# LOWER PASSAIC RIVER RESTORATION PROJECT

# LOWER PASSAIC RIVER STUDY AREA RI/FS

## BACKGROUND AND REFERENCE CONDITIONS ADDENDUM TO THE QUALITY ASSURANCE PROJECT PLAN

## SURFACE SEDIMENT CHEMICAL ANALYSES AND BENTHIC INVERTEBRATE TOXICITY AND BIOACCUMULATION TESTING

**FINAL**

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# Acronyms

| | |
|---|---|
| **ALS** | ALS Environmental |
| **AMNET** | Ambient Biomonitoring Network |
| **ASTM** | American Society for Testing and Materials |
| **AVS/SEM** | acid volatile sulfide/simultaneously extracted metals |
| **BERA** | baseline ecological risk assessment |
| **BRL** | Brooks Rand Labs |
| **CARB** | California Air Resources Board |
| **CAS** | Columbia Analytical Services, Inc. |
| **CCC** | continuing calibration criteria |
| **CCV** | continuing calibration verification |
| **CERCLA** | Comprehensive Environmental Response, Compensation, and Liability Act |
| **COC** | chain of custody |
| **CPG** | Cooperating Parties Group |
| **CSM** | conceptual site model |
| **CSO** | combined sewer overflow |
| **CVAFS** | cold vapor atomic fluorescence spectrometer |
| **CWCM** | chemical water column monitoring |
| **ddms** | de maximis Data Management Solutions, Inc. |
| **DGPS** | differential global positioning system |
| **DL** | detection limit |
| **DO** | dissolved oxygen |
| **DQI** | data quality indicator |
| **ECD** | electron capture detector |
| **Ecology** | Washington State Department of Ecology |
| **EDD** | electronic data deliverable |
| **EPH** | extractable petroleum hydrocarbon |
| **ERA** | ecological risk assessment |
| **FC** | field coordinator |
| **FID** | flame ionization detector |
| **GIS** | geographic information system |
| **GPS** | global positioning system |

| | |
|---|---|
| **GC** | gas chromatography/mass spectrometry |
| **GPC** | gel permeation chromatograph |
| **HHRA** | human health risk assessment |
| **HP** | Hewlett Packard |
| **HPLC** | high-performance liquid chromatography |
| **HRGC** | high-resolution gas chromatography |
| **HRMS** | high-resolution mass spectrometry |
| **HSP** | health and safety plan |
| **ICAL** | initial calibration |
| **ICP** | inductively coupled plasma |
| **ICV** | initial calibration verification |
| **ID** | identification |
| **LCS** | laboratory control sample |
| **LRC** | low-resolution coring |
| **LPR** | Lower Passaic River |
| **LPRSA** | Lower Passaic River Study Area |
| **LRC** | low-resolution coring |
| **MD** | matrix duplicate |
| **MDL** | method detection limit |
| **MEDD** | multimedia electronic data deliverable |
| **MPI** | Malcolm Pirnie |
| **MS** | matrix spike |
| **MSD** | matrix spike duplicate |
| **NJDEP** | New Jersey Department of Environmental Protection |
| **NJDOT** | New Jersey Department of Transportation |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **NYDEC** | New York Department of Environmental Conservation |
| **NY/NJ** | New York/New Jersey |
| **OC** | organic carbon |
| **OES** | optical emission spectrometry |
| **PAH** | polycyclic aromatic hydrocarbon |
| **PCB** | polychlorinated biphenyl |

| | |
|---|---|
| **PCDD/PCDF** | polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans |
| **PFD** | problem formulation document |
| **PM** | project manager |
| **PPE** | personal protective equipment |
| **PQO** | project quality objective |
| **QA** | quality assurance |
| **QAPP** | quality assurance project plan |
| **QC** | quality control |
| **QL** | quantitation limit |
| **RARC** | risk analysis and risk characterization |
| **RF** | response factor |
| **RI/FS** | remedial investigation/feasibility study |
| **RM** | river mile |
| **RPD** | relative percent difference |
| **RSD** | relative standard deviation |
| **SEM** | simultaneously extracted metals |
| **SGS** | *Société Générale de Surveillance* |
| **SIM** | selective ion monitoring |
| **SOP** | standard operating procedure |
| **SPCC** | system performance check compounds |
| **SQT** | sediment quality triad |
| **SSO** | sanitary sewer overflow |
| **SVOC** | semivolatile organic compound |
| **TOC** | total organic carbon |
| **TPH** | total petroleum hydrocarbons |
| **USACE** | US Army Corps of Engineers |
| **USEPA** | US Environmental Protection Agency |
| **USFWS** | US Fish and Wildlife Service |
| **USGS** | US Geological Survey |
| **UV-VIS** | ultraviolet-visible spectrophotometry |
| **VOA** | volatile organic analysis |
| **Windward** | Windward Environmental LLC |

| | |
|---|---|
| **WM** | wide-mouth |
| **WRDA** | Water Resources Development Act |

# Introduction

This is an addendum to the Lower Passaic River (LPR) Restoration Project *Quality Assurance Project Plan: Surface sediment chemical analyses and benthic invertebrate toxicity and bioaccumulation testing* (Windward 2009), hereafter referred to as the Benthic Quality Assurance Project Plan (QAPP). The Benthic QAPP reviewed by the US Environmental Protection Agency (USEPA) and its Partner Agencies[1] was approved by USEPA on October 8, 2009.

Appendix B *(Use of Regional Background and Reference Conditions Data in the Lower Passaic River Study Area Risk Assessments*) of the *Revised Risk Analysis and Risk Characterization Plan for the Lower Passaic River Study Area* (Windward and AECOM [in prep]-b), hereafter referred to as the Risk Analysis and Risk Characterization RARC Plan, recommended the collection of sediment above Dundee Dam in order to establish a freshwater background dataset, as well as reference conditions for the benthic invertebrate community, for the Lower Passaic River Study Area (LPRSA). This addendum to the Benthic QAPP, hereafter referred to as the Benthic QAPP Addendum No. 5, describes the upstream background sediment and reference conditions sampling effort. Additional upstream background and/or reference sampling efforts may be required.

The field activities for the collection of surface sediment (0 to 15 cm) above Dundee Dam will occur during fall 2012 over a 2-week period, following a 2- to 3-day reconnaissance field effort to verify sampling location accessibility, and to obtain grain size data from the 24 targeted sediment quality triad (SQT) sampling locations. The reconnaissance will also be used to ensure, to the extent possible, that none of the sampling locations are near a combined sewer overflow (CSO) or other potential point source.

SQT sampling target locations may be relocated following the reconnaissance field effort in order to meet targeted grain sizes comparable to the LPRSA SQT data. Sediment for SQT analysis will be collected from 24 sampling locations within a 4.1-mile area extending above Dundee Dam from River Mile (RM) 17.4 to RM 21.5. The 4.1-mile stretch between Dundee Dam and Fairlawn Avenue represents the upstream portion of the river where relatively low velocities are expected (i.e., a velocity similar to that of the upper portion of the LPRSA). Aerial photos of the Passaic River indicate that there are higher velocities above Fairlawn Avenue; this region would not, therefore, be representative of conditions in the upper LPRSA.

Surface sediment (0 to 15 cm) for chemistry-only analysis will also be collected from 16 additional sampling locations within the approximately 1.4-mile stretch between Dundee Dam and I-80. The area between Dundee Dam and I-80 represents a likely primarily depositional area for sediment impacted by urban sources from the upper Passaic River. These sediment chemistry data will allow for a comparison of concentrations measured within the LPRSA with sediment concentrations upstream of the LPRSA, which are the result of exposure to off-site sources that are inputs into the LPRSA.

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[1] The Partner Agencies include the US Army Corps of Engineers (USACE), New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (NJDOT), National Oceanic and Atmospheric Administration (NOAA), and the US Fish and Wildlife Service (USFWS).

For the 24 SQT sampling locations, surface sediment samples will be collected for chemistry, toxicity testing, and benthic community analyses. Analysis will proceed as follows:

1. The sediment samples will be analyzed for: polychlorinated biphenyls (PCBs) congeners (and homologues), PCB Aroclors, polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs) (and homologues), organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), alkylated PAHs, metals (including total mercury, methylmercury, and butyltins), semivolatile organic compounds (SVOCs) (including phthalates), total petroleum hydrocarbons (TPH) (extractable, purgeable, and alkanes), sulfide, ammonia-N, cyanide, total phosphorus, total Kjeldahl nitrogen, acid volatile sulfide/simultaneously extracted metals (AVS/SEM), percent moisture, grain size, and total organic carbon (TOC).
2. Two toxicity tests will be performed: the 28-day *Hyalella azteca* growth and mortality test and the 10-day *Chironomus dilutus* growth and mortality test. Tests will be conducted following methodology used for the freshwater sediments samples collected in fall 2009 from the LPRSA; this methodology is described in the Benthic QAPP (Windward 2009).
3. Benthic community samples will also be collected at all of the SQT sampling locations. Four replicates will be collected, three of which will be analyzed separately per location for the benthic invertebrate community analysis. The fourth replicate will be archived and analyzed only if one of the three replicates is damaged or lost. Benthic invertebrate community samples will be collected from a 0.05-$m^2$ area and sieved through a 0.5-mm sieve. Following standard practice, 300 invertebrates will be identified in the freshwater samples (Barbour et al. 1999). As stated in the *Rapid Bioassessment Protocols for Use in Streams in Wadeable Rivers* (Barbour et al. 1999), subsampling reduces the effort required for the sorting and identification aspects of marcroinvertebrate surveys, and provides a more accurate estimate of time expenditure. The protocol is based on a 200-organism subsample, but it could be used for any subsample size (e.g., 100, 300, 500). A subsample of 300 invertebrates was chosen for this program to be consistent with the methods used on freshwater community samples collected in the LPRSA in fall 2009. The invertebrates will be identified to the lowest practical taxonomic level: generally genus or species level, unless the organisms are damaged, incomplete, or juveniles, which may preclude identification to this level.

For the 16 chemistry-only samples, the sediment samples will be analyzed for: PCB congeners (and homologues), PCB Aroclors, PCDDs/PCDFs (and homologues), organochlorine pesticides, PAHs, alkylated PAHs, metals (including total mercury, methylmercury, and butyltins), SVOCs (including phthalates), TPH (extractable, purgeable, and alkanes), sulfide, ammonia-N, cyanide, total phosphorus, total Kjeldahl nitrogen, AVS/SEM, percent moisture, grain size, and TOC.

This Benthic QAPP Addendum No. 5 includes updates to worksheets and attachments relevant to the upstream background sediment and reference conditions sampling. It does not include worksheets or attachments that are unchanged or not relevant to this effort. Applicable and/or updated worksheets and attachments included in this addendum are presented below:

- Worksheet No. 1 contains the title and approval pages for the addendum.
- Worksheet No. 3 provides the distribution list.
- Worksheet No. 9 provides a summary of communication and meetings related to upstream sediment sampling.

- Worksheet No. 10 describes the specific problem definition for the upstream sediment sampling effort.
- Worksheet No. 11 provides the project quality objectives.
- Worksheet No. 12 provides the method performance criteria.
- Worksheet No. 13 provides the secondary data criteria and limitations.
- Worksheet No. 14 provides a summary of project tasks.
- Worksheet No. 16 provides the schedule and timeline.
- Worksheet No. 17 provides the sampling design and rationale.
- Worksheet No. 18 provides the proposed monitoring locations and sampling standard operating procedure (SOP) references.
- Worksheet No. 19 provides the analytical SOP requirements.
- Worksheet No. 20 provides a summary of field quality control (QC) samples.
- Worksheet No. 21 provides the project SOP references.
- Worksheet No. 23 presents the references to the analytical SOPs.
- Worksheet No. 24 presents the analytical instrument calibration criteria.
- Worksheet No. 35 provides the sampling and analysis validation process.
- Worksheet No. 36 provides the sampling and analysis validation summary.
- Attachment AA is an SOP that describes the wet sieving procedure.

## QAPP Worksheet No. 1. Title and Approval Page

Addendum to the *Quality Assurance Project Plan for Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing*

Document Title

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## QAPP Worksheet No. 1. Title and Approval Page

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## QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

| | |
|---|---|
| **Project Name:** | LPRSA Ecological and Human Health Risk Assessment |
| **Site Name:** | LPRSA |
| **Projected Date(s) of Sampling:** | September 2012 |
| **Site Location:** | LPRSA |
| **Project Managers:** | Bill Potter/Robert Law, de maximis, inc. |
| **Date of Session:** | December 14 and 16, 2010 |
| **Scoping Session Purpose:** | Meetings to discuss the LPRSA background approach as part of the discussion of USEPA comments on the *Risk Analysis and Risk Characterization Plan for the Lower Passaic River Study Area* (referred to as the RARC Plan) sent to USEPA on April 16, 2010 |

**Participants:**

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**December 2010 RARC Plan Comments Meetings**

| | |
|---|---|
| **Comments/Decisions:** | Meetings were held to discuss RARC Plan comments related to the ERA and the Data Usability Memo comments, as well as RARC Plan comments related to the human health risk assessment (HHRA). |
| **Action Items:**<br>**(Retrospective Summary)** | • The background appendix to the RARC Plan submitted to USEPA on April 16, 2010, was discussed with USEPA.<br>• The Cooperating Parties Group (CPG) stated that it plans to evaluate the existing regional datasets for surface sediment chemistry, benthic toxicity, benthic community, and tissue, and then present USEPA with an approach for using existing regional data to develop a range of background and reference conditions. |

## QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

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|---|---|
| **Consensus Decisions:** | • USEPA and CPG agreed that the background appendix to the RARC Plan submitted to USEPA on April 16, 2010, would not be included in the Revised RARC Plan (Windward and AECOM [in prep]-b) to be submitted to USEPA on February 10, 2011. Instead, CPG would evaluate the existing regional datasets for surface sediment chemistry, benthic toxicity, benthic community, and tissue, and then present USEPA with an approach for using existing regional data to develop a range of background and reference conditions.<br>• USEPA and CPG agreed to evaluate existing data (Delaware Bay to southern New England) from regional datasets (benthic communities, benthic toxicity tests, fish tissue, and sediment chemistry) to develop a potential range of background conditions.<br>• Once CPG compiles the data, a meeting will be set up with USEPA to discuss using these existing data for a range of background and reference conditions.<br>• The outcome of these meetings was the February 2, 2011, ERA and Data Usability and HHRA term sheet, which documents the agreements reached during the December 14 and 16, 2010, meetings. |

## QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

| | |
|---|---|
| **Project Name:** | LPRSA Ecological and Human Health Risk Assessment |
| **Site Name:** | LPRSA |
| **Projected Date(s) of Sampling:** | September 2012 |
| **Site Location:** | LPRSA |
| **Project Manager:** | Bill Potter/Robert Law, de maximis, inc. |
| **Date of Sessions:** | February 15, 2011 |
| **Scoping Session Purpose:** | Meeting to discuss the LPRSA background and reference approach following the submittal of the Revised RARC Plan (Windward and AECOM [in prep]-b) on February 11, 2011 |

**Participants:**

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**February 2011 Background Approach Meeting**

| | |
|---|---|
| **Comments/Decisions:** | Meeting was held to discuss the approach for establishing background and reference area conditions for the LPRSA. |
| **Action Items:**<br>**(Retrospective Summary)** | • CPG presented the proposed approach for defining background and reference area conditions for the LPRSA<br>• CPG presented an overview of the available regional datasets that potentially could support the determination of LPRSA background and reference area conditions<br>• USEPA requested additional analysis, including further evaluation of sediment data from upstream of Dundee Dam and a comparison of those sediment data to the data from the LPRSA.<br>• USEPA requested an analysis of data from Chesapeake Bay or Delaware Bay, as well as an analysis of Mullica River toxicity and benthic community data.<br>• USEPA asked CPG to provide additional summaries of regional tissue studies.<br>• CPG discussed with USEPA that the focused feasibility study (FFS), which had been prepared by USEPA, had used background samples collected from directly above Dundee Dam.<br>• After internal discussions, USEPA agreed to use background samples from directly above Dundee Dam. USEPA asked CPG to evaluate the current samples and determine whether additional samples will be required for a background dataset and if so, how many. |
| **Consensus Decisions:** | • The area above Dundee Dam was agreed upon for the potential development of a background dataset and CPG would continue evaluating regional datasets. |

## QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

| | |
|---|---|
| **Project Name:** | LPRSA Ecological and Human Health Risk Assessment |
| **Site Name:** | LPRSA |
| **Projected Date(s) of Sampling:** | September 2012 |
| **Site Location:** | LPRSA |
| **Project Manager:** | Bill Potter/Robert Law, de maximis, inc. |
| **Date of Sessions:** | February 3, 2012 |
| **Scoping Session Purpose:** | Meeting to discuss further the LPRSA background approach |

**Participants:**

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**February 2012 Background Approach Meeting**

| | |
|---|---|
| **Comments/Decisions:** | Meeting was held to provide USEPA and its Partner Agencies with a status briefing on the background and reference conditions approach for the LPRSA. |
| **Action Items:**<br>**(Retrospective Summary)** | • CPG summarized the process to date on background and reference conditions approach.<br>• CPG provided the definitions for background and reference conditions.<br>• CPG presented criteria for evaluating available regional datasets that potentially could support the determination of LPRSA background and reference area conditions.<br>• CPG provided the data sources for the background and reference conditions data.<br>• CPG summarized the evaluation of existing data.<br>• CPG recommended the collection of additional sediment (chemistry-only and SQT samples) and fish tissue data above Dundee Dam to support the development of background and reference area conditions for the LPRSA<br>• CPG recommended use of existing data for the estuarine dataset. |
| **Consensus Decisions:** | • USEPA asked CPG to start developing QAPPs for the collection of freshwater background and reference conditions data. |

