LOWER PASSAIC RIVER RESTORATION PROJECT

LOWER PASSAIC RIVER STUDY AREA RI/FS

QUALITY ASSURANCE PROJECT PLAN

FISH AND DECAPOD CRUSTACEAN TISSUE COLLECTION FOR CHEMICAL ANALYSIS AND FISH COMMUNITY SURVEY

FINAL

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ES 1 Introduction

The following serves as an executive summary of the fish/decapod crustacean tissue chemistry analysis and fish community survey quality assurance project plan (QAPP) for the Lower Passaic River Study Area (LPRSA) (Figure 1). The data collected during this effort will be used by the Cooperating Parties Group (CPG), US Environmental Protection Agency (USEPA), and its Partner Agencies (PA)[1] for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-related decisions. Specifically, these include the ecological risk assessment (ERA), the human health risk assessment (HHRA), and other purposes, including activities supporting the Water Resources Development Act (WRDA) study, such as restoration planning.

The data collected during this sampling effort, in conjunction with data collected from other sampling efforts, will be used to support the ERA and HHRA. This sampling effort addresses the two main sampling objectives related to fish and decapods outlined in the 2006 Field Sampling Plan Volume 2 (FSP2) prepared by Malcolm Pirnie et al. (2006) for the USEPA/PA:

1. Determine if exposure to site-related contaminants in the LPRSA poses unacceptable risks to fish and decapod populations
2. Determine if the consumption of fish and decapod poses unacceptable risks to human and ecological receptors

Data collected from other sampling efforts will also be used (in conjunction with the data collected under this QAPP) to support the ERA and HHRA. Sediment chemistry,[2] sediment toxicity, benthic community, and tissue data collected as part of the benthic invertebrate sampling effort (presented in the benthic invertebrate QAPP [Windward, in preparation]) will be used in the ERA. These 2009 sampling efforts are expected to satisfy the majority of data needs for the ERA and HHRA; however, additional field events may be conducted, if necessary, per agreement with USEPA and CPG. Surface water data collected as part of the 2010 surface water monitoring program to be developed by CPG will be used to support both risk assessments. Existing data that have been collected from the LPRSA will also be used in the HHRA and ERA. Seasonal bird surveys and potential additional habitat surveys will also be conducted, primarily to support WRDA activities, such as restoration planning, and also to support the risk assessments as appropriate.

ES 2 Data Use

The primary sample type that will be collected as part of this sampling event is tissue from target fish and decapod crustaceans (crab and crayfish) from the LPRSA. These tissue samples will be retained for chemical analyses. Other analytical data, including fish egg lipid analyses, fish stomach content taxonomy analyses, and fish health condition observations, will also be

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

[2] Sediment chemistry data proposed for collection in the benthic invertebrate QAPP (Windward in preparation) will include the collection of sediment data that will be co-located with sampled mummichog, darter/killifish, blue crab, and crayfish locations as part of the sampling effort outlined in this fish/decapod QAPP. The data will be used to derive site-specific biota-sediment accumulation factors. In addition to chemical residues for these samples, lipid content for tissues and organic carbon content for sediment will be analyzed.

generated under this sampling program. Fish community observations will be made as part of fish community surveys, the first of which will be conducted concurrent with this tissue collection program.

ES 3 Ecological Risk Assessment

The data collected under this QAPP will be used to support the ERA in evaluating the assessment endpoints of the benthic invertebrate community, and fish, bird and aquatic mammal populations as presented in the Problem Formulation Document (PFD) (Windward and AECOM 2009) and summarized below:

Assessment Endpoint No. 3 – "Protection and maintenance (i.e., survival, growth, and reproduction) 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."

Decapod whole-body tissue chemistry data collected as part of this sampling event will be used as one measurement endpoint for evaluating risks to benthic invertebrates in order to answer the following risk question: **"Are COPC residues in benthic invertebrate tissues from the LPRSA at levels that might cause an adverse effect on survival, growth, and/or reproduction of macroinvertebrate (blue crab and crayfish) populations in the LPRSA?"** Measured tissue chemical concentrations in macroinvertebrates will be compared to tissue-residue toxicity reference values (TRVs). The collection of data for the additional measurement endpoints are presented in the benthic invertebrate QAPP (Windward, in preparation).

Assessment Endpoint No. 5 – "Protection and maintenance (i.e., survival, growth, and reproduction) of omnivorous, invertivorous, 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."

Fish whole-body tissue chemistry data collected as part of this sampling event will be used as part of the tissue-residue measurement endpoint for evaluating risks to fish in order to answer the following risk question: **"Are COPC concentrations in fish tissue from the LPRSA at levels that might cause an adverse effect on survival, growth, and/or reproduction of populations of fish that use the LPRSA?"** Measured tissue chemical concentrations or toxic equivalencies will be compared to tissue-residue TRVs.

In addition, fish egg lipid data collected as part of this sampling event will be used to develop adult-to-egg lipid ratios and to estimate egg chemical concentrations from adult chemical concentrations. Estimated egg tissue chemical concentrations or toxic equivalencies will be compared to egg tissue-residue TRVs.

Decapod and fish whole-body tissue chemistry data collected as part of this sampling event will also be used to evaluate dose-based dietary risks to upper-trophic-level fish from chemicals, in order to answer the following risk question: **"Are modeled dietary exposures to COPCs from LPRSA prey at levels that might cause an adverse effect on survival, growth, and/or reproduction of fish populations that use the LPRSA?"** Tissue chemistry will be used (along with sediment and surface water chemistry and benthic body burdens of laboratory-exposed benthic invertebrates) in a dietary model to estimate dietary intake for selected fish receptors. Modeled dietary dose concentrations will be compared to dietary dose TRVs.

The collection of tissue-residue data from laboratory-exposed benthic invertebrates is presented in the benthic invertebrate QAPP (Windward, in preparation). Fish stomachs from target species

will be collected during this sampling event, and stomach contents will be analyzed for the identification of prey organisms (to the lowest taxonomic level possible) and used to identify prey species in selected fish receptor diets.

Additional physical and biological information collected during the fish community surveys (including internal/external health observations) will be used to assist in the interpretation of the results in terms of fish population health.

Per USEPA direction, mummichog eggs may be collected as part of a separate sampling effort, and eggs in selected gravid fish will be counted (or mass of eggs per fish will be estimated) in order to answer the following risk question: **"What are the egg numbers (or mass) from estuarine benthic omnivores (i.e., mummichog) from the LPRSA?"** This sampling effort is likely to occur in 2010, and the methods that will be used to complete this data collection effort will be detailed in a future addendum to this QAPP. These data will be used to assist in the interpretation of the results in terms of fish population health.

Assessment Endpoints No. 6 and No. 7 – "Protection and maintenance (i.e., survival, growth, and reproduction) of herbivorous, omnivorous, sediment-probing, and piscivorous bird populations," and "Protection and maintenance (i.e., survival, growth, and reproduction) of aquatic mammal populations."

Fish and decapod whole-body tissue chemistry data collected as part of this sampling event will be used (along with sediment and surface water chemistry data [proposed for collection in 2010] and tissue data from laboratory-exposed benthic invertebrates and *in situ* bivalve tests) in a dietary model to estimate dietary intakes for selected bird and mammal receptors. Modeled dietary dose concentrations will be compared to dietary dose TRVs to answer the following risk question: **"Are modeled dietary doses of COPCs based on LPRSA biota, sediment, and surface water and/or modeled piscivorous bird egg tissues based on LPRSA fish at levels that might cause an adverse effect on survival, growth, and/or reproduction of bird/aquatic mammal populations that use the LPRSA?"** The collection of tissue-residue data from laboratory-exposed benthic invertebrates is presented in the benthic invertebrate QAPP (Windward, in preparation).

Table ES-1 presents a summary of how the fish and decapod data will be used in the ERA.

Table ES-1. Proposed ERA Use of Fish and Decapod Data

DATA TYPE	ERA DATA USE	RECEPTOR GROUP
Decapod tissue chemistry	tissue-residue evaluation of decapods	benthic invertebrates
	dietary evaluation	fish
	dietary evaluation	birds
	dietary evaluation	mammals
Fish tissue chemistry	tissue residue evaluation of fish	fish
	dietary evaluation	fish
	dietary evaluation	birds
	dietary evaluation	mammals
Fish egg tissue lipid content	estimating egg residues for egg tissue evaluation	fish
Fish egg counts (or mass)	overall health assessment of fish	fish
Fish health assessment data	overall health assessment of fish	fish
Fish community survey data	overall health assessment of fish	fish
Fish stomach contents	identification of prey species for dietary evaluation	fish

DATA TYPE	ERA DATA USE	RECEPTOR GROUP
taxonomy		

ERA – ecological risk assessment

ES 4 Human Health Risk Assessment

The data collected during this sampling effort will also be used to support the HHRA in evaluating the following risk question: **"What are the potential adverse effects of river chemicals to human health via fish or decapod crustacean consumption from the LPRSA?**" As defined in the PFD (Windward and AECOM 2009), the data use objective for this endpoint is to estimate potential human exposures and assess the potential impact of chemicals on human health via consumption of fish or decapod crustaceans from the LPRSA. Potential tissue consumption scenarios are presented in the human health conceptual site model (CSM) included in the PFD (Windward and AECOM 2009). Target pelagic and demersal fish species of interest for human consumption and blue crab will be collected throughout the LPRSA for chemical analyses for use in evaluating potential human consumption scenarios. For fish, fillet tissue chemistry data will be collected; for blue crab, individual tissue type (muscle/ hepatopancreas combined, hepatopancreas-only, and muscle-only) chemistry data will be collected. The HHRA will use data from combined blue crab muscle/hepatopancreas samples as the basis for quantitatively evaluating the reasonable maximum exposure (RME) of individuals under current and future exposure scenarios for both cancer and non-cancer health effects following USEPA Superfund guidance, guidelines, and policies. Risks associated with the consumption of hepatopancreas-only and muscle-only tissue will be discussed qualitatively in the uncertainty section of the HHRA.

ES 5 Overview of Tissue Chemistry Sampling Design

The overall sampling design is a simple, stratified random approach within known or likely habitat areas of the (LPRSA). Per the agreements resulting from the January 14-15, 2009, meetings between the USEPA/PA and the CPG, the general sampling design divides the LPRSA into two zones according to surface water salinity: the estuarine zone and the freshwater zone. Consistent with the preliminary salinity reaches defined in the PFD (Windward and AECOM 2009), the estuarine zone includes both the brackish and transition river segments from River Mile (RM) 0 to RM 10, and the freshwater zone includes the freshwater river segment from RM 10 to RM 17.4. The freshwater and estuarine zones are further subdivided into reaches approximately 2 miles in length to allocate the sampling within each zone and support the calculation of zone-wide estimates of mean tissue chemical concentrations.

Target receptors from the estuarine and freshwater zones will be collected to represent species consumed by humans and key fish and decapod feeding guilds:

- **Estuarine zone (RM 0 to RM 10)** – Target receptors include a benthic omnivore, mummichog (*Fundulus heteroclitus*); an epibenthic/pelagic invertivore,[3] white perch (*Morone americana*); a demersal carnivore/piscivore, American eel (*Anguilla rostrata*); and a benthic omnivore, blue crab (*Callinectes sapidus*). Mummichog will be evaluated only in the ERA because this species is not consumed by humans. All other receptors will be evaluated in both the HHRA and ERA.

[3] Young fish (less than 2 years) are epibenthic invertivores (consuming amphipods and insect larvae); while the older fish also prey on larger benthic organisms (e.g., mud crabs) and pelagic organisms (e.g., shrimp and sometimes smaller fish).

- **Freshwater zone (RM 10 to RM 17.4)** – Target receptors include benthic omnivores, available species of darter (e.g., *Etheostoma olmstedi*) or killifish (e.g., *Fundulus heteroclitus* or *Fundulus diaphanus*); demersal invertivores/omnivores, channel catfish (*Ictalurus punctatus*) or brown bullhead (e.g., *Ameiurus nebulosus*); a pelagic piscivore, largemouth bass (*Micropterus salmoides*); and a benthic omnivore, available species of crayfish (e.g., *Orconectes resticus* [an invasive species], *Oronectes limosus,* or *Cambarus diogenes*). Crayfish, darter, and killifish will be evaluated only in the ERA because these species are not consumed by humans. All other receptors will be evaluated in both the HHRA and ERA. If found, estuarine blue crab will be collected in the freshwater zone. Note that mummichog are a type of killifish and will be the preferred species of benthic omnivore in the freshwater zone if found in sufficient quantity to meet tissue mass and gender allocation requirements. In addition, per agreement with USEPA, all incidentally caught carp (*Cyprinus carpio*) will be retained for chemical analysis.

As requested by USEPA (April 6, 2009), individual fish collected from the field of a sufficient size to meet analytical mass requirements (and quality control requirements and splits) will be analyzed as individual samples (e.g., largemouth bass and white perch). For individual organisms that do not meet minimum analytical mass requirements, a sample composed of multiple individual fish or decapods species (composite sample) will be prepared. Compositing is consistent with the previous USEPA-approved 1999 ecological sampling plan (ESP) biota sampling program (Tierra Solutions 1999) that was implemented in the lower portion (RM 1 to RM 7) of the LPRSA (Figure 2). The number of individuals in a single sample will be based on analytical mass requirements and the actual catch in the field. Samples will be created for each target tissue type and analyzed separately.

Target tissue types for the HHRA include fish fillet and several types of blue crab tissue samples, including combined muscle and hepatopancreas samples and muscle-only samples. Target tissue types for the ERA include whole-body fish and whole-body (represented by soft tissue) decapods (crabs/crayfish). To meet the needs of both risk assessments with one sampling event, fish fillet portions and blue crab tissue portions (muscle and hepatopancreas combined tissue portions) will be analyzed separately from the remaining tissue (carcass) in fish receptors being analyzed for both the HHRA and ERA and blue crabs. Fillet chemical concentrations will be combined mathematically (proportionally to their average weights in each species) with carcass chemical concentrations to compute whole-body fish chemical concentrations for the ERA. Similarly, chemical concentrations of blue crab tissue type portions (muscle and hepatopancreas combined and carcass tissue [i.e., non-edible soft tissue] portions) will be combined mathematically (proportionally to their average weights) to compute whole-body blue crab chemical concentrations for the ERA. A similar approach is described in FSP2 (Malcolm Pirnie et al. 2006). Per USEPA request, a limited number of samples will also be collected for analysis of blue crab hepatopancreas-only tissue. Per agreement with USEPA, the purpose of these data is to qualitatively compare hepatopancreas-only tissue concentrations with muscle-only tissue concentrations in the uncertainty section of the HHRA and show the relative difference in bioaccumulation potential in the two tissue types.

Inasmuch as it may not be possible to collect adequate tissue mass at each specified sampling location to constitute a full analytical sample, the following sampling design considerations will be implemented in coordination with USEPA during sampling to ensure that the QAPP elements are satisfied or determine whether they need to be adjusted (see Worksheet No. 18 for details on sampling locations).

- All collection methods (e.g., traps, trotlines, gillnets, electrofishing) will be attempted up to five times[4] at each target sampling location (where each method is appropriate within the LPRSA) within each 2-mile reach. For all species, sampling locations may be resampled or moved to different locations within the targeted 2-mile reach based on the catch success of sampling locations.
- If insufficient tissue is collected, alternative species (i.e., summer flounder [*Paralichthys dentates*], white catfish [*Ameiurus catus*], Atlantic tomcod [*Microgadus tomcod*], northern pike [*Esox lucius*], carp [*Cyprinus carpio*][5]) may be analyzed, depending on the catch. Tissue from different species will not be combined.[6]
- If insufficient tissue is collected after five attempts, a chemical prioritization scheme will be employed for analysis of the volume of tissue collected. The prioritization is presented in Worksheet No. 10 of this QAPP.
- Some unsuccessful sampling locations may need to be relocated or abandoned or new ones added to ensure that the QAPP elements are satisfied or determine whether they need to be adjusted.

USEPA will be consulted on decisions about modifications to the sample design if insufficient tissue of target species is collected (to evaluate if additional sampling time, additional locations, or shortened analytical list should be pursued). Per agreement between USEPA and CPG, flow charts documenting the general decision process that will be implemented during the collection of samples in the field have been prepared and are in Attachment W.

[4] An attempt is defined as the deployment of fishing gear, followed by an overnight soak, and retrieval the following day. Hence, five consecutive attempts will take up to 6 consecutive days.

[5] Per agreement with USEPA, all carp caught will be retained for chemical analysis, even if incidentally caught.

[6] If there are no other alternatives, it may be necessary to composite across species (for darter/killifish or crayfish), which may be acceptable given their similar life histories, if sufficient tissue mass is not available after the maximum number of attempts have been made or if the individuals cannot be identified to the species level.

