section 5.1.1, 5.2, and 7.3
3	September 2010	Minor revisions throughout the document
4	June 2011	Updates to references
5	July 2011	Include Newark Bay Study Area (NBSA)
6	May 2019	Remove NBSA. Minor editorial changes for Current Conditions program

Appendix D
Laboratory Standard Operating Procedures

ALS Standard Operating Procedure

DOCUMENT TITLE:	SAMPLE PREPARATION FOR SEDIMENT, PARTICULATE CARBON AND NITROGEN, AND PARTICULATE ORGANIC CARBON IN WATER
REFERENCED METHOD:	EPA 440.0/ASTM D3977
SOP ID:	GEN-POC PC PN SSC PREP
REV. NUMBER:	03.0
EFFECTIVE DATE:	05/21/2019

ALS Environmental

SAMPLE PREPARATION FOR SEDIMENT, PARTICULATE CARBON AND NITROGEN, AND PARTICULATE ORGANIC CARBON IN WATER

EPA 440.0/ASTM D3977

SOPID:	GEN-POC PC PN SSC PREP	Rev. Number:	03.0	Effective Date:	5/21/19

Approved By: _____ Date: 5/21/19
Client Services Manager – Wendy Hyatt

Approved By: _____ Date: 5/21/19
QA Manager – Bradley Kryst

Approved By: _____ Date: 5/21/19
Laboratory Director – Ralph Poulsen

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Archival Date:	5/21/19	Doc Control ID#:	19-GEN-001	Editor:	BJK

TABLE OF CONTENTS

SAMPLE PREPARATION FOR SEDIMENT, PARTICULATE CARBON AND NITROGEN, AND PARTICULATE ORGANIC CARBON IN WATER

1) Scope and Applicability

1.1 Particulate Carbon (PC) and Particulate Nitrogen (PN) in the sediment fraction of water are determined by first separating the sediment from the water through filtration using glass fiber filters. PC and PN are then determined concurrently using a CHN elemental analyzer. PC can also be determined using a carbon elemental analyzer. A Perkin Elmer model 2400, LECO Micro TruSpec CHN, or LECO Macro TruSpec CHN analyzers are used for this analysis. A LECO SC832 Sulfur – Carbon analyzer can also be used if only PC or POC are required.

1.2 Particulate Organic Carbon (POC) is determined using this method by exposing the sediment on the filter to fuming HCl and then analyzing the filter for total carbon. This treatment step removes inorganic forms of carbon (carbonates) leaving the organic carbon on the filter.

1.3 The Suspended Sediment concentration (SSC) in the water by can be determined by measuring the weight of the filter and the filter plus the sediment after going through the water filtration step. This method is based on ASTM method D3977. If PC, PN, or POC reported as a weight % of the dried sediment is required, then the SSC must be determined.

1.4 The method detection limits (mdl) for PC, POC, and PN are approximately 0.5 mg/L for PN or 0.2 mg/L for PC and POC based on analyzing a 200 mL water sample depending on the instrument used to perform the analyses. The approximate MDL for the Sediment contraction in water is approximately 2 mg/L for a 200 mL water sample. The MDLs are determined by the replicate analyses of blank filters that have gone through the normal sample preparation processes following the EPA protocol for July, 2018. The smaller or larger volumes of water can be filtered depending on the amount of sediment is the sample.

1.5 The filtrate collected from the filtrating process can be analyzed for Dissolved Organic Carbon (DOC) after the filtrate is preserved to a pH of < 2 with concentrated Sulfuric Acid.

2) Summary of Procedure

2.1 A water sample is filtered through a pre-combusted GF/F glass fiber filter to remove sediment from the water. If SSC is required, the pre-combusted filter is weighed prior to filtering and then re-weighed after filtering and drying to determine the concentration of sediment in the water sample. The filter containing the sediment is analyzed by an elemental CHN or Carbon analyzer. These instruments employ direct combustion of the sample in ultrapure oxygen at 935˚C to 1350˚C depending on instrument used. The elements of interest are converted to gases by the combustion process. Carbon is converted to CO2 and nitrogen to NOx which is then reduced to N_2 and reported as PC or PN.

2.2 POC is analyzed using the same analytical technique by analyzing GF/F filters that have been treated with fuming HCl after filtering sediment from the water sample.

2.3 After performing the preparation of water samples using the procedures detailed in the SOP, the analyses are performed for PC, PN, and/or POC following procedures detailed in the appropriate SOPs for CHN or Total Carbon analyses.

3) Definitions

3.1 Analytical Protocol – Samples are analyzed in a set referred to as an analytical protocol or sequence. The protocol begins with instrument calibration followed by calibration verification, samples, and batch QC samples. The instrument calibration must be verified at a method-required frequency by the analysis of verification standards. The sequence ends when the set of samples has been analyzed and continuing calibration has been demonstrated. As long as the continuing calibration criteria are met, analysis may continue to proceed.

3.2 Benchsheet – A form used to record the analytical protocol, sample information and data.

3.3 DI Water – Deionized water is laboratory pure water that has been passed through an initial deionizing system followed by a polishing deionizing system (ultrapure or Nanopure) producing water that meets ASTM Type I criteria for conductivity.

3.4 Prep Blank (PB) – The prep blank for this method consists of analyzing a blank GF/F filter that has gone through the sample treatment procedure as the samples. The purpose of the PB is to determine the levels of contamination associated with the sample preparation process as well as the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples.

3.5 Organic Analytical Standard (OAS) – These are analytically pure single compounds that are purified by multiple re-crystallizations. These standards are available from Elementar Americas or other micro-elemental supplier and must be NIST traceable.

3.6 Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) – A LCS is a QC sample with known concentrations of analytes that is of the same or similar matrix as the samples being analyzed. It is typically purchased from a qualified vendor and is supplied with certified true values and statistical acceptance ranges. The LCS may be a chemical, natural sample, or spiked natural matrix. Another name for LCS is Certified Reference Material (CRM), Standard Reference Material (SRM) or Quality Control Sample (QCS).

3.7 Laboratory Fortified Blank (LFB) – A LFB is a QC sample with known concentrations of analytes. It is prepared by analyzing an OAS (EDTA, Acetanilide and Phenacetin are examples) in a tin capsule for Total C and Total N or on a glass fiber filter for PC, POC and PN.

4) Responsibilities

4.1 Analyst

4.1.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the laboratory supervisor or designee.

4.1.2 The analyst is also responsible for the proper maintenance of the equipment according to the instructions in both this SOP as well as any other supplemental material sources. Maintaining the inventory of reagents, standards, and consumables for the proper function of this method is also a key responsibility of the analyst as they perform this method. This

responsibility includes following the laboratory supply ordering process to replace quantities as it becomes necessary.

4.2 Laboratory Supervisor

4.2.1 It is the responsibility of the Laboratory Supervisor or designee to ensure that the analyst receives proper training and that it is documented according to the SOP for the Documentation of Training as well as scheduling, and supervising the performance of the instrumental analysis. The supervision of the performance is done through the review and approval of QC and sample data, benchsheets and any pertinent instrument logbooks.

5) Interferences

5.1 Samples with suspended sediment or organic material that is larger than 0.5 mm can be homogenized using a blender in order to obtain a representative sample on the filter to improve the representativeness of the analytes in the sample.

5.2 POC values may exhibit a high bias for samples with high concentration of sediments with high levels of carbonates that do not fully react during the fuming HCl pretreatment step. A more aggressive acid treatment may be required in these situations.

6) Safety

6.1 Follow all ALS Environmental safety practices as described in the Chemical Hygiene Plan.

6.2 The toxicity or carcinogenicity of each compound or reagent used in the method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to the compounds should be reduced to the lowest possible level. A reference file of material safety data sheets is available to all personnel involved in these analyses. ALS Environmental also maintains a file of OSHA regulations regarding the safe handling of chemicals specified in these procedures.

6.3 Follow safety guidelines regarding Oxygen/Compressed Air Gas Cylinders.

6.3.1 Keep oil and grease away from regulators and gages.

6.3.2 Keep combustibles away from oxygen and eliminate ignition sources.

6.3.3 Release regulator tension before opening cylinder valve.

6.3.4 Stand away from outlet when opening cylinder valve.

6.3.5 Keep cylinder out of sun and away from heat and corrosive environment.

6.3.6 Keep cylinder secure at all times.

7) Sample Collection, Handling, and Preservation

7.1 Environmental samples can be adversely affected by biological activity and must be collected, preserved and analyzed in accordance with EPA method 440.0, “Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis”.

7.1.1 Water samples are collected in clean amber glass or plastic bottles for SSC, PC, PN and/or POC. The sample should be filtered through pre-combusted (550°C for 1.5 hour), pre-weighed GF/F glass fiber filters preferably with 48

hours of collection, but as soon as practical if samples are received past the 48 hours.

7.1.2 Used filters are stored at -20˚C or can be dried at 103-105˚C for 24 hours and placed in a desiccator.

7.1.3 A minimum of 2 filters and preferably three or four filters are needed for each sample. If the water sample cannot be filtered immediately, then the sample must be stored at 4˚C.

7.1.4 There are no established holding times for this method. Samples should be handled as detailed above to avoid degradation of the samples.

8) Apparatus and Equipment

8.1 Oven, 103-105˚C

8.2 Box Furnace, 550˚C

8.3 Blender, glass or stainless steel

8.4 Analytical Balance, 0.1 mg

8.5 Stainless steel fine tip forceps

8.6 Glass petri dish with lid, 60 x 15 mm

8.7 Porcelain dish, 100 mm

8.8 Vacuum Pump at < 10 in Hg

8.9 HCl Reaction Chamber, polypropylene box with lid and raised mesh floor

8.10 Refrigerator, 4˚C

8.11 Freezer, -20˚C

9) Standards, Reagents, and Consumable Materials

9.1 Acetanilide, OAS 99.9%+ purity

9.2 Phenacetin, OAS 99.9%+ purity

9.3 EDTA, OAS 99.9%+ purity

9.4 Hydrochloric Acid (HCl), Concentrated, ACS Reagent grade

9.5 Sulfuric Acid (H_2SO_4), Concentrated, ACS Reagent grade

9.6 Calcium Carbonate ($CaCO_3$), ACS Reagent grade

9.7 GF/F Glass Fiber Filters (47 mm and 25 mm)

9.8 NIST Buffalo River Sediment Standard Reference Material SRM 8704

10) Preventive Maintenance

10.1 General preventive maintenance is required of support equipment used in this method. Follow the equipment manual for operation and preventive maintenance.

11) Procedure

11.1 Filtration of Water Samples for PC and PN Determination

11.1.1 Record samples to be tested on a “PC PN and POC Prep Sheet”. If SSC is required, also use a “TS, TSS, TDS and/or TVS in Water” benchsheet form (see

Attachment 2 and 3). Each sample will use two to four filters. List each filter on the benchsheet. The water sample may be contained in a single 1L amber glass bottle or several smaller containers. If multiple smaller containers are provided use one container for each filter.

11.1.2 Place 47 mm GF/F glass fiber filters (25 mm filters if C & N are required) in a clean porcelain dish and heat at 550˚C in a furnace for 1.5 hours. Filters can be stacked.

11.1.3 Remove the porcelain dish with filters from the furnace and allow cooling for ~ 30 minutes. Place each pre-combusted filter in a labeled glass petri dish with cover and then store in a desiccator for a minimum of 60 minutes.

11.1.4 If SSC or the POC value reported as a wt% of the sediment is not required, the following weighing steps can be omitted.