## QAPP Worksheet No. 10. Problem Definition

| **The problem to be addressed by the project:** |
|---|
| The LPR watershed is highly urbanized and receives inputs of industrial and municipal wastes. These inputs have resulted in widespread losses in habitat and biodiversity, the accumulation of chemicals in river sediments and biota, and impacts on water quality – the cumulative effects of which have substantially degraded the ecosystem of the LPRSA. The LPRSA is the estuary portion of the Passaic River between Dundee Dam and Newark Bay that is the subject of a remedial investigation/feasibility study (RI/FS). Conceptual site models (CSMs) of the LPRSA presented in summary reports and planning documents (e.g., Battelle (2005), Windward and AECOM (2009), Malcolm Pirnie (MPI) (2007b), MPI et al. (2005); and MPI (2007a)), as well as USEPA guidance and recommendations (USEPA 2002, 2008a), recognize that conditions within the LPRSA and ongoing inputs of chemicals originating from areas both inside and outside the LPRSA need to be taken into account during the risk assessment and remedial decision-making processes. Each regional background input has a corresponding contribution to the overall risks potentially posed to humans and ecological receptors within the LPRSA.<br>The LPRSA is the subject of a RI/FS, which includes the performance of a HHRA and a baseline ecological risk assessment (BERA). These assessments will be used to evaluate the potential for hazardous substances present in environmental media to have current and future impacts on the health of human and ecological receptors within the LPRSA. Because the primary focus of the RI/FS is historically contaminated sediments present within the LPRSA, potential impacts associated with these sediments need to be distinguished from potential impacts from regional background inputs to the LPR.<br>Ongoing inputs of water and suspended particulates into the LPRSA are being quantified by elements of the RI chemical water column monitoring (CWCM) program and the CSO study. These include inputs entering the LPRSA from: 1) the watershed above Dundee Dam; 2) tributaries to the LPRSA; 3) CSOs, sanitary sewer overflows (SSOs), and point source discharges, including stormwater outfalls; and 4) tidal inputs from Newark Bay and regional background inputs. However, while these quantifications will provide estimates of current inputs to the LPRSA and their potential contribution to conditions within the LPRSA, they will not provide a basis for direct comparison of LPRSA sediment to sediment in areas comparable to the LPRSA but outside the influence of LPRSA sediment.<br>Because there are no comprehensive comparable regional background or reference condition datasets that can be used to compare conditions within the freshwater portion of the LPRSA, this QAPP addendum describes the activities that will be performed for the collection of data to establish freshwater background and reference conditions for the LPRSA. The collection and/or review of additional freshwater background and/or reference conditions data may be required. The approach that will be used to establish regional estuarine background and reference conditions datasets is still being developed. |
| **The environmental questions being asked:** |
| The specific questions covered in this addendum are: |

## QAPP Worksheet No. 10. Problem Definition

"How do the chemical concentrations in sediments upstream of the LPRSA compare with those within the LPRSA?"

“Are benthic assemblages from the LPRSA similar to benthic assemblages in reference locations found above Dundee Dam?”

“Are benthic toxicity test responses from LPRSA sediment similar to benthic toxicity test responses in reference conditions found above Dundee Dam?”

Further detail on how the data will be used is presented on Worksheet No. 11.

**Observations from any site reconnaissance report:**

A site reconnaissance survey above Dundee Dam has not been performed to date to support this effort. A 2- to 3-day field reconnaissance effort to verify accessibility of sampling locations, and to obtain grain size data from the 24 targeted SQT sampling locations, will occur prior to the collection of sediments samples above Dundee Dam. Grain size from the selected targeted locations will be confirmed in the field using the wet sieving methods, as described in Appendix AA. If inclement weather conditions prevail, wet sieving will be performed in a field laboratory. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources.

SQT sampling target locations may be relocated following the reconnaissance field effort in order to meet targeted grain sizes comparable to the LPRSA SQT data.

**A synopsis of secondary data or information from site reports:**

Appendix B of the Revised RARC Plan (Windward and AECOM [in prep]-b) presents a summary of the available regional freshwater and estuarine sediment data, including an evaluation of the quality of these regional data. A general summary of the secondary freshwater datasets is presented in Worksheet No. 13.

**The possible classes of contaminants and the affected matrices:**

There are several different classes of organic and inorganic chemicals in LPRSA media, in addition to environmental stressors resulting from the urban nature of the system. Surface sediment samples (0 to 15 cm) collected upstream of Dundee Dam will be analyzed for PCB congeners (and homologues), PCB Aroclors, PCDDs/PCDFs (and homologues), organochlorine pesticides, PAHs, alkylated PAHs, metals (including total mercury, methylmercury, and butyltins), SVOCs (including phthalates), TPH (extractable, purgeable, and alkanes), sulfide, ammonia-N, cyanide, total phosphorus, total Kjeldahl nitrogen, AVS/SEM, percent moisture, grain size, and TOC.

**The rationale for chemical and non-chemical analyses and sampling areas:**

Sediment data from the LPRSA, extending from RM 0 to Dundee Dam at RM 17.4, have been collected. LPRSA sediment has been

## QAPP Worksheet No. 10. Problem Definition

analyzed for chemistry, and has undergone SQT analysis wherein sediment chemistry, toxicity, and benthic community data were analyzed from a given location. Available regional sediment chemistry, toxicity, and benthic community data collected from outside the LPRSA are presented in Appendix B of the Revised RARC Plan (Windward and AECOM [in prep]-b). In Appendix B of the Revised RARC Plan, it was recommended that, because of the limited number and spatial extent of sediment data available from the surface depth interval of 0 to 15 cm in the area above Dundee Dam, additional freshwater sediment chemistry data should be collected to establish the freshwater background sediment dataset. It was also recommended that SQT data be collected from above Dundee Dam to establish a dataset for defining benthic invertebrate community reference conditions in the freshwater portions of the LPRSA.

**SQT Data**

SQT data (i.e., sediment to be analyzed for chemistry, toxicity, and benthic invertebrate community) from 24 locations upstream of Dundee Dam will provide a dataset to establish reference conditions for comparison to data collected in the LPRSA. Dundee Dam provides a physical barrier between the LPRSA and upstream reference area. The area above Dundee Dam represents the same river system and geologic foundation as the LPRSA, and has an urban setting and urban sources (e.g., CSOs and runoff from major highways) similar to areas within the freshwater portion of the LPRSA. The 4.1-mile stretch between Dundee Dam and Fairlawn Avenue represents an upstream portion of the river with relatively low flow velocity, similar to that of the upper portion of the LPRSA. Aerial photographs of the Passaic River indicate that there are areas of higher flow velocities and shallow conditions (aerial photographs show a series of riffles) above Fairlawn Avenue (located approximately 4.1 miles above Dundee Dam at RM 21.5), making the area less comparable to conditions in the upper LPRSA. For those SQT stations that are near shore, the chemistry-only data will also be evaluated in the HHRA.

**Sediment Chemistry-Only Data**

Chemistry-only data from 16 sediment samples collected from the approximately 1.4-mile stretch between Dundee Dam and I-80 will be analyzed. The area between Dundee Dam and I-80 represents a likely primarily depositional area for urban-impacted sediments in the upper Passaic River. Upstream background sediment chemistry data will be compared to chemistry data collected within the LPRSA. The comparison will be used to provide context for the LPRSA by determining background chemical concentrations of an urban river outside the influence of the LPRSA for those COPCs estimated in the risk characterization of the HHRA and BERA. Sediment samples just above Dundee Dam were also used by USEPA as background conditions for potential recontamination in the FFS (Malcolm Pirnie 2007b). Chemistry data collected from nearshore sediments at locations representing potential human access areas between Dundee Dam and Fairlawn Avenue will be evaluated in the HHRA.

## QAPP Worksheet No. 10. Problem Definition

| **Information concerning various environmental indicators:** |
|---|
| As described in Appendix B of the Revised RARC Plan (Windward and AECOM [in prep]-b), a number of chemistry, toxicity, and benthic invertebrate community data have been collected from estuarine environments in the LPR region. The need for additional sediment collection efforts to obtain background and/or reference data from estuarine environments in the LPR region may be required, but such a collection effort is not described in this QAPP Addendum. Because there are relatively limited sediment chemistry data and no toxicity or benthic invertebrate community data upstream of Dundee Dam to establish freshwater background and reference conditions for the LPRSA, the collection of data for establishing a freshwater background sediment and reference conditions datasets is proposed in this QAPP Addendum. |
| **Project decision conditions:** |
| The conditions for project decisions (i.e., those decisions that may require communication between the CPG and USEPA during the field effort) include the identification of target sampling locations, the need to add or relocate locations during sampling, the need to delay or suspend sampling due to hazardous weather conditions, and the need to relocate sampling locations.<br>Twenty-four SQT target sampling locations and 16 target chemistry-only target sampling locations have been identified. A two- to three-day reconnaissance survey will be conducted prior to sediment sampling to verify sampling location accessibility, confirm the grain size at the selected SQT targeted locations, and ensure adequate coverage of the area of chemistry-only samples above Dundee Dam. SQT and chemistry-only target locations may be relocated in order to meet targeted grain sizes comparable to the LPRSA SQT data. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources. Any changes made to target sampling locations during the sampling effort will be communicated to USEPA.<br>If adverse weather occurs during sampling, CPG will immediately suspend operations under conditions of extreme weather and/or environmental conditions that are a threat to worker health and safety. |

## QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

**Who will use the data?**

The data collected under this QAPP addendum will be used by CPG and USEPA for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-related decisions, specifically for the ecological risk assessment (ERA) and HHRA, and by other interested parties (e.g., USACE, NJDEP, USFWS, NJDOT, and NOAA) for other purposes, including Water Resources Development Act (WRDA) activities, such as restoration planning.

**What will the data be used for?**

The data collected during this sampling effort will be used in the HHRA and BERA to differentiate the site-related risks from the risks resulting from regional background (i.e., non-site-related) sources.

**Sediment chemistry data** will be used to:

- Document background chemical concentrations that contribute to sediment quality in the LPRSA.
- Provide context for the risk estimates for the LPRSA by determining background chemical concentrations of an urban river outside the influence of the LPRSA for those COPCs estimated in the risk characterization of the HHRA and BERA.
- Support an analysis of recontamination potential following remedial actions.

**SQT data** will be used to:

- Document the level of biological responses (e.g., benthic invertebrate community) in the freshwater portion of the LPRSA, based on regional conditions.
- Document benthic invertebrate community conditions expected in the LPRSA following remedial actions.

The manner in which background and, as appropriate, reference data will be used in the baseline risk assessments will be consistent with USEPA's *Role of Background in the CERCLA Cleanup Program* (USEPA 2002).

**ERA Assessment Endpoints**

The data collected will be used to support the ERA in evaluating the following assessment endpoints, summarized below, which were presented in the problem formulation document (PFD) (Windward and AECOM 2009).

**Assessment Endpoint No. 2** – "Protection and maintenance of the benthic invertebrate community, both as an environmental resource in itself and as one that serves as a forage base for fish and wildlife populations."

**Assessment Endpoint No. 3, 4, 5, 6, 7, and No. 8** – "Protection and maintenance of healthy populations of blue crab and crayfish that serve as a forage base for fish and wildlife populations, and as a base for sports fisheries;" "Protection and maintenance of healthy mollusk populations," and "Protection and maintenance (i.e., survival, growth, and reproduction) of omnivorous, invertivorous,

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and piscivorous fish populations that serve as a forage base for fish and wildlife populations and of fish populations that serve as a base for sports fishery;" "Protection and maintenance (i.e., survival, growth, and reproduction) of herbivorous, omnivorous, sediment-probing, and piscivorous bird populations;" "Protection and maintenance (i.e., survival, growth, and reproduction) of aquatic mammal populations;" and "Maintenance of healthy aquatic plant populations as a food resource, and as a habitat for fish and wildlife populations."

**HHRA Assessment Endpoint**

The background sediment chemistry data collected from above Dundee Dam will be compared to LPRSA. The comparison will provide context for the risk estimates from exposure to sediment concentrations within the LPRSA by determining background chemical concentrations of an urban river outside the influence of the LPRSA for those COPCs estimated in the risk characterization of the HHRA.

**What types of data are needed?**

For the 24 SQT sampling locations, surface sediment (0 to 15 cm) samples will be collected for chemistry, toxicity testing, and benthic invertebrate community analyses:

1. Surface sediment samples from all of the SQT sampling locations will be analyzed for the following: PCBs congeners (and homologues), PCB Aroclors, PCDDs/PCDFs (and homologues), organochlorine pesticides, PAHs, alkylated PAHs, metals (including total mercury, methylmercury, and butyltins), SVOCs (including phthalates), TPH (extractable, purgeable, and alkanes), sulfide, ammonia-N, cyanide, total phosphorus, total Kjeldahl nitrogen, AVS/SEM, percent moisture, grain size, and TOC.
2. Two toxicity tests will be performed on sediment from each location: the 28-day *Hyalella azteca* growth and mortality test and the 10-day *Chironomus dilutus* growth and mortality test.
3. Sediment samples will also be collected for determining benthic invertebrate community metrics at all SQT sampling locations. Four replicates will be collected, three of which will be analyzed separately per location. The fourth replicate will be archived and analyzed only if one of the three replicates is damaged or lost. Benthic invertebrate community samples will be collected from a 0.05-$m^2$ area and sieved through a 0.5-mm sieve. Following standard practice, 300 invertebrates will be identified in the freshwater samples (Barbour et al. 1999). As stated in the *Rapid Bioassessment Protocols for Use in Streams in Wadeable Rivers* (Barbour et al. 1999), subsampling reduces the effort required for the sorting and identification aspects of marcroinvertebrate surveys, and provides a more accurate estimate of time expenditure. The protocol is based on a 200-organism subsample, but it could be used for a subsample of any size (e.g., 100, 300, 500). A subsample of 300 invertebrates was chosen for this program to be consistent with the methods used on freshwater community samples collected in the LPRSA. The invertebrates will be identified to lowest practical taxonomic level: generally genus or species

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| |
|---|
| level unless the organisms are damaged, incomplete, or juveniles, which may preclude identification to this level.<br>In addition to the sediment samples collected from the 24 SQT locations, sediment samples on which only sediment chemistry analyses will be conducted will be collected at 16 additional locations. These samples will be analyzed for the following: PCB congeners (and homologues), PCB Aroclors, PCDDs/PCDFs (and homologues), organochlorine pesticides, PAHs, alkylated PAHs, metals (including total mercury, methylmercury, and butyltins), SVOCs (including phthalates), TPH (extractable, purgeable, and alkanes), sulfide, ammonia-N, cyanide, total phosphorus, total Kjeldahl nitrogen, AVS/SEM, percent moisture, grain size, and TOC.<br>The following water quality parameters will be measured in the field at all sediment sampling stations: temperature, dissolved oxygen (DO), conductivity, and pH (see Attachment P of the Benthic QAPP (Windward 2009) for water quality sampling methods). |
| **Matrix** |
| Chemical analysis will be conducted on all surface sediment (0 to 15 cm) samples. Toxicity testing and benthic invertebrate community analysis will also be conducted on the SQT surface sediment samples. |
| **How "good" do the data need to be in order to support the environmental decision?** |
| The evaluation factors that will be used to establish an appropriate dataset for background freshwater tissue are still being developed.<br>The data usability memorandum (Windward and AECOM [in prep]-a) describes the data acceptability requirements for use in the HHRA and ERA. |
| **How many data are needed?** |
| Benthic invertebrate community, toxicity, and surface sediment chemistry data will be collected from 24 SQT locations between Dundee Dam (RM 17.4) and Fairlawn Avenue (RM 21.5) to provide similar spatial coverage and density of SQT samples as was collected in the LPRSA. Eight of the SQT sample locations will be in the area between Dundee Dam and I-80.<br>Surface sediment (for sediment chemistry only) will also be collected from an additional 16 sampling locations between Dundee Dam (RM 17.4) and I-80 (RM 18.8). A total of 40 sediment chemistry samples will be collected between Dundee Dam and Fairlawn Avenue, 24 of which will be collected in the area between Dundee Dam and I-80. |
| **Where, when, and how should the data be collected/generated?** |
| **River Segments**<br>The general sampling design divides the portion of the Passaic River between Dundee Dam (at RM 17.4) and Fairlawn Avenue |

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(RM 21.5) into four segments: RM 17.4 to RM 18.5, RM 18.5 to RM 19.5, RM 19.5 to RM 20.5, and RM 20.5 to RM 21.5.

**SQT Sampling Locations**

The SQT analyses (i.e., surface sediment for chemistry, toxicity tests, and community analyses) will be conducted at 24 locations between RM 17.4 and RM 21.5 (Figure 1). The total sampling area has been subdivided into one 1.1-mile segment (the first segment above Dundee Dam from RM 17.4 to RM 18.5) and three 1-mile segments (RM 18.5 to RM 19.5, RM 19.5 to RM 20.5, and RM 20.5 to RM 21.5) to allow for even spatial allocation of samples. The 24 SQT stations represent 6 stations per segment that have been selected with the intent of representing areas within two general habitat types: fine-grained and coarse-grained sediment.

Fine-grained sediment is defined as having ≥ 60% fines (fines are the sum of clay and silt particles less than 63 µm in diameter). Coarse-grained sediment is defined as having < 60% fines. Approximately half of the SQT samples targeted in the shallow depth areas of the LPRSA were targeted as fine-grained sediments, and half as coarse-grained sediments. Therefore, to be consistent, half of the targeted SQT samples above Dundee Dam will be targeted as fine-grained. As a result, 3 fine-grained and 3 coarse-grained SQT locations per segment will be targeted for sampling, a targeted total of 12 fine-grained and 12 coarse-grained sediment SQT locations for the entire 4.1-mile sampling area. Regardless of whether the targeted number of grain size sampling locations can be achieved per segment for SQT sampling (i.e., three fine-grained and three course-grained locations per segment), a total of six samples will be collected from each segment to ensure adequate spatial coverage for SQT sampling.