ES 6 Sampling Locations

The general sampling design uses two zones, based on the preliminary salinity reaches defined in the PFD (Windward and AECOM 2009): the estuarine zone (RM 0 to RM 10) and the freshwater zone (RM 10 to RM 17.4). Each zone was subdivided into 2-mile river reaches,[7] and sampling locations were allocated among these reaches (Figure 3). In general, samples will be randomly collected within known or likely habitat areas in each 2-mile river reach identified based on prior field sampling events (Tierra Solutions 1999), on ecological benchmarking surveys (Shisler et al. 2008), and on the 2007 field reconnaissance (described in Worksheet 10 of this QAPP). At least three target bank-specific (targeted habitat area) sampling locations have been identified in each reach; however, additional sampling areas may be identified in the field to collect sufficient numbers of fish to meet the tissue mass requirements of the recommended number of samples. Target sampling areas for mummichog will be located in intertidal mudflat areas in the five estuarine reaches; darter/killifish target sampling areas will be located in any available shallow water habitats (mud or sandflats, vegetated shallows) in the three freshwater reaches. The target sampling area for these species will focus on localized habitat areas (i.e., areas with a radius of approximately 50 ft). This size sampling area is consistent with the ecology of small-home-range fish such as mummichog (Abraham 1985), with the approximate area of sampling locations specified in FSP2 (Malcolm Pirnie et al. 2006), and with EPA's comments (USEPA 2008b) and guidance (USEPA 2000b).

ES 7 Estimates of Sample Size

The overall approach for estimating the number of samples to represent tissue types for target receptors in each zone relied on the following steps:

- Existing fish and crab tissue data from the ESP and Contaminant Assessment and Reduction Program (CARP)[8] datasets were evaluated for key contaminant groups (e.g., polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans [PCDDs/PCDFs], mercury, polychlorinated biphenyls [PCBs], PAHs, pesticides) to help determine statistical characteristics (variability and skewness) of tissue residues in target receptors (where data were available).
- Parametric and non-parametric[9] statistical methods were used to compute sample sizes needed to achieve different levels of precision in the estimate of the mean tissue concentration for each species (e.g., ability to estimate within 50%, 100%, or 150% of the true mean) based on the statistical characteristics of the existing data.
- Sample size requirements to calculate a 95% upper confidence limit on the mean (95%UCL) using ProUCL (Version 4.00.02) (USEPA 2007c) and frequency of detection of the chemicals of potential concern (COPCs) were used to adjust the sample size estimates for each species.

Proposed sample sizes for fish and decapod tissue are summarized in Table ES-2 and are based on the agreement between CPG and USEPA as presented in the Sample Size Estimate

[7] Each zone is sub-divided into 2-mile river reaches, with the exception of the uppermost freshwater reach which will extend from RM 14 to RM 17.4.

[8] CARP data were collected within the New York/New Jersey Harbor, including the LPRSA. Data are available at: http://www.carpweb.org/main.html.

[9] Non-parametric sample size calculations are based on Chebyshev's inequality and bootstrapping.

Term Sheet (Attachment V). Additional details regarding the derivation of the sample sizes are provided in the fish/decapod tissue sampling design memo (Attachment Q).

Table ES-2. Sample size proposed for fish and decapod tissue chemistry collection

Feeding Guild[a]	Target Species	Zone[b]	No. of Locations per Zone	No. of Samples per Location	No. of Samples per Zone	Type of Sample	Total No. of Analytical Samples
Benthic omnivore forage fish	mummichog	estuarine	13	3	39[c]	whole body	39
	darter or killifish species	freshwater	14	3	42[c]	whole body	42
Invertivore / omnivore	white perch	estuarine	12	2	24[d]	skin-on fillet and carcass[e]	48
	channel catfish or brown bullhead	freshwater	13	2	26[d]	skinless fillet and carcass with skin[e]	52
Carnivore/ piscivore	American eel	estuarine	12	2	24[d]	skinless fillet and carcass with skin[e]	48
	largemouth bass	freshwater	13	2	26[d]	skin-on fillet and carcass[e]	52
Epibenthic omnivore	blue crab	estuarine[f]	12	field determined[g]	24[c, d, f]	muscle/ hepatopancreas combined[h]	63
			12	field determined[g]	24 [c, d, f]	carcass[h]	
			12	field determined[g]	12 [d]	muscle only[h]	
			3	field determined[g]	3	hepatopancreas only[h]	
		freshwater [f]	9	field determined[g]	17[c]	muscle/ hepatopancreas combined[h]	30
			9	field determined[g]	9	muscle only[h]	
			4	field determined[g]	4	hepatopancreas only[h]	
	crayfish	freshwater	9	3	27[c, d]	whole body	27
Total							**401**

[a] Target species are organized according feeding guilds designated for the ERA. The target demersal (bottom-dwelling) species for the HHRA are blue crab (estuarine), American eel (estuarine) and channel catfish/brown bullhead (freshwater). The target pelagic species for the HHRA are white perch (estuarine) and largemouth bass (freshwater).

[b] Zones represent the estuarine (RM 0 to RM 10) and freshwater (RM 10 to RM 17.4) habitats within the LPRSA.

[c] Blue crab, crayfish, mummichog, and darter or killifish samples will be co-located with sediment samples collected as part of the benthic invertebrate QAPP in order to derive site-specific biota-sediment accumulation factors. In addition to chemical residues for these samples, lipid content for tissues and organic carbon content for sediment will be analyzed.

[d] Sample size was adjusted to address ProUCL (Version 4.00.02) requirements, assuming a minimum detection frequency of 60%.

[e] Carcass tissue will be composed of the remaining (non-fillet) portion. Tissue type chemical concentrations will be combined mathematically (proportionally to their average weights in each species) to calculate whole-body chemical concentrations.

[f] Target sample size (n = 24) is based on blue crab collected from the estuarine zone. Additional blue crab samples may be collected from the freshwater zone if sufficient numbers of blue crab are captured in the freshwater zone.

[g] Three crab traps will be deployed per location in both the estuarine zone and the freshwater zone. However, the number of samples collected per location will vary for all blue crab tissue sample types based on the number of crabs that are collected and on analytical tissue mass requirements.

[h] Blue crab muscle/hepatopancreas combined and muscle-only tissue samples are to satisfy HHRA data needs; carcass (i.e., non-edible soft tissue) and muscle/hepatopancreas combined tissue samples will be combined mathematically to yield all soft tissue concentrations for the ERA. Because crayfish is the target ERA species for the freshwater zone, carcass tissue samples are not required for this zone. The HHRA will use data from combined blue crab muscle/hepatopancreas samples as the basis for quantitatively evaluating the RME of individuals under current and future exposure scenarios for both cancer and non-cancer health effects following USEPA Superfund guidance, guidelines, and policies. Risks associated with the consumption of hepatopancreas-only and muscle-only tissue will be discussed qualitatively in the uncertainty section of the HHRA.

RM – river mile

ES 8 Tissue Analytes

The low-resolution sediment core (LRC) sampling program analyte list as outlined in the LRC QAPP (ENSR et al. 2008) was used as the basis for the development of the proposed analyte list for the fish and decapod tissue sampling. Table ES-3 provides a summary of the chemical groups that were analyzed in the LRC program and identifies the analytical groups that are proposed for fish and decapod tissue analyses.

Table ES-3. Analyte groups for tissue sampling

Analyte Group	Proposed for Analysis in Fish/Decapod Tissue?	Rationale for Exclusion
Metals	yes	
Mercury and methylmercury	yes	
Butyltins	yes	
SVOCs[a]	yes	
PAHs (including alkylated PAHs)	yes	
Volatile organic compounds	no	It is not possible to analyze VOCs in tissue samples because of volatilization during sample preparation.
PCBs – congeners[b]	yes	
PCBs – Aroclors	yes	
PCDD and PCDF congeners	yes	
Pesticides	yes (excluding toxaphene)	Toxaphene was not detected in any of the LRC sediment samples.
Herbicides	no[c]	Herbicides were rarely detected in surface sediment samples in the LRC sampling event.

[a] 1,2,4,5-tetrachlorobenzene and 2,3,4,6-tetrachlorophenol will not be included because they were rarely detected in the LRC sediment samples. 1,2,4,5-tetrachlorobenzene was detected twice, and 2,3,4,6-tetrachlorophenol was not detected.

[b] Up to 209 PCB congeners will be analyzed.

[c] Per agreement between USEPA and CPG, herbicides are not included for analysis for the following reasons: 1) there are no published methods for herbicides in tissue, 2) herbicides are infrequently detected in recent studies, 3) the likely levels of detection are below levels to be toxic to wildlife, and the bioaccumulation potential is low. Windward is currently drafting a memorandum explaining the above points in more detail for USEPA. Note, herbicides will be analyzed in sediment as part of the benthic invertebrate QAPP sampling effort.

ERA – ecological risk assessment
HHRA – human health risk assessment
LRC – low-resolution core
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
SVOC – semivolatile organic compound
VOC – volatile organic compound

ES 9 Overview of Tissue Collected for Non-Chemistry Analysis

Non-chemistry analyses will also be conducted on a subset of fish tissue collected during the summer to early fall of 2009. These analyses include: fish egg lipid analysis, fish stomach content taxonomy analysis, and fish health condition observations. An overview of how these data will be collected is presented in the following subsections. Table ES-4 presents a summary of the species and number of fish that will be targeted for collection for non-chemistry analysis.

Table ES-4. Target number of fish proposed for non-chemistry analysis

Analysis	Species	Target No. of Fish	Type of Sample
Fish egg lipid	mummichog	varies[a]	egg tissue
	darter or killifish species	varies[a]	egg tissue
Fish stomach content taxonomy	white perch	5 – 10[b]	stomach contents
	channel catfish or brown bullhead	5 – 10[b]	stomach contents
	American eel	5 – 10[b]	stomach contents
	largemouth bass	5 – 10[b]	stomach contents
Fish health evaluation	all species collected	up to 5 per species[c]	whole body (gross internal and external pathological observation)

[a] The number of fish will vary depending on the number of eggs present in each fish. A minimum of 5 grams of egg tissue is needed to make a composite sample for lipid analysis.

[b] Stomach contents will be collected for enumeration from individual fish and not composited to the extent possible.

[c] Up to five individuals per species collected (including target and non-target species), or the total number of individuals as agreed to with USEPA, will be sacrificed for gross internal and external pathological observations.

ES 9.1 Fish Egg Lipid Analysis

Fish egg tissue will be retained for a subset of fish collected during the tissue sampling event, depending on the availability of fish collected for chemical analysis and on the availability of gravid females. An evaluation of fish community literature suggested that gravid mummichog and/or darter species may be present in late summer/early fall. Mummichog may spawn eight or more times in a season that begins in March and ends in the late summer or early autumn (July to September), and one species of killifish (striped killifish) spawn in New Jersey from June

through August (Abraham 1985). Gravid females are expected to be present in the LPRSA in August when tissue sampling is anticipated to begin. Ten fish egg composites will be collected for mummichog (from the estuarine zone), and ten fish egg composites will be collected from darters or killifish (from the freshwater zone). Species-specific egg composites will be prepared in the field laboratory and analyzed only for lipid content.

ES 9.2 Fish Stomach Content Taxonomy Analysis

Fish stomach content samples will be retained for a subset of fish collected during the tissue sampling event, depending on the availability of fish collected for chemical analysis. Fish stomach samples will be collected for the invertivore/omnivore species (i.e., white perch and channel catfish/brown bullhead) and carnivorous/piscivorous species (i.e., American eel and largemouth bass) in the estuarine and freshwater zones, respectively. The data use objective for these qualitative data is to identify the prey items, to the lowest taxonomic level possible, of these fish species in order to evaluate dietary exposure in the ERA. A target of 5 to 10 stomach content samples from each species (within its respective zone) will be collected.

ES 9.3 Fish Health Evaluation

Gross internal and external pathological observations will be conducted for a subset of all fish (including target and non-target species) collected during the tissue sampling event, including those fish caught for stomach content analysis. Gross internal and external pathological observations and examination results will be recorded electronically in the field laboratory and recorded on the Specimen Data Form (Attachment C). The data use objective for these qualitative data is to assist in the interpretation of results in terms of fish population health. Up to five individuals per species collected, or the total number of individuals as agreed to with USEPA, will be sacrificed for evaluation of gross internal and external pathological condition. Analyzing target fish species for tissue chemistry will be prioritized over sacrificing these species for the health evaluation.

ES 10 Fish Community Metrics/Characterization

Fish community survey observations, including the identification of species, count, length, weight, and gender (if practicable), will be compiled over three fish community survey events. These data will be used to determine relative abundance, structure, and indices of the fish community over multiple seasons. During the first survey and analytical sampling effort, community survey observations will be compiled for all fish caught. A subset of locations sampled during the first community survey will be revisited as part of the subsequent community surveys conducted the following winter and spring. A minimum of two sampling locations from each 2-mile reach will be reoccupied over a 2-to-3-week survey effort. The targeted locations and sampling methods (e.g., trotlines, gillnets) to be used during the subsequent surveys will be dependent on the catch results of the first sampling event and survey.

The first community survey will be conducted in late summer/early fall of 2009 (i.e., August to September) when fish and decapod tissues will be collected for analytical sampling. The second community survey is planned for winter 2009/2010, and the third survey is planned for spring 2010. The results of all three community surveys will be reviewed to determine if additional community survey events are needed.

TABLE OF CONTENTS

Introduction

This document presents the quality assurance project plan (QAPP) for the proposed fish and decapod crustacean (crab and crayfish) tissue collection and analyses and the fish community survey for the Lower Passaic River Study Area (LPRSA). Per the agreements resulting from the January 14-15, 2009 meetings between the US Environmental Protection Agency (USEPA), its Partner Agencies (PA),[10] and the Cooperating Parties Group (CPG) to discuss the elements of the 2006 Field Sampling Plan Volume 2 (FSP2) (Malcolm Pirnie et al. 2006), this QAPP was developed to address the two main sampling objectives outlined in FSP2 for fish and decapod populations:

1. Determine if exposure to site-related contaminants in the LPRSA poses unacceptable risks to fish and decapod populations

2. Determine if the consumption of fish and decapod poses unacceptable risks to human and ecological receptors

The tissue collection event and first seasonal community survey is scheduled for summer/fall 2009. The purpose of this effort is two-fold: 1) to conduct a tissue-residue analysis to better understand which chemicals may be bioaccumulating in fish and decapod crustacean species in the LPRSA and the variability of the chemical concentrations in these organisms, and 2) to enhance the knowledge regarding abundance and diversity of the LPRSA fish community. The results of the tissue chemistry analysis and fish community survey will be used in the ecological risk assessment (ERA) and human health risk assessment (HHRA). Subsequent fish community surveys are scheduled for winter 2009/2010 and spring 2010 to collect seasonal information on the fish community of the LPRSA. The results of the proposed fish community surveys will be reviewed to determine if additional community survey events are needed.

Background Information

The LPRSA is an operable unit of the Diamond Alkali Superfund Site. In 1984, the Diamond Alkali Superfund Site was placed on the National Priorities List because of past industrial operations at the Diamond Alkali plant (80-120 Lister Avenue in Newark, New Jersey), which resulted in the release of hazardous substances, such as polychlorinated dibenzo-*p*-dioxins (PCDDs) and pesticides. Sampling in Passaic River sediments conducted during the remedial investigation/feasibility study (RI/FS) for the Diamond Alkali plant revealed many hazardous substances including, but not limited to PCDDs/polychlorinated dibenzofurans (PCDFs), pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and metals. In 1994, an investigation of a 6-mile stretch of the Passaic River centered on the Diamond Alkali plant was begun. Extensive sampling showed that evaluation of a larger area was necessary because sediments contaminated with hazardous substances and other potential sources of hazardous substances were present along at least the entire 17-mile tidal stretch of the Passaic River and were further dispersed by the tidal nature of the Lower Passaic River (LPR). As a result, in 2001, US Environmental Protection Agency (USEPA), expanded the scope of the Superfund study to encompass the 17-mile tidal stretch of the LPR and to add a

[10] 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 US Fish and Wildlife Service (USFWS).

large number of parties potentially responsible for historical releases that contributed to the contamination found in the river, including the 73 companies that make up the CPG.

The USEPA, 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 US Fish and Wildlife Service (USFWS) have partnered to conduct a comprehensive study of the LPR and its tributaries. The Lower Passaic River Restoration Project (LPRRP) is an integrated, joint effort among state and federal agencies to evaluate environmental conditions within the LPRSA and identify remediation and restoration options as part of a program to restore human use and ecological functions in the LPR that have been lost as a result of more than 200 years of urbanization and industrialization. The LPRRP is governed by the:

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): RI/FS, and natural resource damage assessment and restoration (NRDAR) program

2. Water Resources Development Act (WRDA): study and FS

Initial scoping and investigative activities have been performed by contractors retained by members of the government partnership. However, as of May 8, 2007, the LPRSA CPG, an unincorporated group of companies that has entered into an Administrative Settlement Agreement and Order on Consent (Settlement Agreement) with the USEPA Region 2 (USEPA 2007a), assumed the role of scoping and executing remaining activities to be performed as part of the LPRRP CERCLA RI/FS. This work will be performed under the Settlement Agreement with oversight provided by USEPA and its government partners.