11.1.5 Weigh pre-combusted filter to 0.1 mg on analytical balance, record weight, and return filter to petri dish and cover with lid. (Note - Use flat nose Teflon tip forceps when handling the filters).

11.1.6 Set up filtration rack with pre-cleaned 2 L filtering flasks and magnetic filtering funnels.

11.1.7 Assemble filtering funnel with first pre-weighed filter. Place filtering funnel into filtering flask.

11.1.8 Thoroughly mix the sample in the 1 L amber bottle and pour off 200 mL of sample into a pre-cleaned 200 mL Class A graduated cylinder. Larger or smaller volumes of sample can be used depending on the amount of sediment in the water and the desired detection limit. If the sample contains coarse organic matter, blend the sample in a glass or stainless steel high speed blender until the particles are < 0.5 mm is size.

11.1.9 Apply vacuum (at < 10 in Hg) to filtration unit and pour 50 mL aliquots of sample into the filtering funnel until the entire 200 mL is filtered. Gently swirl the last 50 mL aliquot in the graduated cylinder to re-suspend any sediment that has dropped out. Make sure that all sediment is transferred to the filtering funnel. If necessary use some of the filtered sample to rinse any remaining sediment from the cylinder into the filtering funnel or any sediment that may be adhering to the side of the filtering funnel down to the filter. Continue to apply vacuum until the GF/F filter is air dried.

- NOTE - Do not rinse the graduated cylinder, filtering funnel or filters with deionized water.

11.1.10 Turn off vacuum and carefully remove the filter and place in the appropriate petri dish and cover with lid.

11.1.11 Repeat steps 11.1.6 through 11.1.9 one to three more times for a total of two to four filters for each sample depending on the number of filters to be analyzed. At a minimum this number is two. Collect the filtrate in the original 2 L filtering flask for all 200 mL fractions. If the filtrate is needed for Dissolved Organic Carbon (DOC) or other analyses, proceed to 11.1.11. If not, the solution can be discarded and proceed to 11.1.12.

11.1.12 After completing the filtration steps for the all 200 mL aliquots, discard the remaining sample in the original 1 L amber bottle or separate 200 mL bottles. Rinse the bottles with several small aliquots of filtered sample

discarding the rinses. Pour the remaining filtered sample into the rinsed bottle. If the 1 L amber bottle cannot be rinsed clean, use a new bottle.

11.1.13 Preserve the filtered sample to a pH of < 2 with concentrated H_2SO_4 and mark with appropriate label. This sample can be used for Dissolved Organic Carbon.

11.1.14 Place petri dish and filter with lid removed in an oven at 103-105°C for 24 hours or for repeated drying cycles of 1 hour.

11.1.15 Remove petri dish and filter from oven, cover with lid and place petri dish in a desiccator for at least 30 minutes.

11.1.16 Remove petri dish and filter from desiccator and weigh filter with sediment and record weight to nearest 0.1 mg taking care to not lose any sediment on the filter.

11.1.17 If the filter and sediment were not dried for the 24 hours, return filter to petri dish and then to oven and repeat steps 12 through 14 drying the sample for one hour. Record second dry weight of filter on benchsheet. Repeat steps 12 through 14 if the difference between the initial and second weighing of the dried filter is greater than 0.5 mg. If the sediment on the filter weighs 12.5 mg or more, repeat the drying and re-weighing steps if the difference between the weights of the filter is > 4% of the mass of the sediment.

11.1.18 Record the weights of the filter and volume of sample used on the benchsheet and calculate the concentration of sediment in the sample in mg/L for each filter. The filters are now ready for analysis for PC and/or PN or for pre-treatment for POC.

11.2 Fuming HCl Treatment for POC Determination

- NOTE – all of the following steps must be conducted in a fume hood to prevent exposure to HCl fumes. Proper personal protection gear including lab coat, safety glasses and gloves must be worn.

11.2.1 Prepare the HCl reaction chamber (polypropylene box with lid and raised mesh floor) by pouring 100 mL of concentrated HCl in the bottom of the chamber. Place the raised floor in the chamber making sure that it is above the HCl.

11.2.1.1 A modification of the Fuming procedure is to use a sealable polypropylene tote with three 250 mL beakers with ~150 mL of conc. HCl placed evenly spaced apart inside.

11.2.2 Remove the lids from the petri dishes and place petri dishes with the filters on the raised floor of the reaction chamber. Close the chamber and leave the samples in the chamber undisturbed for 24 hours.

11.2.3 At the end of 24 hours, remove the petri dishes and cover them with their lids. Wipe the outside of the petri dishes with a damp paper towel to remove any HCl residue. The samples are now ready to analyze for POC.

12) Quality Assurance/Quality Control Requirements

12.1 Preparation Blank – A blank GF/F filter must be prepared following the same procedure as the samples at a frequency of one every 20 or less samples.

12.2 Several $CaCO_3$ filter blanks are prepared for each set of 20 or less samples. This blank is used to determine the effectiveness of the HCl fuming step. 2.5 to 5 mg of $CaCO_3$ is applied evenly across the surface of a blank filter. This filter is treated and analyzed with the samples. This sample is analyzed before running samples. The carbon value should be below the MDL and must be below the RL value. If the carbon value exceeds these limits, then the filters must be re-fumed with HCl for another 24 hour period.

12.3 NIST Buffalo River Sediment SRM 8704 is also used as a Laboratory Control Sample (LCS) that is fumed along with each set of 20 or less samples. 50 mg of the standard is spread out on a filter and then fumed with the samples. The TOC values are not certified and are based on in-house analyses for the fumed standard. The value is comprised of 40 or more historical analyses and has an average of 2.550% with a standard deviation of 0.138%.

12.4 A set of duplicate analyses are performed for each set of 20 samples.

13) Data Reduction and Reporting

13.1 Reporting Requirements

13.1.1 The benchsheet is to include the date and time that the fuming started as well as the end time.

13.1.2 The benchsheet is to be included with the analysis paperwork and labeled as POC Prep to identify it.

13.1.3 The lot number of the filters is to be recorded in the paperwork to allow for traceability.

14) Method Performance

14.1 Reporting Limit

14.1.1 The method detection limits (MDL) for PC, POC and PN are approximately 0.5 mg/L for PN or 0.2 mg/L for PC and POC based on analyzing a 200 mL water sample depending on the instrument used to perform the analyses. The approximate MDL for the Sediment contraction in water is approximately 2 mg/L for a 200 mL water sample.

14.2 Method Detection Limit

14.2.1 For data to be reported to the MDL, determine the MDL using the following procedure following the EPA protocol in “Definition and Procedure for the Determination of the Method Detection Limit– Revision 2”.

14.3 Practical Range

14.3.1 The practical range for this method is 3 to 5 times the MDL.

14.4 Precision and Accuracy

14.4.1 EPA Method 440.0 states the analysis of carbon and nitrogen in sediments was 1-11% RSD, while the analyses of particulate carbon and nitrogen in estuarine water samples was 9-14%. They state that the pooled method detection limits for particulate nitrogen and carbon in estuarine waters were 0.014 mg N/L and 0.064 mg C/L.

15) Pollution Prevention and Waste Management

15.1 It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible and within method requirements. Standards are prepared in volumes consistent with the laboratory use in order to minimize the disposal volume of expired standards. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

15.2 The laboratory will comply with all federal, state and local regulations governing waste management, paying particular attention to hazardous waste identification rules and land disposal restrictions as specified in the laboratory Chemical Hygiene Plan.

16) Corrective Actions for Out-of-Control Data

16.1 Corrective Action – The corrective action process is initiated when data quality problems are observed or suspected. These cases include contamination of blanks, RPD or recovery outside of Laboratory established limits, exceeded sample holding time, etc.

16.2 Duplicate Measurements – If the relative percent difference in the matrix sample/sample duplicate is ≥ 20% RPD, check sample for homogeneity and repeat analysis if the sample appears homogenous. A duplicate LCS can be included in the preparation to ensure that the duplicate measure is on a homogenous sample and represents the reproducibility of the preparation and analysis steps.

16.3 Laboratory Control Standard – LCS values must be within 85-115% recovery. If the values are outside of these values, the process is deemed out of control and **Section 16.4** needs to be initiated.

16.4 Nonconformity Documentation – Out of control events, conditions adverse to quality, are reported, documented and corrected. Out of control events (OOCE) may arise from the failure of a process, human error, non-compliance with requirements, inadequate controls or sample matrix problems.

16.4.1 Data quality issues must be documented on the analytical raw data and/or the data review checklist. All appropriate data qualifiers must be added to the final reported results.

16.4.2 Problems that arise from actions under laboratory control (e.g. blank contamination, blank spike failure), affect more than one batch, are more serious in nature or are indicative of an ongoing problem are documented on a Nonconformity and Corrective Action Form (NCAR).

16.4.3 The SOP for Corrective Actions contains a copy of the NCAR along with the procedure for filling out the form. It is filled out by the person identifying the event. Corrective action may require consultation with the Department Manager, the QA Manager and the Laboratory Director. The corrective action is then approved by the Supervisor and/or section Manager. The QA Manager gives final approval, and if necessary, provides to Project Chemists(s) for client notification.

17) Contingencies for Handling Out-of-Control Data

17.1 Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this (and other applicable) SOP(s). Also, refer to the SOP for *Nonconformance and Corrective Action* for correct procedures for identifying and

documenting such data. Procedures for applying data qualifiers are described in the ALS Environmental – Tucson Quality Assurance Manual or in project-specific requirements.

18) Training

18.1 Refer to the SOP for *Training Policy* (CE-QA003). The SOP describes the training outline and necessary documentation.

18.2 Review literature (see References section), this SOP and also review the safety procedures of the laboratory. Following these reviews, observe the procedure performed by an experienced analyst at least three times.

18.3 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from assisting in the procedure to performing the analysis with minimal oversight.

18.4 Independently perform an Initial Demonstration of Proficiency study and QC analyses. Summaries of the studies are reviewed and signed by the supervisor and Quality Assurance Program Manager. Copies are maintained in the employee's training file.

18.5 The training and proficiency is documented in accordance with the SOP CE-QA003.

19) Method Modifications

19.1 None

20) Summary of Changes

Table 20.1 Summary of Changes

Revision Number	Effective Date	Document Editor	Description of Changes
03.0	5/21/19	RP	Major revision of format and method
02.1	6/30/16	AJM	Added a review section to signature page 11 – Minor revision for clarity
02.0	9/30/14	AJM	Major revision of format 12 – adjust the mass of $CaCO_3$ used to match actual practice and added an LCS 13 – inserted a reporting section 16 – Revised and expanded for clarity
1	7/27/2013	AJM	Revise the format 3.6 – Revised for clarity 3.7 – Revised to accommodate the use of multiple instruments 12.2 – Renumbered to 12.1 and simplified for clarity 12.3 – 12.6 – Moved to CHM-CHN MAC SOP to separate preparation procedures from the analysis procedures 13 – Removed 14 – 23 – Renumbered to reflect the removal of 13 13.4 – Format change to match the rest of the SOP

21) References

21.1 EPA, Method 440.0 – Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis, Rev. 1.4, September 1997

21.2 ASTM D3977 – Determination of Sediment Concentration in Water Samples, 1997

21.3 ALS Environmental, Tucson, Arizona , Standard Operating Procedure for CHN by Combustion / Thermo-Conductivity Detection, most current version.

21.4 ALS Environmental, Tucson, Arizona , Standard Operating Procedure for Carbon and Sulfur by Combustion / IR Detection, most current version.