SQT locations in the first segment (RM 17.4 to RM 18.5) are locations above Dundee Dam previously sampled by MPI for USEPA in 2007 (ddms 2011), and by CPG in 2008 (low-resolution coring [LRC] sampling) (AECOM [in prep]), where grain size was measured during prior sampling events. Grain size data in the second (RM 18.5 to RM 19.5), third (RM 19.5 to RM 20.5), and fourth (RM 20.5 to RM 21.5) segments are unavailable. Consequently, SQT sampling locations in these three segments were initially selected based on expected grain size using stream morphology and geographic information system (GIS) data. Expected depositional areas (e.g., areas inside river curves) or areas below bridge abutments are assumed to have fine-grained sediment, and expected scouring areas (e.g., areas on the outside of river curves) are assumed to have coarse-grained sediment. A 2- to 3-day reconnaissance survey will be conducted prior to sediment sampling to verify sampling location accessibility, and to confirm the grain size at the selected targeted locations in the field using the wet sieving methods described in Appendix AA. If inclement weather conditions prevail, wet sieving will be performed in a field laboratory. SQT sampling target locations may be relocated following the reconnaissance field effort in order to meet targeted grain sizes comparable to the LPRSA SQT data. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources.

**Sediment-Chemistry Only Sampling Locations**

Surface sediment (0 to 15 cm) from 16 additional locations between Dundee Dam (RM 17.4) and the I-80 bridge (RM 18.8) will be collected for chemistry analysis only. These locations were selected randomly (Figure 1) by dividing the area into four equal sections

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and using a random points tool in GIS to generate the locations within each section. Target locations may be re-established following the reconnaissance survey to ensure adequate coverage of the area above Dundee Dam based on field observations and accessibility.

With the inclusion of the SQT samples, chemistry analysis of surface sediments will be performed at a total of 40 locations between Dundee Dam and Fairlawn Avenue; 24 of these locations will be between Dundee Dam and I-80 bridge (i.e., 16 chemistry-only locations, and 8 SQT locations).

A portion of the sediment sampling locations are also intended to be representative of nearshore areas where human access is likely (e.g., parks, boat ramps, paths along natural shoreline). Of the 40 sediment sampling locations, 8 have been identified in Worksheet No. 16 as being potential human access locations. The exact location of these sampling locations may be modified during field reconnaissance in order to ensure that they are representative of potential nearshore human access areas. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources.

**Timing**

All sediment samples will be collected in fall 2012.

**Sediment Collection Protocols**

All sediment sampling locations are presented on Figure 1. Surface sediment will be collected at each sampling location from the top 6 in. (15 cm). Adequate surface sediment will be collected at each SQT sampling location to support benthic invertebrate community characterization (enumeration and taxonomic characterization), sediment toxicity testing, and sediment chemistry analysis. Adequate surface sediment will be collected at chemistry-only sampling locations to support sediment chemistry analysis.

Attachment O of the Benthic QAPP (Windward 2009) presents the flow charts for sampling sediment in the field. At each SQT sampling location, a minimum of four sediment samples will be taken with a power grab, van Veen (0.2 $m^2$) grab, or other sediment grab sampler to obtain the four replicate samples for benthic community characterization. The four benthic community sediment samples (0.05 $m^2$ for freshwater samples) will be kept separate to provide four replicates per location. Additional grab samples may be collected to provide sufficient sediment for sediment chemistry analysis and toxicity. The sediment will be apportioned into sample containers for chemistry analysis or toxicity testing. Because sampling will occur in an area not designated as a CERLCA site, excess sediment will be disposed of at the location of collection.

Some locations may be sampled by hand depending on access agreements, issues potentially affecting field crew safety, and accessibility of sediment sampling locations. If sampling by hand is possible, the station locations will be documented using a handheld differential global positioning system (DGPS) (see Attachment B of the Benthic QAPP (Windward 2009)). The sediment will be collected by a handheld grab sampler (e.g., ponar) or, if necessary, by scooping sediment to a depth of 15 cm with a large, clean,

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and dedicated stainless steel serving spoon, until sufficient sediment is obtained for SQT analysis.

Subsamples of sediment for volatile analytes (AVS/SEM, ammonia, sulfides, TPH-purgeables) will be distributed to the appropriate sample containers immediately after collection.

**Toxicity Testing Protocols**

The *H. azteca* and *C. dilutus* tests will be conducted on all SQT sediment samples.

**Benthic Invertebrate Community Analyses**

Benthic invertebrate community samples will be taken as part of the fall 2012 sediment collection effort for comparison to LPRSA data collected in early fall 2009. Four replicates will be collected, three of which will be analyzed separately per location for the benthic invertebrate community analysis. The fourth replicate will be archived and analyzed only if one of the three replicates is damaged or lost. Benthic invertebrate community samples will be collected from a 0.05-$m^2$ area and sieved through a 0.5-mm sieve. Following standard practice, 300 invertebrates will be identified in the freshwater samples (Barbour et al. 1999). As stated in the *Rapid Bioassessment Protocols for Use in Streams in Wadeable Rivers* (Barbour et al. 1999), subsampling reduces the effort required for the sorting and identification aspects of marcroinvertebrate surveys, and provides a more accurate estimate of time expenditure. The protocol is based on a 200-organism subsample, but may be used for a subsample of any size (e.g., 100, 300, 500). A subsample of 300 invertebrates was chosen for this program to be consistent with the methods used on freshwater community samples collected in the LPRSA. The invertebrates will be identified to lowest practical taxonomic level: generally genus or species level unless the organisms are damaged, incomplete, or juveniles, which may preclude identification to this level.

**Sample Volume**

A total of 8 L (2 gal.) and 5.7 L (1.5 gal.) are needed for the toxicity testing and chemistry analyses, respectively. For each of the benthic invertebrate community replicates per station (i.e., four replicates will be taken, consistent with the method described in the Benthic QAPP (Windward 2009)), approximately 8 L (1.8 gal.) are required for processing through a 0.5-mm sieve.

**Who will collect and generate the data?**

Windward will provide the field sampling coordination and laboratory coordination and support. Windward will also supply the field personnel who will conduct the sediment collection efforts. If necessary, additional field personnel may be provided by de maximis, inc., or Ocean Surveys, Inc.

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| **How will the data be reported?** |
|---|
| Daily updates on locations and sample collection progress will be communicated (e.g., telephone conversation, e-mail) to CPG and USEPA Project Managers (PMs) and Project Coordinators.<br>An electronic database, including the coordinates of sediment sampling locations and sediment sample characteristics recorded on the Surface Sediment Collection Form (see Attachment D of the Benthic QAPP (Windward 2009), will be provided at the conclusion of the sampling effort. Preliminary data will be available upon request.<br>Data reports summarizing the toxicity test results, invertebrate taxonomy results, and chemistry analysis results will be provided within 90 days after receipt of validated toxicity test, taxonomy, and chemistry data. These reports will include a map that presents the actual locations of the sampling effort, along with a summary of any modifications to the proposed sampling plan outlined in this QAPP addendum. |
| **How will the data be archived?** |
| Data records, forms, and notes will be scanned and stored electronically in a project file. Hard copies will be archived at Windward's main office in Seattle, Washington. Data will be provided to USEPA in data reports and other acceptable electronic deliverables. The data reports will be issued and then archived electronically and as a hard copy. |

## QAPP Worksheet No. 12. Measurement Performance Criteria Table

| **Matrix** | Sediment | | | | |
|---|---|---|---|---|---|
| **Analytical Group[a]** | TPH – Extractables | | | | |
| **Concentration Level** | Low | | | | |
| **Sampling Procedure[b]** | **Analytical Method/SOP[c]** | **DQIs** | **Measurement Performance Criteria** | **QC Sample and/or Activity Used to Assess Measurement Performance** | **QC Sample Assesses Error for Sampling (S), Analysis (A) or Both (S & A)** |
| 3 | NJDEP EPH/M33 | Accuracy/bias – contamination | No target compound > QL (5 x MDL) | Method blank/ instrument blank | A |
| | NJDEP EPH/M33 | Accuracy/bias – contamination | No target compound > QL (5 x MDL) | Equipment rinsate blanks[d] | S & A |
| | NJDEP EPH/M33 | Accuracy/bias | Percent recovery = 40 – 140% | LCS | A |
| | NJDEP EPH/M33 | Accuracy/bias | Percent recovery = 40 – 140% | Surrogates | A |
| | NJDEP EPH/M33 | Accuracy/bias, precision | Percent recovery = 40 – 140%, RPD ≤ 50 % | MS/MSD | S & A |
| | NJDEP EPH/M33 | Precision | RPD ≤ 50% if both samples are > 5 x QL | MD | A |
| | NJDEP EPH/M33 | Precision | RPD ≤ 50% if both samples are > 5 x QL | Field duplicate | S & A |
| | NJDEP EPH/M33 | Completeness | ≥ 90% | Data completeness check | S & A |

Note: Worksheet 12 of this QAPP addendum presents only measurement performance criteria tables for those analytical groups that have criteria that have been updated since the Benthic QAPP (Windward 2009) was finalized; all other measurement performance criteria tables are presented in Worksheet 12 of the Benthic QAPP.

[a] Refer to Worksheet No. 15 of the Benthic QAPP (Windward 2009) for a complete list of analytes for each analytical group.

[b] Reference number from Worksheet No. 21 of this QAPP addendum.

[c] Reference number from Worksheet No. 23 of this QAPP addendum.

[d] Rinsate blank will be created from the homogenization equipment.

DQI – data quality indicator
EPH – extractable petroleum hydrocarbon
LCS – laboratory control sample
MD – matrix duplicate
MDL – method detection limit
MS – matrix spike
MSD – matrix spike duplicate
NJDEP – New Jersey Department of Environmental Protection
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
TPH – total petroleum hydrocarbons

## QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table

| Secondary Data | Data Source (originating organization, report title, date) | Data Generator(s) (originating organization, data types, data generation/collection dates) | How Data Will Be Used | Limitations on Data Use |
|---|---|---|---|---|
| Sediment chemistry data | MPI (2007b) for a USEPA sediment sampling program, Dundee Lake coring program, included in the CPG project database (ddms 2011) | MPI (for USEPA). Sediment chemistry collected from 2- and 4-cm intervals within upper 16 cm at 5 locations within a 1-mile area above Dundee Dam. 2007. | Data used to inform sampling target locations above Dundee Dam based on available grain size. | Limited spatial extent of sampling locations |
| | MPI (2007b) for a USEPA sediment sampling program, empirical mass balance model surface sediment sampling program, included in the CPG project database (ddms 2011) | MPI (for USEPA). Sediment chemistry collected from 0 to 2.5 cm surface depth at 4 locations within a 1-mile area above Dundee Dam. 2007. | | Limited spatial extent of sampling locations; sediment surface interval not directly comparable to LPRSA surface sediment interval (0 to 15 cm). |
| | CPG, 2008 sediment LRC sampling by CPG (AECOM [in prep]) | AECOM. Surface sediment chemistry cores, including sediment from 0 to 15 cm surface depth at 6 locations within a 1-mile area above Dundee Dam. 2008. | | Limited spatial extent of sampling locations |
| Toxicity data | AMNET, NJDEP Bureau of Freshwater and Biological Monitoring Program http://www.state.nj.us/dep/wms/monitingdata.html | NJDEP. Sediment toxicity based on 10-day test using *H. azteca* from numerous stations throughout New Jersey. | Data not proposed for use in defining reference conditions. | No samples in targeted area above Dundee Dam; 10-day test not directly comparable to 28-day tests conducted in LPRSA; no sediment chemistry data synoptically collected with toxicity data. |
| Benthic community data | AMNET, NJDEP Bureau of Freshwater and Biological Monitoring Program http://www.state.nj.us/dep/wms/monitingdata.html | NJDEP. Taxonomic identification of benthic invertebrates from numerous stations throughout New Jersey. | Data not proposed for use in defining reference conditions. | Limited community data synoptically collected with sediment chemistry and/or sediment toxicity for evaluation of SQT assessment; identification was performed on a subsample of approximately 100 organisms. |

Note: Only freshwater secondary data sources that represent potential background and/or reference conditions are included in the above table. Estuarine datasets reviewed for potential use in the development of background and reference conditions datasets are presented in Appendix B of the RARC Plan (Windward and AECOM [in prep]-b).

AMNET – Ambient Biomonitoring Network
CPG – Cooperating Parties Group
LRC – low-resolution coring
LPRSA – Lower Passaic River Study Area
MPI – Malcolm Pirnie, Inc
NJDEP – New Jersey Department of Environmental Protection
SQT – sediment quality triad
USEPA – US Environmental Protection Agency

## QAPP Worksheet No. 14. Summary of Project Tasks

| **Project Area:** Upstream LPRSA: 4.1-mile stretch above Dundee Dam (RM 17.4 to FM 21.5) | |
|---|---|
| Sampling Tasks: | **SQT Sampling Locations**<br>Sediment will be collected for the SQT assessment (i.e., surface sediment (0 to 15 cm) for chemistry, toxicity tests, and community analyses) from 24 locations throughout the 4.1-mile stretch between RM 17.4 (Dundee Dam) and RM 21.5 (Figure 1). The 24 SQT stations represent 6 stations for each of the approximately 1-mile river segments that have been selected with the intent of representing areas within two general habitat types: fine-grained sediment and coarse-grained-sediment. Fine-grained sediment is defined as having ≥ 60% fines (fines are the sum of clay and silt particles that less than 63 µm in diameter). Coarse-grained sediment is defined as having < 60% fines. Three fine-grained and three coarse-grained SQT locations are being targeted per segment. The locations were chosen based on previously sampled locations where grain size had been measured (in the first segment between RM 17.4 and RM 18.5), and on expected grain size using river morphology (in the three segments between RM 18.5 and RM 21.5). A 2- to 3-day reconnaissance survey will be conducted prior to sediment sampling to verify sampling location accessibility, and to confirm the grain size of the selected targeted locations using the wet sieving methods in the field described in Appendix AA. If inclement weather conditions prevail, wet sieving will be performed in a field laboratory. SQT sampling target locations may be relocated following the reconnaissance field effort in order to meet targeted grain sizes comparable to the LPRSA SQT data.<br>**Sediment-Chemistry Only Locations**<br>Surface sediment (0 to 15 cm) will be collected for chemistry-only analysis from 16 additional locations randomly selected from within the 1.4-mile stretch between Dundee Dam (RM 17.4) and the I-80 bridge (RM 18.8). The stations were selected by dividing the area into four equal sections and using a random points tool in GIS to generate the location within each section (Figure 1). Target locations may be re-established following the reconnaissance survey to ensure adequate coverage of the area above Dundee Dam based on field observations and accessibility.<br>The 2- to 3-day reconnaissance survey will also verify that selected sampling locations (identified in Worksheet No. 18) represent potential nearshore human access locations. The exact locations of these sampling locations may be modified during the field reconnaissance in order to ensure that they are representative of potential nearshore human access areas.<br>**Sediment Collection Protocols**<br>Sediment will be collected with power grab, van Veen (0.2 $m^2$) grab, or other sediment grab sampler or, if necessary, by scooping sediment from a depth of 15 cm with a large, clean, and dedicated stainless steel serving spoon. The four benthic invertebrate community sediment samples will be kept separate to provide four replicates per location. A minimum of four replicate samples within a radius of 10 m and the biological active zone (0 to 15 cm) will be sampled. A 0.05-$m^2$ portion of each sample will be allocated to benthic community analysis. The remaining sediment will be homogenized and apportioned into appropriate containers for toxicity tests and chemistry analysis.<br>The sediment for chemistry and toxicity analysis will be placed in a pre-cleaned stainless steel bowl and homogenized as described in Attachment D of the Benthic QAPP (Windward 2009). Any large non-sediment items such as rocks, shells, wood chips, or organisms (e.g., clams) will be removed (i.e., scraped off any surface) prior to homogenization. Homogenized sediment will be split into appropriate sample containers as described in Attachment E of the Benthic QAPP (Windward 2009).<br>Benthic community samples will be collected from a 0.05-$m^2$ area and sieved through a 0.5-mm sieve. The material retained on the sieve will be transferred into appropriate containers and preserved with buffered formalin (final concentration about 10%). |

## QAPP Worksheet No. 14. Summary of Project Tasks

| | |
|---|---|
| | **Sample Volume**<br>A minimum of 8 L (2 gal.) and 5.7 L (1.5 gal.) per sample is needed for the toxicity tests and chemistry analysis, respectively. For each of the benthic community replicates per station (i.e., four replicates will be taken, consistent with the method described in the Benthic QAPP (Windward 2009)),approximately 8 L (1.8 gal.) are required for processing through a 0.5-mm sieve. Additional grabs may be collected to provide sufficient sediment for sediment chemistry analysis and toxicity. |
| Analysis Tasks: | Coordinates and water depth will be recorded at each sampling location.<br>Following collection, the sediment samples for chemistry and toxicity analysis will be homogenized and shipped to the analytical laboratory for chemical analysis and to the toxicity testing laboratory for toxicity testing. The benthic invertebrate community samples will be collected as described above and shipped to the taxonomy laboratory.<br>Sediment samples from SQT locations and chemistry-only locations will be analyzed for the chemicals listed in Worksheet No. 10.<br>The organisms in the benthic invertebrate community samples will be identified to lowest practical taxonomic level and in concordance with the taxonomic level from other surveys in New Jersey (Table 11-1 of the Benthic QAPP (Windward 2009)) following rapid bioassessment protocols (Barbour et al. 1999).<br>The toxicity tests will be conducted according to USEPA and American Society for Testing and Materials (ASTM) protocols (ASTM 2004, 2007; USEPA 2000) (quality indicators are presented in Table 11-2 of the Benthic QAPP (Windward 2009)). For further details, including the toxicity test SOPs, see Attachment M of this QAPP addendum and Attachment M of the Benthic QAPP (Windward 2009). |
| QC Tasks: | All field notes and forms completed during the field sampling task will be checked daily by the Field Coordinator (FC). The FC will also communicate daily with the Task QA/QC Manager to confirm project quality objectives (PQOs) are being met.<br>Electronic sampling equipment (e.g., global positioning system [GPS] units) will be calibrated, maintained, tested, and inspected according to manufacturers' specifications as necessary to ensure they are functioning properly (refer to Worksheet No. 22 of the Benthic QAPP (Windward 2009)).<br>The analytical laboratories will follow QC procedures outlined in the Benthic QAPP (see Worksheet Nos. 19, 24, 25, and 28 of the Benthic QAPP (Windward 2009)), their SOPs for the analytical methods being conducted (see Worksheet No. 23 of the Benthic QAPP (Windward 2009)), and their quality management plans.<br>Chemical data will be validated according to procedures outlined in the Benthic QAPP (see Worksheet Nos. 35 and 36 of the Benthic QAPP (Windward 2009)).<br>The biological laboratories will follow QC procedures outlined in the Benthic QAPP (see Worksheet No.14 of the Benthic QAPP (Windward 2009), their SOPs for the toxicity tests and taxonomy analysis being conducted (see Attachment M of this QAPP addendum and Attachment M of the Benthic QAPP (Windward 2009)), and their quality management plans. |
| Secondary Data: | Community and chemistry data are summarized in Worksheet No. 13 and Appendix B of the RARC Plan (Windward and AECOM [in prep]-b). |