The LPRSA has been identified as one area within the New York/New Jersey Harbor complex requiring investigation and evaluation. The LPRSA encompasses the 17.4-mile tidal reach of the Passaic River below the Dundee Dam to the mouth of the river at Newark Bay, its tributaries (e.g., Saddle River, Second River, and Third River), and the surrounding watershed below the Dundee Dam. Information from investigations conducted by other parties, both within the LPRSA and in major physically connected water bodies, including the upper Passaic River, Hackensack River, Newark Bay, the Arthur Kill, and the Kill van Kull may also be utilized in completing the RI/FS. Additional background information on the LPRSA is provided in the *LPRSA Human Health and Ecological Risk Assessment Streamlined 2009 Problem Formulation* document (PFD).

Document Organization

This document was prepared using the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) guidance (USEPA et al. 2005). Worksheet No. 2 identifies the location of each element of this QAPP. A brief summary of the information provided in this document is presented below.

Information on personnel and project organization related specifically to this QAPP, including personnel responsibilities, qualifications, and special training; project organization, distribution, and communications pathways, is presented in Worksheet Nos. 3 through 8. A summary of the scoping session conducted for the development of this QAPP (i.e., the FSP2 meeting held on January 14-15, 2009, in Newark, New Jersey), is presented in Worksheet No. 9.

The problem definition, project quality objectives (PQO), a summary of project tasks, and the project schedule and timeline for this QAPP are summarized in Worksheet Nos. 10, 11, 14, and 16, respectively. A summary of secondary data that may be used for the completion of this QAPP is provided in Worksheet No. 13. The field sampling design and rationale and a list of proposed sampling locations are provided in Worksheet Nos. 17 and 18.

Information related to laboratory analyses, including performance criteria; reference limits and evaluations; analytical standard operating procedure (SOP) requirements; field quality control (QC) samples; SOP references; instrument calibration, maintenance, testing, and inspection; QC samples; and analytical services, is presented in Worksheet Nos. 12, 15, 19, 23, 24, 25, 28, and 30, respectively.

Field QC samples are summarized in Worksheet No. 20. Field sampling SOPs are presented in Attachments G through P of this document, and the location of each SOP is identified in Worksheet No. 21. Procedures for the calibration and maintenance of field equipment are presented in Worksheet No. 22. Field sample handling and custody procedures are provided in Worksheet Nos. 26 and 27, respectively.

A summary of the documents and records associated with this QAPP, from field sampling effort to the delivery of the data report, is presented in Worksheet No. 29. Internal and external assessments of the field activities, map production, laboratory analytical method compliance, data usability, and document review are described in Worksheet No. 31, and types of findings and corrective action responses are outlined in Worksheet No. 32. A summary of quality assurance (QA) management reports for this QAPP is provided in Worksheet No. 33. Verification of field sampling data, validation of laboratory analytical data, and an assessment of data usability are presented in Worksheet Nos. 34 through 37.

QAPP Worksheet No. 1. Title and Approval Page

Quality Assurance Project Plan for Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey

Document Title

Windward Environmental LLC (Windward)

Lead Investigative Organization

Thai Do, Windward

Preparer's Name and Organizational Affiliation

200 West Mercer St., Suite 401, Seattle, WA 98119, 206.812.5407, thaid@windwardenv.com

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

06/03/09

Preparation Date (mm/dd/yy)

Investigative Organization's Project Manager:

Signature

Lisa Saban, Windward, Date

Printed Name/Organization/Date

Investigative Organization's Task QA/QC Manager:

Signature

Tad Deshler, Windward, Date

Printed Name/Organization/Date

Project Coordinators:

Signature

Bill Potter, de maximis, inc., Date

Printed Name/Organization/Date

QAPP Worksheet No. 1. Title and Approval Page (cont.)

Signature

Robert Law, de maximis, inc., Date
Printed Name/Organization/Date

Approval Signatures:

USEPA Project Managers	
Approval Authority	Signature
	Alice Yeh, USEPA, Date
	Printed Name/Title/Date
	Signature
	Stephanie Vaughn, USEPA, Date
	Printed Name/Title/Date
USEPA Project QA Officer	
Approval Authority	Signature
	William Sy, USEPA, Date
	Printed Name/Title/Date

QAPP Worksheet No. 2. QAPP Identifying Information

1. Identify guidance used to prepare QAPP:

   Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Final Version 1. March 2005. Intergovernmental Data Quality Task Force (USEPA, US Department of Defense, US Department of Energy). EPA 505-B-04-900A.

2. Identify regulatory program: CERCLA

3. Identify approval entity: USEPA Region 2

4. Indicate whether the QAPP is a ~~generic~~ or a project-specific QAPP

5. List dates of scoping sessions that were held: January 14-15, 2009

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title
Tierra Solutions. 1999. *Passaic River Study Area Ecological Sampling Plan. Quality Assurance Project Plan.* Volume 2 of 6. Tierra Solutions, Inc., Newark, NJ.
Malcolm Pirnie. 2005. *Lower Passaic River Restoration Project. Quality Assurance Project Plan*. Prepared for USEPA and USACE. Malcolm Pirnie, Inc., White Plains, NY.
Malcolm Pirnie, Earth Tech, Battelle. 2006. *Lower Passaic River Restoration Project. Draft Field Sampling Plan.* Volume 2. Prepared for USEPA, USACE, and NJDOT/Office of Maritime Resources. Malcolm Pirnie, Inc., White Plains, NY; Earth Tech, Inc., Bloomfield, NJ; Battelle, Stony Brook, NY.
Malcolm Pirnie. 2007. *Lower Passaic River Restoration Project*. *Quality Assurance Project Plan/ Field Sampling Plan Addendum for Lower Passaic River Restoration Project Empirical Mass Balance Evaluation*. Prepared for USEPA and USACE. Malcolm Pirnie, Inc., White Plains, NY.
ENSR, AECOM, Windward. 2008. *Lower Passaic River Restoration Project*. *Quality Assurance Project Plan: RI Low Resolution Coring/Sediment Sampling.* Revision 4. Prepared for CPG. ENSR AECOM, Newark, NJ.

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

   The USEPA, USACE, NJDOT, NJDEP, and the state and federal Natural Resource Trustees (NJDEP, NOAA, and USFWS) have partnered to conduct a comprehensive study of the LPR and its tributaries.

   As of May 8, 2007, the LPRSA CPG has entered into an Administrative Order on Consent (Settlement Agreement) with USEPA Region 2 (USEPA 2007a) and assumed the role of scoping and executing remaining activities to be performed as part of the LPRRP CERCLA RI/FS. This work will be performed under the Settlement Agreement with oversight conducted by USEPA and its government partners. de maximis, inc. (acting as project coordinator for the CPG), Windward and its subcontractors are conducting the work on behalf of the CPG.

QAPP Worksheet No. 2. QAPP Identifying Information (cont.)

8. List data users:

All entities identified in Item 7 above are considered to be data users.

Required QAPP Element(s) and Corresponding QAPP Section(s)	QAPP Worksheet Number	Required Information
Project Management and Objectives		
2.1 Title and Approval Page	1	Title and Approval Page
2.2 Document Format and Table of Contents		
2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	2	Table of Contents QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet		
2.3.1 Distribution List	3	Distribution List
2.3.2 Project Personnel Sign-Off Sheet	4	Project Personnel Sign-Off Sheet
2.4 Project Organization		
2.4.1 Project Organizational Chart	5	Project Organizational Chart
2.4.2 Communication Pathways	6	Communication Pathways
2.4.3 Personnel Responsibilities and Qualifications	7	Personnel Responsibilities and Qualifications Table
2.4.4 Special Training Requirements and Certification	8	Special Personnel Training Requirements Table
2.5 Project Planning/Problem Definition		Project Planning Session Documentation (including Data Needs tables)
2.5.1 Project Planning (Scoping)	9	Project Scoping Session Participants Sheet
2.5.2 Problem Definition, Site History, and Background	10	Problem Definition, Site History, and Background Site Maps (historical and present)
2.6 Project Quality Objectives and Measurement Performance Criteria		
2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process	11	Site-Specific PQOs
2.6.2 Measurement Performance Criteria	12	Measurement Performance Criteria Table
2.7 Secondary Data Evaluation	13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule	14	Summary of Project Tasks
2.8.1 Project Overview	15	Reference Limits and Evaluation Table
2.8.2 Project Schedule	16	Project Schedule/Timeline Table

QAPP Worksheet No. 2. QAPP Identifying Information (cont.)

Required QAPP Element(s) and Corresponding QAPP Section(s)		QAPP Worksheet Number	Required Information
Measurement/Data Acquisition			
3.1 Sampling Tasks			
	3.1.1 Sampling Process Design and Rationale	17	Sampling Design and Rationale Sample Location Map
	3.1.2 Sampling Procedures and Requirements	18	Sampling Locations and Methods/ SOP Requirements Table
	3.1.2.1 Sampling Collection Procedures	19	Analytical Methods/SOP Requirements Table
	3.1.2.2 Sample Containers, Volume, and Preservation	20	Field Quality Control Sample Summary Table Sampling SOPs
	3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures	21	Project Sampling SOP References Table
	3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table
	3.1.2.5 Supply Inspection and Acceptance Procedures		
	3.1.2.6 Field Documentation Procedures		
3.2 Analytical Tasks			
	3.2.1 Analytical SOPs	23	Analytical SOP References Table
	3.2.2 Analytical Instrument Calibration Procedures	24	Analytical Instrument Calibration Table
	3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table
	3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures		26	Sample Collection Documentation Handling, Tracking, and Custody SOPs
	3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	27	Sample Container Identification Sample Handling Flow Diagram Example Chain-of-Custody Form and Seal

QAPP Worksheet No. 2. QAPP Identifying Information (cont.)

Required QAPP Element(s) and Corresponding QAPP Section(s)		QAPP Worksheet Number	Required Information
3.4	Quality Control Samples	28	QC Samples Table Screening/Confirmatory Analysis Decision Tree
	3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples		
3.5	Data Management Tasks	29	Project Documents and Records Table
	3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	30	Analytical Services Table
Assessment/Oversight			
4.1	Assessments and Response Actions	31	Assessments and Response Actions
	4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	32	Planned Project Assessments Table Audit Checklists Assessment Findings and Corrective Action Responses Table
4.2	QA Management Reports	33	QA Management Reports Table
4.3	Final Project Report		
Data Review			
5.1	Overview		
5.2	Data Review Steps		
	5.2.1 Step I: Verification	34	Verification (Step I) Process Table
	5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities	35	Validation (Steps IIa and IIb) Process Table
	5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	36	Validation (Steps IIa and IIb) Summary Table
	5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	37	Usability Assessment

QAPP Worksheet No. 3. Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Lisa Saban	Investigative Organization Project Manager	Windward	206.812.5429	lisas@windwardenv.com
Mike Johns	Technical Advisory Team member	Windward	206.812.5418	mikej@windwardenv.com
Tad Deshler	Investigative Organization Task QA/QC Manager	Windward	206.812.5406	tad@windwardenv.com
Susan McGroddy	Investigative Organization Project Chemist	Windward	206.812.5421	susanm@windwardenv.com
Kimberley Goffman	Investigative Organization Information Manager	Windward	206.812.5414	kimg@windwardenv.com
Jennifer Parker	Investigative Organization Data Validation Coordinator	Windward	206.812.5442	jenniferp@windwardenv.com
Thai Do	Field Coordinator/Site Safety and Health Officer	Windward	206.812.5407	thaid@windwardenv.com
Angelita Rodriquez	Field Coordinator/Site Safety and Health Officer (alternate)	Windward	512.436.8645	angelitar@windwardenv.com
Joanna Florer	Field Personnel	Windward	206.812.5438	joannaf@windwardenv.com
Shannon Katka	Field Personnel	Windward	206.812.5427	shannonk@windwardenv.com
Suzanne Replinger	Field Personnel	Windward	206.812.5435	suzanner@windwardenv.com

QAPP Worksheet No. 3. Distribution List (cont.)

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Rick Berg	Field Personnel	Windward	206.812.5428	rickb@windwardenv.com
Daniel Diedrich	Field Personnel	Windward	206.812.5441	danield@windwardenv.com
Chelsea Lorenz	Field Personnel	Windward	206.812.5436	chelseal@windwardenv.com
Sarah Fowler	Field Personnel	Windward	206.812.5440	sarahf@windwardenv.com
Bill Potter/Robert Law	Project Coordinators	de maximis, inc.	908.735.9315	otto@demaximis.com rlaw@demaximis.com
William Hyatt	Coordinating Counsel	K&L Gates	973.848.4045	william.hyatt@klgates.com
Steven Brodman	Boat Operator	Aqua Survey, Inc	908.347.3927	brodman@aquasurvey.com
Polly Newbold	CPG QA Coordinator	de maximis Data Management Solutions, Inc.	908.479.1975	pnewbold@ddmsinc.com
Denise Shepperd	Third-Party Independent Validator	Trillium	302.992.9737	dshepperd@trilliuminc.com
Peter Henriksen	Laboratory Project Manager	Alpha Analytical	508.844.4113	phenriks@alphalab.com
Kimberly Mace	Laboratory Project Manager	Analytical Perspectives	910.794.1613, ext. 102	kmace@ultratrace.com
Misty Kennard-Mayer	Laboratory Project Manager	Brooks Rand Labs	206.753.6125	Misty@brooksrand.com
Lynda Huckestein	Laboratory Project Manager	Columbia Analytical Services, Inc.	360.430.7733	LHuckestein@caslab.com
Mike Challis	Laboratory Project Manager	Maxxam Analytics	800.563.6266, ext. 5790	mike.challis@maxxamanalytics.com

QAPP Worksheet No. 3. Distribution List (cont.)

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Alice Yeh	USEPA Project Manager	USEPA Region 2	212.637.4427	yeh.alice@epa.gov
Stephanie Vaughn	USEPA Project Manager	USEPA Region 2	212.637.3914	vaughn.stephanie@epamail.epa.gov
William Sy	USEPA Project QA Officer	USEPA Region 2	732.632.4766	sy.william@epa.gov
Lisa Baron	Project Manager	USACE	917.790.8306	Lisa.A.Baron@usace.army.mil
Janine MacGregor	Project Coordinator	NJDEP	609.633.0784	Janine.MacGregor@dep.state.nj.us
Timothy Kubiak	Assistant Supervisor of Environmental Contaminants	USFWS	609.646.9310, ext. 26	tim_kubiak@fws.gov
Reyhan Mehran	Coastal Resource Coordinator	NOAA	212.637.3257	reyhan.mehran@noaa.gov