21.5 EPA, Definition and Procedure for the Determination of the Method Detection Limit, Revision 2, December 2016.

22) Attachments

Attachment 1 – Training Plan

Attachment 2 – PC PN and POC Prep Sheet

Attachment 3 – TS, TSS, TDS, and/or TVS Benchsheet

Attachment 1 – Training Plan

Training Plan for Analysis of:

Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water

SOP Title: *Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water*
SOP Code: *GEN-POC PC PN PREP*

Revision: _____ Date: _____

Trainee:_____

- Read SOP, method literature and instrument manual — Trainer: ____ Trainee: ____ Date: _____
  - understands the scientific principles of the method
- Demonstrated familiarity with: — Trainer: ____ Trainee: ____ Date: _____
  - analytical batches and analytical sequences
  - making entries into logbooks and onto benchsheets
  - significant figures
  - reporting limits
  - out of control events
- Observe performance of SOP — Trainer: ____ Trainee: ____ Date: _____
  - sample preparation
  - analytical sequence setup
- Perform SOP with supervision — Trainer: ____ Trainee: ____ Date: _____
  - sample preparation
  - analytical sequence setup
- Independent performance of the SOP — Trainer: ____ Trainee: ____ Date: _____
  - sample preparation
  - analytical sequence setup

Additional Training not listed above (*classes, seminar, web-based, etc. – description, place, and date*):

_____

_____

_____

_____

Training Form - POC Prep.doc
Created on 8/11/2011 9:49:00 AM

Attachment 2 - PC PN and POC Prep Sheet

ALS Environmental - Tucson, AZ

C H N O S

Analysis (circle appropriate)

POC and PC Prep

Instrument

Work Group #:
Analyst:
Analysis Date:
Analyst Review:
Supervisor Review:

Seq. No.	Sample ID	Sample Wt. mg	Pos	Remarks	Seq. No.	Sample ID	Sample Wt. mg	Pos	Remarks
1	GF/F Blank	200000	blank	POC	31				
2	CaCO3 Blank	200000	caco2	with ~ 3 mg CaCO3	32				
3	NIST 8704 (4634)	53.991	Nist1		33				
4	NIST 8704 (4634)	52.301	Nist2		34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Remarks

Duplicates prepped but not needed for test, only run as needed

CHNOS Benchsheet
Rev 01.0

Page__ of __

Benchsheet - PC PN and POC Prep Sheet
5/20/2019

Attachment 3 – TS, TSS, TDS, and/or TVS Benchsheet

ALS Environmental - Tucson, AZ
TS, TSS, TDS, and/or TVS in Water
Gravimetric, 105C, 180C, & 450C

Reporting Limit	
Detection Limit	

Work Group #:	
Analyst:	
Analysis Date:	
Analyst Review:	
Supervisor Review:	

Method of Drying	Temperature °C	Start Time	End Time	Oven used

Method of Ashing	Temperature °C	Start Time	End Time	Furnace used

SX Type	Sample ID	Cup No.	Sample Vol mL	Cruc. Wt. g	Cruc. & Dried Sx Wt. g	Cruc. & Ash Sx Wt g	TS, TSS, or TDS mg/L	TVS mg/L	TS, TSS, or TDS % RPD	Ash % RPD	Remarks

Note: If the sample matrix is organic with no free moisture and requires only ash, enter the sample & cruc. wt. in both "Cruc. & Wet Sx Wt." and "Cruc. & Dried Sx Wt." columns. SX type must be dup for the spreadsheet to calculate the %RPD

TS, TSS, TDS, and/or TVS in Water
Rev 01.1

Page ___ of ___

Benchsheet - TSS TDS TVS in Water Rev01.1
5/20/2019

ALS Standard Operating Procedure

DOCUMENT TITLE:	TOTAL CARBON AND SULFUR BY COMBUSTION / INFRARED DETECTION
REFERENCED METHOD:	ASTM D4239, D6316, D5373, D1552, E1915, EPA 440.0
SOP ID:	CHM-SC832
REV. NUMBER:	00.0
EFFECTIVE DATE:	05/20/2019

TOTAL CARBON AND SULFUR BY COMBUSTION / INFRARED DETECTION

ASTM D4239, D6316, D5373, D1552, E1915, EPA 440.0

SOPID:	CHM-SC832	Rev. Number:	00.0	Effective Date:	05/20/19

Approved By: _____ Date: _____
Project Manager – Wendy Hyatt

Approved By: _____ Date: _____
QA Manager/Technical Director – Brad Kryst

Approved By: _____ Date: _____
Laboratory Director – Ralph Poulsen

Reviewed By: _____ Date:_____

Reviewed By: _____ Date:_____

Reviewed By: _____ Date:_____

Reviewed By: _____ Date:_____

Reviewed By: _____ Date:_____

Archival Date: _____ Doc Control ID#: _____ Editor: _____

TABLE OF CONTENTS

TOTAL CARBON AND SULFUR BY COMBUSTION/INFRARED DETECTION

1) Scope and Applicability

1.1 Total Carbon and Sulfur (CS) are determined concurrently using direct measurement that includes sample combustion at either 1350˚C or 1550˚C followed by infrared cell detection (IR) of the resulting CO_2 and SO_2 gases. A LECO SC832 is used for this analysis. The LECO Macro TruSpec can be used for Total Sulfur and Total Carbon. This SOP addresses the operation of the LECO SC832 only.

1.2 An important aspect of the SC832 analyzer is that there are three total "channels" or optical cells. There is a high carbon optical cell, a low sulfur optical cell and a high sulfur optical cell. It is important to be aware of which sulfur measurement the software is reporting as a final result.

1.3 This method is applicable to a variety of sample matrices ranging from chemically pure solid and liquid organic and inorganic chemicals to complex solid, semi-solid and liquid matrix samples such as pharmaceuticals, environmental samples, fuels, plant and animal tissues, etc. The concentration ranges based on using the optimum sample weights for C is 0.05% to 100.0% and S is 0.03% to 100.0%. High concentrations of these elements require analysis on smaller sample aliquots.

1.4 This method can be used to analyze Particulate Carbon (PC) or Particulate Organic Carbon (POC) in water. A water sample is filtered through a pre-combusted and pre-weighed GF/F glass fiber filter to remove sediment from the water. The filter with sediment is dried and then re-weighed to determine the concentration of sediment in the water sample. The filter containing the sediment is analyzed by the SC832. POC is analyzed using the same analytical technique by analyzing GF/F filters that have been treated with fuming HCl after filtering sediment from the water sample. Special sample preparation procedures and QA requirements exist for these analyses and must be followed. They can be found in the most current SOP - *Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water, CHM-POC PC PN PREP.*

1.5 Total Organic Carbon (TOC) or Combustible Carbon can be performed using this method. These methods follow the Khan method for TOC and ASTM D6316 for Combustible Carbon. Both methods involve an acid pretreatment to remove carbonates leaving only organic carbon. This method can also be used to determine Acid Insoluble Sulfur or Sulfur Forms.

2) Summary of Procedure

2.1 Carbon and Sulfur concentrations are determined through the infrared radiation absorbing property of CO_2 and SO_2 gases. Each of these gases absorbs specific characteristic spectral wavelengths of infrared radiation. Samples of 1 mg to 500 mg dependent on sample matrix and availability are introduced into the SC832 analyzer and combusted in a stream of ultra high purity grade oxygen at 1350˚ or 1550˚C depending on the combustibility of the samples. The elements of interest are converted to gases by the combustion process. Carbon is converted to CO_2 and sulfur to SO_2.

3) Definitions

3.1 Analytical Protocol – Samples are analyzed in a set referred to as an analytical protocol or sequence. The protocol begins with instrument calibration followed by calibration verification, samples and batch QC samples. The instrument calibration must be verified at a method-required frequency by the analysis of verification standards. The

sequence ends when the set of samples has been analyzed and continuing calibration has been demonstrated. As long as the continuing calibration criteria are met analysis may continue to proceed.

3.2 Benchsheet – A form used to record the analytical protocol, sample information and data.

3.3 Type I Water – Type I water is laboratory pure water that has been passed through an initial deionizing system followed by a polishing deionizing system (ultrapure or Nanopure) producing water that meets ASTM Type I criteria for conductivity.

3.4 Organic Analytical Standard (OAS) – These are analytically pure single compounds that are purified by multiple re-crystallizations. These standards are available from Elementar America or other suitable supplier and must be NIST traceable or have a purity of > 99.9%.

3.5 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) – An LCS is a QC sample with known concentrations of analytes that is of the same matrix as the samples being analyzed. It is typically purchased from a qualified vendor and is supplied with certified true values and statistical acceptance ranges or a purity. The LCS may be a chemical, natural sample or spiked natural matrix.

3.6 Initial Calibration (ICAL) – A series of standards of known concentrations is analyzed to establish the relationship (ratio) between instrument response and analyte concentration. The calibration standards must be NIST traceable or have a purity of ≥ 99.9%.

3.7 Initial Calibration Verification (ICV) – Standards are used to verify that the instrument calibration is accurate. Standards used as ICVs are from sources different than those used to calibrate the instrument. The independent calibration standards must be NIST traceable or have a purity of ≥ 99.9%. An OAS, LCS, or CRM can be used as an ICV.

3.8 Continuing Calibration Verification Standard (CCV) – CCVs are standards analyzed at various points in the analytical sequence to verify that the instrument is still in calibration. The CCVs are typically the same standards used to calibrate the instrument but may include different OASs, LCSs or CRMs.

3.9 Lower Limit of Quantitation Check (LLOQ) - The lower limit of quantitation check (LLOQ) sample should be analyzed after establishing the lower laboratory reporting limits to demonstrate the desired detection capability.

3.10 Very High Level Standard (VHL) – standard prepared at the highest concentration that the analyst would like to report at for each analyte.

3.11 Instrument Blank (IB) – The instrument blank consists of performing an analysis without introducing any reagents into the instrument. The purpose of the IB is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carryover of analytes from standards or highly contaminated samples.

3.12 Prep Blank (PB)/Method Blank (MB) – The prep blank consists of analyzing a weighing boat that has undergone the same procedure as the samples to be evaluated. The purpose of the PB is to determine the levels of contamination associated with the instrumental analysis itself, as well as any contamination associated with the preparation procedure.

4) Responsibilities

4.1 Analyst

4.1.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the laboratory supervisor or designee.

4.1.2 The analyst is also responsible for the proper maintenance of the SC832 instrument according to the instructions in both this SOP as well as the instrument manual. Maintaining the inventory of reagents and standards for the proper operation of the instrument is also a key responsibility of the analyst as they operate the instrument. This responsibility includes following the laboratory supply ordering process to replace quantities as it becomes necessary.

4.2 Laboratory Supervisor

4.2.1 It is the responsibility of the Laboratory Supervisor or designee to ensure that the analyst receives proper training and that is documented according to the SOP for the Documentation of Training as well as scheduling and supervising the performance of the instrumental analysis. The supervision of the performance is done through the review and approval of QC, sample data, benchsheets and any pertinent instrument logbooks.

5) Interferences

5.1 The samples analyzed by this method must be of a very fine particle size, preferably < 60 mesh and thoroughly homogenized.

5.2 Samples that are refractory in nature such as silicon carbide will show low results by this method due to incomplete combustion and oxidation of carbon.

5.3 For carbon analysis, the ceramic combustion boats used to introduce the sample should be pre-combusted at a minimum of 1000˚C for one hour by furnace. Optionally, two boats can be combusted one at a time at ≥ 1,350˚C with the instrument as blanks. The Boat Cleaning Function may be used: **Instrument > Automation > Maintenance.**

5.4 Samples high in moisture or water samples can use up the magnesium perchlorate drying tubes very quickly. The reagent tubes must be routinely monitored – before and during an analytical run.