## QAPP Worksheet No. 14. Summary of Project Tasks

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|---|---|
| Data Management Tasks: | The data management task will include keeping accurate records of field activities and observations so that project team members using the data will have accurate and appropriate documentation. Data management activities will be conducted in accordance with the project data management rules. Data transfer to USEPA will include a multimedia electronic data deliverable (MEDD) that conforms to the USEPA Region 2 MEDD format. The MEDD will include all qualified and rejected data (including the reported numerical value for rejected data). Field data will be stored in its native format and in the project sampling database. GPS data will also be downloaded and stored electronically in a project file. Laboratory analytical data will be loaded into the project sampling database, verified against laboratory reports, merged with corresponding field data, and updated based on validation. Subsequently, the spatial data will be mapped for the data report. |
| Documentation and Records: | It is important that field activities be documented in an organized, chronologic, and accurate manner. All field activities will be recorded in a field logbook maintained by the FC. The field logbook is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period.<br>Procedures for documentation are presented in Attachment H of the Benthic QAPP (Windward 2009). All relevant forms and records are presented on Worksheet No. 29 of the Benthic QAPP (Windward 2009). In general, the following information must be recorded:<br>• The identities and affiliation of the personnel conducting field activities<br>• Model numbers and serial numbers of instruments and/or equipment being used, to the extent available<br>• A description of the type of field work being conducted and the equipment used<br>• The date and time field activities were initiated and completed, with specific temporal information for each task (e.g., record the time activities commenced at each individual location, if applicable)<br>• The site where the field activities were conducted, and any locations within that site where work was performed (e.g., specific sampling sites, coordinates, and depths)<br>• The general methodology used to conduct the activities<br>• Communications with PMs and personnel regarding field activities<br>• Field-collected data (e.g., GPS measurements)<br>• Daily health and safety briefings<br>• Deviations from QAPP, SOP, or project health and safety plan (HSP) (Attachment L), reason for change, and any corrective actions taken. Corrective actions will be electronically documented on the Protocol Modification Form (Attachment A of the Benthic QAPP (Windward 2009)).<br>All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate.<br>The Surface Sediment Collection Form (Attachment D of the Benthic QAPP (Windward 2009)) will be filled out electronically to document sediment sampling location information.<br>A record of all personnel briefed on the HSP will be maintained by the FC, Site Safety and Health Officer, or designee. The record will be archived at Windward's Seattle office upon completion of the sampling efforts. |

## QAPP Worksheet No. 14. Summary of Project Tasks

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|---|---|
| Assessment/Audit Tasks | The FC will also communicate frequently with the Investigative Organization Task QA/QC Manager to confirm PQOs are being met. Assessment/audit tasks will be conducted, as summarized in Worksheet No. 31 of the Benthic QAPP (Windward 2009). Reviews of field activities/sampling method compliance and laboratory method compliance will be conducted periodically. |
| Data Review Tasks: | All field records will be reviewed by the FC for completeness and accuracy, and verified by the Task QA/QC Manager or a designee.<br>All data will be presented in a data report, which will also undergo a senior and peer review process before the final draft is submitted to USEPA (see Worksheet Nos. 34 through 37of the Benthic QAPP(Windward 2009) for relevant procedures). |
| Deliverables: | A data report that summarizes the results of the background sediment and reference location investigation above Dundee Dam will be prepared once the sediment chemistry, toxicity testing, and community results have been validated. The data report will be provided to USEPA within 90 days of receipt of validated data. |

## QAPP Worksheet No. 16. Project Schedule/Timeline Table

| Activities | Organization | Date (MM/DD/YY) | | Deliverable | Deliverable Due Date |
|---|---|---|---|---|---|
| | | Anticipated Date of Initiation | Anticipated Date of Completion | | |
| QAPP preparation and delivery to USEPA | Windward | 07/23/12 | 10/23/12 | Benthic QAPP Addendum No. 5 | 10/23/12 |
| 2- to-3-day reconnaissance survey | Windward | 10/23/12 | 10/25/12 | na | na |
| Surface sediment collection | Windward | 10/29/12 | 11/09/12 | See below for data report deliverables. | See below |
| Toxicity testing | EnviroSystem | Within 8 weeks of the earliest sediment collection date | Maximum of 32 days after test initiation | Draft toxicity test reports within 30 days of test completion | Final toxicity test reports 30 days after validation |
| Validation of toxicity test reports | Dinnel Marine Resources | Upon receipt of draft toxicity test reports | 30 days after receipt of toxicity test reports | One final validation report | Final toxicity test validation report 30 days after receipt of test reports |
| Benthic invertebrate community data | EcoAnalysts | Upon receipt of samples from the field | 6 weeks after receipt of last benthic invertebrate community samples | Benthic invertebrate community data and QA/QC report | 30 days after identification of invertebrates in last samples received |
| Surface sediment chemical analyses | Alpha Analytical, SGS – Analytical Perspectives, Brooks Rand Labs, ALS – CAS, Kelso, and Maxxam Analytics | Upon receipt of samples from the field | 9 weeks after receipt of last sediment samples | Final laboratory data reports and EDD | 9 weeks after receipt of last sediment samples |
| Validation of surface sediment | Laboratory Data Consultants | Upon receipt of final laboratory data reports and EDDs | 45 days after receipt of final laboratory data report | Final validation report | 45 days after receipt of laboratory data reports and EDDs |

## QAPP Worksheet No. 16. Project Schedule/Timeline Table

| Activities | Organization | Date (MM/DD/YY) | | Deliverable | Deliverable Due Date |
|---|---|---|---|---|---|
| | | Anticipated Date of Initiation | Anticipated Date of Completion | | |
| Preparation and delivery of the freshwater background and reference conditions data report to USEPA | Windward | Upon receipt of validated data | 90 days after receipt of validated data | Freshwater background and reference conditions data report | 90 days after receipt of validated data |

CAS – Columbia Analytical Services, Inc.
EDD – electronic data deliverable
na – not applicable
QA/QC – quality assurance/quality control
QAPP – quality assurance project plan
SGS – *Société Générale de Surveillance*
USEPA – US Environmental protection Agency

## QAPP Worksheet No. 17. Sampling Design and Rationale

| **Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):** |
|---|
| The results of the proposed 2012 upstream freshwater sediment sampling effort will be used to support the ERA and HHRA, specifically to address the assessment and measurement endpoints described in Worksheet No. 11 and outlined in Appendix B of the Revised RARC Plan (Windward and AECOM [in prep]-b). The specific goal of this effort is to collect sediment data from above Dundee Dam for SQT parameters and chemistry-only analyses for a subset of samples.<br>The general SQT sampling design uses four segments in the freshwater area above Dundee Dam, each approximately 1 mile in length. These segments are from RM 17.4 to RM 18.5, RM 18.5 to RM 19.5, RM 19.5 to RM 20.5, and RM 20.5 to RM 21.5. Sampling locations for the chemistry-only samples were placed randomly within four equal areas in the area between Dundee Dam (RM 17.4) and the I-80 bridge (RM 18.8). |
| **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):** |
| The rationale and description of the sampling design is provided in the above section entitled “Describe and provide a rationale for choosing the sampling approach” and in the section entitled “Where, when, and how should the data be collected/generated?” in No. Worksheet 11.<br>Sampling protocols will be consistent with those used for the SQT and sediment-only samples collected from the LPRSA in 2009. The sampling protocols will be implemented, as practicable, for conducting the field sampling effort and laboratory testing, as described in further detail in Worksheet No. 21 and Attachment M of this QAPP addendum and Attachment M of the Benthic QAPP (Windward 2009). Surface sediment (0 to 15 cm) samples will be collected in a consistent, repeatable manner with a stainless steel, 0.2-$m^2$ hydraulic power grab or a van Veen grab sampler, or by hand with a large, clean, and dedicated stainless steel serving spoon, and must also meet the acceptability criteria (described in Attachment D of the Benthic QAPP (Windward 2009)). Samples for AVS/SEM, ammonia, sulfide, and TPH-purgeable analyses will be subsampled as discrete, non-homogenized samples immediately after collection. Any large non-sediment items such as rocks, shells, wood chips, or organisms (e.g., clams) will be removed prior to homogenization; the surfaces of these items will be scraped to remove any invertebrates, which will be homogenized with the rest of the sample. Homogenized sediment will be split into appropriate sample containers. Because sampling will occur in an area not designated as a CERLCA site, excess sediment will be disposed of at the location of collection. |

## QAPP Worksheet No. 18. Proposed Sampling Locations

| Sampling Location/ID Number | Easting (X)[a] | Northing (Y)[a] | RM | Data Collection Method | Analyses | Rationale for Monitoring Location |
|---|---|---|---|---|---|---|
| UPRT18A | 594848 | 747167 | 17.5 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT18B | 594661 | 747548 | 17.5 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT18C | 594566 | 747744 | 17.6 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT18D | 594206 | 747732 | 17.6 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT18E | 594168 | 748505 | 17.7 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80; potential nearshore human access location based on proximity to intertidal island area[b] |
| UPRT18F | 594476 | 748691 | 17.8 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT18G | 594733 | 749155 | 17.8 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80; potential nearshore human access location based on proximity to several small clearings along River Drive[b] |
| UPRT18H | 595077 | 747203 | 17.4 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grained sediment based on reoccupy of LRC-098; previous sampling of location (AECOM [in prep]) indicates fine-grained sediment[c] |
| UPRT18I | 594952 | 747479 | 17.5 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grained sediment based on reoccupy of G0000030; potential nearshore human access location based on proximity to several small clearings along River Drive, previous sampling of location (Malcolm Pirnie 2007b) indicates coarse-grained sediment[c] |
| UPRT18J | 594080 | 748441 | 17.7 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grained sediment based on reoccupy of LRC-103; previous sampling of location (AECOM [in prep]) indicates fine-grained sediment[c] |

## QAPP Worksheet No. 18. Proposed Sampling Locations

| Sampling Location/ID Number | Easting (X)[a] | Northing (Y)[a] | RM | Data Collection Method | Analyses | Rationale for Monitoring Location |
|---|---|---|---|---|---|---|
| UPRT18K | 594251 | 749712 | 17.9 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grained sediment based on reoccupy of G0000032; previous sampling of location (Malcolm Pirnie 2007b) indicates coarse-grained sediment[c] |
| UPRT19A | 594219 | 749946 | 18.0 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19B | 594674 | 750594 | 18.1 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19C | 594725 | 751259 | 18.2 | Grab sampler or hand collection | Sediment chemistry | Randomly selected location for spatial coverage of area between Dundee Dam and I-80 was moved closer to shore to target potential nearshore human access location based on proximity to dock and park[b] |
| UPRT19D | 594233 | 751595 | 18.3 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80; nearshore potential human access location based on proximity to dock and park[b] |
| UPRT19E | 593866 | 751384 | 18.4 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19F | 593625 | 752027 | 18.5 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19G | 593350 | 751983 | 18.5 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19H | 593312 | 752258 | 18.5 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19I | 593270 | 753421 | 18.8 | Grab sampler or hand collection | Sediment chemistry | Randomly selected for spatial coverage of area between Dundee Dam and I-80[b] |
| UPRT19J | 594963 | 750944 | 18.2 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grained sediment based on reoccupy of G0000028; previous sampling of location (Malcolm Pirnie 2007b) indicates coarse-grained sediment[c] |
| UPRT19K | 594346 | 751403 | 18.3 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grained sediment based on reoccupy of LRC-104; previous sampling of location (AECOM [in prep]) indicates fine-grained sediment[c] |

## QAPP Worksheet No. 18. Proposed Sampling Locations

| Sampling Location/ID Number | Easting (X)[a] | Northing (Y)[a] | RM | Data Collection Method | Analyses | Rationale for Monitoring Location |
|---|---|---|---|---|---|---|
| UPRT19L | 593689 | 752159 | 18.5 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT19M | 593521 | 753139 | 18.7 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT20A | 593940 | 754560 | 19.0 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT20B | 593771 | 754769 | 19.0 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT20C | 593698 | 755909 | 19.3 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT20D | 593865 | 756426 | 19.3 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology; potential nearshore human access location adjacent to Elmwood Park[c] |
| UPRT20E | 593572 | 757468 | 19.6 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT20F | 593304 | 757808 | 19.6 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT21A | 594227 | 759384 | 20.0 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT21C | 594383 | 760392 | 20.2 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT21D | 593984 | 761127 | 20.3 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |

## QAPP Worksheet No. 18. Proposed Sampling Locations

| Sampling Location/ID Number | Easting (X)[a] | Northing (Y)[a] | RM | Data Collection Method | Analyses | Rationale for Monitoring Location |
|---|---|---|---|---|---|---|
| UPRT21B | 594132 | 759525 | 20.0 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT21E | 592804 | 761478 | 20.6 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology[c] |
| UPRT21F | 592304 | 761240 | 20.6 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT21G | 591753 | 761500 | 20.8 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |
| UPRT22A | 591091 | 763070 | 21.1 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology; potential nearshore human access location adjacent to Fairlawn Park[c] |
| UPRT22B | 591048 | 763692 | 21.2 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted fine-grain sediment expected based on river morphology; potential nearshore human access location adjacent to Fairlawn Park[c] |
| UPRT22C | 590921 | 763968 | 21.3 | Grab sampler or hand collection | Toxicity test, sediment chemistry, taxonomy | Targeted coarse-grain sediment expected based on river morphology[c] |

[a] New Jersey State Plane (US survey feet).

[b] A 2- to 3-day reconnaissance survey will be conducted prior to sediment sampling to verify sampling location accessibility, and to confirm human site accessibility of the selected targeted locations. Chemistry-only target locations may be moved following the reconnaissance survey to ensure adequate coverage of the area above Dundee Dam based on field observations and accessibility. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources.

[c] A 2- to 3-day reconnaissance survey will be conducted prior to sediment sampling to verify sampling location accessibility, and to confirm the grain size and human site accessibility of the selected targeted locations. SQT sampling target locations may be relocated following the reconnaissance field effort in order to meet targeted grain sizes comparable to the LPRSA SQT data. USEPA oversight will be present during the site reconnaissance survey to identify target sampling locations. Target sampling locations will not be identified in areas near a CSO or other potential point sources.