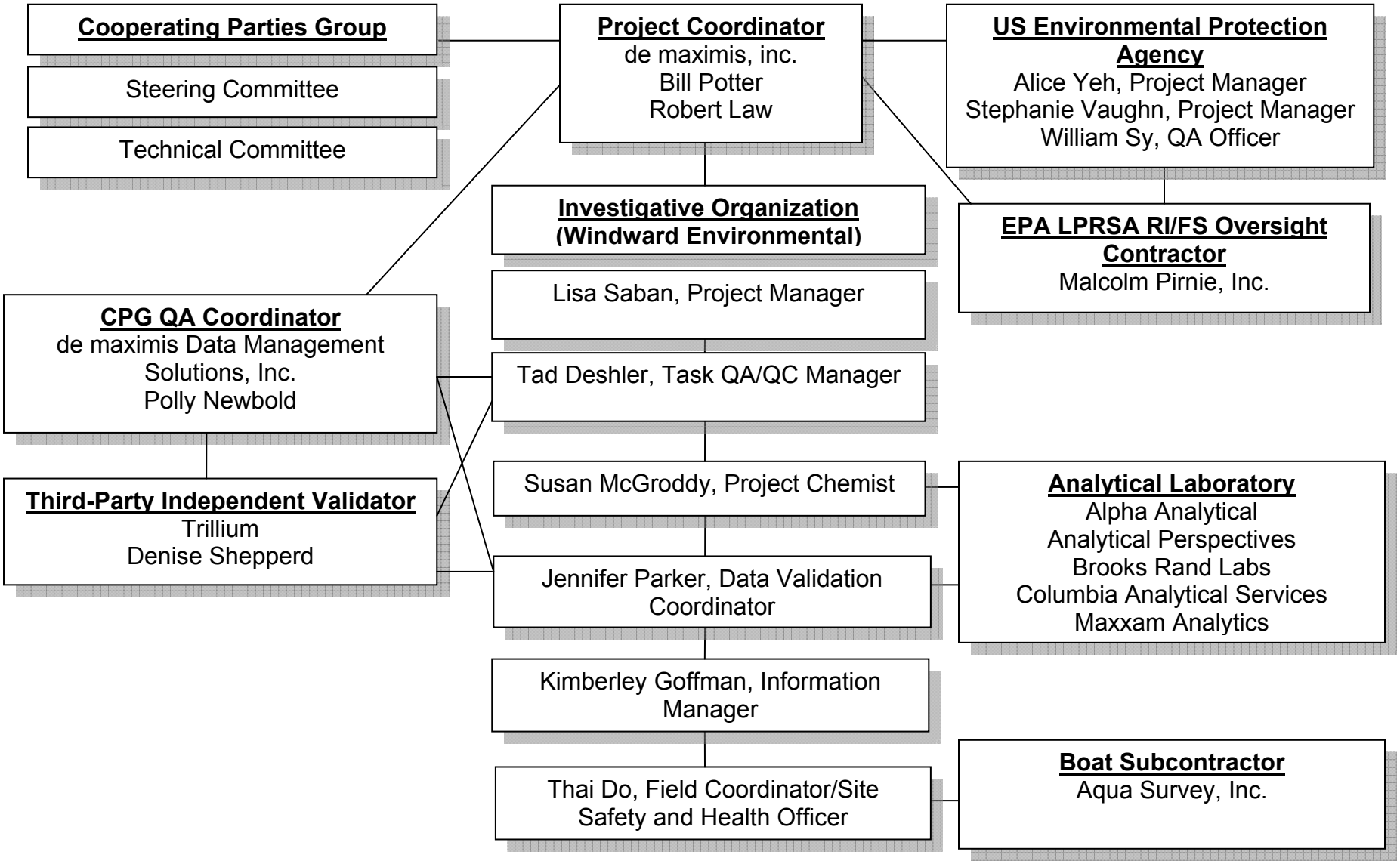
QAPP Worksheet No. 4. Project Personnel Sign-Off Sheet

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read E-mail Receipt
Lisa Saban	Investigative Organization Project Manager, Windward	206.812.5429		
Tad Deshler	Investigative Organization Task QA/QC Manager, Windward	206.812.5406		
Susan McGroddy	Investigative Organization Project Chemist, Windward	206.812.5421		
Kimberley Goffman	Investigative Organization Information Manager, Windward	206.812.5414		
Jennifer Parker	Investigative Organization Data Validation Coordinator, Windward	206.812.5442		
Thai Do	Field Coordinator/Site Safety and Health Officer, Windward	206.812.5407		
Angelita Rodriquez	Field Coordinator/Site Safety and Health Officer (alternate), Windward	512.436.8645		
Joanna Florer	Field Personnel, Windward	206.812.5438		
Suzanne Replinger	Field Personnel, Windward	206.812.5435		
Rick Berg	Field Personnel, Windward	206.812.5428		
Daniel Diedrich	Field Personnel, Windward	206.812.5441		

QAPP Worksheet No. 4. Project Personnel Sign-Off Sheet (cont.)

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read E-mail Receipt
Chelsea Lorenz	Field Personnel, Windward	206.812.5436		
Sarah Fowler	Field Personnel, Windward	206.812.5440		
Bill Potter/Robert Law	Project Coordinators, de maximis, inc.	908.735.9315		
Steven Brodman	Boat Operator, Aqua Survey, Inc.	908.788.8700, ext. 213		
Peter Henriksen	Laboratory PM, Alpha Analytical	508.844.4113		
Kimberly Mace	Laboratory PM, Analytical Perspectives	910.794.1613, ext. 102		
Misty Kennard-Mayer	Laboratory PM, Brooks Rand Labs	206.753.6125		
Lynda Huckestein	Laboratory PM, Columbia Analytical Services	360.430.7733		
Mike Challis	Laboratory PM, Maxxam Analytics	800.563.6266, ext. 5790		
Polly Newbold	CPG QA Coordinator, de maximis Data Management Solutions, Inc.	908.479.1975		
Denise Shepperd	Third-Party Independent Validator, Trillium	302.992.9737		

QAPP Worksheet No. 5. Project Organizational Chart



QAPP Worksheet No. 6. Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Field sampling communications	Field Coordinator	Thai Do	206.812.5407	Communicate daily, or as needed, with field personnel, subcontractors, and Investigative Organization Project Manager and Task QA/QC Manager directly, or via e-mail or phone. Catch results will be reported daily so it can be determined which species will be retained for analysis.
Communications with Investigative Organization Project Manager				
Communications with Investigative Organization Task QA/QC Manager				
Health and safety briefing	Site Safety and Health Officer			Communicate daily, or as needed, with field personnel directly, or via e-mail or phone, on matters regarding health and safety.
Communications with Project Coordinator	Investigative Organization Project Manager	Lisa Saban	206.812.5427	Communicate as needed with Project Coordinator via e-mail or phone.
	Investigative Organization Data Validation Coordinator	Jennifer Parker	206.812.5442	
	Investigative Organization Task QA/QC Manager	Tad Deshler	206.812.5406	

QAPP Worksheet No. 6. Communication Pathways (cont.)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Communications with AECOM HHRA task lead and support staff	Investigative Organization Project Manager	Lisa Saban	206.812.5427	Communicate as needed with AECOM HHRA task lead (Betsy Ruffle) and support staff (Kristen Durocher) via e-mail or phone to coordinate on HHRA-related issues.
Communications with analytical laboratories	Investigative Organization Project Chemist	Susan McGroddy	206.812.5421	Communicate with Field Coordinator (FC), Project Managers, and laboratory Project Manager as needed via phone or e-mail, regarding laboratory- and chemical analysis-related issues.
	Investigative Organization Data Validation Coordinator	Jennifer Parker	206.812.5442	Communicate with Project Managers and laboratory Project Manager as needed via phone or e-mail, regarding laboratory- and chemical analysis-related issues.
	Investigative Organization Information Manager	Kim Goffman	206.812.5414	Communicate with FC, Project Managers, and laboratory Project Manager as needed via phone or e-mail, regarding chemical data management.
Communications with USEPA	Project Coordinators	Bill Potter/Robert Law (de maximis, inc.)	908.735.9315	Communicate with USEPA Project Manager as needed via e-mail or phone.
	Investigative Organization Project Manager	Lisa Saban	206.812.5427	Communicate with USEPA Project Manager as needed via e-mail or phone.
Quality status and issues	CPG QA Coordinator	Polly Newbold	908.479.1975	Communicate with CPG Project Coordinator as needed via e-mail or phone.

QAPP Worksheet No. 6. Communication Pathways (cont.)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Sampling vessel operations	Boat subcontractor	Steven Brodman (Aqua Survey, Inc.)	908.347.3927	Communicate daily, or as needed, with FC directly. The sampling vessel captain has the ultimate authority for stopping work while working on water. The vessel captain, in consultation with the Site Safety and Health Officer, will follow guidelines documented in the site-specific health and safety plan (Attachment R). In addition, standard safe boating practices related to weather conditions and vessel operations will also apply, even if not specifically addressed in the health and safety plan (Attachment R).

QAPP Worksheet No. 7. Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Lisa Saban	Investigative Organization Project Manger	Windward	Oversight of performance by investigative organization	MS, Aquatic Toxicology and Ecology, 22 yrs. exp.
Mike Johns	Technical Advisory Team member	Windward	Implementation strategy and guidance	PhD, Oceanography, 30 yrs. exp.
Tad Deshler	Investigative Organization Task QA/QC Manager	Windward	Coordinate QAPP production; oversee implementation of QA/QC procedures; senior review of deliverables	MS, Animal Science, 23 yrs. exp.
Susan McGroddy	Investigative Organization Project Chemist	Windward	Coordinate with the FC and analytical testing laboratories to ensure that QAPP chemistry requirements are followed	PhD, Environmental Science, 16 yrs. exp.
Jennifer Parker	Investigative Organization Data Validation Coordinator	Windward	Manage data validation tasks, ensure that validation is conducted and documented according to the QAPP, and interact with laboratories to resolve any issue	MS, Soil Chemistry, 9 yrs. exp.
Kimberley Goffman	Investigative Organization Information Manager	Windward	Oversees import and export of chemistry data to and from project database	BS, Geology, 17 yrs. exp.
Thai Do	Investigative Organization Field Coordinator/Site Safety and Health Officer	Windward	Manager of field sampling efforts; daily and site health and safety briefings with field staff; communications with project management; HSP and report preparation	MS, Tropical Biology, 6 yrs. exp.
Angelita Rodriquez	Investigative Organization Field Coordinator/Site Safety and Health Officer (alternate)	Windward	Manager of field sampling efforts; daily and site health and safety briefings with field staff; communications with project management; HSP and report preparation	BS, Environmental Science, 5 yrs. exp.

QAPP Worksheet No. 7. Personnel Responsibilities and Qualifications Table (cont.)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Joanna Florer	Investigative Organization Field Personnel	Windward	Implementation of QAPP in field collection of samples, as directed by the FC	BS, Environmental Science, 7 yrs. exp.
Shannon Katka	Investigative Organization Field Personnel	Windward	Implementation of QAPP in field collection of samples, as directed by the FC	BA, Biology and Environmental Studies, 7 yrs. exp.
Suzanne Replinger	Investigative Organization Field Personnel	Windward	Implementation of QAPP in field laboratory processing, as directed by the FC	BS, Environmental Science, 2 yrs. exp.
Rick Berg	Investigative Organization Field Personnel	Windward	Implementation of QAPP in field laboratory processing, as directed by the FC	MS, Earth Sciences, 1 yr. exp.
Daniel Diedrich	Investigative Organization Field Personnel (alternate)	Windward	Implementation of QAPP in field collection of samples, as directed by the FC	MS, Environmental Science/Toxicology, 4 yrs. exp.
Chelsea Lorenz	Investigative Organization Field Personnel (alternate)	Windward	Implementation of QAPP in field laboratory processing, as directed by the FC	BS, Aquatic and Fishery Sciences, 1 yr. exp.
Sarah Fowler	Investigative Organization Field Personnel (alternate)	Windward	Implementation of QAPP in field laboratory processing, as directed by the FC	BS, Environmental Science/Toxicology, 2 yrs. exp.
Linda Marsh	Investigative Organization GIS database management	Windward	Management of GIS database; verify field-collected GPS coordinates	BA, Zoology; GIS certificate, 5 yrs. exp.
Bill Potter	CPG Project Coordinator	de maximis, inc.	Coordination of successful delivery of task products to USEPA	BS, Chemical Engineering, 38 yrs. exp.
Robert Law	CPG Project Coordinator	de maximis, inc.	Coordination of successful delivery of task products to USEPA	PhD, Geology, 28 yrs. exp.

QAPP Worksheet No. 7. Personnel Responsibilities and Qualifications Table (cont.)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Polly Newbold	CPG QA Coordinator	de maximis Data Management Solutions, Inc.	Oversight of project QA/QC. Periodically review and audit operations to ensure that QAPP/FSP Addendum QA/QC procedures are being followed.	BS, Textile Science, 26 yrs. exp.
Denise Shepperd	Third-party Independent Validator	Trillium	Third-party independent validation of chemistry data	BS, Environmental Science, 32 yrs. exp.
Steven Brodman	Boat Operator	Aqua Survey, Inc.	Safe vessel operation in accordance with project objectives and site-specific HSP	BA, Geography, 18 yrs. exp.
Peter Henriksen	Laboratory Project Manager	Alpha Analytical	Execute sample management and analysis consistent with prescribed analyses	BS, Environmental Science, 15 yrs. exp.
Kimberly Mace	Laboratory Project Manager	Analytical Perspectives	Execute sample management and analysis consistent with prescribed analyses	PhD, Chemical Oceanography, 15 yrs. exp.
Misty Kennard-Mayer	Laboratory Project Manager	Brooks Rand Labs	Execute sample management and analysis consistent with prescribed analyses	BS, Environmental Sciences, 10 yrs. exp.
Lynda Huckestein	Laboratory Project Manager	Columbia Analytical Services	Execute sample management and analysis consistent with prescribed analyses	BS, 19 yrs. exp.
Mike Challis	Laboratory Project Manager	Maxxam Analytics	Execute sample management and analysis consistent with prescribed analyses	BS, Chemistry, 21 yrs. exp.

QAPP Worksheet No. 8. Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates[a]
Field Coordinator/Site Safety and Health Officer	40-hr HAZWOPER	Prezant Associates, Inc.	11/21/03	Thai Do	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	1/2/09			
	OSHA 8-hr Training for Supervisors	Association of Bay Area Governments	1/6/07			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/1/08			
	Backpack Electrofishing and Fish Handling Techniques	Northwest Environmental Training Center	5/24/07			
Field Coordinator/Site Safety and Health Officer (alternate)	40-hr HAZWOPER	Compliance Solutions	5/19/04	Angelita Rodriquez	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	10/13/08			
	OSHA 8-hr Training for Supervisors	Association of Bay Area Governments	3/20/07			
	Adult CPR	American Red Cross	7/19/09			
	First Aid	American Red Cross	7/19/09			
	Backpack Electrofishing and Fish Handling Techniques	Northwest Environmental Training Center	5/24/07			

QAPP Worksheet No. 8. Special Personnel Training Requirements Table (cont.)

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates[a]
Windward Field Personnel	40-hr HAZWOPER	Prezant Associates, Inc.	12/15/00	Joanna Florer	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	11/3/08			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/1/08			
Windward Field Personnel	40-hr HAZWOPER	Prezant Associates, Inc.	8/9/02	Shannon Katka	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	12/9/08			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/1/08			
Windward Field Personnel	40-hr HAZWOPER	Prezant Associates, Inc.	1/13/06	Suzanne Replinger	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	2/20/09			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	Medic First Aid	6/7/08			

QAPP Worksheet No. 8. Special Personnel Training Requirements Table (cont.)

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates[a]
Windward Field Personnel	40-hr HAZWOPER	RGA Environmental	6/20/09	Rick Berg	Environmental Scientist/Windward	Windward: certificates available on request
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/22/08			
Windward Field Personnel (alternate)	40-hr HAZWOPER	Prezant Associates, Inc.	11/10/06	Daniel Diedrich	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	1/2/09			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/22/08			
Windward Field Personnel (alternate)	40-hr HAZWOPER	RGA Environmental	8/24/07	Chelsea Lorenz	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	9/5/08			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/22/08			

QAPP Worksheet No. 8. Special Personnel Training Requirements Table (cont.)

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates[a]
Windward Field Personnel (alternate)	40-hr HAZWOPER	Prezant Associates, Inc.	9/15/06	Sarah Fowler	Environmental Scientist/Windward	Windward: certificates available on request
	HAZWOPER 8-hr Refresher	Advance Online	10/2/08			
	Adult CPR	American Red Cross	7/1/09			
	First Aid	American Red Cross	7/22/08			
Boat Operator	40-hr HAZWOPER	Steve Hornberger (Aqua Survey, Inc. in-house NASP-certified HAZWOPER trainer)	2/26/07	Steven Brodman	Sr. Field Operations Specialist/Aqua Survey, Inc.	Aqua Survey, Inc.: certificates available upon request
	HAZWOPER 8-hr Refresher	National Association of Safety Professionals	3/14/08			
	US Coast Guard license	US Coast Guard	2/16/07			

[a] If training records and/or certificates are on file elsewhere, document their location in this column. If training records and/or certificates do not exist or are not available, then this should be noted.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	January 14 and 15, 2009
Scoping Session Purpose:	Workshop to discuss the ERA, the HHRA, and the implementation of FSP2 in 2009.