5.5 The chemical containers must be closed immediately to avoid the saturation of carbon dioxide or moisture.

6) Safety

6.1 Follow all ALS Environmental safety practices as described in the *Chemical Hygiene Plan*.

6.2 The toxicity or carcinogenicity of each compound or reagent used in the method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to the compounds should be reduced to the lowest possible level. A reference file of material safety data sheets is available to all

personnel involved in these analyses. ALS Environmental also maintains a file of OSHA regulations regarding the safe handling of chemicals specified in these procedures. Volatile samples, such as gasoline, should not be analyzed to avoid damaging the instrument and for the safety of the analyst.

6.3 Follow safety guidelines regarding oxygen/compressed air gas cylinders.

6.3.1 Keep oil and grease away from regulators and gages.

6.3.2 Keep combustibles away from oxygen and eliminate ignition sources.

6.3.3 Release regulator tension before opening cylinder valve.

6.3.4 Stand away from outlet when opening cylinder valve.

6.3.5 Keep cylinder out of sun and away from heat and corrosive environment.

6.3.6 Keep cylinder secure at all times.

7) Sample Collection, Handling, and Preservation

7.1 For non-environmental samples there are no specific requirements for sample collection, containers, shipping, storage or handling. Samples should be treated in a sound scientific manner that does not compromise the sample integrity by keeping the samples in inert containers and away from heat, moisture or prolonged exposure to air.

7.2 Samples that may be affected by biological activity should be kept in the refrigerator at 4 ± 2°C. Some samples are air sensitive or hydroscopic and require the use of a nitrogen purged dry box to handle and weigh the sample prior to analysis. In these situations, the sample must remain in a nitrogen atmosphere until just prior to analysis. The physical state and any changes in the sample are written on the benchsheet.

7.3 Samples must be homogeneous and of a fine particle (< 60 mesh) to insure accurate and precise data. Samples that do not meet these requirements and can be prepped without changing the chemical integrity of the sample should be ground using an agate mortar and pestle or mini ball mill or milled using the knife mill or coffee mill. Samples that require grinding or milling may require air drying the sample prior to the preparation process. The Air Dry Loss (ADL) moisture and residual moistures are determined to report data on an “As Received” or “Moisture Free” basis.

7.4 There are no established holding times for non-environmental samples. Some samples are unstable and require immediate analysis. The client must notify the laboratory of these situations and the samples handled accordingly. Any special sample handling is noted on the sample submittal form and final report.

7.5 Environmental samples can be adversely affected by biological activity and must be collected, preserved, and analyzed in accordance with EPA method 440.0, “Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis”.

7.5.1 Water samples are collected in clean amber glass bottles for Particulate Carbon (PC) or Particulate Organic Carbon (POC). The sample should be filtered through pre-combusted (550°C for 1.5 hr), pre-weighed GF/F glass fiber filters immediately after collection. Filters are stored at -20°C or can be dried at 103-105°C for 24 hr and placed in a desiccator. A minimum of two filters and preferably three filters are need for each sample. If the water sample cannot be filtered immediately, then the sample must be stored at 4°C.

7.5.2 Environmental sample matrices for Total Carbon (TC) or Total Organic Carbon (TOC) are preferably stored at 4˚C. Freezing at -20˚C is also acceptable.

7.5.3 There is no EPA regulatory holding time for TC and TOC, but 28 days is often used as a project requirement.

8) Apparatus and Equipment

8.1 LECO SC832 Analyzer

8.2 Microbalance with 0.001 mg capability

8.3 Balance with 0.0001 g capability

8.4 Dry box (glove box) with nitrogen purge

8.5 Stainless steel fine tip forceps

8.6 Boat Insertion Rod

8.7 Boat Removal Rod

8.8 Spatula

9) Standards, Reagents, and Consumable Materials

9.1 The items listed below are routinely used in performing CS analyses. Items with manufacturer and part numbers are proven to work well with this instrumentation. These items can be purchased from other vendors if the item is equivalent to those normally used.

9.2 Magnesium Perchlorate, Anhydrous – reagent grade - $Mg(ClO_4)_2$ is used to absorb the moisture in the samples (water trap).

9.3 Potassium Iodide – reagent grade - used as a halogen trap material

9.4 Antimony metal – Alpha Resources, AR608 - used as a halogen trap material

9.5 Alphasolve II ® – Alpha Resources, AR2174 - Alphasolve is NaOH with a binder and is used to absorb the carbon dioxide in the samples (CO_2 trap).

9.6 Combustion Control for Liquid – Alpha Resources, AR427 - used to avoid the evaporation of liquids samples.

9.7 Coal Standards – CRM that can be used as an LCS, CCV or ICV from Alpha Resources, QAR, ARMI, NIST, etc. Standards should be dried or have current moisture analysis.

9.8 Residual Oil Ultimate Standards – CRM that can be used as an LCS, CCV or ICV from Alpha Resources, ARMI, NIST, etc.

9.9 Soil Standards – CRM that can be used as an LCS, CCV or ICV from Alpha Resources, NIST, etc. analyzed on an as received basis.

9.10 Waste Oil Standards – CRM that can be used as an LCS, CCV or ICV from Alpha Resources, NIST, etc.

9.11 Oxygen – ultra high purity grade

9.12 Sulphanilamide - OAS > 99.99% purity

9.13 Combustion Boat

9.14 Tin capsules, 6 x 4 mm – Alpha Resources, ATD1006

9.15 Vanadium Pentoxide – Alpha Resources, AR636 - an additive to help liberate sulfur

9.16 Phosphoric Acid - ACS grade

9.17 Potassium Carbonate (~ 0.1%), Anhydrous - ACS grade

9.18 Sodium Carbonate, Anhydrous - ACS grade

10) Preventive Maintenance

10.1 If the software is not open, select the cornerstone software and open.

10.2 To access the instrument for maintenance go to **Instrument > Automation > Maintenance > Front Panel Maintenance**

- Execute Step 1 to move the autosampler out of the way and Step 2 to move the autosampler back into position.

10.3 The counters of the instrument will indicate what maintenance needs to be performed. They are located at **instrument > Maintenance > Counters**

- Use the Inspect function to indicate that the selected maintenance was checked, but not needed to be performed. IE Halogen trap is not orange and does not need to be changed.
- Use the Perform function to indicate that the maintenance was performed.
- The notes for the maintenance will list the approximate steps to perform the maintenance. See the instrument manual for further details.

10.3.1 WARNING!

10.3.1.1 The idling temperature of the instrument is 1100°C and must be cooled to room temperature for some of the maintenance such as replacing the combustion tube

10.3.1.2 Other maintenance may bring the analyst in close proximity to heated surfaces.

10.4 Check the UHP O_2 tank pressure, replace the tank if it is < 500 psi to avoid running out of gas during the run.

10.5 Turn the Gas on from the bottom row of tools and go to **Diagnostics > System Check** Start the system check. All twelve checks should pass. If any check fails, do not operate the instrument and determine the source of the error.

11) Procedure

11.1 Detailed operating procedures of the SC832 analyzer can be found in the instrument manual.

11.2 **Preparation of the instrument for analysis**

11.2.1 At the start of the analytical run it may be useful to clear the previous data off of the screen. This is done with the use of the filter function located at the top tool bar of the Analysis screen.

11.2.1.1 There are various filters that can be applied to data, the most commonly used one is by date. Select the date tab and the following options will appear.

- Clear – removes any previous filters
- Date and Hour options - will filter out any data that has not occurred within that time range

- Apply - will apply the selected filtering options
- Collapse – will hide the options for filters without removing the filter from the data

11.2.2 Go to **Analysis > + Blank** to create a Blank Type Entry. Select the appropriate method and autosampler location and press the Analyze or LECO button to begin. The instrument will begin warming up to the method set furnace temperature.

11.2.3 This is the Instrument Blank and No Boat is loaded onto the autosampler. The listed position is left blank.

11.2.4 The instrument will require at least 15 minutes to reach operating temperature. After it has reached that temperature it will run the instrument blank.

11.3 Setting up the Analysis Batch

11.3.1 After the Instrument Blank, a conditioner is analyzed. The conditioner is used to prepare the IR cells for analysis after the instrument has been allowed to return to the idling temperature. It is performed at the start of the day prior to the analysis of the blanks.

11.3.1.1 Go to **Analysis > + Standard** to create a Standard Type Entry. Enter the name of the standard used and place a boat onto the balance.

11.3.1.2 Tare the boat and weigh an aliquot into the boat using the table in 11.5.5.2 as a guide.

11.3.1.3 This is just to treat the IR cells, the obtained value is not important.

11.3.2 Next, three blanks are measured and used to perform the blank correction.

11.3.2.1 Go to **Analysis > + Blank** to create a Blank Type Entry.

- Log in three blanks and run them. Multi-select the three consecutive blanks and check the display at the bottom of the screen. If the values are reproducible use the **Blank** button up at the top tool list. Pressing it will take you to the blank correction window. Using the save button will save the new blank correction.
- Use the Multi Select tool at the top tool bar of the Analysis screen by tapping the tool multiple data entries can be selected at the same time. Selecting the Select tool will clear all of the multiple selections.

11.3.3 Next, three drift standards are measured and used to perform the drift correction.

11.3.3.1 Go to **Analysis > + Drift** to create a Drift Type Entry.

- Log in three drift standards. The method will determine which standards can be used to drift and what masses are allowed.
- After they are analyzed multi-select the three consecutive drift standards and check the % RSD if the value is ≤ 10% or the deviation listed in the Certificate of Analysis it can be used to drift by selecting the Drift Icon from the tools at the top of the analysis screen. Save to accept the new drift.

11.4 **Instrument QC**

11.4.1 After the Blank/Drift Corrections are done the applied corrections must be verified by the analysis of a CCV, CCB, ICV and LLOQ. So long as the standards are logged in to the standards list and the correct values entered, the instrument will highlight failing QC in orange on the Analysis screen.

11.4.1.1 The CCB is a boat blank at the same mass that was used to blank correct the instrument. It is also logged in as a Blank Type Entry and must have a wt% < RL.

- The CCB may also double as the PB/MB if there is no prep associated with the samples.

11.4.1.2 The CCV is the same standard that was used to drift the instrument at the same mass that was used to drift the instrument and must have a % recovery of 90-110% or the limits listed in the Certificate of Analysis, whichever is greater.

11.4.1.3 The ICV is an independent standard checked at a different concentration and lot number from the CCV and must also have a % recovery of 90-110% or the limits listed on the Certificate of Analysis, whichever is greater.

- The ICV may also double as the LCS if there is no prep associated with the samples.

11.4.1.4 The LLOQ is used to determine the reporting limit for the data that day. Due to the low concentration and mass of the LLOQ the acceptance limits are expanded to 70-130% recovery or the listed limits in the Certificate of Analysis, whichever is greater.

11.4.2 The CCV is repeated every 10 or fewer samples.

11.4.3 The ICV and CCB is repeated every 20 or fewer samples.

11.5 **Procedure for Standard Analysis of Carbon and Sulfur (or Sulfur only)**

11.5.1 An analytical batch consists of one method blank and one LCS analyzed every 20 samples. One duplicate will be analyzed every 10 samples. The blanks and duplicates are prepared along with the samples. If there is no prep associated with the samples the MB is also the CCB and the LCS is also the ICV.

11.5.2 Log in the MB like a normal blank. Log in the LCS as a standard.

11.5.3 Log in the samples as samples with **Analysis > + Sample** be sure to include at least one duplicate. If more than one duplicate is needed be sure to decrease the number of samples in the analytical batch appropriately.