ID – identification
RM – river mile
SOP – standard operating procedure
SQT – sediment quality triad

## QAPP Worksheet No. 19. Analytical SOP Requirements Table

| Matrix | Analytical Group | Concentration Level | Analytical Laboratory/ SOP Reference | Sample Size | Containers (number, size, type)[a] | Preservation Requirements (chemical, temperature, light protected)[b] | Maximum Holding Time (preparation/ analysis)[c] |
|---|---|---|---|---|---|---|---|
| Sediment | PCBs – congeners | Low | Analytical Perspectives/ Attachment M2 | 10-g minimum | One 8-oz WM clear or amber glass jar | 0 – 6°C and dark until analysis at laboratory and during shipment | 1 year |
| Sediment | PCDDs/PCDFs | Low | Analytical Perspectives/ Attachment M3 | 10-g minimum | | | |
| Sediment | PAHs | Low | Maxxam Analytics/ Attachment M4 | 10-g minimum | One 8-oz WM clear or amber glass jar | Frozen in the dark at < 0°C until analysis at laboratory and during shipment | 100 days to prep if frozen, 40 days to analysis |
| Sediment | Organochlorine pesticides | Low | Maxxam Analytics/ Attachment M5, M6, M7 | 10-g minimum | One 8-oz WM clear or amber glass jar | Frozen in the dark at < 0°C until analysis at laboratory and during shipment | 299 days to prep if frozen, 40 days to analysis |
| Sediment | SVOCs | Low | Alpha Analytical/ Attachment M18, M19, M20, M48 | 10-g minimum | One 8-oz WM amber glass jar | Frozen in the dark at < 0°C until analysis at laboratory and during shipment | 6 months to extract if frozen, 14 days to extract if refrigerated, 40 days to analysis once extracted |
| Sediment | TPH – purgeables | Low | Alpha Analytical/ Attachment M34 | 20-g minimum | One 40-mL VOA vial (MeOH) collected for TPH-purgeables and one 60-mL container for total solids | 0 – 6°C at laboratory and during shipment; store in the dark, deionized water vials frozen at < 0°C until analysis at laboratory | Field preservation upon collection (MeOH); 14 calendar days for preparation and analysis |
| Sediment | TPH – extractables | Low | Alpha Analytical/ Attachment M33, M50 | 100-g minimum | One 8-oz WM amber glass jar | 0 – 6°C at laboratory and during shipment; store in the dark | 14 calendar days to preparation; 40 calendar days from preparation to analysis |

## QAPP Worksheet No. 19. Analytical SOP Requirements Table

| Matrix | Analytical Group | Concentration Level | Analytical Laboratory/ SOP Reference | Sample Size | Containers (number, size, type)[a] | Preservation Requirements (chemical, temperature, light protected)[b] | Maximum Holding Time (preparation/ analysis)[c] |
|---|---|---|---|---|---|---|---|
| Sediment | Alkylated PAHs | Low | Alpha Analytical/ Attachment M43, M46, M48 | 10-g minimum | One 8-oz WM amber glass jar | Frozen in the dark at < 0°C until analysis at laboratory and during shipment | 100 days to prep if frozen, 40 days to analysis |
| Sediment | TPH – alkanes | Low | Alpha Analytical/ Attachment M46, M47, M48 | 30-g minimum | | Frozen in the dark at < 0°C until analysis at laboratory and during shipment | 100 days to extraction if frozen, 40 calendar days from extraction to analysis |
| Sediment | General chemistry – TOC | Low | Alpha Analytical/ Attachment M25 | 20-g minimum | One 8-oz WM amber jar with Teflon | 0 – 6°C and dark until extraction at laboratory and during shipment | 14 calendar days to analysis |
| Sediment | General chemistry – percent moisture | Low | Alpha Analytical/ Attachment M24 | 5-g minimum | | | 14 calendar days to analysis |
| Sediment | PCBs – Aroclors | Low | Alpha Analytical/ Attachment M19, M35, M48 | 10-g minimum | | | 1 year |
| Sediment | Grain size | na | Alpha Analytical/ Attachment M26 | 250-g minimum | One 16-oz WM glass jar | 0 – 6°C at laboratory and during shipment | 6 months |
| Sediment | Total mercury | Low | Brooks Rand Labs/ Attachment M14, M15 | 10-g minimum | One 4-oz WM glass or plastic jar, clear or amber | < 0°C until analysis at laboratory and during shipment | 6 months if frozen |
| Sediment | Methylmercury | Low | Brooks Rand Labs/ Attachment M16 | 10-g minimum | | | |
| Sediment | Metals | Low | CAS, Kelso/ Attachment M8, M10, M11, M12 | 10-g minimum | One 8-oz WM glass or plastic jar, clear or amber | 0 – 6°C during shipment, 0 – 6°C at the laboratory or frozen at < 0°C | 1 year if frozen, 180 calendar days if refrigerated |

## QAPP Worksheet No. 19. Analytical SOP Requirements Table

| Matrix | Analytical Group | Concentration Level | Analytical Laboratory/ SOP Reference | Sample Size | Containers (number, size, type)[a] | Preservation Requirements (chemical, temperature, light protected)[b] | Maximum Holding Time (preparation/ analysis)[c] |
|---|---|---|---|---|---|---|---|
| Sediment | General chemistry – total sulfide | Low-high | CAS, Kelso/ Attachment M32 | 20-g minimum | One 4-oz WM glass jar | Fill jar completely with sediment; pour 10 mL NaOH/zinc acetate solution over the top of the sample; 0 – 6°C at laboratory and during shipment | 7 calendar days to analysis |
| Sediment | General chemistry – AVS/SEM | Low | CAS, Kelso/ Attachment M13 | 20g minimum | One 4-oz WM glass jar | 0 – 6°C at laboratory and during shipment, minimize headspace | AVS: evolution within 14 calendar days; analysis within 24 hours of evolution; SEM: analysis within 14 calendar days of extraction |
| Sediment | General chemistry – ammonia-N | Low | CAS, Kelso/ Attachment M27 | 20-g minimum | | | 7 calendar days to extraction; extracts preserved by lab with sulfuric acid; 28 calendar days to analysis |
| Sediment | General chemistry – cyanide | Low | CAS, Kelso/ Attachment M28, M29 | 20-g minimum | One 8-oz WM glass jar | 0 – 6°C at laboratory and during shipment | 14 calendar days to analysis |
| Sediment | Butyltins | Low | CAS, Kelso/ Attachment M21, M22 | 5-g minimum | | | 1 year to extract if frozen, 40 days to analysis, 14 calendar days to extraction if refrigerated, 40 days to analysis |
| Sediment | General chemistry – total Kjeldahl nitrogen | Low | CAS, Kelso/ Attachment M30 | 20-g minimum | | | None established for soils/sediments |

## QAPP Worksheet No. 19. Analytical SOP Requirements Table

| Matrix | Analytical Group | Concentration Level | Analytical Laboratory/ SOP Reference | Sample Size | Containers (number, size, type)[a] | Preservation Requirements (chemical, temperature, light protected)[b] | Maximum Holding Time (preparation/ analysis)[c] |
|---|---|---|---|---|---|---|---|
| Sediment | General chemistry – total phosphorus | Low | CAS, Kelso/ Attachment M31 | 20-g minimum | | | 28 calendar days to analysis |
| Sediment | Toxicity tests[d] | na | EnviroSystems/ Attachment M36, M37 | 2 gal. | Two 1-gal. food-grade plastic buckets with Teflon liners | 0 – 4°C at laboratory and during shipment; store in the dark without headspace or with nitrogen headspace | 8 weeks (56 days) after collection |
| Benthic invertebrates | Taxonomy[e] | na | EcoAnalysts/ Attachment M42 | 0.5 – 4 L | Appropriate size plastic jar (0.5 to 4 L) | 10% buffered formalin | Years once preserved |

[a] Container size may be modified by the laboratory, particularly for tissue samples that will have a small sample mass. The smallest container size should be selected; however, volume increases due to expansion of water upon freezing must be accounted for to avoid breaking the container upon freezing.

[b] Sediment samples will be either refrigerated or frozen after collection, depending on preservation requirements. When frozen samples for chemical analysis are couriered and the transit time is guaranteed to be less than 24 hours, wet ice or ice packs may be used as a preservative. Frozen samples shipped via overnight delivery will be packed with a combination of dry ice and wet ice or ice packs.

[c] Holding times are in calendar days. Any remaining sample mass will be archived frozen. When frozen samples are allowed to thaw, the cumulative time the sample is removed from the freezer is considered the holding time at 0 to 4°C.

[d] The toxicity test samples will be couriered to EnviroSystems on a weekly basis.

[e] The taxonomy samples will be shipped to EcoAnalysts using a commercial carrier.

AVS – acid volatile sulfide
CAS – Columbia Analytical Services, Inc.
na – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
SEM – simultaneously extracted metals
SOP – standard operating procedure
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons
VOA – volatile organic analysis
WM – wide mouth

## QAPP Worksheet No. 20. Field Quality Control Sample Summary Table

| Matrix | Analytical Group | Conc. Level | SOP Reference[a] | No. of Sampling Locations | No. of Field Duplicates[b] | No. of Rinsate Blanks/ Trip Blanks[c] | No. of CRMs | No. of MD/MS/MSD | Total No. of Samples[d] |
|---|---|---|---|---|---|---|---|---|---|
| Sediment | PCB – congeners | Low | M2 | 40 | 2 | 2/0 | 4 | 4/0/0 | 52 |
| Sediment | PCB – Aroclors | Low | M17, M19, M35, M48 | 40 | 2 | 2/0 | 0 | 2/2/2 | 50 |
| Sediment | PCDDs/PCDFs | Low | M3 | 40 | 2 | 2/0 | 4 | 4/0/0 | 52 |
| Sediment | Butyltins | Low | M21, M22 | 40 | 2 | 2/0 | 0 | 2/2/2 | 50 |
| Sediment | PAHs | Low | M4 | 40 | 2 | 2/0 | 2 | 2/0/0 | 48 |
| Sediment | Alkylated PAHs | Low | M18, M48 | 40 | 2 | 2/0 | 0 | 2/0/0 | 46 |
| Sediment | SVOCs | Low | M17, M18, M19, M20, M48 | 40 | 2 | 2/0 | 0 | 2/2/2 | 50 |
| Sediment | Metals[e] | Low | M8, M10, M11, M12 | 40 | 2 | 2/0 | 2 | 2/2/0 | 50 |
| Sediment | Methylmercury | Low | M16 | 40 | 2 | 2/0 | 2 | 4/4/4 | 58 |
| Sediment | Total mercury | Low | M14, M15 | 40 | 2 | 2/0 | 2 | 4/4/4 | 58 |
| Sediment | Organochlorine pesticides | Low | M5, M6, M7 | 40 | 2 | 2/0 | 2 | 2/0/0 | 48 |
| Sediment | General chemistry – TOC | Low | M25 | 40 | 2 | 2/0 | 0 | 2/2/0 | 48 |
| Sediment | Grain size | na | M26 | 40 | 2 | 0/0 | 0 | 2/0/0 | 44 |
| Sediment | General chemistry – percent moisture | na | M24 | 40 | 2 | 0/0 | 0 | 2/0/0 | 44 |
| Sediment | General chemistry – AVS/SEM | Low | M13 | 40 | 2 | 0/0 | 0 | 2/2/0 | 46 |

## QAPP Worksheet No. 20. Field Quality Control Sample Summary Table

| Matrix | Analytical Group | Conc. Level | SOP Reference[a] | No. of Sampling Locations | No. of Field Duplicates[b] | No. of Rinsate Blanks/ Trip Blanks[c] | No. of CRMs | No. of MD/MS/MSD | Total No. of Samples[d] |
|---|---|---|---|---|---|---|---|---|---|
| Sediment | General chemistry – ammonia-N | Low | M27 | 40 | 2 | 0/0 | 0 | 2/2/0 | 46 |
| Sediment | General chemistry – cyanide | Low | M28, M29 | 40 | 2 | 6/0 | 0 | 2/2/0 | 52 |
| Sediment | General chemistry – total Kjeldahl nitrogen | Low | M30 | 40 | 2 | 2/0 | 0 | 2/2/0 | 48 |
| Sediment | General chemistry – total phosphorus | Low | M31 | 40 | 2 | 2/0 | 0 | 2/2/0 | 48 |
| Sediment | General chemistry – total sulfide | Low – high | M32 | 40 | 2 | 0/0 | 0 | 2/2/0 | 46 |
| Sediment | TPH – extractables | Low | M33, M50 | 40 | 2 | 2/0 | 0 | 2/2/2 | 50 |
| Sediment | TPH – purgeables | Low | M34 | 40 | 2 | 0/10 | 0 | 0/2/2 | 56 |
| Sediment | TPH – alkanes | Low | M46, M47, M48 | 40 | 2 | 2/0 | 0 | 2/2/2 | 50 |
| Sediment | Toxicity tests[f] | na | M36, M37 | 24 | 0 | 0 | 0 | 0 | 24 |
| Benthic invertebrates | Taxonomy | na | M42 | 24[g] | 0 | 0 | 0 | 0 | 24 |

[a] Refer to Worksheet No. 23 for SOP titles.

[b] Field duplicate will be collected at a rate of 1 per 20 samples, and consist of a thoroughly homogenized sample collected from one location that has been split between two sets of containers and labeled as representing two separate sampling locations. Samples for AVS/SEM, ammonia, sulfide, and TPH-purgeable analyses will be collected as discrete, non-homogenized samples. Field duplicates for AVS/SEM, ammonia, sulfide, and TPH analyses will be collected from the same grab sample as the parent sample and will not be homogenized.

[c] Rinsate blanks will include a deionized water rinse of decontaminated equipment used to homogenize sediment and tissue samples. The number provided for the trip blanks is an estimate; one trip blank per analysis will be included in each cooler transporting sediment samples for TPH-purgeable analysis to Alpha Analytical, the laboratory conducting both analyses.

## QAPP Worksheet No. 20. Field Quality Control Sample Summary Table

[d] Additional containers will not be collected for laboratory duplicate, MS, and MSD samples; the aliquot for MDs, MSs, and MSDs will be taken from the same container as the parent sample, with the exception of TPH-purgeables. Separate containers will be collected for MS and MSD samples for TPH-purgeable analyses.

[e] Metals will be analyzed using either USEPA SW-846 6020 or 6010.

[f] Two toxicity tests (i.e., the 28-day *Hyalella azteca* and the 10-day *Chironomus dilutes* growth and mortality tests) will be performed on each of the SQT surface sediment samples.

[g] Four replicates will be collected per SQT location. Three replicates will be analyzed separately per location and one will be archived.

AVS – acid volatile sulfide
CRM – certified reference material
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
na – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
SEM – simultaneously extracted metals
SOP – standard operating procedure
SQT – sediment quality triad
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons
USEPA – US Environmental Protection Agency

## QAPP Worksheet No. 21. Project Sampling SOP References Table

| Reference Number[a] | Title, Revision Date and/or Number | Originating Organization | Equipment Type | Modified for Project Work? | Comments | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|
| 1 | Locating Sample Points Using a Hand-held Global Positioning System (GPS) SOP, (July 2007), Revision 0 | Windward | Hand-held GPS unit | No | Attachment B; for use with backpack electrofishing gear and boat operations | No |
| 2 | Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS) (July 2007), Revision 0 | Windward | Trimble (or similar boat-mounted GPS unit) with related cable and power supply | No | Attachment C; for use with boat-based operations | No |
| 3 | Collection and Processing of Sediment Grab Samples SOP (August 2012), Revision 1 | Windward | Sediment grab samplers and fathometer (or weighted demarcated line) | No | Attachment D; for collection of surface sediment samples and benthic invertebrate samples | Yes |
| 4 | Procedure to Decontaminate Sediment Sampling Equipment SOP (July 2007), Revision 0 | Windward | Sediment grab samplers, spoons, mixing pots and bowls, and any equipment that comes into contact with sediment | No | Attachment E | No |
| 5 | Management and Disposal of Investigation-Derived Waste SOP (July 2007), Revision 0 | Windward | open-top drums, storage racks, and insulated coolers | No | Attachment F | No |

## QAPP Worksheet No. 21. Project Sampling SOP References Table

| Reference Number[a] | Title, Revision Date and/or Number | Originating Organization | Equipment Type | Modified for Project Work? | Comments | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|
| 6 | Chain-of-Custody (COC) Tracking and Sample Packaging SOP (July 2007), Revision 0 | Windward | COC forms, custody seals, sample containers, packaging supplies and coolers | No | Attachment G | No |
| 7 | Documenting Field Activities SOP (March 2009), Revision 0 | Windward | Computer, camera | No | Attachment H | No |
| 8 | Benthic Macroinvertebrate Sampling SOP (April 2009), Revision 0 | Windward | Kick net, D-frame dip net, and sieve bucket | No | Attachment I | No |
| 10 | Measuring Water Quality Parameters Using a Handheld Multi-Probe Meter (September 2009), Revision 0 | Windward | Handheld multi-probe YSI meter | No | Attachment P | No |
| 13 | Wet Sieving for Approximate Grain Size Analysis | USEPA Region 10 in cooperation with the US Army Corps of Engineers-Seattle District, and the Washington State Department of Ecology | No. 230 (63 µm) sieve, beaker/graduated cylinder, squirt bottle, spoon, bucket | No | Attachment AA | Yes |

[a] SOPs that were presented in the Benthic QAPP (Windward 2009), but are not applicable to this QAPP addendum were removed from this worksheet; therefore not all SOP numbers are listed in this table.

[b] The SOP is attached to this QAPP addendum if it was updated by the laboratory after the Benthic QAPP (Windward 2009) was finalized. The updated SOP replaces the SOP presented in the Benthic QAPP. All other SOPs are provided in as attachments to the Benthic QAPP.