Participants: USEPA, PA (NOAA, USFWS, NJDEP, NJDOT, USACE), CPG, dmi, AECOM, Windward

Name	Affiliation	Phone No.	E-mail Address
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Gary Fisher	Alcatel-Lucent USA	908.582.5791	gmfisher@lucent.com
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QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

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Lucinda Tear	Windward Environmental	206.378.1364	lucindat@windwardenv.com
Carlie Thompson	Tierra Solutions, Inc.	732.246.5849	carlie.thompson@tierra-inc.com
Len Warner	Malcolm Pirnie, Inc.	914.641.2972	lwarner@pirnie.com
Maryann Welsch	Windward Environmental	207.899.1369	maryannw@windwardenv.com
Peter Weppler	USACE-PL	917.790.8634	peter.m.weppler@usace.army.mil
Alice Yeh	USEPA	212.637.4427	yeh.alice@epa.gov

January 2009 Risk Assessment and FSP2 Field Sampling Program Goals Meeting	
Comments/Decisions:	The meeting to discuss ERA, HHRA, and FSP2 was held January 14 and 15, 2009, at K&L Gates in Newark, New Jersey. The purpose of this meeting was to address the components of the ERA and HHRA and to discuss the goals of the 2009 FSP2 field sampling program.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Action Items: (Retrospective Summary)	• CPG to provide USEPA/PA with a briefing document (1 to 2 pages) on statistical design for fish tissue sampling needs for the HHRA and ERA. • USEPA to look at the regional/national practice of compositing vs. individual fish for chemical analyses as well as review the Passaic River Study Area (PRSA) Ecological Sampling Plan (ESP) (approved by USEPA Region 2), which relied upon composited fish samples. • USEPA/PA to provide the data use objective, test species and standard American Society for Testing and Materials (ASTM)/USEPA protocol reference for use of fish early life stage sediment toxicity test (including overlying site water exchange), and specific examples/information on what CERCLA sites this test has been successfully used to make management decisions. • CPG to look into feasibility of small-volume lipid analysis (for fish eggs). • CPG to determine if surface water will be used in oral (dietary) dose fish calculation. • USEPA to confirm with NJDEP that there is not a human exposure-related data use objective for hepatopancreas-only chemical data for CERCLA remedy decision-making for the LPRSA. • USEPA/PA and CPG to determine how to incorporate a regional background approach into the risk characterization.
Consensus Decisions:	• USEPA/PA and CPG agreed, in concept, to a list of target species to serve as receptors (to be confirmed upon review of CPG fish sampling summary). • CPG agreed to visually document internal and external fish abnormalities on fish collected. USEPA/PA/CPG will work together to determine the appropriate method (and ensuring consistency with USEPA-approved methods used previously in the LPRSA). • USEPA/PA and CPG agree that toxicity reference values (TRVs) for use in the ERA do not need to be developed for this QAPP. However, the data quality limits (DQLs) in the QAPPs will be set to ensure detection limits are adequate for the risk assessments (assuming conservative TRVs). • USEPA/PA and CPG agreed to adding a line of evidence to fish assessment to look at fish egg exposure concentrations based on measured lipid content in whole-body and egg samples and chemistry in whole-body samples. No chemical analyses of fish eggs will be performed. Fish egg samples will be collected from one or more estuarine fish species and fresh water species and submitted to a laboratory for lipid analysis only. • USEPA/PA and CPG agreed to using reconstituted whole-body fish as an estimate of whole-body fish tissue concentrations (i.e., one fillet will be taken and analyzed, the remaining portions of the fish will be analyzed, and the tissue concentrations will be mathematically combined as an estimate of whole body fish tissue concentration).

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	June 25, 2009
Scoping Session Purpose:	Conference call to discuss the major issues CPG identified in the USEPA comments on the Problem Formulation Document and the Fish/Decapod Tissue QAPP

Participants: USEPA, Malcolm Pirnie, Inc., dmi, AECOM, Windward

Name	Affiliation	Phone No.	E-mail Address
Joe Battipaglia	USEPA	212.637.4384	battipaglia.joseph @epa.gov
Robert Law	de maximis, inc.	908.735.9315	rlaw@demaximis.com
Jim McCann	Malcolm Pirnie, Inc.	201.398.4310	jmccann@pirnie.com
Chuck Nace	USEPA	212.637.4164	nace.charles@epa.gov
Betsy Ruffle	AECOM	978.589.3071	betsy.ruffle@aecom.com
Lisa Saban	Windward Environmental	206.812.5429	lisas@windwardenv.com
Stephanie Vaughn	USEPA	212.637.3914	vaughn.stephanie@epa.gov
Alice Yeh	USEPA	212.637.4427	yeh.alice@epa.gov

June 2009 Problem Formulation Document and Fish/Crab Tissue QAPP Field Sampling Program Goals Meeting	
Comments/Decisions:	A conference call to discuss the Problem Formulation Document and Fish/Decapod Tissue QAPP was held on June 25, 2009. The purpose of this meeting was to discuss the major issues CPG identified in the USEPA comments on the Problem Formulation Document and the Fish/Decapod Tissue QAPP.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Action Items: **(Retrospective Summary)**	**Streamlined PFD:** • CPG explained to USEPA that the analysis of herbicides in tissue in not typically performed and the reasons why, including lack of adequate toxicity thresholds, rapid degradation in the environment, and laboratory concerns with recovery. CPG also explained that there were few detections in the surface sediment from the LRC program and that analysis of herbicides was attempted for the Portland Harbor Superfund Site but abandoned due to analytical problems with percent recovery. CPG asked USEPA to talk with their chemist regarding these concerns. CPG also stressed the importance of having resolution quickly because this change has a significant impact on the Tissue QAPP preparation. • CPG asked USEPA what their current position was on caged bivalves. USEPA explained that they would like this test added to the PFD, and they would provide the CPG with methods for both an estuarine bivalve test (oyster over 6- to 10-month deployment) and a freshwater bivalve test (possibly eastern mussel and likely of less duration). USEPA indicated that method for the oyster caged bivalve was well developed but acknowledged that they are still developing the method for the mussel. USEPA indicated that starting the test next spring would likely be adequate (i.e., not needed for the 2009 sampling season). USEPA pushed for next spring because they did not want to hold up the 2009 sampling season. • CPG asked USEPA to clarify their comment regarding the evaluation of the homeless scenario. USEPA stated that they would like the homeless receptor evaluated qualitatively for all pathways in the uncertainty section of the HHRA due to the lack of established exposure assumptions/methods for this receptor. • CPG asked USEPA to provide specifics regarding their comment that the CAS peer review did not conform to guidance. USEPA indicated that they had concerns regarding the qualifications of the peer review team regarding the creel/angler surveys and that the team members were not appropriate subject matter experts. USEPA also stated that convening an expert panel is not a substitute for USEPA approval of a work plan, which was implied by the language in the revised PFD. **Tissue QAPP:** • Herbicides were already discussed. • USEPA has also asked for alkylated PAHs in tissue. CPG asked if CPG could use the low-resolution method, and USEPA indicated that this may be acceptable if the DLs meet the DQLs. • CPG asked what USEPA's position was on the fish histopathology. USEPA stated they would like mummichog and possibly Atlantic tomcod gonad and liver to determine cell abnormalities. CPG questioned how this information will be used in the CERCLA risk assessments. USEPA said they would provide information on how this information could be used to address how fish reproduction could be adversely affected. CPG mentioned that there are already lines of evidence examining fish survival, growth, and/or reproduction. USEPA said they wanted this additional information. CPG (asked that they provide a list of CERCLA sites where this had

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

	been done, and USEPA indicated they will. USEPA said this work could be a data need for next year and could be included in a QAPP addendum. USEPA was uncertain whether they could get the protocols and methods and rationale quickly. USEPA was inclined to push this to next year rather than hold up the 2009 field work for this data need. • CPG asked about USEPA's request for additional fish surveys, what timing was best based on biology, and how this would be used in the risk assessment. USEPA said they would provide information on when they thought the best times to survey would be and how this would advance the risk assessment. CPG asked if the CPG could keep the language in the Tissue QAPP flexible on exact number, and USEPA concurred. • CPG asked USEPA to clarify what they meant when they asked CPG to sample sediment in the Tissue QAPP. CPG explained that the sediment sampling will be conducted as part of the Benthic QAPP and if mummichog sampling locations change, the CPG will move the mummichog sediment locations identified in the Benthic QAPP to correspond to where the CPG actually caught mummichog. USEPA agreed. • CPG asked about fish gender. USEPA mentioned they would like this information documented (including indeterminate gender) but would like to see the fish composites with approximately equal sexes. • CPG explained there will be a number of decisions that will happen in the field, and it would be prudent to have a "what-if" call with USEPA prior to sampling to make sure everyone understands and agrees to the potential decisions that need to happen (and most importantly, both CPG and USEPA agree to what is the "correct" decision if faced with multiple options in the field). CPG stated a communication chain-of-command needs to be established. USEPA agreed. USEPA had sent CPG a sample flow chart of some of these decisions, but agreed a call would help work through all the details. USEPA suggested that CPG add language to the Tissue QAPP saying an addendum that documents the general decision flow based on the upcoming call will be provided. • CPG asked when CPG would receive the statistician's comments on compositing and sample number. USEPA did not know and said at this point, if they get comments, we should "take them into consideration". CPG reiterated how important it was to get everything nailed down by next week so the Tissue QAPP can be turned around in July for August sampling. • A tentative date for the next call was set for Tuesday, June 30, in the afternoon. CPG indicated that the CPG will provide a list of issues for discussion on Monday, June 29.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Consensus Decisions:	• USEPA and CPG agreed to schedule the caged bivalve and fish histopathology next spring inasmuch as USEPA did not want to hold up the 2009 sampling season. Also, USEPA will provide methods for the caged bivalve sampling. • CPG asked if CPG could use the low-resolution method, and USEPA indicated that this may be acceptable if the DLs meet the DQLs. • USEPA and CPG agreed that CPG could keep the language in the Tissue QAPP flexible on exact number of additional fish surveys. • USEPA and CPG agreed that the sediment sampling will be conducted as part of the Benthic QAPP and if mummichog sampling locations change, the CPG will move the mummichog sediment locations identified in the Benthic QAPP to correspond to where the CPG actually caught mummichog. • USEPA and CPG agreed that a communication chain of command needs to be established. USEPA had sent CPG a sample flow chart of some of these decisions but agreed a call would help work through all the details.

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	June 30, 2009
Scoping Session Purpose:	Conference call regarding resolution of specific Problem Formulation Document (PFD) and Tissue QAPP EPA comments

Participants: USEPA, Malcolm Pirnie, Inc., Batelle, dmi, AECOM, Windward

Name	Affiliation	Phone No.	E-mail Address
Amy Marie Accardi-Dey	Malcolm Pirnie, Inc.	914.641.2699	aaccardi-dey@pirnie.com
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Jennifer Parker	Windward Environmental	206.812.5442	jenniferp@windwardenv.com
Robert Law	de maximis, inc.	908.735.9315	rlaw@demaximis.com
Chuck Nace	USEPA	212.637.4164	nace.charles@epa.gov
Marian Olsen	USEPA	212.637.4313	olsen.marian@epa.gov

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

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Stephanie Vaughn	USEPA	212.637.3914	vaughn.stephanie@epa.gov
Alice Yeh	USEPA	212.637.4427	yeh.alice@epa.gov

June 2009 Problem Formulation Document and Fish/Crab Tissue QAPP Field Sampling Program Goals Meeting	
Comments/Decisions:	A conference call to discuss the resolution of specific Problem Formulation Document and Fish/Decapod Tissue QAPP EPA comments was held June 30, 2009. The purpose of this meeting was to resolve the major issues CPG identified in the USEPA comments on the Problem Formulation Document and the Fish/Decapod Tissue QAPP.
Action Items: **(Retrospective Summary)**	• Additional chemistry issues – The chemists discussed data validation SOPs, blank correction on inorganic arsenic, and dilution and calibration range, and USEPA did not have the correct person on the phone to answer questions. The chemists agreed to have another call on July 1, 2009, with USEPA's acting branch chief (John Burban). • Caged bivalve – As a follow up to last week's discussion, USEPA provided the method number (ASTM E 2122-02) and indicated they would provide SOPs along with or prior to Benthic QAPP comments. USEPA made two significant points: 1) this will only be a bioaccumulation test to measure tissue concentrations, and 2) CPG can develop a steady-state argument to allow for a deployment of less than 10 months. USEPA was uncertain as to whether the test could be started this fall or in the spring. CPG asked USEPA if they thought the organisms would be available for a fall deployment, and USEPA thought so but was not sure. Nor were they sure the winter would be the best time to deploy. • Histopathology – USEPA indicated that they will provide methods by the end of this week. USEPA would like any obvious tumors excised and histopathology performed; they would also like histopathology performed on a subset of fish (regardless of whether there are obvious tumors). USEPA was uncertain as to whether this would be an activity they would require during this August's sampling effort; but their preference is to include histopathology during the August 2009 sampling, if possible. • Mummichog eggs – USEPA would like a new line of evidence for fish, which is counting mummichog fish eggs. They are concerned that mummichog produce fewer eggs in the Passaic based on recent research (USEPA provided this work to CPG). If employed,

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

	this would probably be a 2010 activity. This would also need to be added to the PFD as a new line of evidence. • CSO language in the PFD – USEPA stated that the reference to CSOs and SWOs in one particular sentence was not balanced. They indicated that most statements and references to CSOs, etc., were balanced; however, in this one sentence they requested either deleting the reference to CSOs, etc., or expanding on the historical industrial discharges. • Fish community surveys – USEPA recommended the performance of three fish community surveys (August/September – fish moving in system, December/February – what fish overwinter, spring/early summer – fish coming in during spring). USEPA suggested adding a box trap in the winter to count wintering tomcod. • Additional sediment samples – USEPA would like sediment samples to be collected from locations where crab/crayfish are found. • Additional crab samples – USEPA would like three analytical samples at each crab location versus one analytical sample, as was presented in the QAPP. • Overarching sample design issues – This is a major issue that USEPA promised to address; yet CPG still has not received USEPA comments. USEPA indicated they are still waiting to hear from their statistician and that they hope the comments are focused and will provide a constructive framework for going forward. USEPA indicated that they will provide comments by the end of this week regarding design and sample numbers, replicates, use of individual vs. composite samples, and compositing strategy. USEPA indicated they want to composite only within a station, not across stations. Sample design issues will be the focus of next week's discussion with USEPA (Tuesday, July 7), assuming that the comments are received by the end of this week. USEPA indicated that there would be no fundamental changes from what CPG has recommended. • Carp – USEPA would like CPG to keep (analyze) any carp found using existing methods, but carp do not need to be added as a target species. • Hepatopancreas – USEPA confirmed hepatopancreas samples can be partially thawed for sample preparation. • Full validation references – USEPA will provide the guidance they followed for full validation (provided to CPG today) and would like CPG to do the same.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Consensus Decisions:	• Herbicides – After listening to CPG arguments regarding the problems with analyzing herbicides in tissue, USEPA agreed to drop herbicides from tissue pending adequate justification. USEPA would need to see a memorandum justifying the dropping of herbicides based on a preponderance of evidence approach (frequency of detection in sediment, what herbicides, ability to bioaccumulate, and a screening-level analysis that uses bioaccumulation factors to predict body burdens for comparison with toxicity values). If USEPA does not agree, herbicides may be added in subsequent tissue sampling. Herbicides will be required in sediments. USEPA acknowledged the challenges of analyzing herbicides in tissue and that analytical methods were developmental. Many of these developmental methods employ liquid chromatography-mass spectrometry (LC-MS), and USEPA recommended exploring LC-MS methods if herbicides in tissue were required at a later date. • Alkylated PAHs – After listening to CPG arguments regarding the lack of toxicity values for alkylated PAHs and the problems with high resolution methods necessary to perform alkylated PAHs, USEPA agreed to conducting alkylated PAHs by a low-resolution method that uses a gas chromatography/mass spectrometry (GC/MS) detector. • Lipid analysis – After listening to CPG arguments regarding the problems with using the same organic extract to analyze both organic chemicals and lipids, USEPA agreed to lipid analysis based on its own (extract) method.

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	July 8, 2009
Scoping Session Purpose:	Conference call with USEPA to discuss what additional comments EPA may have on the Tissue QAPP statistical design

Participants: USEPA, Malcolm Pirnie, Inc., Kern Statistical Services, Inc., dmi, AECOM, Windward

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QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

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July 2009 Fish/Decapod Tissue QAPP Field Sampling Design Conference Call	
Comments/Decisions:	A conference call to learn what additional comments USEPA may have on the Tissue QAPP statistical design was held July 8, 2009. USEPA's statistician John Kern (Kern Statistical Services, Inc.), a subcontractor to Malcolm Pirnie, Inc., stated that he has been involved in statistical sample design work at the Fox River and Kalamazoo River sites and other Midwest sites. USEPA first explained that they did not think the CPG proposed sample size (number of samples) was sufficient. (USEPA in its October 2008 comments on the FSP 2 recommended 96 crab sampling location in the lower 8 miles of the LPRSA; the Tissue QAPP proposed 12 locations.) USEPA stated that they thought 4 to 5 times the CPG-proposed number of samples would be required. They want more samples to allow for greater precision of the mean, to allow for assessing variability on a smaller areal scale, and to help develop biota-sediment bioaccumulation factors (BSAF).