11.5.4 The Multi Select tool can be used to highlight and examine multiple data entries and the Multi Field tool can be used to copy select fields from the first selected entry to the proceeding entries and saved via the apply button at the bottom of the analysis screen.

11.5.5 When the mass reading is stable, click the “Balance” button in the software or press the transfer button on the balance to transfer the weight from the balance to the software. The weight is read from the balance and appears in the “Weight (mg)” field. Each press of the transfer button will make a new entry in the analysis list moving from top to bottom. The weight can also be manually typed into the software with either the touchscreen or the keyboard.

11.5.5.1 For analysis of small masses, the sample can be weighed into a tin capsule on a microbalance. The tin capsule would then be placed into the combustion boat and the mass from the microbalance typed into the software manually.

11.5.5.2 The following is a list of matrix types and the general mass requirements. The sample mass should be approximately the amount in the table. The actual masses used will depend on the analyte concentration and the desired analytical signal. The analytical signal from the measured standards needs to bracket or be within ± 10% that of the samples. The analytical signal refers to the instrument response (the area measured) and not the analyte concentration. If the sample saturates, is outside of the linear range or forms soot in the trap Combustion Control and/or less sample should be used.

Sample	mg
Ash	50
Soil	200
Salt	25
Coal	100
Wood	150
TDF	100
Sludge	100
Fuels, Oils	75
Aqueous	50
Black Liquor	50
Other Misc.	200

11.5.5.3 Liquid samples that are volatile or quickly absorb into the boat should always be analyzed using Combustion Control. This is to reduce the loss of analyte due to a volatile sample or sample soaking through the boat. Samples that do not measurably evaporate in the time frame of an analysis and do not soak through the boat can be analyzed without Combustion Control.

- A minimum amount of Combustion Control should be used to minimize the occurrence of extended combustions.

11.5.5.4 Fluffy samples that quickly combust and cause soot to gather in the trap must be covered with Combustion Liquid and if possible the sample mass reduced.

11.5.6 Place the combustion boat with sample on the corresponding autosampler tray and position.

11.5.6.1 Click the "START" button in the software the instrument will begin running the listed samples until it reaches the end of the list or reaches a point that has been paused by the analyst.

11.5.7 As the carbon and sulfur combust, the computer screen graph will show real time tracings of the carbon and sulfur peaks. Blanks and some samples with no carbon or sulfur will show a steady baseline with minimal peaks.

11.5.8 Upon completion of the analysis, the carbon and sulfur data will be shown on the screen next to the analysis entry and the instrument will begin to move to the next sample.

11.6 Correcting errors in login

11.6.1 Errors made while creating entries into the analysis list can be corrected before they are analyzed by tapping on the incorrect entry and selecting the correct entry from the list at the bottom of the screen for most information.

11.6.2 If an entry was missed it is possible to create a space for the missed entry or when another measurement is required for failed QC.

11.6.2.1 Select the analysis line closest to where the new space is needed and increase the number of replicates from one to two.

11.6.2.2 Then select the first replicate and use the split function from the tool bar at the top of the screen to remove the replicate from that sample and place it in an entry of its own.

11.6.2.3 Then fix all of the sample information paying close attention to the auto loader location.

11.7 Pausing the analysis

11.7.1 To pause the analysis at a specific sample, halting the analysis at that point.

11.7.1.1 Highlight the analysis line, use the Pause tool in the top tool bar. An analysis that has been paused will have a double bar icon over the select point of the replicate.

11.7.2 To remove a pause on an analysis simply select the entry and the Pause tool and use the Clear option.

11.7.2.1 Note that if the analysis is running, the next sample in line cannot be paused as the instrument already has it queued.

11.8 **Exporting Data**

11.8.1 Open the Excel benchsheet from the benchsheets and templates folder.

11.8.2 In the cornerstone software use the multi select tool to select all of the analytical run data from the Instrument Blank to the final CCV.

11.8.2.1 Go to **Analysis > Output** and choose the copy option.

11.8.2.2 Go to the blank Excel benchsheet and paste the data into the tab labeled Raw Data.

11.8.2.3 The benchsheet will format the data into an easy to view format on the Benchsheet Tab.

11.9 **Analysis of Total Organic Carbon**

11.9.1 Weigh 100-500 mg of the sample into combustion boat and record sample weight on benchsheet.

11.9.1.1 200 mg is the preferred mass to increase the chance of analyzing a representative sample.

11.9.2 Add 1:1 Phosphoric Acid dropwise until any effervescence stops.

11.9.3 Heat the sample to 75-85˚C. The samples need to get to 75˚C for the reaction to completely convert the carbonates present to CO_2 and to partially dry the samples to prolong the life of the analyzer trap. The samples should be left in for 30-60 minutes. The time and the temperature of the oven must be written on the benchsheet.

11.9.4 Analyze using the Total Organic Carbon Matrix method following the procedure in **Section 11.5** and analyte specific LCS standards.

11.9.5 The method will be calibrated using soil standards with certified values for total carbon and standards with certified TOC values will be prepared and analyzed every 20 samples to ensure the preparation procedure is valid.

11.9.5.1 A preparation blank with the same number of drops of acid as the sample that took the most drops will be prepared and analyzed every 20 samples as well.

11.9.5.2 The preparation batch at a minimum will consist of one method blank per 20 samples, one LCS per 20 samples and one duplicate per 10 samples.

11.9.5.3 A CCV is analyzed every 10 samples. The blanks and duplicates are prepared along with the samples. If the prepared duplicates have an RPD larger than 20%, a duplicate CCV must be performed at the next instance to demonstrate the reproducibility of the instrument.

11.10 **Analysis of Combustible Carbon**

11.10.1 Weigh 100-500 mg of the sample into combustion boat and record sample weight on benchsheet.

11.10.2 Add 10% HNO_3 dropwise to wet the sample and allow the sample to stand for five minutes before continuing to the drying step.

11.10.3 Heat the sample in an oven or on a hotplate at < 150˚C until dry, taking care that the sample does not spatter.

11.10.4 Analyze using the Total Organic Carbon Matrix method following the procedure in **Section 11.5** and analyte specific LCS standards.

11.10.5 The method will be calibrated using soil standards and standards with certified TOC values will be prepared and analyzed every 20 samples to ensure the preparation procedure is valid.

11.10.6 A preparation blank with the same number of drops of acid as the sample that took the most drops will be prepared and analyzed every 20 samples as well.

11.10.7 The preparation batch at a minimum will consist of one method blank per 20 samples, two LCSs per 20 samples and two duplicates per 10 samples.

11.10.8 The analytical batch will consist of a CCV every 10 samples. The blanks and duplicates are prepared along with the samples. If the prepared duplicates

have an RPD larger than 20%, a duplicate CCV must be performed at the next instance to demonstrate the reproducibility of the instrument.

11.11 **Analyzing PC and POC on Glass Fiber Filter**

11.11.1 Analyze the filters prepared following *SOP Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water by Combustion/Thermo-Conductivity or Infrared Detection*, using the PC POC Matrix method.

11.11.2 Calibration of the instrument is performed using 50 mg of Soil or Sediment CRMs following the steps outlined in **Sections 11.5**.

11.11.3 The filters are rolled or folded to avoid losing sediment and placed in the combustion boat.

11.11.4 The sample weight is manually entered into the software. It is the volume of the water filtered through the filter in µL * fraction of the filter used. The reported values from the instrument are in ppm.

11.11.5 Perform the analyses following procedures in **Sections 11.5**.

11.11.6 This method has specific QA/QC requirements that must be followed. See these in the SOP listed above.

12) Quality Assurance/Quality Control Requirements

12.1 Instrument Blank and Conditioner: No associated QC

12.2 Blank correction: Reproducibility is impacted by the cleanliness of the boats, the analytes to be tested and the use of Combustion Control and has no specific requirements as long as the CCB passes.

12.3 Drift correction: the three consecutive replicates must have ≤ 10% RSD or the deviation listed in the Certificate of Analysis.

12.4 Continuing Calibration Verification – CCV are analyzed after the blank and drift corrections and every tenth or fewer samples. Recovery for CRMs used as CCVs must be 90-110% recovery or within the certified values whichever is larger.

12.5 Continuing Calibration Blank – CCB are analyzed after the blank and drift corrections and every 20 or fewer samples. The value must be less than the reporting limit or 10% of the lowest sample analyzed.

12.6 Initial Calibration Verification – ICV are analyzed every 20 or fewer samples and the values must be within 90-110% recovery or the certified values whichever is larger.

12.7 Lower Limit of Quantitation Check (LLOQ) – standard prepared with a known concentration to check the accuracy of the calibration at the quantitation limit. LLOQ is analyzed once per run. Recovery for LLOQ s must be 70-130% recovery.

12.8 VHL Standard - A standard at the highest reporting level is run if necessary. Recovery must be 90-110%. If the VHL standard does not pass the high samples must be reanalyzed at a lower sample mass with Combustion Control.

12.9 Preparation Blank/Method Blanks – PB/MB are measured every 20 samples or fewer at the beginning of the batch. PB/MB values must be < RL. The acceptable levels may be higher if the analytical results are more than 10X the blank value or if the preparation steps inherently adds to the analytical signal. An example is the TOC method where the act of adding acid and drying introduces carbon into the system. One source of carbon is the adsorption of carbon species from the air by the sample and the boat.

12.10 Duplicate Analyses – A duplicate sample must be analyzed every ten or fewer samples and have a RPD of ≤ 5% of the original value for chemically pure samples greater than 10X MRL. Environmental or natural matrix samples such as coal, plant tissue, etc. may have a larger variation. For these samples a RPD of ≤ 20% is acceptable if greater than 10X MRL. If there is insufficient sample to perform a duplicate analysis, a duplicate LCS can be substituted. If the duplicate falls outside of the acceptance limits a triplicate must be tested.

12.11 Quality Control for PC and POC by EPA 440.0 – These analyses have specific QA requirements in addition to the instrument QA requirements. These requirements are listed in the most current SOP - *Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water by Combustion/Thermo-Conductivity or Infrared Detection*.

12.12 Any deviations of the QA/QC requirements must be documented on the benchsheet and the Laboratory Supervisor or his/her designate notified prior to submitting data for approval.

13) Data Reduction and Reporting

13.1 Calculations

13.1.1 Use the equation below to correct for an error in the mass that was input into the software:

$$\text{Corrected wt\%} = \frac{\text{Measured wt\%} * \text{mass}_1}{\text{mass}_2}$$

Where: Measured wt% = the wt% calculated by the software
mass_1 = the original mass input into the software
mass_2 = the corrected mass

13.1.2 Use the equation below to convert from OV wt% to total mg:

$$\text{Total mg} = \text{sample weight (mg)} * \frac{\text{OV wt\%}}{100}$$

13.1.3 Use the equation below to calculate the RPD.

$$\text{RPD} = \frac{S - SD}{AVG} * 100\%$$

Where: S = Sample result
SD = Sample duplicate result
AVG = Average of S and SD

13.1.4 Use the equation below to calculate the RSD.

$$\text{RSD} = \frac{\text{StDev}}{AVG} * 100\%$$

Where: StDev = Standard Deviation
AVG = Average Values

13.1.5 Use the equation below to calculate the % Recovery.

$$\%R = \frac{OV}{TV} * 100\%$$

Where: OV = Observed value

TV = True value

13.2 The values entered for all of the weights and volumes should be confirmed to be correct as well as a confirmation that all of the QC limits have been met according to **Section 12**.