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M2 | USEPA 1668C | AP-CM-7, High Resolution Mass Spectrometry, Method 1668 for Solid/Air/Aqueous/Tissue Matrices, Revision 10-2, 8/22/12 | Definitive | PCBs - congeners | Micromass Autospec Ultima HRMS | SGS - Analytical Perspectives | No | Yes |
| M3 | USEPA 1613B | AP-CM-5, Polychlorinated dibenzo dioxin/furans, USEPA Methods 8290, 1613, 23, 0023A, & TO-9A, Revision 12-7, 10/16/09 | Definitive | PCDDs/PCDFs | Micromass Autospec Ultima HRMS | SGS - Analytical Perspectives | No | Yes |
| M4 | CARB 429 Mod. | SOP No. BRL-00423, PAH Compounds by HRGC HRMS in Food Products, Sediment and Water, 8/5/10 | Definitive | PAHs | VG Autospec HRMS or Autospec Ultima HP 5890 Series II GC or HP 6890 Gas Chromatograph Autosampler | Maxxam Analytics | No | Yes |
| M5 | NA | BRL SOP-00003, Cleanup of Sample Extract Using Gel Permeation Chromatography, 4/13/09 | Definitive | Organochlorine pesticides | Gel Permeation Chromatograph Autoprep and Model 1002B or J2Scientific AccuPrep MPS GPC System | Maxxam Analytics | No | No |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M6 | na | BRL SOP-00010, Extraction Organochlorine Pesticides from Liquids and Solids, 4/13/09 | Definitive | Organochlorine pesticides | Cal-Glass LG-6900 Soxhlet (or equivalent), Cal-Glass LG-6901-122 thimble, and 500 mL round-bottom flask | Maxxam Analytics | No | No |
| M7 | USEPA 1699 Mod. (NYSDEC HRMS-2) | BRL SOP-00415, OC Pesticides by HRMS, 8/5/10 | Definitive | Organochlorine pesticides | HP HRGC, Model: 6890A, 6890, 6890D, 6890N, 5690 Series II, or 6890A Plus; with an HRMSr Micromass Autospec Ultima or VG AutoSpec "S" | Maxxam Analytics | No | Yes |
| M8 | USEPA SW-846 3050B | SOP No. MET-3050, SOP for Metals Digestion, Revision 12, 2/25/12 | Definitive | Metals | na | ALS - CAS, Kelso | No | Yes |
| M10 | USEPA SW-846 6020 | MET-6020, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS); EPA Method 6020, Revision 14, 4/10/10 | Definitive | Total metals | Thermo ICP/MS (VG PQ-S or ExCell or X-Series model) | ALS - CAS, Kelso | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M11 | USEPA SW-846 6010 | MET-ICP, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP), Revision 23, 10/28/11 | Definitive | Total metals | Thermo Jarrell ash atomic emission spectrometer (ICAP-61 or IRIS model) | ALS - CAS, Kelso | No | Yes |
| M12 | USEPA SW-846 7742 | MET-7742, Standard Operating Procedure for Selenium by Borohydride Reduction Atomic Absorption, Revision 3, 2/19/10 | Definitive | Total metals | Varian SpectrAA-20 atomic absorption spectrometer | ALS - CAS, Kelso | No | Yes |
| M13 | USEPA 821/R-91-100, SW-846 6010/6020 | SOP No. GEN-AVS, Sulfides, Acid Volatile, Rev. 6, 2/6/12 | Definitive | General chemistry – AVS/SEM | Ultraviolet Visible Spectroscopy (UV-Visible) ICP, Cold Vapor Atomic Adsorption Spectrometry | ALS - CAS, Kelso | No | Yes |
| M14 | na | SOP No.BR-002, BRL Procedure for EPA Method 1631, Appendix to (1/01): Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation by Cold Vapor Atomic Fluorescence Spectrophotometry (CVAFS), Revision 010d, 5/31/11 | Definitive | Total mercury | BRL Model III cold vapor atomic fluorescence spectrophotometer | Brooks Rand Labs | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M15 | USEPA 1631 | SOP No.BR-0006, BRL Procedure for EPA Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, Revision 004e, 05/24/10 | Definitive | Total mercury | BRL Model III cold vapor atomic fluorescence spectrophotometer | Brooks Rand Labs | No | Yes |
| M16 | USEPA 1630 | SOP No.BR-0011, Determination of Methyl Mercury by Aqueous Phase Ethylation, Trap Pre-Collection, Isothermal GC Separation, and CVAFS Detection: BRL Procedure for EPA Method 1630 (Waters) and EPA Method 1630, Modified (Solids), Revision 013d, 6/6/11 | Definitive | Methylmercury | BRL Model III cold vapor atomic fluorescence spectrophotometer | Brooks Rand Labs | No | Yes |
| M17 | USEPA 3570 | SOP ID 2172 (OP-016), Microscale Solvent Extraction (MSE), Revision 2, 3/2/12[c] | Definitive | SVOCs, PCB Aroclors | Custom Tumbler, Kuderna-Danish 10 mL concentrator tubes, 500 mL evaporation flasks, 3-ball macro Snyder columns, Organomations N-EVAP, or Zymark TurboVap | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M18 | na | SOP ID 2167 (OP-006), Gel Permeation Chromatography Method 3640A, Revision 2, 3/2/12[c] | Definitive | SVOCs | Waters HPLC 600E Controller and Pump, 486 Tunable Absorbance Detector, Auto System, Envirogel GPC Guard and Cleanup Columns, and Phenomonex Guard and Cleanup Columns | Alpha Analytical | No | Yes |
| M19 | na | SOP ID 2170 (OP-014), Silica Gel Cleanup Procedure (Automated and Manual), Revision 2, 3/2/12[c] | Definitive | SVOCs | Waters HPLC 600E System Controller, 717 Autosampler, and 486 Tunable Absorbance Detector; Waters uPorasil Prep-pak and guard-pak cartridges or Modcol column | Alpha Analytical | No | Yes |
| M20 | USEPA SW-846 8270D | SOP ID 2155 (No.O-006), Method 8270, Semivolatile Organic Compounds by GC/MS, Revision 4, 8/10/12[c] | Definitive | SVOCs | Agilent 6890 GC with Agilent 5973 detector | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M21 | na | SOP No.SOC-OSWT, Extraction of Organotins in Sediment, Water, and Tissue Matrices, Revision 6, 11/25/09 | Definitive | Butyltins | Nitrogen evaporator, centrifuge, Kuderna-Danish apparatus, vacuum pump and manifold, water bath, vortex and tumbler for VOA vials | ALS - CAS, Kelso | No | Yes |
| M22 | Krone et al (1989) | SOP No.SOC-BUTYL, Butyltins, Revision 10, 1/20/12 | Definitive | Butyltins | Hewlett Packard 6890 gas chromatograph with a flame photometric detector | ALS - CAS, Kelso | No | Yes |
| M24 | SM2540G Mod. | SOP ID 2175 (W-001), Percent Solids Determination, Revision 2, 3/2/12[c] | Definitive | Percent moisture | Analytical balance capable of weighing to the nearest 0.0001 g and a top-loading balance capable of weighing to the nearest 0.01 g | Alpha Analytical | No | Yes |
| M25 | Lloyd Kahn | SOP ID 2182(W-028), Total Organic Carbon in Soil, Sediment and Water, Revision 3, 8/13/12[c] | Definitive | General chemistry – TOC | Perkin Elmer 2400 Series II CHNS/O Analyzer with Thermal Conductivity Detector | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M26 | ASTM D422 | SOP ID 2183 (W-029), Particle Size Analysis of Soils – With / Without Hydrometer and Liquid Limit, Plastic Limit, and Plasticity Index, Revision 3, 8/3/12[c] | Definitive | Grain size | Analytical balance capable of weighing to the nearest 0.0001 g and a top-loading balance capable of weighing to the nearest 0.01 g | Alpha Analytical | No | Yes |
| M27 | USEPA 350.1 Mod. | SOP No. GEN-350.1, Ammonia by Flow Injection Analysis, Revision 9, 2/23/12 | Definitive | General chemistry – ammonia-N | Rapid Flow Analyzer Colorimeter | CAS – Kelso | Yes, modified to include sulfide cleanup procedures in nitrogen, ammonia, colorimetry, salicylate-hypochlorite automated-segmented flow, USGS I-6522-90 | Yes |
| M28 | na | SOP No. GEN-9013, Cyanide Extraction of Solids and Oils, Revision 0, 7/8/98 | Definitive | General chemistry – cyanide | na | ALS - CAS, Kelso | No | No |
| M29 | USEPA SW-846 9012A | SOP No. GEN-335, Total Cyanides and Cyanides Amenable to Chlorination, Revision 17, 2/3/12 | Definitive | General chemistry – cyanide | Lachat Automated Analyzer | ALS - CAS, Kelso | No | Yes |
| M30 | ASTM D1426-93B Mod. | SOP No. GEN-TKN, Nitrogen, Total and Soluble Kjeldahl, Revision10, 1/7/08 | Definitive | General chemistry – total Kjeldahl nitrogen | Ion selective electrode | ALS - CAS, Kelso | No | No |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M31 | USEPA 365.3 Mod. | SOP No. GEN-365.3, Phosphorus Determination Using Colorimetric Procedure, Revision 10, 8/28/08 (includes sample preparation) | Definitive | General chemistry – total phosphorus | UV-VIS | ALS - CAS, Kelso | No | No |
| M32 | USEPA SW-846 9030M | SOP No. GEN-9030M, Total Sulfides by Methylene Blue Determination, Revision 8, 1/5/06 (includes sample preparation) | Definitive | General chemistry – total sulfide | UV-VIS | ALS - CAS, Kelso | No | No |
| M33 | NJDEP EPH | SOP ID 2131 (04-21), New Jersey Extractable Petroleum Hydrocarbons (NJ EPH), Revision 2, 4/27/12[c] | Definitive | TPH – extractables | GC/FID | Alpha Analytical | No | Yes |
| M34 | USEPA SW-846 8015C | SOP ID 2126 (04-13), TPH-Gasoline Range Organics, Revision 2, 4/27/12[c] | Definitive | TPH – purgeables | GC/FID | Alpha Analytical | No | Yes |
| M35 | USEPA SW-846 8082A | SOP ID 2160 (O-012), Determination of Polychlorinated Biphenyls (PCBs) as Aroclors or Congeners By Gas Chromatography/Electron Capture Detection (GC-ECD), Revision 3,, 4/18/12[c] | Definitive | PCBs – Aroclors | HP 5890 Series II GC, HP 6890 Plus or similar, HP 6890 series autosampler with controller or equivalent | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M36 | USEPA/600/ R-99/064 | SOP No. QA-1407, Acute Toxicity of Sediments To Midge Larvae, *Chironomus dilutus,* Revision 12c, 11/18/09 | Definitive | Benthic invertebrates | Toxicity testing equipment | EnviroSystems | No | Yes |
| M37 | USEPA/600/ R-99/064 | SOP No. QA-1467, Assessment Toxicity (28-Day) of Sediments To The Amphipod, *Hyalella azteca* based on Survival and Growth – Project-Specific Document, Revision 6, 10/22/09 | Definitive | Benthic invertebrates | Toxicity testing equipment | EnviroSystems | Yes | Yes |
| M42 | Barbour et al. (1999) | Standard Operating Procedures for Laboratory Analysis: Benthic Macroinvertebrate Indicator, Revision 2, 5/8/12 | Definitive | Benthic invertebrates | Taxonomic identification of benthic invertebrates | EcoAnalysts | No | Yes |
| M43 | USEPA SW-846 8270D | SOP ID 2247 (O-008). Analysis of Parent and Alkylated Polynuclear Aromatic Hydrocarbons, Selected Heterocyclic Compounds, Steranes, Triterpanes, and Triaromatic Steroids by GC/MS – SIM, Revision 4, 8/10/12 [c] | Definitive | Alkylated PAHs | GC Model Agilent/HP6890 or equivalent, Mass spectrometer Agilent/HP5973 or equivalent | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M46 | NA | SOP ID 2260 (OP-009). Alumina Column Cleanup of Organic Extracts, Revision 2, 3/22/12 [c] | Definitive | Alkylated PAHs, TPH – alkanes | Glass preparation column, muffle furnace, and a top-loading balance capable of weighing to the nearest 0.01 g | Alpha Analytical | No | Yes |
| M47 | USEPA SW-846-8015D | SOP ID 2246 (O-003). Total Petroleum and Saturated Hydrocarbons by Gas Chromatography/Flame Ionization Detector, Revision 4, 4/11/12 [c] | Definitive | TPH – alkanes | GC Model Agilent/HP6890 or equivalent, auto sampler HP6890 with a GC autosampler controller or equivalent | Alpha Analytical | No | Yes |
| M48 | na | SOP ID 2261 (OP-013). Shaker Table Extraction, Revision 2, 3/22/12[c] | Definitive | TPH – alkanes | New Brunswick Scientific shaker table and drying oven capable of maintaining 105 ºC and 400 ºC | Alpha Analytical | No | Yes |
| M49 | na | SOP ID 1754 (G-003). Balance Calibration and Maintenance, Revision 2, 3/2/12 [c] | Definitive | Percent moisture, grain size | Analytical balance capable of weighing to the nearest 0.0001 g and a top-loading balance capable of weighing to the nearest 0.01 g | Alpha Analytical | No | Yes |

## QAPP Worksheet No. 23. Analytical and Biological SOP References Table

| Reference Number[a] | Primary Method Reference | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? | Attached to this QAPP Addendum?[b] |
|---|---|---|---|---|---|---|---|---|
| M50 | na | SOP ID1959 (02-12).Microwave extraction, Revision 3, 6/1/12 [c] | Definitive | TPH – extractables | Kuderna-Danish apparatus, analytical balance capable of weighing 0.01 g, water bath, microwave | Alpha Analytical | No | Yes |

[a] SOPs presented in the Benthic QAPP (Windward 2009) but inapplicable to this QAPP addendum were removed from this worksheet.
[b] The SOP is attached to this QAPP addendum if it was updated by the laboratory after the Benthic QAPP (Windward 2009) was finalized. The updated SOP replaces the SOP presented in the Benthic QAPP. All other SOPs are provided in Attachment M of the Benthic QAPP.
[c] Alpha Analytical revised its SOP numbering system after the Benthic QAPP was finalized. The original SOP number is provided in parentheses. The revised SOP number reflects only the revisions made to the SOP under the new numbering scheme.

ALS – ALS Environmental
ASTM – American Society for Testing and Materials
AVS/SEM – acid volatile sulfide/ simultaneously extracted metals
BRL – Brooks Rand Labs
CARB – California Air Resources Board
CAS – Columbia Analytical Services, Inc.
COC – chain of custody
CVAFS – cold vapor atomic fluorescence spectrometer
ECD – electron capture detector
EPH – extractable petroleum hydrocarbons
FID – flame ionization detector
GC/MS – gas chromatography/mass spectrometry
GPC – gel permeation chromatograph
HP – Hewlett Packard
HPLC – high-performance liquid chromatography
HR – high resolution
ICP – inductively coupled plasma
na – not applicable
NJDEP – New Jersey Department of Environmental Protection
NYSDEC – New York State Department of Environmental Conservation
OC – organic carbon
OES –optical emission spectrometry
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
QAPP – quality assurance project plan
SGS – *Société Générale de Surveillance*
SIM – selective ion monitoring
SOP – standard operating procedure
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons
USEPA – US Environmental Protection Agency
USGS – US Geological Survey
UV-VIS – ultraviolet-visible spectrophotometry
VOA – volatile organic analysis

## QAPP Worksheet No. 24. Analytical Instrument Calibration Table

| Instrument/ Chemical | Calibration Procedure | Frequency of Calibration | Acceptance Criteria | Corrective Action (CA) | Person Responsible for CA | SOP Reference[a] |
|---|---|---|---|---|---|---|
| GC/MS – SVOCs | Refer to Alpha Analytical SOP ID 2155 (O-006). | ICAL after instrument set up, after major instrument changes, and when CCC are not met | ICAL: ≤ 20% RSD for all target analytes or linear/quadratic curve r ≥ 0.990.<br>ICV: ± 30% recovery of the true values. Sporadic marginal failures accepted.<br>CCV: ≤ 40% difference or drift; SPCC minimum average RF. | Inspect system; correct problem; rerun calibration and affected samples. | Analyst or Elizabeth Porta or Julie DeSousa, Alpha Analytical | M20 |
| GC/FID – TPH | Refer to Alpha Analytical SOP ID 2131 (04-21), 2126 (04-13), and 2246 (O-003). | Initial calibration after instrument set up, after major instrument changes, and when CCC are not met; CCV verified on each working day | ICAL %RSD ≤ 20%.<br>CCV: ±25% for alkanes and ±25 for ranges and ±30% for individual compounds for extractables. | Inspect system, correct problem rerun calibration and affected samples. | Analyst or Mitch Ostrowski, John Trimble, or Ray Siegener, Alpha Analytical | M33, M34, M47 |

Note: Worksheet 24 of this QAPP addendum presents only calibration procedures that have been updated since the Benthic QAPP (Windward 2009) was finalized, all other calibration procedures are presented in Worksheet 24 of the Benthic QAPP.

[a] From Analytical SOP References table (Worksheet No. 23 of this QAPP addendum).

CCC – continuing calibration criteria
CCV – continuing calibration verification
GC/FID – gas chromatograph/flame ionization detector
GC/MS – gas chromatograph/mass spectrometer
ICAL – initial calibration
ICV – initial calibration verification
ID – identification
QAPP – quality assurance project plan
RF – response factor
RSD – relative standard deviation
SOP – standard operating procedure
SPCC – system performance check compounds
SVOC – semivolatile organic compound
TOC – total organic carbon
TPH – total petroleum hydrocarbons

## QAPP Worksheet No. 35. Sampling and Analysis Validation Process Tables

**Analytical Validation (Steps IIa and IIb) Process Table**

| Step IIa/IIb | Validation Input | Description | Responsible for Validation (name, organization) |
|---|---|---|---|
| IIa | Analytical data deliverables | Verify that the required deliverables were provided by the laboratory as specified in the contractual documents. | Jennifer Parker, Windward /Polly Newbold, ddms |
| 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. | Thai Do, Windward |
| IIa | Field records, database output | Verify transcription of field data from field forms to database. | Thai Do, Windward/Kim Goffman, Windward |
| IIa | Custody records, analytical data reports | Review traceability from sample collection through reporting. | Jennifer Parker, Windward /Polly Newbold, ddms |
| IIa | Analytical data reports | Verify reported analytes conform to contractual specifications. | Jennifer Parker, Windward/ /Polly Newbold, ddms |
| IIa | Laboratory SOPs, analytical data reports | Verify conformance to approved preparation and analytical procedures; ensure that measurement performance criteria were met; and verify that deviations from procedures or criteria were documented. | Jennifer Parker, Windward/Stella Cuenco, Laboratory Data Consultants, Inc. |
| IIa | Methods, analytical data reports | Verify that samples were prepared and analyzed within method-specific holding times. | Jennifer Parker, Windward/ Stella Cuenco, Laboratory Data Consultants, Inc. |
| IIa | Laboratory EDDs | Verify that EDD conforms to USEPA Region 2 MEDD format. | Ellen Collins, Alpha Analytical/ Kimberly Mace, SGS - Analytical Perspectives/Tiffany Stilwater, Brooks Rand Labs/ Ivana Vukovic, Maxxam Analytics/ Lynda Huckestein, ALS - Columbia Analytical Services, Inc. |
| IIa | Laboratory EDDs, analytical data reports, database output | Verify loading of EDDs into database against hard-copy analytical reports. | Polly Newbold, ddms |