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Action Items: **(Retrospective Summary)**	**Sample Number:** • Kern indicated that he did not agree with the sample size estimates described in Sample Design Memo (Attachment Q). Kern indicated that the bootstrap results presented in Attachment Q indicated that more than 30 to 60 samples were required per zone. • Kern did not present an alternative statistical basis for USEPA's desired sample numbers. Kern stated his rationale was based on the need to: 1. Achieve a more reasonable precision than 100%, which he thought was too coarse based on his work at other sites, and indicated that 50% was more reasonable, especially if we were interested in seeing the relative difference in tissue concentrations before and after remediation 2. Determine whether there is sub-zone (inter-station) variability 3. Collect sufficient data to develop BSAFs • Kern indicated that mummichog samples should be increased to achieve a better relationship between sediment and tissue. He mentioned he would like to see 50% precision for the mean and a coefficent of variation (CV) of less than 1.5. • Kern stated he would also like to see the other fish species (with larger foraging ranges) follow the same sampling design as that for mummichog. • USEPA stated they were interested in seeing differences between reaches (and using an analysis of variance to evaluate differences between reaches) and to look at differences over time. They were concerned about "missing" a smaller scale data point. CPG representatives explained that the fish foraging range is larger than the reaches they want to sample; but USEPA stated that they wanted the information anyway. Kern acknowledged that we may not see much variability across the zone for larger species. CPG representatives also explained that, based on previous data, there is not a great deal of variation in the fish tissue data; but USEPA wants additional samples anyway. • USEPA explained they also want additional samples to develop BSAFs. CPG representatives explained that a food web model will be used for the fish species with larger home range and point estimates for larger-foraging-range fish are not needed. Furthermore, CPG and USEPA agreed, even with the mummichog relationship development, sediment will be averaged over an area represented by the foraging area for mummichog. USEPA still contended they wanted a much larger number of large-foraging-range fish. • USEPA suggested using the same sampling location design as proposed by the CPG (i.e., two zones,2-mile "reaches"). Starting with the CPG sample design of three samples per reach, USEPA would like to add 3 to 5 subsamples per sample location, resulting in 9 to 15 samples per reach. If each zone has approximately 4 reaches, this would be 36 to 60 samples per zone or 72 to 120 samples total (per species). For the mummichog, use the same sample design as that for CPG (base sampling location on both reach and mudflat habitat), but increase the number of samples, as

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

	indicated above for approximately 72 to 120 samples total. For crabs, set three traps per location for three separate composites (similar to mummichog). • For the last 2.4 river miles (RM 15 to RM 17.4), USEPA expressed concern that no biota samples were proposed. CPG indicated that they will sample as far as they can get up the river but indicated that based on recent reconnaissance, it is not likely to be possible to get a boat further upriver than RM 15. It was discussed that sampling beyond RM 15 would likely require backpack electroshocking or possibly use of a pontoon boat. USEPA stated that they would like samples as far up the river as possible. USEPA mentioned Chris Purkiss at MPI may know of some good access points. USEPA/CPG agreed they would have both USEPA and CPG field personnel go together to select the correct locations in the upper 2.4 river miles. **Compositing:** • USEPA would like a table that presents the proposed species and whether it will be an individual sample or a composite. In general, if the fish is large enough, USEPA would like CPG to collect only individuals. USEPA does not want mixed sample types within a species – their preference is for either all composites or all individuals. USEPA acknowledged that this is a new comment and not consistent with the prior call, during which it was agreed that if a large individual was caught, it would be analyzed separately. • CPG representatives reminded USEPA of the need for the exposure point concentration to be a measure of the population mean for the risk assessment and that composites achieve that goal. USEPA stated that they did not want to composite large individuals because it is not as representative of how they are consumed. • USEPA stated that they thought perch, bullhead, and catfish would need to be composited and that eel and largemouth bass could be individuals. • When compositing is required, USEPA would like CPG to composite by same species, similar size range, and equal numbers of male/females. (The CPG had previously agreed to this.) **Other Issues**: • CPG indicated there was one outstanding chemistry question regarding validation SOPs. USEPA indicated Jennifer Parker (Windward) could directly contact Bill Sy (USEPA) to resolve. • Amy Marie Accardi-Dey of MPI had a series of questions related to oversight. She will e-mail these to Lisa Saban (Windward).

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Consensus Decisions:	• USEPA suggested that the individual vs. composite sample table for species will help reduce the need for field decisions. • USEPA agreed with CPG that no more than five attempts will be made for each trap type. If inadequate tissue is collected, CPG will follow the analyte priority scheme in the QAPP. Discussions about compositing may also have to occur. • For crab, after five attempts, first prioritize the reasonable maximum exposure (RME) tissue type (muscle plus hepatopancreas), then collect muscle-only samples, and lastly collect hepatopancreas-only samples. It was discussed that although sufficient samples for muscle-only may be collected, it is expected to be challenging to get sufficient tissue for hepatopancreas-only samples in the five-attempt time frame. It was agreed that the sampling effort will not extended past five attempts to gather hepatopancreas-only samples. Available hepatopancreas-only tissue will be analyzed based on the analyte priority list. • USEPA asked CPG to develop the flow chart they gave us in more detail. It was also recommended to create a memo and/or table along with the flow chart to reduce decisions in the field. CPG has been doing this.

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	July 15, 2009
Scoping Session Purpose:	Conference call to discuss amendments to the sample size estimates for the sample design for the implementation of FSP2 in 2009

Participants: USEPA, CPG, Crowell and Moring, dmi, AECOM, Kern Statistical Services, Inc., Windward

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QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

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July 2009 Fish/Decapod Tissue QAPP Field Sampling Design Conference Call	
Comments/Decisions:	A conference call to discuss the sampling design was held July 14, 2009. The purpose of this call was to address the sample size estimates for the components of the ERA and HHRA and to discuss the goals of the 2009 FSP2 field sampling program.
Action Items: **(Retrospective Summary)**	• The CPG proposes to amend the sample size estimates presented in the May 1, 2009, Tissue QAPP in the following manner: 1. Table 5 of Appendix Q (sample design memorandum) forms the technical basis for decisions on sample sizes for the fish and decapods tissue samples based on discussions with USEPA and CPG on July 13, 2009. 2. Target precision percent of mean preferred by USEPA is between 50% (per July 13, 2009, internal e-mails from USEPA). Table 5 provides a look-up matrix to determine sample size given a preferred precision goal and an expected CV for the tissue data. 3. Revised sample numbers reflect the number of tissue samples required to meet the target precision between 50% precision for all target species groups, depending upon the CV for the target species. 4. Site-specific CVs are available from the Contaminant Assessment and Reduction Program (CARP) and Tierra Solutions studies (Table 3 of Attachment Q of the Tissue QAPP presents ranges of CVs per chemical and per species). Median CVs for each of the receptor groups listed in Table 3 of Attachment Q range from 0.67 (for mummichog) to 0.32 (for blue crab). CPG's goal is to develop sample sizes in which the sample size selected results in a CV that is lower than the majority of the chemical-specific CVs for each species. For setting sample sizes, CPG compared the proposed sample size and CV to a sample size and CV of 0.5, which is higher than the CV for a number of chemicals per species. These result in the following: • Proposed sample numbers for foraging fish (median CVs between 0.43 and 0.56 for multiple species), will at least meet the target precision of 50%, • Crabs sample numbers will more than meet the target precision range of 50%; crayfish chemical concentrations in fresh water are assumed to be similar for the purposes of these sample size estimates.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

	• For mummichog, the proposed number of samples, assuming a median CV of 0.67, will result in a precision between 50% and 75%. 5. The proposed increase in mummichog samples is three times the original proposed sample size. In addition, the increase to 39 to 42 samples per zone is responsive to USEPA's preference for multiple samples (i.e., three samples/mudflat/zone) as discussed on July 8, 2009. 6. The level of effort (five attempts per target area) remains the same as that defined in Worksheet Nos. 11 and 17 of the Tissue QAPP. Following completion of chemical analyses of the tissue in Q3 and Q4 of CY 2009, a preliminary data assessment will be conducted to determine the variability and sample mean precision of the tissue data. If there is a sound technical justification (e.g., increase precision of the sample means), additional data collection will be considered following this evaluation for the Q2/Q3 2010 field season following approval by USEPA. 7. The Revised CPG Sample Size Estimate Term Sheet accepted by USEPA will be added as an addendum to the Tissue QAPP. The current CPG sample design memo, Attachment Q will not be changed because it provides the underlying statistical rationale; however, the sample number tables within the QAPP will be changed to reflect these new sample numbers and the Sample Size Estimate Term Sheet will be referenced. • After USEPA reviewed the Sample Size Estimate Term Sheet, USEPA sent an e-mail on July 15, 2009, to CPG and requested an additional station above RM 16 that would be much closer to the dam. CPG would collect samples as proposed for all the other stations under the Sample Size Estimate Term Sheet. USEPA calculated that this would add 17 more samples to the total. • USEPA will call CPG to discuss some suggested clarifications to the proposed Sample Size estimate Term Sheet, for example, Item 6, that additional samples or other changes to the proposed plan would be subject to USEPA approval. • USEPA asked if an agreement from the technical committee or the CPG would be necessary for the addition of one more sampling station.
Consensus Decisions:	• USEPA agreed not to request more samples from all of the current stations that have been proposed in the QAPP. But, USEPA requested the addition of one additional station between RM 16 and RM 17.4 that is much closer to the dam, based on suggestions from the USEPA ecological risk team. • During a July 16, 2009, conference call, Stephanie Vaughn and Robert Law agreed that specimens for histopathology would not be collected as part of the 2009 sampling effort.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Project Name:	LPRRP Ecological and Human Health Risk Assessment
Site Name:	LPRSA
Projected Date(s) of Sampling:	August-September 2009
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	August 4, 2009
Scoping Session Purpose:	Conference call to discuss USEPA comments to the Quality Assurance Project Plan, Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey, Revised Draft, July 24, 2009.

Participants: USEPA, dmi, AECOM, Windward

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August 4, 2009, Fish/Decapod Tissue QAPP Field Sampling Design Conference Call

Comments/Decisions:	A conference call to discuss resolution of comments received from USEPA on July 31 and August 3 by USEPA on the Revised Draft Tissue QAPP (July 24) was held on August 4, 2009.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Action Items: **(Retrospective Summary)**	• Use of dry ice vs. wet ice to ship fish tissue – It was explained that the analytical laboratory has concerns about using dry ice to ship frozen samples because it is a hazardous material, and, more importantly, they are concerned that samples may become compromised by sublimation when using dry ice. However, there is also concern that samples may not be kept completely frozen if shipped on wet ice. USEPA agreed that wet ice can be used when transporting samples directly by courier because the transit time will be less than 24 hours. The processing laboratory will be contacted to see if they can use dry ice to ship tissue samples to other laboratories by overnight commercial courier (e.g., FedEx) to ensure that homogenates remain frozen during transit time. Dry ice may be used to ship samples by overnight courier service to better ensure that samples will remain frozen throughout shipping. • Eel fillet with skin on – Betsy Ruffle (AECOM) explained that analyzing eel with skin off follows USEPA guidance on tissue sampling, which recommends using skin-off fillets for scaleless fish such as eel. USEPA agreed that eel fillets would be analyzed with skin off per the current QAPP. The eel skin will be analyzed along with the carcass. • DQL – As agreed upon at the January Workshop, TRVs will be developed later and provided to USEPA in a memorandum (as presented in Section 1 of the PFD). CPG and USEPA discussed comparing the DQLs in the FFS to the DQLs in the QAPP. There also was discussion about providing TRVs and assumptions. Lisa Saban (Windward) explained that the DQLs used in the Tissue QAPP are based on the lowest-available analytical methods, and quantitation limits are below the revised DQLs. • Sample location LPR2C and Tierra Solutions sampling –Rob Law (dmi) suggested a field modification that would resolve the issue and accommodate both field efforts: CPG will postpone sampling between RM 2 to RM 4 until the week of August 31 and, in addition, will move location LPR2C 1,000 ft downstream provided that the habitat type is the same as that at the originally proposed location. • Flow charts – Flow charts have been modified to include the options for decision making if insufficient tissue is collected. It was agreed that the fourth option, combining different species from the same stations, is not appropriate for the large forage fish or crab but would be included as an option for small forage fish and for crayfish. The flow charts will be added as an attachment to the QAPP.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet (cont.)

Consensus Decisions:	• Wet ice will be used for transport between the field facility and the laboratories conducting the homogenization when samples are transported by courier and travel time will be less than 24 hours. • USEPA and CPG will develop an agreed-upon method (dry ice or wet ice) for shipping the homogenate following a conference call with the laboratory and Bill Sy (USEPA). • American eel fillets will be analyzed with skin off per USEPA 2000 tissue sample preparation guidance. The skin will be included for analysis with the carcass. • Windward will review the DQLs in the FFS and compare them to the DQLs in the tissue QAPP. • A field modification will be made to accommodate Tierra Solutions' field sampling. CPG will postpone sampling in RM 2 to RM 4 until August 31, and location LPR2C will be moved 1,000 ft downstream provided that the habitat type is similar to that at the originally proposed location. • Flowcharts will be updated per the call and added as Attachment W to the QAPP.

QAPP Worksheet No. 10. Problem Definition

The problem to be addressed by the project:

A better understanding (quantification) of fish and decapod crustacean (crab and crayfish) tissue-residue chemical concentrations in the LPRSA is needed to effectively complete the ERA and HHRA. Because previous investigations focused primarily on the lower portion of the of the LPRSA (RM 1 to RM 7) (Tierra Solutions 2002c), there are very few fish and invertebrate tissue-residue data and fish community data available from the upper part of the LPRSA, from approximately River Mile [RM] 7 to RM 17.4.

Fish and decapod crustacean tissue samples will be collected from sport fish and target species at different trophic levels and analyzed to better understand which chemicals may be bioaccumulating in these species in the LPRSA. Fish eggs will be collected for lipid content analysis to evaluate fish egg exposure concentrations, estimated from whole-body tissue concentration and whole-body and egg lipid content. Fish stomach content taxonomy samples will be collected to identify prey organisms (to the lowest taxonomic level possible) in order to determine the trophic feeding level of each receptor in the LPRSA and to assist in the development of a food web exposure model for higher-trophic-level organisms. Fish health condition data (i.e., gross internal and external pathological observations) will also be collected during the tissue sampling and first community survey event to assist in interpretation of the results in terms of fish population health. Three seasonal fish community surveys will be conducted to provide important information on the fish community throughout the LPRSA, in particular in the freshwater areas where fish community data are currently limited, and to provide information for restoration-planning, which is a WRDA objective. The results of the proposed fish community surveys will be reviewed to determine if additional community survey events are needed.

The environmental questions being asked:

The questions defined for this effort are:

- Are COPC chemical residues in fish and crustacean tissue from the LPRSA at levels that might cause an adverse effect on survival, growth, and/or reproduction of fish utilizing the LPRSA?
- What species of fish and decapod crustaceans are present in the two salinity zones, the estuarine zone (RM 0 to RM 10) and the freshwater zone (RM 10 to RM 17.4) in the LPRSA?
- What are the potential adverse effects of river chemicals to human health (for the RME of individuals under current and future exposure scenarios for both cancer and non-cancer health effects) or ecological receptors via fish or crustacean consumption from the LPRSA?

These questions were presented as part of the ERA and HHRA approaches in the PFD (Windward and AECOM 2009); further detail on how the data will be used is presented on Worksheet No. 11.

QAPP Worksheet No. 10. Problem Definition (cont.)

Observations from any site reconnaissance reports:

A field reconnaissance was conducted by Windward on July 24 and 25, 2007. Access to the river was limited, particularly in the uppermost section near the Dundee Dam. Riverbank Park, located in Kearny, New Jersey, at approximately RM 7.2, was the starting point and was the location of the boat launch used for the on-water reconnaissance survey. Water depth and water quality measurements, particularly salinity, were obtained at each river mile from approximately RM 6.5 to RM 15.5 to better determine the saltwater influence in the upper reaches of the study area and to determine where electrofishing methods may be used. Water depth ranged from 5 ft (RM 15.5) to 16 ft (RM 8). Surface water temperatures ranged from 22 to 24 ˚C. Salinity ranged from 0.25 ppt (RM 16) to 0.17 ppt (RM 8). It was determined that, based on the water quality observations, electrofishing may not be the most effective fishing method, particularly at that time of year because it appears temperature and conductivity are too high, and the substrate is undesirable, for suitable electrofishing conditions. However, if possible, electrofishing will be attempted at locations to further evaluate this conclusion.