13.3 Reporting Requirements

13.3.1 Because the data is transferred directly from the instrument software to the Excel file, no raw data must be printed.

13.3.2 The % RPD is calculated by hand and entered into cornerstone software in the sample description.

13.3.3 The % recovery is calculated in the benchsheet.

13.3.4 The benchsheet and data are to be filed for secondary analyst review. After secondary analyst review the benchsheet and data are filed for scanning into the network drive.

14) Method Performance

14.1 Reporting Limit

14.1.1 Data is reported to a Reporting Limit (RL) of approximately 0.05 wt% for Carbon and 0.03 wt% for Sulfur based on the mg of sample analyzed, method and LLOQ standard.

15) Pollution Prevention and Waste Management

15.1 It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible and within method requirements. Standards are prepared in volumes consistent with the laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

15.2 The laboratory will comply with all Federal, State and local regulations governing waste management, paying particular attention to hazardous waste identification rules and land disposal restrictions as specified in the laboratory *Chemical Hygiene Plan*.

16) Corrective Actions for Out-of-Control Data

16.1 Corrective Action – The corrective action process is initiated when data quality concerns and problems are observed or suspected. These cases include but are not limited to the contamination of blanks, RPD or recovery outside of Laboratory established limits, etc.

16.2 CCV - If the CCV recovery falls out of acceptable range and fails a retest, the analytical batch must be stopped and the source of the problem identified and resolved.

16.2.1 The samples analyzed after the last acceptable CCV and before the failed CCV must be analyzed again.

16.3 ICV – If the ICV recovery falls out of acceptable range and fails a retest, the analytical run must be stopped and the source of the problem identified and resolved.

16.3.1 The initial step is to analyze the standard used to set the calibration correction to determine if the instrumental response has changed.

16.3.2 A different ICV with a similar analyte signal as the failed ICV should be analyzed to determine if the issue is a standard that is no longer of known value. The analyses can continue if the different ICV meets the acceptance criteria.

16.3.3 Re-drift correct the instrument by performing the procedure detailed in **Section 11.5.5** again.

16.4 LLOQ – If the LLOQ recovery falls out of acceptable range and fails a retest, the analytical batch must be stopped and the source of the problem identified and resolved.

16.4.1 The initial step is to check to see if the mg being analyzed are too low. Drift correction should also be reviewed.

16.4.2 If the standard meets the acceptance criteria for the LLOQ , a different standard with a similar analyte signal as the failed LLOQ should be analyzed to determine if the issue is a standard that is no longer of known value. The analyses can continue if the different LLOQ meets the acceptance criteria.

16.5 Preparation Blank/Method Blank – Preparation Blank and/or Method Blank contamination indicates the potential for a positive bias in the sample data.

16.5.1 If the preparation/method blank is above the acceptance criteria and less than 1/20th of the sample concentrations, the analysis is acceptable and a note should be written on the benchsheet.

16.5.2 If there is a limit on available sample, then a new PB/MB and LCS should be prepared and used in addition to the original LCS and samples to allow for an estimation of the effect the contamination had on the sample analysis.

16.5.3 If the preparation/method blank fails to meet the acceptance criteria and causes the retest of samples or a data qualifier to be added to the report, **Section 16.7** must be applied to document the procedure for correcting the situation.

16.6 Relative Percent Difference – If the relative percent difference in the sample/sample duplicate does not meet acceptance criteria, check sample for homogeneity. If the sample duplicate is outside of the RPD acceptance range analyze a triplicate and determine the % RSD.

16.7 Nonconformity Documentation – Out of control events are reported, documented, and corrected. Out of control events (OOCE) may arise from the failure of a process through human error, inadequate controls or sample matrix problems.

16.7.1 Data quality issues must be documented on the analytical raw data and/or the data review checklist. All appropriate data qualifiers must be added to the final reported results.

16.7.2 Problems that arise from actions under laboratory control (e.g. blank contamination) and affect more than one batch are more serious in nature or are indicative of an ongoing problem are documented on a Nonconformity and Corrective Action Report (NCAR).

16.7.3 The NCAR is filled out by the person identifying the event. Corrective action may require consultation with the Department Manager, the QA Manager, and the Laboratory Director. The corrective action is then approved by the Supervisor and/or section Manager. The QA Manager gives final approval and if necessary informs the Project Manager(s) for client notification.

17) Contingencies for Handling Out-of-Control Data

17.1 Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this (and other applicable) SOP(s). Procedures for applying data qualifiers are described in the ALS Environmental – Tucson *Quality Assurance Manual* or in project-specific requirements.

18) Training

18.1 Review literature (see References section), this SOP and also review the safety procedures of the laboratory. Following these reviews, observe the procedure performed by an experienced analyst.

18.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from assisting in the procedure to performing the analysis with minimal oversight.

18.3 Independently perform an Initial Demonstration of Proficiency study and QC analyses. Summaries of the studies are reviewed and signed by the supervisor and Quality Assurance Manager. Copies are maintained in the employee's training file.

19) Method Modifications

19.1 None

20) Summary of Changes

Table 20.1 Summary of Changes

Revision Number	Effective Date	Document Editor	Description of Changes
00.0	5/20/19	N. Bordowitz	New SOP

21) References and Related Documents

21.1 Standard Test Methods for Sulfur in the Analysis Sample of Coal and Coke Using High-Temperature Tube Furnace Combustion Methods, ASTM Method D4239, Revision 14.

21.2 Standard Test Method for Determination of Total, Combustible and Carbonate Carbon in Solid Residues from Coal and Coke, ASTM Method D6316, Revision 09b.

21.3 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal and Coke, ASTM Method D5373, Revision 14.

21.4 Standard Test Method for Sulfur in Petroleum Products (High-Temperature Method), ASTM Method D1552, Revision 15.

21.5 Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared-Absorption Spectrometry, ASTM Method E1915, Revision 13.

21.6 Kahn, L. Determination of Total Organic Carbon in Sediment. U.S.EPA 1988. Total Organic Carbon (TOC) in Soil, SW-846 Method 9060, 1999.

21.7 EPA, Method 440.0 – Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis, Rev. 1.4, September 1997.

21.8 ALS Environmental, Tucson, Arizona , Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon, most current version.

21.9 832 Series Sulfur/Carbon Analyzer with cornerstone brand software, Instruction Manual Version 2.5 Part # 200-765.

22) Attachments

22.1 Figure 1 – Carbon and Sulfur Prep Benchsheet

22.2 Figure 2 – Carbon and Sulfur Analysis Benchsheet

Figure 1 - Carbon and Sulfur Prep Benchsheet

ALS Environmental - Tucson, AZ

C H N O S

Analysis (circle appropriate)

Instrument

Work Group #:
Analyst:
Analysis Date:
Analyst Review:
Supervisor Review:

Seq. No.	Sample ID	Sample Wt. mg	Pos	Remarks	Seq. No.	Sample ID	Sample Wt. mg	Pos	Remarks
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

Remarks

CHNOS Benchsheet
Protected 3/21/2012

Page___ of ____

Figure 2 – Carbon and Sulfur Analysis Benchsheet

ALS Environmental - Tucson, AZ
SC 832, Sulfur and Carbon Analyzer

RUN #:
Analyst and Start Date:
Analyst Review:
Supervisor Review:

	[Conc.] % LLOQ STD	g LLOQ STD	mg analyte	BAL-012 for mass >20mg
CRL	0.10		#VALUE!	BAL-001 for mass <20mg
SRL	0.10		#VALUE!	

						SULFUR					Carbon			
Seq	Analysis Date and Time	Name	Sample Mass (g)	Notes and RSD	Moist. %	Sulfur Range	S% Report Dry	TV (W%)	%R	S mg	C% Report Dry	TV Wt%	%R	Cmg
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														
51														
52														
53														
54														
55														
56														
57														
58														
59														
60														
61														
62														
63														
64														
65														
66														
67														
68														
69														
70														
71														

TOTAL AND DISSOLVED ORGANIC CARBON (TOC, DOC), TOTAL INORGANIC CARBON (TIC), AND TOTAL CARBON (TC) IN WATER

SM 5310C-2011; EPA 9060A; EPA 415.1

DOCUMENT I.D. GEN-TOC

Prepared By: _____ Date: 1/4/19
Department Manager, Jeff Coronado

Prepared By: _____ Date: 1/4/19
Quality Assurance Manager, Carl Degner

Approved By: _____ Date: 1/4/19
General Manager, Ambrose Hughey

Doc Control ID:	_____	Archived Date:	_____

1) Scope & Applicability

1.1 This procedure is applicable to the determination of Total Organic Carbon (TOC) in drinking, surface and saline waters, domestic and industrial wastewater using methods EPA 9060A, EPA 415.1,and Standard Methods 5310C-2011. The procedure may also be extended to certain domestic or industrial wastes.

1.2 This procedure may be modified for quantification of Dissolved Organic Carbon (DOC) where

1.3 DOC is determined from a filtered sample.

1.4 Normal operating parameters (i.e. 1 ml sample loop) yield a Method Reporting Limit (MRL) of 0.5 mg/L C. A 5 ml sample loop may be used to lower the MRL to 0.1 mg/L C. The data quality objectives for target analytes in water are presented in Table 2 and in the ALS Kelso DQO Table.

1.5 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD)* may supersede the requirements defined in this SOP.

2) Summary of Procedure

2.1 Total Organic Carbon (TOC) is determined by measuring carbon dioxide released by chemical oxidation of the non-purgeable organic carbon in the sample. After the sample has been acidified and purged of inorganic carbon, sodium persulfate, a strong oxidizer, is added. This oxidant quickly reacts with non-purgeable organic carbon in the sample at 100°C to form carbon dioxide. When the reaction is complete, the carbon dioxide is purged from the solution, concentrated by trapping then thermally desorbed (200°C) and carried into a non-dispersive infrared detector that has been calibrated to directly display the mass of carbon dioxide detected. The resulting carbon mass in the form of carbon dioxide is the equivalent to the mass of organic carbon originally in the sample.

2.2 Total Inorganic Carbon is determined by carbon dioxide released by acidification of a sample. The pH of the sample is lowered; the carbonate and bicarbonate ions are then converted to carbon dioxide. This carbon dioxide is purged from the solution, concentrated by trapping, and detected as described for TOC.

3) Definitions

3.1 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.1.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start

of processing of the first and last samples in the batch to be 24 hours.

3.1.2 Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2 Sample

3.2.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3 Quality System Matrix - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1 Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.

3.3.2 Drinking water - Any aqueous sample that has been designated a potable or potential potable water source.

3.3.3 Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.4 Method Blank (MB) - a solution of the laboratory prepared deionized water that is carried through analysis like a sample, to serve as a measure of contamination associated with laboratory storage, preparation, or instrumentation.

3.5 Filtration Blank - The filtration blank is an artificial sample composed of analyte-free water and is designed to monitor the introduction of artifacts into the filtration process. The filtration blank is carried through the entire filtration procedure.

3.6 Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.7 Sample Duplicate - a second aliquot of a sample that is treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures. Matrix Spike - aliquots of sample to which known amounts of an analyte of interest has been added. These are treated exactly the same throughout laboratory analytical procedures. The purpose of a matrix spike is to determine whether the sample matrix contributes bias to the analytical results.

3.8 Calibration Standards - a solution of analytes prepared in the laboratory from stock standard solutions, diluted as needed, and used to calibrate the instrument response with respect to analytical concentration.