## QAPP Worksheet No. 35. Sampling and Analysis Validation Process Tables

**Analytical Validation (Steps IIa and IIb) Process Table**

| Step IIa/IIb | Validation Input | Description | Responsible for Validation (name, organization) |
|---|---|---|---|
| IIa | Analytical data reports | Verify that the qualifiers applied by the laboratory are defined in the analytical report and are in conformance to the contractual requirements. | Jennifer Parker, Windward/Polly Newbold, ddms |
| IIa | Laboratory SOPs, analytical data reports | Verify that the measurement criteria were met for all analyses and, if not, that appropriate corrective action and notification were taken and made. | Jennifer Parker, Windward /Polly Newbold, ddms |
| IIa | Analytical data reports | Verify that project quantitation limits conformed to the contractual specifications and that any deviations were justified. | Jennifer Parker, Windward /Polly Newbold, ddms |
| IIa | Analytical data reports, validation guidance | Validate 100% of the analytical data reports according to the method-specific USEPA Region 2 validation SOPs (if available). Qualifiers will be applied based on the criteria in the USEPA Region 2 validation SOPs or QAPP. Verify manual transcriptions from the raw data. Verify calculations from the raw data. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIa | Data validation reports, database output | Verify that entry of qualifiers was correct and complete. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | Analytical data reports | Verify reported analytes conform to target analytes in QAPP. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | QAPP, analytical data reports | Verify that samples were prepared and analyzed within the holding times specified in the QAPP. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | QAPP, analytical data reports | Verify that samples were prepared and analyzed according to the procedures specified in the QAPP. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | QAPP, analytical data reports | Verify that the measurement criteria specified in the QAPP were met for all analyses and, if not, that appropriate corrective action and notification were taken and made. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | QAPP, analytical data reports | Verify that project quantitation limits conformed to the QAPP and that deviations were justified. | Stella Cuenco, Laboratory Data Consultants, Inc |

## QAPP Worksheet No. 35. Sampling and Analysis Validation Process Tables

**Analytical Validation (Steps IIa and IIb) Process Table**

| Step IIa/IIb | Validation Input | Description | Responsible for Validation (name, organization) |
|---|---|---|---|
| IIb | Analytical data reports, validation guidance | Validate 100% of the analytical data reports according to the measurement performance criteria in the QAPP. Qualifiers will be applied based on the criteria in the QAPP or method-specific Region 2 validation SOPs, whichever is more stringent. | Stella Cuenco, Laboratory Data Consultants, Inc |
| IIb | QAPP, analytical data reports, validation guidance | Verify that the qualifiers applied during validation were in conformance with the QAPP and specified validation guidance. | Stella Cuenco, Laboratory Data Consultants, Inc |
| 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. | Jennifer Parker, Windward /Polly Newbold, ddms |

ddms – de maximis Data Management Solutions, Inc.
EDD – electronic data deliverable
MEDD – multimedia electronic data deliverable
QAPP – quality assurance project plan
SGS – *Société Générale de Surveillance*
SOP – standard operating procedure
USEPA – US Environmental Protection Agency
Windward – Windward Environmental LLC

## QAPP Worksheet No. 35. Sampling and Analysis Validation Process Tables

Biological Validation Process Table

| Validation Input | Description | Responsible for Validation (name, organization) |
|---|---|---|
| Biological data deliverables | Verify that the required deliverables were provided by the laboratory as specified in the contractual documents. | Karen Tobiason, Windward |
| 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. | Karen Tobiason, Windward |
| Field records, database output | Verify transcription of field data from field forms to database. | Thai Do, Windward /Kim Goffman, Windward |
| Custody records, analytical data reports | Review traceability from sample collection through reporting. | Karen Tobiason, Windward |
| Biological data reports | Verify reported biological data conform to contractual specifications. | Karen Tobiason, Windward |
| Laboratory SOPs, analytical data reports | Verify conformance to approved testing procedures; ensure that performance criteria were met; and verify that deviations from procedures or criteria were documented. | Karen Tobiason, Windward |
| Methods, analytical data reports | Verify that samples were tested within the required holding times. | Karen Tobiason, Windward |
| Laboratory EDDs, biological data reports, database output | Verify loading of EDDs into database against hard-copy analytical reports. | Karen Tobiason, Windward |
| Analytical data reports, validation guidance | Data validation review of test and QA/QC data from the testing laboratory, including a 100% check of all data transcribed from the raw data bench sheets to the electronic databases. Note any data gaps or items that were out of compliance with the bioassay protocols. Where appropriate, provide guidance regarding the severity of any out-of-compliance items. Recommend retesting where necessary. | Paul Dinnel, Dinnel Marine Resources |
| 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. | Karen Tobiason, Windward |

## QAPP Worksheet No. 35. Sampling and Analysis Validation Process Tables

EDD – electronic data deliverable
QAPP – quality assurance project plan
QA/QC – quality assurance/quality control
SOP – standard operating procedure
Windward – Windward Environmental LLC

## QAPP Worksheet No. 36. Validation Summary

**Analytical Validation (Steps IIa and IIb) Summary Table**

| Step IIa/IIb | Matrix | Analytical Group | Concentration Level | Validation Criteria[a] | Data Validator (title and organizational affiliation) |
|---|---|---|---|---|---|
| IIa | Sediment | PCBs – congeners[b] | Low | USEPA Region 2 validation SOP HW-46, modified for method | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | PCBs – congeners[b] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | PCBs – Aroclors[c] | Low | USEPA Region 2 validation SOP HW-45 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | PCBs – Aroclors[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | PCDDs/PCDFs[d] | Low | USEPA Region 2 validation SOP HW-25 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | PCDDs/PCDFs[d] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Organochlorine pesticides[e] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Organochlorine pesticides[e] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | PAHs[e] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | PAHs[e] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Alkylated PAHs[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Alkylated PAHs[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Metals[c] | Low | USEPA Region 2 validation SOP HW-2 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |

## QAPP Worksheet No. 36. Validation Summary

**Analytical Validation (Steps IIa and IIb) Summary Table**

| Step IIa/IIb | Matrix | Analytical Group | Concentration Level | Validation Criteria[a] | Data Validator (title and organizational affiliation) |
|---|---|---|---|---|---|
| IIb | Sediment | Metals[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | TPH[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | TPH[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | General chemistry[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | General chemistry[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Total mercury[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Total mercury[c] | Low | QAPP Worksheets 12, 15, 19, and 24 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Methylmercury[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Methylmercury[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | SVOCs[c] | Low | USEPA Region 2 validation SOP HW-22 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | SVOCs[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Butyltins[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Butyltins[c] | Low | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Particle size[c] | na | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |

## QAPP Worksheet No. 36. Validation Summary

**Analytical Validation (Steps IIa and IIb) Summary Table**

| Step IIa/IIb | Matrix | Analytical Group | Concentration Level | Validation Criteria[a] | Data Validator (title and organizational affiliation) |
|---|---|---|---|---|---|
| IIb | Sediment | Particle size[c] | na | QAPP Worksheets 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Lipids[c] | Low | QAPP Worksheet Nos. 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Lipids[c] | Low | QAPP Worksheet Nos. 12, 15, 19, 24, 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIa | Sediment | Percent moisture[c] | Low | QAPP Worksheet Nos. 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |
| IIb | Sediment | Percent moisture[c] | Low | QAPP Worksheet Nos. 12, 15, 19, 24, and 28 | Stella Cuenco, Senior Chemist, Laboratory Data Consultants, Inc. |

[a] Validation follows the most recent *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA 2008b), *Contract Laboratory Program National Functional Guidelines for Chlorinated Dibenzo-*p*-dioxins and Chlorinated dibenzofurans Data Review*.(EPA 2011), *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (USEPA 2010), and Region 2 modifications to the extent they are applicable. Validation includes professional judgment where appropriate and necessary.

[b] All data packages will be submitted for full validation (USEPA Level 4) of all 209 PCB congeners and homologues.

[c] One SDG or 20% of the data (whichever is greater) will be submitted for full validation, and the remaining SDGs will be submitted for reduced validation (USEPA Stage 2B). Validation for each analytical group will be limited to the target analytes in Worksheet No. 15 for that group.

[d] All data packages will be submitted for full validation (USEPA Level 4); validation will be limited to the 2,3,7,8-substituted congeners and homologues.

[e] All data packages will be submitted for full validation (USEPA Level 4); validation for each analytical group will be limited to the target analytes in Worksheet No. 15 for that group.

na – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD/PCDF – polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans
QAPP – quality assurance project plan
SDG – sample delivery group
SOP – standard operating procedure
SVOC – semivolatile organic compound
TPH – total petroleum hydrocarbons
USEPA – US Environmental Protection Agency

## References

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# Attachment D: SOP—Collection and Processing of Sediment Grab Samples (Revision 1)

I. Purpose

A. This standard operating procedure (SOP) describes the collection and processing of sediment grab samples for the Lower Passaic River Restoration Project and is based on SOP 34 of the field sampling plan (Malcolm Pirnie et al. 2006). Grab samples will be collected for chemical, toxicological, and biological (i.e., benthic community) analyses.

II. Definitions

A. No specific terms have been identified as requiring definitions.

III. Supplies and Equipment

The following will be needed to collect sediment grab samples:

1. Grab sampler (type will depend on river bottom conditions and sampling needs): a 0.2-$m^2$ power grab or a 0.5-$m^2$ Ponar grab (for the upper reaches of the Lower Passaic River Study Area [LPRSA]). Examples of grab samplers covered by the SOP include: Young-modified van Veen, van Veen, Smith-McIntyre, Eckman, Shipek, and Petersen.
2. Extra weights for the grab sampler
3. Sampling vessel, with a fathometer, capable of deploying grab apparatus with sufficient room for all aspects of grab sampling (e.g., homogenization, sieving, cleaning). Sufficient room must also be available for storage of collected samples
4. Appropriate winch and cable to deploy grab sampler in deep waters
5. Wooden base or stand for grab sampler
6. Bucket with pour spout
7. 2.54-cm-diameter syringe
8. Sieve table with tube
9. Sieves, mesh size 0.5 mm
10. Sample containers: plastic wide-mouth jars in various sizes for infauna, glass or plastic jars with Teflon®-lined screw caps for chemistry and grain size, or as specified in the Benthic quality assurance project plan (QAPP) (Windward 2009)
11. Squirt bottles
12. Funnels
13. Tape: electrical and Teflon® tape for sealing sample jar lids, and clear packing tape for securing/protecting computer-generated barcode labels
14. Pencils
15. Plastic ruler

16. Reagents

    37 to 40% solution of formaldehyde (100% formalin)

    Borax (to buffer the formalin)

17. Solvents for cleaning equipment between stations and other sampling equipment as listed in Attachment E: SOP—Procedure to Decontaminate Sampling Equipment (Section III) of the Benthic QAPP (Windward 2009).
18. Personal protective equipment (PPE)
19. Weighted demarcated line
20. Refractometer (if measuring interstitial salinity)

IV. Procedures

A. Collection of Benthic Sediment Samples

1. Samples should be collected upstream of the boat's engine or any other machinery that may release exhaust, fumes, or oil into the sample. Once the vessel is at the sampling station, all engines should be turned off. The boat captain, or designee, will determine the depth of the sampling station using a fathometer (or weighted demarcated line). If the sampling stations are located within a short distance of each other, then the most downstream sample, considering the tide, should be collected first to avoid contamination from disturbance and resuspension of sediment due to sampling activities. Sampling in areas of aquatic vegetation, where macrophyte roots or other vegetation might inhibit sample collection, should be avoided. Station coordinates will be recorded manually in the station log. The sampler must be thoroughly washed with Alconox™ prior to use at a station, then rinsed with ambient water to ensure that no sediments remain from the previous station. As stated in Worksheet No. 11, the following water quality parameters will be measured in the field: temperature, dissolved oxygen (DO), salinity, conductivity, and pH (see Attachment P of the Benthic QAPP (Windward 2009) for water quality sampling methods).
2. Attach the sampler to the end of the winch cable with a shackle and tighten the pin.
3. Adjust the weight of the grab sampler according to the substrate (i.e., soft bottom – few/no weights; hard bottom – multiple weights). Set the grab sampler according to the manufacturer's instructions.
4. Once the grab sampler is cocked, it should be lowered into the water column such that travel through the last 5 m is no faster than about 1 m/sec. This approach minimizes the dispersal of fine material due to a sampler-induced shock wave. Grab samplers should never be allowed to free fall into the substrate. In shallow waters, some grab samplers can be pushed directly into the sediment with a minimum penetration of 3 in.; care must be taken to not overfill the sampling apparatus. For example, 5- and 10-ft extension handles can be attached to Eckman grabs for sampling in shallow waters.
5. When the cable goes slack, the grab sampler is on the bottom. Initiate recovery slowly, until the grab sampler is free from the bottom. After that, retrieve the cable at a steady rate, until the grab sampler is visible near the surface. When the grab

sampler is visible, slow the rate of ascent so that the sampler can be steadied as it is brought on board. If an insufficient or improper sample is collected, additional weights should be added to the sampler to allow deeper penetration into the sediment. Set the sampler on the wooden stand, open the lid, and inspect the sample for acceptability. An acceptable grab is one that displays the following characteristics:

a. Sampler is not overfilled with sediment, the jaws are fully closed, and the top of the sediment is below the level of the open doors.

b. The overlying water is not excessively turbid.

c. The sampler is at least half full, indicating that the desired penetration has been achieved.

d. The sediment is level on at least one side.

6. In certain locations, slight over-penetration may be acceptable at the discretion of the field coordinator (FC). The FC will make the final decision regarding acceptability of all grab samples. The overall condition of the grab sample (e.g., slightly sloped on one side) should be noted in the field application. This information will be the same as the information required on the Surface Sediment Collection Form (Figure 1).

7. Carefully drain overlying water from the grab sample. If the grab sample is used for benthic community analysis, the water must be drained into the container that will receive the sediment to ensure no organisms are lost.

8. All grab samples taken are recorded in the station log. If the grab sample is rejected, record the reasons on the Surface Sediment Collection Form (Figure 1), along with other pertinent station information.

9. The following methods will be used to handle excess sediment when a sample is rejected:

   a. For sampling in the LPRSA (a Comprehensive Environmental Response Compensation, and Liability Act [CERCLA]-designated site), the following methods will be used. If the sample is rejected, empty the grab sampler, placing the discarded sediment into an appropriately labeled waste container (see Attachment F: SOP–Management and Disposal of Investigation-Derived Waste), then wash the grab sampler thoroughly with site water and re-cock the sampler. Note that decontamination cleaning procedures are not required when the grab sampler is redeployed at the same sampling station. Repeat the sampling procedure until an acceptable grab sample is obtained.

   b. For sampling outside the LPRSA (at non-CERCLA-designated areas), the following methods will be used. If the sample is rejected, empty the grab sampler, then wash the grab sampler thoroughly with site water and re-cock the sampler. Note that decontamination cleaning procedures are not required when the grab sampler is redeployed at the same sampling station. Repeat the sampling procedure until an acceptable grab sample is obtained.

V. Decontamination Cleaning Procedures

A. Sediment collection for non-chemistry (e.g., infaunal) analysis requires that the grab sampler be cleaned with at least soap and water between stations. For samples collected for chemical analyses, follow the cleaning procedures in Attachment E: SOP—Procedure to Decontaminate Sampling Equipment.

   Note that all solvents and discarded sediments must be captured and disposed of in appropriately labeled waste containers (see Attachment F: SOP—Management and Disposal Investigation-Derived Waste). All instruments that come into contact with the sample (i.e., syringe, ruler, collection buckets) must be cleaned in the same manner as the grab sampler.

VI. Collection of Sediment Sample from the Grab

A. General

1. Once the grab sample is deemed acceptable, processing can begin. Measure the penetration depth of the grab sampler by inserting a clean ruler into the sediment near the center of the sample. Record the depth and corresponding volume on the Surface Sediment Collection Form (Figure 1). It is important that all sediment be retained if the grab sample is collected for infaunal analysis. If the grab sample is going to be analyzed for infauna, then the ruler should be rinsed over the grab so that any adhering sediment washes back into the sample.
2. Estimate the apparent redox potential discontinuity. Insert a 2.54-cm-diameter syringe into the sediment and withdraw a core. Estimate the distance from the surface of the sediment to the upper portion of the black subsurface sediment (if visible) to the nearest 0.5 cm and record the distance on the Surface Sediment Collection Form (Figure 1). If the grab sample is collected for infaunal analysis, the contents of the syringe and any adhering sediment must be washed back into the sample as described above. For all other analyses, the core may be properly disposed of.
3. If measuring the interstitial salinity, use the procedures described in Attachment N of the Benthic QAPP (Windward 2009).

B. Chemical and Sediment Toxicity Samples

1. A subsample from the biological active zone (i.e., the top 15 cm [6 in.]) of the grab is required for samples collected for chemical, sediment toxicity, and bioaccumulation (if bioaccumulation testing is being conducted) analysis. Once the grab has been deemed acceptable, the following chemistry samples will be collected first as discrete grabs, prior to homogenization, by using a contaminant-free utensil: acid volatile sulfide/simultaneously extracted metals (AVS-SEM), volatile organic compounds (VOCs) (if VOCs are being collected), total petroleum hydrocarbons (TPH)-purgeables, sulfides, and ammonia. For preservation of these samples, see Worksheet No. 19.
2. Once the chemistry samples have been removed, place the remaining sediment in a clean receptacle. Additional acceptable grab samples will be collected to meet the following sediment volume requirements for the different analyses: toxicity tests 8 L (2 gal.) and chemistry 7.6 L (1.5 gal.). The number of grab samples collected for the composite will be recorded. From each acceptable grab the top 15 cm (6 in.) will be collected and placed in one or more clean

receptacles. Worksheet No. 18 lists the different sampling stations and analytical requirements.

.3. When sufficient sediment has been collected, combine the contents from each receptacle into one and gently homogenize the sediment for 1 to 2 minutes with a mixer. Following homogenization, partition the sediment into the appropriate sample containers in the amounts specified by the selected laboratory. At the SQT sampling locations, 8 L [2 gal.] are needed for bioassay, and 5.7 L [1.5 gal.] are needed for chemistry. Refer to Worksheet No.19 for sample preservation requirements.