In addition, substrate variability was noted as follows:

- From RM 6.5 to RM 8, the eastern bank contained large expanses of intertidal habitat with gravel and sand, which may provide potential fishing habitat and wadeable waters. While the western bank had small pockets of potential fish habitat, it was mostly covered by an impervious concrete surface with silt and sand deposition in isolated areas. The Conrail Arlington Bridge, at approximately RM 7.8, was the first transitional sediment zone noted where the main channel was composed of mostly gravel and sand.
- Further upstream at RM 8, at the confluence with the Second River, the substrate was rocky on the western bank, and the boat driver needed to stay to the eastern bank to keep the boat in the deeper water and off the rocks.
- From approximately RM 9 to RM 10, the substrate in the main channel was mostly silt, the eastern shoreline was composed of sand and gravel, and the western shoreline was a concrete slab with silt deposits.
- From RM 10 to RM 11, the substrate composition changed from gravel and sand to sand in the main channel. In general, the eastern shoreline was more flat with potential good fish habitat and wadeable waters, and the western shoreline was steeper and modified.
- For the next few miles, RM 12 to RM 15, the substrate was composed of mostly silt and sand with some gravel; and the main channel and deeper water is on the western side of the river. Above RM 15, there was a major change in substrate, with a composition of coarse gravel and rock. Because of this rocky composition, on-water site reconnaissance ended at the confluence of the Saddle River, at approximately RM 15.5.

After identifying the substrate composition, collecting water quality parameters, and noting shoreline characteristics, several potential fish sampling locations were identified in the upper reaches of the LPRSA. In addition, Windward determined that the fish community

QAPP Worksheet No. 10. Problem Definition (cont.)

and tissue collection effort will have to be conducted around the high tide due to the significant tidal influence on the site.

A synopsis of secondary data or information from site reports:

Both fish community and fish and crab/crayfish tissue chemistry data have been collected in the LPRSA over the past 25 years, but data from the lower portion of the LPRSA (RM 1 to RM 7) are more abundant.

Fish community

In spring and late summer 1981, alewife, blueback herring, American shad, white perch, and striped bass were collected during two separate fish community surveys from the mouth of the LPR to Dundee Dam; striped bass have been sighted in the area on a limited basis, although their spawning has not been confirmed (USACE 1987).

In 1981 and 1982, Princeton Aqua Science conducted a biocommunities study in the Passaic Valley (Princeton Aqua Science 1982); mummichogs were the only species caught during the seining efforts at three sampling stations from the mouth up to ~ RM 9.

The USEPA Coastal Assessment Program sampled the upstream reach of the LPR near Bellevue-Lyndhurst (RM 9.9) in August 2000 via trawl (USEPA 2007b). Only two individuals were collected, one white perch and one Atlantic menhaden.

The largest fish community survey to date was conducted by Tierra Solutions during the late summer/early fall of 1999 and spring of 2000 to characterize the fish community in the lower portion of the LPRSA (RM 1 to RM 7) on a seasonal basis (Tierra Solutions 2002c). Fifteen stations were sampled between RM 0 and RM 6 (Figure 2) using eel, minnow and crab traps. Gillnets were deployed at four stations. Length, weight and pathology data were collected for several species. The most abundant fish species were mummichog (77% of the total), followed by inland silverside (11% of total), and white perch (5.4% of total) (Table 10-1).

A single station in the Saddle River, a tributary to the LPR (~ RM 15.5), was sampled by electrofishing in August 2004 (NJDEP 2006). Five-hundred and eight individuals were collected from fifteen species. The three most abundant species were white sucker (45% of total), tessellated darter (23% of total), and blacknose dace (16% of total). That habitat rating for that location was considered suboptimal, and the index of biotic integrity (IBI) rating was fair (NJDEP 2006).

Tissue Chemistry

Sampling efforts for tissue chemistry have been conducted in the transitional and freshwater reaches of the study area (i.e., upstream of RM 6), but they have been very narrow in scope. NJDEP sampled two stations (at Newark Bay and Monroe Street Bridge [RM 16]) for American eel, carp, striped bass, and blue crab for tissue analysis from 1986 to 1991 (NJDEP 1990, 1993); tissues were analyzed for PCBs, chlordanes, and DDTs. Belton et al. (1985) investigated the potential extent of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) contamination in fish collected from the Newark Bay Complex, including the tidal Passaic River.

QAPP Worksheet No. 10. Problem Definition (cont.)

Additional tissue chemistry surveys are included in the PREmis database (created January 21, 2006; available at http://www.ourpassaic.org). The New York State Department of Environmental Conservation (NYSDEC) collected blue crab (hepatopancreas and muscle), oyster (soft tissue), butterfish, scup, and striped bass (the latter three were standard fillet samples) near the mouth of the LPR at approximately RM 0.1 in 1993. Chemical analyses for this survey included PCDDs/PCDFs, metals, PCBs, pesticides, and lipids.

Tierra Solutions conducted a limited biological sampling program in the summer of 1995, which included two sampling locations between RM 1.1 and RM 4.5 in the LPR. The species collected for this effort included blue crab (edible muscle and hepatopancreas), mummichog (whole body), and striped bass (fillet). The chemical analyses included PCDDs/PCDFs, metals, PAHs, PCBs, pesticides, semivolatile organic compounds (SVOCs), and total petroleum hydrocarbons (TPH).

The largest tissue chemistry survey to date was conducted by Tierra Solutions (2002c) from RM 1 to RM 7 during the community sampling described above. During those surveys, tissue samples from mummichog, striped bass, white perch, American eel, American menhaden, bluefish, inland silverside, and blue crab were collected to measure contaminant residues (Iannuzzi et al. 2004).

Three whole-body composite mummichog samples and one composite sample each of blue crab whole body and hepatopancreas were collected from each of the 15 sampling stations in the fall of 1999. One whole-body composite mummichog sample and one whole-body composite crab sample were also collected from each of Stations 1, 4, 8, and 11 in the spring of 2000. The composite sample collection breakdown from the two surveys is as follows (Iannuzzi et al. 2004):

- 49 mummichog whole-body samples
- 19 blue crab whole-body (soft tissue) samples
- 15 blue crab hepatopancreas samples

In addition, 50 resident and migratory (composite whole body) fish tissue samples were collected, including:

- 6 American eel
- 2 bluefish
- 9 striped bass (6 adults and 3 juveniles)
- 6 Atlantic menhaden
- 9 inland silversides
- 18 white perch

QAPP Worksheet No. 10. Problem Definition (cont.)

Fillet samples of adult striped bass, bluefish, and white perch and edible muscle samples of blue crabs were also collected. In addition, Tierra Solutions conducted a supplemental tissue sampling program in August 2001 to collect American eel and brown bullhead (fillet samples) between RM 6 and RM 7 (PREmis project database created January 21, 2006).

Between July 1 and October 31, 2002, fish tissue was collected from two upstream areas of the LPRSA (above RM 7) as part of a routine monitoring program for NJDEP. At Garfield (~RM 16 to RM 17), American eel, channel catfish, common carp, striped bass and white sucker tissue were analyzed for PCBs, pesticides, mercury, and PCDDs. At Lyndhurst (~RM 10 to RM 11.5), common carp tissue was analyzed for PCBs and pesticides (Horwitz et al. 2005). Crab (hepatopancreas and muscle) were also collected in the LPRSA as part of the NJDEP routine monitoring program for toxics in fish,[11] and tissues were analyzed for PCDDs/PCDFs, DDTs, PCBs, pesticides, conventional parameters. The NJDEP website includes crab tissue collection data for the LPR from 2004 at RM 1 and 2005 at RM 8.

Fish and invertebrate tissue were collected at a location in the estuarine section of the LPRSA (RM 2.6) between 2000 and 2004 as part of the Contaminant Assessment and Reduction Program (CARP) Harbor Fish/Crustacean Collection (http://www.carpweb.org/main.html). The species collected included: American eel, mummichog, white perch, blue crab, opossum shrimp, ribbed mussel, and seven spine bay shrimp. Analyses included PCDDs/PCDFs, metals, PAHs, PCBs, and pesticides.

White perch and blue crab (one composite sample each) were collected at two locations in the LPRSA in September 2002 as part of the USEPA Environmental Monitoring and Assessment Program (EMAP) and Regional Environmental Monitoring and Assessment Program (REMAP) National Coastal Assessment- Northeast/New Jersey Coast (http://www.epa.gov/emap/nca/html/about.html). Analyses included metals, DDTs, PCBs, and pesticides.

The possible classes of contaminants and the affected matrices:

There are several different classes of organic and inorganic contaminants in the LPRSA, many of which may accumulate in fish, crab and crayfish. Fish and decapod crustacean tissue samples (whole body, fillet, and several types of blue crab tissue samples) will be analyzed for the following analytes: PCB congeners, PCB Aroclors, PCDDs/PCDFs, organochlorine pesticides, PAHs, alkylated PAHs, SVOCs (including phthalates), metals (including methylmercury, inorganic arsenic, and butyltins), lipid content, and percent moisture. Worksheet No. 15 lists the specific analytes in each of these chemical classes that will be analyzed. Although volatile organic compounds (VOCs) and herbicides were identified as contaminants of potential ecological concern in sediment by the pathways analysis report (Battelle 2005), VOCs were not identified as bioaccumulative chemicals by USEPA (2000a). Therefore, VOCs will not be analyzed in tissue samples. Per agreement between USEPA and CPG, herbicides are not included for analysis in

[11] NJDEP 2004 Routine Monitoring Program for Toxics in Fish: Year 2 – Estuarine and Marine Waters (http://www.state.nj.us/dep/dsr/2004data.htm).

QAPP Worksheet No. 10. Problem Definition (cont.)

tissue for the following reasons: 1) there are no published methods for herbicides in tissue, 2) herbicides are infrequently detected in recent studies, 3) the likely levels of detection are below levels to be toxic to wildlife, and the bioaccumulation potential is low. Windward is currently drafting a memorandum explaining the above points in more detail for USEPA. Note, herbicides will be analyzed in sediment as part of the benthic invertebrate QAPP sampling effort.

Fish egg samples will only be analyzed for lipid content.

The rationale for inclusion of chemical and non-chemical analyses:

Fish and decapod crustacean tissue-residue concentrations will provide additional information for the existing LPRSA tissue concentration datasets that will be used to perform the baseline ERA and HHRA for the LPRSA.

Fish egg lipid content will be used to evaluate fish egg exposure concentrations, estimated from whole-body tissue concentration and egg lipid content.

Fish stomach content taxonomy samples (including both stomach and gastrointestinal [GI] tract contents) will identify prey organisms (to the lowest taxonomic level possible) in order to confirm the trophic feeding level of each receptor in the LPRSA and to assist in the development of a food web exposure model for higher-trophic-level organisms.

Fish health condition data (i.e., gross internal and external pathological observations) will assist in the interpretation of results in terms of fish population health. Fish community survey data will provide important information on the abundance and diversity of the fish community throughout the LPRSA.

Information concerning various environmental indicators:

As described in the summary of secondary data section of this worksheet, a considerable amount of tissue chemistry data have been collected in the downstream section (RM 0 to RM 7) of the LPRSA. These data will provide a useful baseline for assessing temporal trends in bioaccumulation. There are very few tissue chemistry data from RM 7 to RM 17, so temporal trend analysis will be more uncertain in this region.

Project decision conditions:

The conditions for project decisions (i.e., those decisions that may require communication between CPG and USEPA during the field event) include the identification of species targeted for collection, the appropriate size of those species for collection, the prioritization of chemical analyses if insufficient tissue is collected, the prioritization for compositing (if necessary) in a given sampling area, and the need to relocate sampling locations within the zones.

QAPP Worksheet No. 10. Problem Definition (cont.)

Based on the previous fish community investigations conducted in the LPRSA, summarized above, the fish species that have been collected in the upstream sections of the LPRSA (i.e., RM 7 to RM 17.4) include mummichog, alewife, blueback herring, white perch, striped bass, white sucker, tessellated darter, and blacknose dace. Because previous sampling efforts were limited in the LPRSA, the most common fish and crustacean species, and the sizes of individuals of those species, is not known. Target species have been identified for the estuarine and the freshwater zones (as presented in Worksheet No. 11). Frequent communication with USEPA will be maintained during the sampling effort to discuss the species that are collected throughout the LPRSA and to confirm the target species for tissue analyses.

The targeted sizes for each species collected will be based on relevancy of each species to the ERA and the HHRA (presented in Worksheet No. 11). If there is a change in the target size of species, based on the initial field work, USEPA will be contacted immediately.

A pre-homogenization minimum tissue mass of 150 g and a post-homogenization mass 130 g is needed, per sample, for analysis of all proposed chemical groups.[12] A mass of 20 g was added to the sum of the minimum mass requirements for chemical analyses (130 g) to account for tissue lost during processing and homogenization, for a total pre-homogenization minimum mass of 150 g. The minimum mass requirements per chemical group are provided in the priority list below. Mass requirements have been optimized with each analytical laboratory such that they are the lowest required to achieve the detection limits presented in Worksheet 15. The minimum mass does not include enough mass for re-extractions or matrix-specific quality control samples. If the pre-homogenization minimum tissue mass (150 g) for chemistry analysis cannot be obtained after 8 weeks for a given species/location, the field effort will cease. If a post-homogenization minimum mass of 130 g is not obtained, the following priority list for the chemical analyses of tissue samples will be considered in conjunction with available sediment chemistry data collected:

1. PCDDs/PCDFs (30-g minimum mass, 10 g with reduced detection limits as described in Worksheet 15)
2. PCB congeners (10-g minimum mass)
3. Total and methylmercury (10-g minimum mass)
4. Organochlorine pesticides (10-g minimum mass)
5. Lipids (5-g minimum mass)
6. Metals (including inorganic arsenic and butyltins; 20-g minimum mass)
7. PAHs (10-g minimum mass)
8. SVOCs (including phthalates; 10-g minimum mass)

[12] It should be noted that additional tissue mass will be needed for certain samples to accommodate USEPA split sample objectives. Furthermore, additional mass will be required to include the analysis of matrix specific quality control samples.

QAPP Worksheet No. 10. Problem Definition (cont.)

9. Percent moisture (5-g minimum mass)
10. PCB Aroclors (10-g minimum mass)
11. Alkylated PAHs (10-g minimum mass)

As requested by USEPA (April 6, 2009), individual fish collected from the field that are of a sufficient size to meet analytical mass requirements (and QC requirements and splits) will be analyzed as separate samples.

If tissue samples are composited, they will be composited by species,[13] equal numbers of females and males, and per bank-specific sampling location within 2-mile river reaches for mummichog and darter or killifish, or within a 2-mile reach in each zone for all other species (compositing is further described in Worksheet No. 11). When possible, composites will be composed of approximately equal portions of each gender. If sufficient tissue mass is not available after five attempts have been made (as agreed by USEPA), then the range of sizes of individuals may be expanded, and varying portions of each gender may be included in the composite sample. If target species are not collected in sufficient numbers, alternative species (i.e., summer flounder, white catfish, Atlantic tomcod, northern pike, carp[14]) may be analyzed. See Worksheet 11 ("Where, when, and how should the data be collected/generated?") for additional details on sampling effort per 2-mile reach. Per agreement between USEPA and CPG, flow charts documenting the general decision process that will be implemented during the collection of samples in the field have been prepared and are in Attachment W.

Once sampling efforts are complete, an individual and compositing plan memorandum will be prepared for discussion and approval by USEPA.

Fish egg tissues will be analyzed for lipids only. A minimum tissue mass of 5 g is required per fish egg composite sample.

[13] If there are no other alternatives, it may be necessary to composite across species (for darter/killifish or crayfish), which may be acceptable given their similar life histories, if sufficient tissue mass is not available after five attempts have been made, or if the individuals cannot be identified to the species level.

[14] Per agreement with USEPA, all carp caught will be retained for chemical analyses, even if incidentally caught.

QAPP Worksheet No. 10. Problem Definition (cont.)

Table 10-1. Fish community survey results for the Lower Passaic River (RM 1 to RM 7)

Common Name	Scientific Name	Type of River User	Type of Feeder	Fall 1999		Spring 2000		1999/2000	
				N	% of Total[a]	N	% of Total[a]	N	Combined % of Total[a]
Mummichog	*Fundulus heteroclitus*	R	O	3,021	80	316	55	3,337	77
Inland silverside	*Menidia beryllina*	M	O	477	13	0	0	477	11
White perch	*Morone americana*	R	O	94	2.5	132	23	232	5.4
Atlantic menhaden	*Brevoortia tyrannus*	M	D/O	67	1.8	12	2.1	79	1.8
Striped bass	*Morone saxatilis*	M	P/I	51	1.4	14	2.5	65	1.5
Gizzard shad	*Dorosoma cepedianum*	M	D/O	6	0.16	50	8.8	56	1.3
American eel	*Anguilla rostrata*	M	P/I	0	0	20	3.5	20	0.46
Bluefish	*Pomatomus saltatrix*	M	P	14	0.37	0	0	14	0.32
Blueback herring	*Alosa aestivalis*	M	I	1	0.03	11	1.9	12	0.28
Common carp	*Cyprinus carpio*	R/FW	D	0	0	7	1.2	7	0.16
Green sunfish	*Lepomis cyanellus*	R/FW	I	4	0.11	0	0	4	0.092
Redear sunfish	*Lepomis microlophus*	R/FW	O	4	0.11	0	0	4	0.092
Summer flounder	*Paralichthys dentatus*	M	P/I	4	0.11	0	0	4	0.092
White catfish	*Ameiurus catus*	M/R	D	0	0	4	0.70	4	0.092
Bluegill	*Lepomis macrochirus*	R/FW	O	3	0.08	0	0	3	0.069
Striped killifish	*Fundulus majalis*	R	O	3	0.080	0	0	3	0.069
Brown bullhead	*Ameiurus nebulosus*	R/FW	P/I	0	0	2	0.35	2	0.046

QAPP Worksheet No. 10. Problem Definition (cont.)