3.9 Independent Verification Standard (ICV) - A mid-level standard injected into the instrument after the calibration curve and prepared from a different source than the initial calibration standards. This is used to verify the validity of the initial calibration standards. The LCS when prepared from a different source will also serve as the ICV.

3.10 Laboratory Control Standards (LCS) - a solution of analytes prepared in the laboratory from stock standard solutions purchased or prepared independently from calibration standards.

3.11 Continuing calibration blank (CCB) - a blank solution of deionized water. CCB's are analyzed to verify that the instrument has not become contaminated during the course of the analytical run.

3.12 Continuing calibration verification standard (CCV) - a solution of prepared in the laboratory at approximately the midpoint of calibration curves. CCV's are analyzed to verify that the instrument performance has not changed during the course of the analytical run.

3.13 Rinse Blank (RB) - a solution of the laboratory prepared deionized water that is carried through analysis like a sample, to serve as a measure of carry-over from the previous sampling and analytical run.

4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.

4.2 It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency is also the responsibility of the department supervisor/manager or designee.

5) Interferences

5.1 Carbonate and bicarbonate carbon are interferences under the terms of this test and must be removed or accounted for in the final calculations

5.2 This procedure is applicable only to homogenous samples that can be injected reproducibly by microliter type syringe or pipette. The opening of the syringe or pipette limits the size of particles which may be included in the samples. The Teledyne TOC Fusion™ analyzer can analyze samples with suspended solids up to 500 microns diameter.

5.3 Positive bias may be caused by contaminants in the gas, dilution water, reagents, glassware, or other sample processing hardware. The use of high purity reagents and gases help minimize interference problems. Materials may be demonstrated to be free from interference by running reagent blanks

5.4 Interference by non-CO_2 gases: The infrared detector is sensitized to carbon dioxide and accomplishes virtually complete rejection of response from other gases which absorb energy in the infrared region. Trapping and desorption of carbon dioxide on

the molecular sieve trap isolates the component of interest and allows the complete absence of interference in the system from gases other than carbon dioxide.

6) Safety

6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

6.2 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

6.3 Sodium Persulfate is a strong oxidizer and should be handled with extreme care.

6.4 Phosphoric Acid is a corrosive material should be handled with extreme care.

6.5 Potassium Biphthalate and Sodium Carbonate are chemical irritants and may cause eye burns.

7) Sample Collection, Containers, Preservation, and Storage

7.1 For most accurate analyses, sampling containers should be free of organic contaminants.

7.2 Sampling and storage of samples in glass bottles is preferable. If this is not feasible, sampling and storage in plastic bottles such as conventional polyethylene and cubitainers is permissible if it is established that the containers do not contribute contaminating organics to the samples.

7.2.1 **Note:** A brief study performed at the EPA Laboratory indicated that distilled water stored in new, one quart cubitainers did not show any increase in organic carbon after two weeks exposure.

7.3 For samples requiring very low-level TOC analysis (below about 500 ppb C) attention to limiting contamination may be required. If possible, rinse bottles with sample before filling and carry field blanks through sampling procedure to check for any contamination that may occur. Collect and store samples in glass bottles protected from sunlight and seal with TFE-backed septa. Use certified clean sample vials for sampling and analysis. However if certified clean containers are not available or are found to be cleaned insufficiently further cleaning may be required. If necessary before use, wash bottles with acid, seal with Aluminum foil, and bake at 400˚C for at least one hour. Wash un-cleaned TFE septa with detergent, rinse repeatedly with organic free water, and wrap in aluminum foil and bake at 100˚C for one hour. Check performance of new or cleaned septa by running appropriate blanks. Preferably use thick silicone rubber-backed TFE septa with open ring caps to produce a positive seal. Less rigorous cleaning may be acceptable if the concentration range is relatively high. Check bottle blanks to determine effectiveness or necessity of cleaning.

7.4 Because of the possibility of oxidation or bacterial decomposition of certain components in aqueous samples, the time between sample collection and analysis should be minimized. In addition, the samples should be kept cool (4°C) and protected from sunlight and atmospheric oxygen.

7.5 In situations where analysis cannot be performed within two hours (2 hours) of sampling, the sample must be acidified (pH < 2) with Phosphoric or Sulfuric acid. Once preserved, samples must be analyzed within 28 days. Note that acid preservation invalidates any inorganic carbon determination on the samples.

7.6 Samples requiring DOC analyses should be filtered through a prewashed 0.45 micron glass microfiber membrane filter prior to acid preservation. A DI water filter blank should also be included with the filtration batch to determine potential for sample contamination from filter or filtration apparatus.

8) Apparatus and Equipment

8.1 TOC analyzer: Teledyne -Tekmar, Model TOC Fusion, S/N: US10165001.

8.2 Whatman 0.45µm glass microfiber membrane filter, or equivalent.

9) Standards, Reagents, and Consumable Materials

9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased neats or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.

9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

9.3 Potassium Biphthalate (KHP) stock solutions:

9.3.1 1000 ppm C stock solution is prepared by adding 2.128 g of KHP (previously dried to a constant weight at 105°C) into a 1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 1.0 ug C per ul.

9.3.2 5000 ppm C stock solution is prepared by adding 10.64 g of KHP (previously dried to a constant weight at 105°C) into a 1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 5.0 ug C per ul.

Note: Stock solution has a shelf life of six months after preparation. Sodium oxalate and acetic acid are not recommended as stock solutions.

9.3.3 Calibration standards used are 5 ppm and 50 ppm. The instrument is configured to make Standard dilutions.

9.3.4 Sodium Carbonate Stock solution (1000 ppm C) - Prepare stock solution by adding 8.826 g of Na_2CO_3 (previously dried to a constant mass at 105°C) to a

1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 1.0 ug C per ul.

9.3.5 Sodium Persulfate - Prepare solution of sodium persulfate by dissolving 100g $Na_2S_2O_8$, into (852 mL DI H_2O plus 36 mL H_3PO4), then purge with N_2 for 30 minutes before use. Reagent has a shelf life of one month.

9.3.6 Phosphoric Acid (21%) - Prepare 21% by volume solution of phosphoric acid by adding 150 mL of ACS reagent grade 85% H_3PO_4 to 450 mL reagent water. Reagent has a shelf life of one month.

9.3.7 Continuing Calibration Verification (CCV) - The CCV is prepared by diluting 10.0 mLs of 5000 ppm TOC stock solution 1000 mLs of deionized water in a Class "A" volumetric flask. Resulting concentration is 50.0 ppm. The instrument runs the CCV check standard at a 1:2 dilution (25 ppm).

9.3.8 Laboratory Control Sample (LCS) - The LCS is prepared from an ERA QC - Plus Demand solution. The true value is determined based on the lot number of the standard.

9.3.9 Gas Service: Nitrogen.

10) Preventive Maintenance

10.1 Daily Maintenance Checks

10.1.1 Verify the gas source is supplying an input pressure of 50 psi.

10.1.2 Verify that there is ample persulfate available for sample analysis. Verify that the persulfate has not expired.

10.1.3 Verify that there is ample acid available for sample analysis. Verify that the acid has not expired. Make sure the DI water supply is sufficient for sample analysis.

10.1.4 After the UV lamp has warmed up for 15 minutes, verify that the detector baseline is within the range of 0-5 Absorbance units (Abs). Perform the Detector Offset function if necessary.

10.1.5 Verify that the waste container has sufficient volume to contain the waste generated.

10.2 Weekly Maintenance Checks

10.2.1 Check the copper side of the halogen scrubber. When copper is discolored completely, replace both the copper and tin in the scrubber.

10.2.1 Make sure the two screws that attach the 7-port Valve to the Syringe Pumper are tight.

10.3 Monthly Maintenance Checks

10.3.1 Inspect and clean the reactor and sparger if necessary.

10.3.2 Flush sample transfer line with generous amounts of DI water. Inspect the

permeation dryer for damage and water accumulation.

10.4 Semi-Annually Maintenance Checks

10.4.1 Replace the O-rings in the UV reactor vessel.

10.5 For additional information refer to the Fusion™ Preventative Maintenance section of the User Manual, Page 8-2.

11) Procedure

11.1 TOC analyzer: Teledyne -Tekmar, Model TOC Fusion - Preparation and Analysis

11.1.1 Perform the required daily maintenance checks.

11.1.2 If the TOC TekLink™ software is not already in operation, launch the TOC TekLink™ software.

11.1.3 Login with the User Name: (Fusion 1) and Password: (Fusion1), and connect into the Fusion program.

11.1.4 Open the daily startup schedule, save the schedule to reflect the current date (m/d/y/, make any necessary adjustments, and click "Ready".

- TOC/DOC daily startup schedule: CAS_SALT_010711.
- Extended Reaction (for salt water) daily startup schedule, Extended Reaction 021711.
- TIC/DIC daily startup schedule: IC 030411.
- TOC Low Level daily startup schedule: CAS_High_Sensitivity.

11.1.5 After the UV lamp has warmed up for 15 minutes, verify that the detector baseline is within the range of the 0-5 Absorbance units (Abs).Perform the Detector Offset function if necessary.

Note: *If the instrument is allowed to sit idle for 20 minutes, it will automatically switch to standby mode.*

11.1.6 Click the start button to start the sequence.

11.1.7 The schedule should contain three Cleans, one Reagent/Acid Blank, and one rinse blank before the first CCV.

11.1.8 Scan the samples barcode into the Run Sequence and load the samples into the carousel. Ensure that the sample's positon on the schedule matches the number on the carousel.

11.1.9 An initial CCV is run after the Rinse Blank and must be analyzed following every tenth injection and at the end of the run. The CCV is a 25.0 ppm TOC Standard made from stock KHP solution. Recovery must be **90-110%** of the value (**91-106% for Arizona** samples). For low level analyses (i.e. 0.1ppm MRL), the CCV is a 5.0 ppm standard. Calculate the CCV recovery as follows:

%R = X/TV x 100

Where X = Measured concentration of the CCV
TV = True value of CCV

11.1.10 A Continuing Calibration Blanks (CCB) must be analyzed every 10 injections. CCB measured concentrations must be less than the MRL.

11.1.11 Sample Analysis

11.1.11.1 Once the UV lamp has warmed up for 15 minutes, and the detector baseline is within the range of 0.5 Absorbance units (Abs), the instrument is ready for analysis.

11.1.11.2 Load samples vials into the autosampler carousel according to the analytical run sequence shown below. Thoroughly shake TOC samples before loading. Click the start button on the schedule to begin analysis.

11.1.12 When performing method 5310C and EPA 415.1, analyze all environmental samples in duplicate. .

11.1.13 When performing method 9060A, analyze all samples in quadruplicate.

12) Quality Assurance/Quality Control Requirements

12.1 Initial Precision and Recovery Validation

12.1.1 The ability of each analyst/instrument to generate acceptable accuracy and precision must validated and documented before analysis of samples begins, or whenever significant changes to the procedures have been made To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed. Method criteria must be met for these results.

12.2 Method Detection Limits and Method Reporting Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike seven blank matrix (water or soil) samples with MDL spiking solution at a level below the MRL. Follow the analysis procedures to analyze the samples.

12.2.2 Calculate the average concentration found (x) in µg/mL, and the standard deviation of the concentrations (s) in µg/mL for each analyte. Calculate the MDL for each analyte. Refer to the ALS *SOP Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (CE-QA011).* The MDL study must be verified annually.