C. Infaunal Sample Processing

1. At each location, collect four benthic community replicate samples from four acceptable grabs. Place a 0.05 $m^2$ frame within the power grab, and collect the sediment within the frame to a depth of 15 cm (6 in.). All sediment within the frame must be retained, paying particular attention to organisms visible in overlying water or stuck to the sides of the frame. Transfer the entire frame sample into a clean collection bucket for further processing.
2. Place the contents of the bucket in the sieve in the water-filled tube on the sieving table. Use a 0.5-mm sieve for the samples.
3. Gently remove the sediment by moving the sieve up and down in the tube. If the sample volume is large, sieve the sample in several rounds by placing a portion of the sediment in the sieve. Continue this process until the bucket is empty. While sieving, it is important to make sure that the remaining sediment in the bucket is covered with water to prevent it from drying out.
4. The portion of the sample remaining on the screen after sieving is retained for analysis. Wash the contents of the screen to one side of the sieve, place a funnel in an appropriately sized sample container (the sample material should ideally fill half to three-quarters of the container), and carefully wash the sample through the funnel into the sample container with water. Be sure to rinse the funnel and to cap the jar to prevent loss from spilling. Continue this process until the bucket is empty.
5. Once the entire sample has been sieved and collected in the sample jar, add buffered formalin to obtain a final concentration of 10% formalin (e.g., 100 mL of 37% formaldehyde in a 1-L container), and fill the jar to the threads with water. A heaping tablespoon of Borax should be added to the sample to ensure adequate buffering of the slightly acidic formalin. Gently swirl the contents of the jar to ensure complete mixing of the sample and the formalin. Affix the sample label and cover it with clear packing tape. Seal the jar tightly and tape the lid with Teflon® and/or electrical tape to prevent leakage and the escape of fumes during transport.
6. If the sample is made up of heavy material that will not wash through the sieve (i.e., course sand, rocks, and shell hash), it may be necessary to modify the sieving scheme to avoid injuring the organisms. This may be accomplished by an elutriation procedure. The contents of the bucket are flooded with site water and gently swirled to encourage the small infaunal organisms to float to the top. The elutrient is then poured off onto the screen. The procedure is repeated until organisms are no longer visible in the elutrient. The portion of the sample

retained on the screen is referred to as the light-density fraction; the portion remaining in the bucket is the heavy-density fraction. The two fractions are rinsed into separate, labeled sample jars. Whenever a sample is divided into more than one jar, for any reason, the jar label must reflect the number of jars. The number of jars should also be noted on the chain of custody (COC) form.

## VII. Quality Control

A. Field duplicates and equipment blanks for chemistry analysis will be collected at the frequencies described in Worksheet No. 20 of the QAPP.

B. Any deviations from this SOP must be documented in the station log in the field logbook. Careful attention to the procedures described in this SOP by trained, qualified personnel will ensure the quality of the samples collected.

C. Interferences that may be encountered during sediment sampling using grab devices should be recorded, and every attempt should be made to minimize their impacts. Such interferences include:

1. Shallow depth of penetration
2. Shock wave and loss of very fine-grained surface deposits
3. Water column contamination and nearby down-current sediment redeposition
4. Loss of depth profile
5. Difficulty of sampling in high current waters
6. Large debris materials, such as twigs and stones, that may prevent the closure of grab

## VIII. References

Malcolm Pirnie, Earth Tech, Battelle. 2006. Lower Passaic River Restoration Project. Draft field sampling plan. Volume 2. Prepared for US Environmental Protection Agency, US Army Corps of Engineers, and New Jersey Department of Transportation/Office of Maritime Resources. Malcolm Pirnie, Inc., White Plains, NY; Earth Tech, Inc., Bloomfield, NJ; Battelle, Stony Brook, NY.

NJDEP. 2005. Field sampling procedures manual. New Jersey Department of Environmental Protection. August 2005.

Ohio EPA. 2001. *Sediment Sampling Guide and Methodologies*. Division of Surface Water, Ohio EPA, Columbus, OH.

Reifsteck, D.R. and C.J. Strobel. 1993. Field Operations and Safety Manual for EMAP- Estuaries 1993 Virginia Province. Environmental Monitoring and Assessment Program, Office of Research and Development. U.S. Environmental Protection Agency. Contract Number 68-C1-0005.

# SURFACE SEDIMENT COLLECTION FORM

**Project Name:** _____ **Project no.:** _____

**Date:** _____ **Weather:** _____

**Sampling Method:** _____ **Crew:** _____

| **GRAB DATA** | **Location ID:** | | | | |
|---|---|---|---|---|---|
| **Latitude/Northing(Y):** | | | **Longitude/Easting(X):** | | |
| **Grab time** | **Bottom depth (m)** | **Penetration depth (cm)** | **Acceptable grab (Y/N)** | **Benthic Community Subsample ID** | **Comments:** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| **SAMPLE DATA** | **Sample ID:** | | |
|---|---|---|---|
| **Analyses needed before homogenization (circle):** VOC sulfides AVS/SEM Other: | | | |
| **Sediment type** | **Sediment color** | **Sediment odor** | **Comments:** (i.e. redox potential discontinuity, organic matter, wood debris, shell fragments, sheen, fauna, field duplicate, rinsate blank, etc.) |
| cobble | brown surface | none / $H_2S$ | |
| gravel | drab olive | slight / petroleum | |
| sand (F M C) | brown | moderate / other: | |
| silt | gray | strong | |
| clay | black | | |

| **GRAB DATA** | **Location ID:** | | | |
|---|---|---|---|---|
| **Latitude/Northing(Y):** | | | **Longitude/Easting(X):** | |
| **Grab time** | **Bottom depth (m)** | **Penetration depth (cm)** | **Acceptable grab (Y/N)** | **Comments:** |
| | | | | |
| | | | | |
| | | | | |

| **SAMPLE DATA** | **Sample ID:** | | |
|---|---|---|---|
| **Analyses needed before homogenization (circle):** VOC sulfides AVS/SEM Other: | | | |
| **Sediment type** | **Sediment color** | **Sediment odor** | **Comments:** (i.e. redox potential discontinuity, organic matter, wood debris, shell fragments, sheen, fauna, field duplicate, rinsate blank, etc.) |
| cobble | brown surface | none / $H_2S$ | |
| gravel | drab olive | slight / petroleum | |
| sand (F M C) | brown | moderate / other: | |
| silt | gray | strong | |
| clay | black | | |

**Figure 1: Surface Sediment Collection Form**

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# Attachment AA: SOP—Wet Sieving for Approximate Grain Size Analysis

I. Introduction

This standard operating procedure (SOP) was originally presented as SOP 2-Wet Sieving for Approximate Grain Size Analysis in the *Quality Assurance Project Plan for the Puget Sound Sediment Reference Material Development Project* by the US Environmental Protection Agency (USEPA) Region 10 in cooperation with the US Army Corps of Engineers (USACE)-Seattle District, and the Washington State Department of Ecology (Ecology) (2010).

II. Objective

This SOP describes the volumetric wet-sieving procedures used to determine approximate sediment grain size (coarse/fine-grained fraction) while in the field.

III. Background

Use of the wet-sieving method is important because of the need to estimate grain size in the field. It is often necessary to collect sediment samples in a certain grain size range. Wet-sieving provides a quick method for estimating the coarse/fine-grained fraction of sediments. A known volume of sediment is washed through a 63 µm screen (the division between the gravel/sand and silt/clay grain size fraction is 63 µm), and the remaining gravel/sand fraction is recovered and re-measured to give the coarse-grained fraction. The percent fines (silts/clays) are estimated by subtraction.

The volumetric wet-sieving method will be used to determine the approximate grain size of the test sediments. This method was first developed by USEPA in a reconnaissance survey of reference sediments in Carr Inlet, Washington (PTI, 1990).

IV. Equipment

- No. 230 (63-µm) sieve
- 100-mL plastic or glass beakers and/or graduated cylinders
- Squirt bottle
- Spoon
- Bucket
- Running water supply, if available
- Field log book

V. Procedure

The following procedures will be followed when using the volumetric wet-sieving methods to determine grain size:

A. Using the spoon, carefully collect 50 mL of sediment into the plastic or glass beaker. When obtaining a sample from a grab sampler, care will be taken to ensure that as much overlying water is removed as possible. If the sediment is extremely fine grained with high water content, the sediment should be allowed to settle to minimize any overlying water in the volumetric measurement.

B. Pour or scoop the sediment into the 63-µm sieve. With the squirt bottle, gently wash any sediment adhering to the beaker into the sieve. Once the unit has acquired the initial position and has indicated that it is ready, follow directions on the global positioning system (GPS) to begin collecting sample coordinates.

C. If running water is available, use a low stream of water to gently wash the sediment until the water passing through the sieve is clear. The squirt bottle can be used if the flow of water is too great. For extremely fine sediments, the sieve will have a tendency to clog up and fill with water. Care should be taken to avoid spilling any sediment. Gentle agitation of the sieve or rubbing the underside of the sieve will help clear the screen and allow the water and fine sediments to pass.

D. If running water is not available, use a bucket filled with water to wash the sediments. Gently agitate the sieve in the water, taking extra care to ensure that no sediment is lost. The squirt bottle can also be used to gently wash the sediments.

E. Once the water passing through the sieve is clear, scoop the majority of the remaining coarse-grained sediment into the 100-mL beaker or graduated cylinder. Gently rinse the remaining sediment into the beaker using the squirt bottle. Care should be taken to avoid spilling any sediment.

F. Allow the sediment to settle in the beaker or cylinder before taking a measurement. The sediment remaining is the coarse-grained (sand and gravel) fraction; the fine fraction is estimated by multiplying the sand/gravel content by 2 and then subtracting from 100. For example, if 17.5 mL of sediment remains after sieving (of the original 50 mL), the grain size estimate is 35% sand/gravel and 65% silt/clay.

G. Document results in the field logbook, including raw data: mL sieved, mL coarse-grained material recovered, and percent fines calculated.

## VI. Quality Control

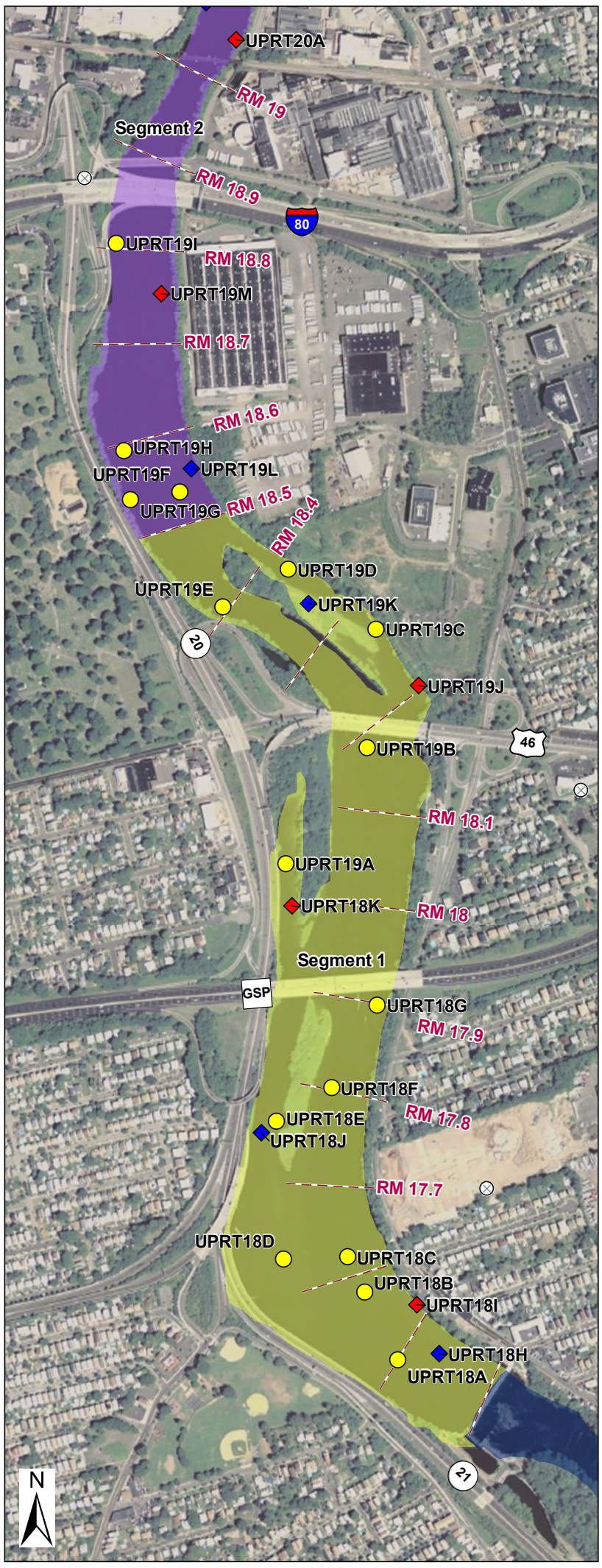
Variability can exist between wet-sieve grain size results and laboratory results because the wet-sieve method is measured by volume, whereas the laboratory method is calculated by weight. Fine-grained sediments often contain higher interstitial water than coarse-grained sediments. When fine-grained sediments are wet sieved, the volumetric measurement can overestimate the amount of fines because of the high water content. The following is recommended when extremely fine-grained sediments are to be wet sieved:

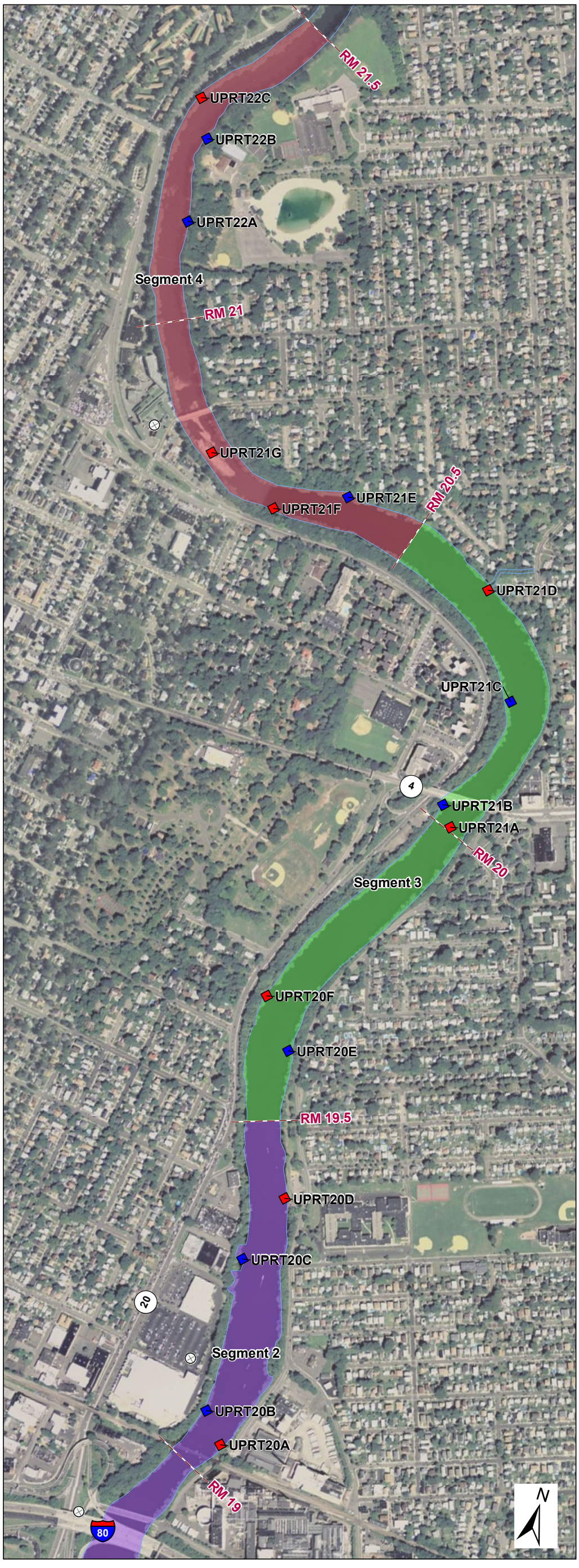
1. Ensure that as much surface water as possible is removed from the grab sample surface before collecting sediment for sieving.
2. The 50 mL of sediment to be sieved should be allowed to settle to minimize any overlying water in the volumetric measurement.

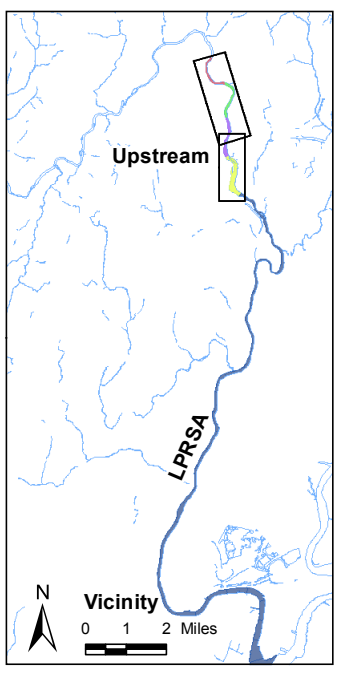
# VII. References

USEPA et al. 2010. *Quality Assurance Project Plan for the Puget Sound Sediment Reference Material Development Project.* US Environmental Protection Agency Region 10, the US Army Corps of Engineers-Seattle District, and the Washington State Department of Ecology.

PTI. 1990. Reconnaissance Survey of Reference Area Sediments in Shallow Waters of Carr Inlet. Technical Memorandum to the U.S. Environmental Protection Agency, Region 10. PTI Environmental Services, Bellevue, WA.




Proposed chemistry-only location

Proposed SQT location

- Coarse
- Fine
- LPRSA

Benthic SQT

- Segment 1 (RM 17.4 to RM 18.5)
- Segment 2 (RM 18.5 to RM 19.5)
- Segment 3 (RM 19.5 to RM 20.5)
- Segment 4 (RM 20.5 to RM 21.5)

Discharge

- CSO

0 500 1,000 Feet

**Figure 1. Proposed upstream sediment sampling locations**

DRAFT

Wind Ward environmental LLC

Data sources: river miles were derived from USGS NHD Streams.
Imagery from ESRI; http://goto.arcgisonline.com/maps/World_Imagery

Prepared by CEH 7/24/12, revised by LSM 7/26/12, Map 5284; W:\Projects\06-58-01 Passaic RI\Data\GIS\Maps_and_Analysis\Upstream