12.3 Limits of Quantification (LOQ)

12.3.1 The laboratory must establish a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. Refer to the ALS SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (*CE-QA011*).*

12.3.2 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.4 Ongoing QC Samples each sample batch (20 or fewer samples) required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QC Samples are:

12.4.1 Method Blank (MB)

12.4.1.1 A method blank is extracted and analyzed daily with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.

12.4.2 Laboratory Control Sample (LCS)

12.4.2.1 A Laboratory Control Sample (LCS) for SM 5310C and EPA 415.1 must be analyzed with each batch of 20 or fewer samples. The LCS is prepared from a standard which is an independent source from the calibration standards. Acceptance criteria are given in Table 2. This statistically derived acceptance limit is subject to change as limits are updated.

12.4.2.2 When performing Method 9060 analysis, the second source LCS must be analyzed every 15 samples rather than every 20 samples.

12.4.2.3 Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered
TV = True value of amount spiked

12.4.3 Sample Duplicates (DUP)

12.4.3.1 A sample duplicate or matrix spike duplicate (MSD) must be analyzed with every analytical batch.

12.4.3.2 Calculate Relative Percent Difference (RPD) as:

$$\%\,RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$ Where R = Result

12.4.3.3 The RPD is calculated as follows:

$$\frac{Hi - Lo}{Avg.} \times 100$$

12.4.4 The percent RPD for EPA 9060A and EPA 415.1 must be $\leq$**20%**. This statistically derived acceptance limit is subject to change as limits are updated. For SM 5310C, all duplicates must be within **10%** RPD.

Relative Percent Difference calculation:

$$\%\,RPD = \frac{(S - D)}{((S + D)/2)}$$

where: S = Initial sample result
D = Duplicate sample result

12.4.5 Matrix Spikes

12.4.5.1 For SM 5310C and EPA 415.1, analyze one matrix spike sample (MS) for every analytical batch of twenty samples.

12.4.5.2 Method 9060A analyze one matrix spike sample (MS) for every analytical batch of ten samples.

12.4.5.3 Spike 50 ul of 5000 ppm KHP stock solution to 10.0 mLs of sample. For low level analysis, spike 50 ul of 1000 ppm KHP stock solution to 10.0 mLs of sample. Acceptance criteria are given in Table 2. This statistically derived acceptance limit is subject to change as limits are updated.

Calculate percent recovery as follows:

$$Matrix\ Spike\ Recovery = \frac{Spiked\ Sample - Sample}{Spike\ Added} \times 100$$

13) Data Reduction and Reporting (or Documentation and Records)

13.1 Refer to the SOP for Data Reporting and Report Generation for reporting guidelines.

13.2 Preliminary results are reviewed to determine if dilutions are required. Sample information is transferred to an Excel spreadsheet for calculations (see R:\WET\ANALYSES\TOC\DATA). Instrument baseline is determined by taking the average of all Method Blanks, CCB's, (see R:\WET\ANALYSES\TOC\TOC_CBA1.SPD). Sample concentration is corrected by subtracting calculated blank average (CBA) from instrument response. Concentration and sample identification number are highlighted for reporting purposes.

13.3 For 5310C, report the result from a single analysis. For 9060A, report both the average and the range from the quadruplicate analyses.

13.4 It is the operators' responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in procedures section of the SOP. Average, RPD, spike level and spike recovery are entered on spreadsheet (see append. B) for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

13.5 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). This compilation is then transferred to a file which Excel© uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.6 As an alternative, reports are generated using Excel© templates located in R:\WET\FORMS. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates the saved to R:\WET\WIP.

13.7 Data Review and Assessment

13.7.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

14) Method Performance

14.1 The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery must meet the laboratory control sample acceptance limits.

14.2 The method detection limit (MDL) is established using the procedure described in the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of*

Detection and Quantification. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

15) Pollution Prevention and Waste Management

15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

15.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

16) Corrective Actions for Out-of-Control Data or Unacceptable Data

16.1 Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

16.2 Handling out-of-control or unacceptable data

16.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.

16.2.2 Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision.
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
- Sample holding time missed due to laboratory error or operations.
- Deviations from SOPs or project requirements.
- Laboratory analysis errors impacting sample or QC results.
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.).
- Sample preservation or handling discrepancies due to laboratory or operations error.
- Customer inquiries concerning data quality or services (when applicable). NCAR not required for simple corrections with no impact to the client.
- Data errors reported to clients, non-conforming re-checks.
- Deficiencies found during internal or external audits.
- Login errors or shipping errors.
- IT issues if there is a significant impact to a client.
- Turnaround time complaints.

17) Training

17.1 Review literature Review this SOP. Also review the applicable SDS for all reagents and standards used. Following these reviews, observe the procedure performed by an experienced analyst.

17.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.3 Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.4 Training is documented following the *ALS-Kelso Training Procedure* (ADM-TRAIN). When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor acknowledges that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

19) Summary of Changes

19.1 Reformatted SOP to current ALS format.

19.2 Updated safety references and definitions.

19.3 Miscellaneous format revisions and typographical/grammatical corrections.

19.4 Section 8: Model 1010 Total Organic Carbon Analyzer: removed from the equipment list and when referenced in the SOP.

TOC analyzer: Teledyne -Tekmar, Model TOC Fusion, - was added into numerous sections throughout the SOP.

19.5 Section 9: Updated calibration standards; sodium persulfate preparation; removed the ICV from the analysis.

19.6 Section 11: Numerous edits throughout the section.

19.7 Added EPA 415.1 into the SOP, which had previously been previously removed.

20) References and Related Documents

20.1 U.S. Environmental Protection Agency, Total Organic Carbon, Method 9060A, Revision 1 November 2004.

20.2 Total Organic Carbon, Combustion-Infrared Method, and 5310C. Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.

20.3 Organic Carbon, Total (Combustion Or Oxidation), Method 415.1.G:\QA\Methods\EPA\415.1.pdf.

20.4 TNI Standard, Volume 1- 2009.

20.5 DoD Quality Systems Manual for Environmental Laboratories. Current version.

20.6 Updated Table 1.

TABLE 1: Summary of Corrective Actions

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
SM 5310C 9060, 415.1	Linearity verification	Annually	R2 ≥ 0.995	Correct problem then repeat ICAL
SM 5310C 9060, 415.1	ICV	After ICAL, prior to sample analysis	90-110%	Correct problem and verify second source standard; rerun second source verification; If fails, correct problem and repeat initial calibration.
SM 5310C 9060, 415.1	CCV	Prior to sample analysis, every 10 injections and end	± 10% Diff	Correct problem then repeat CCV or repeat ICAL
SM 5310C 9060, 415.1	CCB	Prior to sample analysis, every 10 injections and end	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause.
SM 5310C 9060, 415.1	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
SM 5310C, 415.1	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO	If exceeds limits, re-extract and re-analyze
9060	Laboratory Control Sample	Include with each analysis batch (up to 15 samples)	See DQO	If exceeds limits, re-extract and re-analyze
SM 5310C, 415.1	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if the there is a matrix effect or analytical error
9060	Matrix Spike	Include with each analysis batch (up to 10 samples)	See DQO	Evaluate data to determine if the there is a matrix effect or analytical error
SM 5310C,	Sample Duplicates	All samples in batch	≤ 10 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
415.1	Sample Duplicates	All samples in batch	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
9060	Sample Quadruplicate	All samples in batch	≤ 20 % RSD	Re-homogenize and re-analyze if result is > 5 X the MRL

Appendix E
Data Validation Standard Operating Procedures

Laboratory Data Consultants, Inc. (LDC)

SOP #14.0.0
April 13, 2016

STANDARD OPERATING PROCEDURE
FOR DATA REVIEW/
DATA VALIDATION PROCESS

Approved / Date
Stella Cuenco 4/13/16

Stella Cuenco
Operations Manager/
Principal Chemist

1.0 PURPOSE

The data review and validation level of effort required for the Scope of Work outlined for any project will encompass several activities. The steps are categorized below. To perform the tasks, LDC will not use subcontractors since they would reduce the quality and control of the work product.

2.0 CUSTOMER Data Packages delivered via email or CD/DVD.

Data deliverables are delivered to the Data Control Manager. The data is copied temporarily to V:\Login\!ToLogin from Clients on the LDC file server network. Once data deliverables are printed the data is saved into the X Drive: Lab Data Archive.

If the Data arrived via CD/DVD, the original media is placed with the hardcopy data package on the shelf after printing and saving data to the X Drive: Lab Data Archive.

3.0 SAMPLE LOGIN

All samples submitted for data validation are entered into the LDC Log-in system. The system generates various spreadsheets for sample tracking, listings of laboratory and client identifications, sampling dates, analysis requested, matrix, and project due date. These tracking documents are distributed to all data validation, QA and project management staff.

4.0 DEFINITIONS

The following definitions are provided for this SOP.

Definitions

LDC Number	-	Project number given to a Group of SDG numbers to form a batch.
SDG Number	-	Data package number given to a Group of samples by the analytical laboratory.

5.0 PRE SCREENING OF DATA PACAKGES

The pre-screening is performed concurrently with the sample log-in process. This task verifies sample chain-of-custody, data package completeness, and concurrence with the authorized delivery order.

6.0 DATA VALIDATION

The execution of the data review task requires the highest level of effort. The review process will be handled in a stepwise fashion including manual and automated data review. The validator will use manual review to document each finding on a Validation Findings form. Along with the finding, the reviewer will document the date of the occurrence, the lab reference identification, the validation criteria, the associated samples, and the qualification of the data. A Validation Checklist form is marked noting if validation criteria was met or exceeded. A Validation Checklist is enclosed for review (Exhibit A). These checklists are used as an inventory sheet to assure all samples were reviewed for each criteria. The findings documented on the Validation Findings form will be transcribed into the final summary report. Examples of recalculation and findings worksheets used for Level 4 validation are available for review upon request.

All initial validation performed by Laboratory Data Consultants, Inc. has a secondary peer review. All final reports will be reviewed by a Senior Chemist or Principal Chemist.

7.0 LDC Validation Data Packages

LDC Validation Data Packages are processed and stored in the archive room 2D.
Once the LDC Validation report has been delivered to client, the ST (Attachment 1: Sample Table) is pulled from active job file.

8.0 FIRST REPORT REVIEW

The first review of the data validation report verifies that all findings and data qualification has been accurately transferred from the data validation worksheets. All sample identifications, methods, formatting, and general text are reviewed.

9.0 SENIOR REPORT REVIEW

The senior review of the data validation report verifies that all findings, data qualification, and professional judgments previously integrated into the reports reflect the overall quality of the data. Any additional comments required to enhance the usability of the report will be inserted at this time.

10.0 QA REPORT REVIEW

A QA check of selected data validation reports within an individual delivery order will be reviewed by the QA department. A formal nonconformance report will be generated for any identified deficiencies. The deficiency will be addressed with the appropriate staff and corrected prior to submittal to senior management for final review and signature.

11.0 SENIOR MANAGEMENT REVIEW

The program/technical manager will perform an overall review of the final reports. He will sign the report cover letter and submit the report to the sample custodian for shipment to the client.

12.0 Archived Data Packages

LDC Validation Packages Archive Boxes are labeled as follows:

1. Box number is assigned in chronological order
2. LDC job number – Client/Project

12.1 Holding times for archived material

1. Data Packages received from client as hard copy will be held for 3 months.

2. Data Packages received from client electronically will be held for 30 days.
3. Data Packages where client has requested Data to be returned, the data packages will be returned to client upon completed validation.

13.0 Electronic Data Deliverables (EDD)

This process will be initiated at step 1 with the receipt of disks from the client or loading EDDs to LDC's secured Internet portal. After automated verification of the EDD format, content, and fields, the EDD will be populated with the manual review for importing of the final data qualifiers. The final approval of qualifiers will occur after step 5.