Common Name	Scientific Name	Type of River User	Type of Feeder	Fall 1999		Spring 2000		1999/2000	
				N	% of Total[a]	N	% of Total[a]	N	Combined % of Total[a]
Weakfish	*Cynoscion regalis*	M	P	2	0.05	0	0	2	0.046
Channel catfish	*Ictalurus punctatus*	R	O	1	0.027	0	0	1	0.023
Largemouth bass	*Micropterus salmoides*	R/FW	P	1	0.027	0	0	1	0.023
Spotted hake	*Urophycis regio*	M	P/I	0	0	1	0.18	1	0.023
White sucker	*Catastomus commersoni*	R/FW	O	0	0	1	0.18	1	0.023
Total Species Number[b]				**16**		**12**		**22**	
Total Species Count[c]				**3,753**		**570**		**4,329**	

Source: Tierra Solutions (2002a)

[a] Percent of total number of fish caught.
[b] Total number of species identified.
[c] Total number of fish per species.

D – detritivore
FW – freshwater species
H – herbivore
I – insectivore
M – migratory species
O – omnivore
P – piscivore
R – resident species

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

Who will use the data?

The data collected under this QAPP will be used by CPG and USEPA for CERCLA-related decisions, specifically for the ERA and the HHRA, and by other interested parties (e.g., USACE, NJDEP, USFWS, NJDOT, and NOAA) for other purposes, including WRDA activities, such as restoration planning.

What will the data be used for?

The data collected during this sampling effort will be used in risk-based decision-making for the RI/FS at the LPRSA. Specifically, the data will be used to estimate potential human health and ecological risks to receptors that may be exposed to chemicals in the LPRSA. The results of the baseline risk assessments will be used to inform remedial decision-making under CERCLA/National Contingency Plan and other appropriate regulations and future restoration planning.

ERA Assessment Endpoints

The data collected will be used to support the ERA in evaluating the assessment endpoints of the benthic invertebrate community and fish, bird, and aquatic mammal populations as presented in the PFD (Windward and AECOM 2009) and summarized below:

Assessment Endpoint No. 3 – "Protection and maintenance (i.e., survival, growth, and reproduction) 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."

Decapod whole-body tissue chemistry data collected as part of this sampling event will be used as one measurement endpoint for evaluating risks to benthic invertebrates in order to answer the following risk question: **"Are COPC residues in benthic invertebrate tissues from the LPRSA at levels that might cause an adverse effect on survival, growth, and/or reproduction of macroinvertebrate (blue crab and crayfish) populations in the LPRSA?"** Measured tissue chemical concentrations in macroinvertebrates will be compared to tissue-residue TRVs. The collection of data for the additional measurement endpoints are presented in the benthic invertebrate QAPP (Windward; in preparation).

Assessment Endpoint No. 5 – "Protection and maintenance (i.e., survival, growth, and reproduction) of omnivorous, invertivorous, 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."

Fish whole-body tissue chemistry data collected as part of this sampling event will be used as part of the tissue-residue measurement endpoint for evaluating risks to fish in order to answer the following risk question: **"Are COPC concentrations in fish tissue from the LPRSA at levels that might cause an adverse effect on survival, growth, and/or reproduction of populations of fish that use the LPRSA?"** Measured tissue chemical concentrations or toxic equivalencies will be compared to tissue-residue TRVs. In addition, fish egg lipid data collected as part of this sampling event will be used to develop adult-to-egg lipid ratios and to

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

estimate egg chemical concentrations from adult chemical concentrations. Estimated egg tissue chemical concentrations or toxic equivalencies will be compared to egg tissue-residue TRVs.

Decapod and fish whole-body tissue chemistry data collected as part of this sampling event will also be used to evaluate dose-based dietary risks to upper-trophic-level fish from chemicals, in order to answer the following risk question: **"Are modeled dietary exposures to COPCs from LPRSA prey at levels that might cause an adverse effect on survival, growth, and/or reproduction of fish populations that use the LPRSA?"** Tissue chemistry will be used (along with sediment and surface water chemistry and benthic body burdens of laboratory-exposed benthic invertebrates) in a dietary model to estimate dietary intake for selected fish receptors. Modeled dietary dose concentrations will be compared to dietary dose TRVs. The collection of tissue-residue data from laboratory-exposed benthic invertebrates is presented in the benthic invertebrate QAPP (Windward, in preparation). Fish stomachs from target species will be collected during this sampling event, and stomach contents will be analyzed for the identification of prey organisms (to the lowest taxonomic level possible) and used to identify prey species in selected fish receptor diets.

Per USEPA direction, mummichog eggs may be collected as part of a separate sampling effort, and eggs in selected gravid fish will be counted (or mass of eggs per fish will be estimated) in order to answer the following risk question; **"What are the egg numbers (or mass) from estuarine benthic omnivores (i.e., mummichog) from the LPRSA?"** This sampling effort is likely to occur in 2010, and the methods that will be used to complete this data collection effort will be detailed in a future addendum to this QAPP. These data will be used to assist in the interpretation of the results in terms of fish population health.

Additional physical and biological information collected during the fish community survey (including internal/external health observations) will be used to assist in the interpretation of the results in terms of fish population health.

Assessment Endpoint No. 6 and No. 7 – "Protection and maintenance (i.e., survival, growth, and reproduction) of herbivorous, omnivorous, sediment-probing, and piscivorous bird populations," and "Protection and maintenance (i.e., survival, growth, and reproduction) of aquatic mammal populations."

Fish and decapod whole-body tissue chemistry data collected as part of this sampling event will be used (along with sediment and surface water chemistry data [proposed for collection in 2010] and tissue data from laboratory-exposed benthic invertebrates) in a dietary model to estimate dietary intakes for selected bird and mammal receptors. Modeled dietary dose concentrations will be compared to dietary dose TRVs to answer the following risk question: **"Are modeled dietary doses of COPCs based on LPRSA biota, sediment, and surface water and/or modeled piscivorous bird egg tissues based on LPRSA fish at levels that might cause an adverse effect on survival, growth, and/or reproduction of bird/aquatic mammal populations that use the LPRSA?"** The collection of tissue-residue data from laboratory-exposed benthic invertebrates and *in situ* bivalve tests is presented in the benthic invertebrate QAPP (Windward, in preparation).

HHRA Assessment Endpoint

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

The data collected during this sampling effort will also be used to support the HHRA. In addition to the ERA risk questions outlined above, the HHRA risk question relevant to this project is "What are the potential adverse effects of river chemicals to human health under current and future exposure scenarios for both cancer and non-cancer health effects via fish or decapod crustacean consumption from the LPRSA?"

As defined in the PFD (Windward and AECOM 2009), the data use objective for this endpoint is to estimate potential human exposure and assess the potential adverse effects of river chemicals to human health via consumption of fish or decapod crustaceans collected throughout the LPRSA. Potential tissue consumption scenarios are presented in the human health CSM included in the PFD (Windward and AECOM 2009). Target pelagic and demersal fish species of interest for human consumption and blue crab will be collected throughout the LPRSA for chemical analyses for use in evaluating potential human consumption scenarios. For fish, fillet tissue chemistry data will be collected; for blue crab individual tissue type (muscle/hepatopancreas combined, hepatopancreas-only and muscle-only) chemistry data will be collected. The HHRA will use data from combined blue crab muscle/hepatopancreas samples as the basis for quantitatively evaluating the RME of individuals under current and future exposure scenarios for both cancer and non-cancer health effects, following USEPA Superfund guidance, guidelines, and policies. Risks associated with the consumption of hepatopancreas-only and muscle-only tissue will be discussed qualitatively in the uncertainty section of the HHRA.

What types of data are needed (matrix, target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

The following types of data will be collected as part of this effort to address the measurement endpoints as described above:

- Fish and decapod crustacean tissue samples will be collected from RM 0 to RM 17.4 and analyzed for PCB congeners, PCB Aroclors, PCDDs/PCDFs, metals (including methylmercury, inorganic arsenic, and butyltins), organochlorine pesticides, PAHs, alkylated PAHs, SVOCs (including phthalates), lipid content, and percent moisture.
- Fish and decapod crustaceans will be collected using a variety of sampling methods, including gillnets, trotlines, eel traps, minnow traps, crab traps, crayfish traps, and backpack and boat electrofishing units (Worksheet 17). The sampling gear used will be determined at the time of sampling based on an assessment of which gear is most appropriate and potentially effective for that particular location in the LPRSA. Some factors to consider when selecting the appropriate sampling gear and locations include site accessibility, target species and sizes, substrate, water depth, salinity and habitat structure.
- The analysis of Aroclors is being conducted to provide data comparable to historical Aroclor data for the purposes of trend analysis on the basis of Aroclors. The Aroclor data will not be used in either the HHRA or ERA due to the superior accuracy and precision of the PCB congener data. Total PCB concentrations will be calculated as the sum of PCB congeners and not the sum of PCB Aroclors.
- Depending on availability of gravid fish and the fish needed for chemical analysis, additional fish will be collected for the

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

collection fish eggs. Species-specific fish egg composite samples (> 5 g) will be collected from one estuarine fish species (mummichog) and one freshwater fish species (darter or killifish) and submitted to a laboratory for lipid analysis.

- Depending on availability of fish needed for chemical analysis, additional fish will be collected for the collection of stomach content analysis. Fish stomach composite samples will be collected from two estuarine fish species (American eel and white perch) and two freshwater fish species (channel catfish, brown bullhead, or largemouth bass) during this event, and stomach contents will be analyzed for the taxonomic identification of prey organisms.
- Additional fish will be collected during the tissue sampling and first community survey event for a fish health evaluation. Gross internal and external pathological observations and examination results will be recorded electronically on the Specimen Data Form (Attachment C) by field laboratory personnel conducting the examination. These data will be used to assist in the interpretation of results in terms of fish population health. Up to five individuals per species collected (including target and non-target species), or the total number of individuals as agreed to with USEPA, will be sacrificed for the evaluation of gross internal and external pathological condition. Analyzing target fish species for tissue chemistry will be prioritized over sacrificing these species for the health evaluation. Fish community survey observations, including the identification of species, count, length, weight, and gender (if practicable), will be compiled over three seasonal events. During the first survey and analytical sampling effort, community survey observations will be compiled for all fish caught. During the second and third surveys, community survey observations will be compiled for all fish caught; fish will not be retained for chemistry analysis during these community surveys unless additional samples are needed based on the results from the first survey and agreed to by CPG and USEPA.

Matrix

The types of tissue samples collected for chemical analyses are species-specific and dependent upon the relevancy of each species to the ERA and the HHRA. A summary of target species, organized by feeding guilds relevant to the ERA and the sample type (or tissue type) that will be collected for each species is presented in Table 11-1.

USEPA-approved documents for the LPRSA (e.g., ESP Biota Sampling Program (Tierra Solutions 1999) and USEPA guidance (USEPA 1989, 2000b, 2002a) specify that composite samples provide the best estimate of the mean concentration. Therefore, composite samples may be collected at bank-specific sampling locations from both the estuarine zone (approximately RM 0 to RM 10) and the freshwater zone (approximately RM 10 to RM 17.4). The number of fish in each composite sample will vary to meet the anticipated minimum sample mass requirements (150 g pre-homogenization, 130 g post-homogenization). For smaller species and fillet samples, more than five individual fish may be needed to achieve required sample mass. It should also be noted that additional tissue mass will be needed for certain samples to accommodate USEPA split sample objectives. As requested by USEPA (April 9, 2009), individual fish collected from the field of a sufficient size to meet analytical mass requirements (and QC requirements and splits) will be analyzed as separate samples.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

The targeted sizes for species that are relevant to the ERA only (i.e., benthic omnivore forage fish and crayfish) will be based on potential prey size for piscivorous fish, birds, and wildlife. The targeted sizes for species that are relevant to both the ERA and the HHRA (i.e., non-forage fish and blue crab) will be at least the minimum legal catch size, where available. This size range will likely be greater than potential prey size for wildlife; however, per the agreements resulting from the January 14-15, 2009, meetings between the USEPA and the CPG, larger fish will be targeted to represent human consumption and will also be used for the ERA to conserve fish resources. The sizes of all fish and decapod crustaceans collected for each sample will be evaluated prior to compositing (if necessary), and individuals included in a given composite will be of similar size so that the smallest individual in a composite is no less than 75% of the length of the largest individual (USEPA 2000b). This target size requirement will be evaluated during the sampling event in conjunction with USEPA to determine if the range of individual sizes included in a composite needs to be increased or decreased to accommodate the level of effort of the sampling event. When possible, composites will be composed of approximately equal portions of each gender.

The benthic omnivore forage fish species targets are the mummichog (the killifish *Fundulus heteroclitus*) in the estuarine zone and either a darter (e.g., *Etheostoma olmstedi*) or a killifish species (e.g., *Fundulus heteroclitus* or *Fundulus diaphanus*) in the freshwater zone. Mummichog will be the preferred species in the freshwater zone to provide consistent comparisons between zones, but only if they can be collected in sufficient quantities to meet target tissue mass and gender allocation requirements. These species are only relevant to the ecological CSMs and ERA, and therefore, samples of these species[15] will be analyzed on a whole-body basis, and the target size (≤ 5 in. total body length) is based on potential prey size for that species as relevant to piscivorous fish, birds, and mammals.[16]

The invertivore/omnivore and carnivore/piscivore species targets include white perch (*Morone americana*) and American eel (*Anguilla rostrata*) in the estuarine zone and channel catfish (*Ictalurus punctatus*) or brown bullhead (e.g., *Ameiurus nebulosus*) and largemouth bass (*Micropterus salmoides*) in the freshwater zone. These species are relevant to both the ecological and the human health CSMs and risk assessments because they represent different feeding guilds as well as different habitats (e.g., pelagic and demersal), are expected to be present in the study area, and are targeted for human consumption. White perch and largemouth bass represent pelagic predator species in the estuarine and freshwater zone, respectively. American eel and channel catfish/brown bullhead represent demersal (bottom-dwelling) species in the estuarine and freshwater zone, respectively. In addition, per agreement with USEPA, all carp (*Cyprinus carpio*) caught will be retained for chemical analysis even if incidentally caught.

[15] If there are no other alternatives for darter and killifish species, it may be necessary to composite across species, which may be acceptable given their similar life histories, if sufficient tissue mass is not available after five attempts have been made, or if the individuals cannot be identified to the species level.

[16] Of the wildlife receptors, the smallest prey size is for belted kingfisher, whose diet consists of primarily small fish less than 10 cm (4 in.) (Hamas 1994).

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

Samples of these fish will be separated into fillet samples and carcass samples for chemical analyses. If individual fish collected from the field are of a sufficient size to meet analytical mass requirements (and QC requirements and splits), these fish will be analyzed as separate samples, as requested by USEPA. Reconstituted whole-body concentrations will be derived for use in the ERA by combining the analytical results for fillet and carcass samples and adjusting for the relative weight of each fraction, consistent with FSP2 (Malcolm Pirnie et al. 2006). The targeted size for American eel, channel catfish, and the largemouth bass is ≥ 12 in. (total length) based on the minimum legal catch sizes for these species (NJDEP 2009). Though the minimum legal size for eel is 6 in. (total length), eel of this size are typically caught for bait rather than consumption. Eighteen (18) American eel ranging in size from 6 to 27 in. were reportedly caught and kept by anglers during the 2000-2001 creel/angler survey of the LPR (Desvousges et al. 2001). There is no minimum legal catch size for white perch or brown bullhead; however, 44 perch ranging in size from 4 to 10 in. were reportedly caught and kept by anglers during the 2000-2001 creel/angler survey of the LPR (Desvousges et al. 2001). Thus, a targeted white perch and brown bullhead size of ≥ 8 in. (total length) will be used for this program.

The decapod crustacean species targets include the blue crab (*Callinectes sapidus)* in the estuarine zone for both the ERA and the HHRA. The target species for the freshwater zone for the ERA only is the crayfish (e.g., *Orconectes resticus*, *Oronectes limosus,* or *Cambarus diogenes*). Blue crab is not expected to be prevalent in the freshwater zone, but because this species is important to the HHRA, attempts will be made to collect blue crab in the freshwater zone as well. The targeted size range for blue crab is ≥ 3 to 4.5 in. (measured as the carapace width), based on the minimum legal catch size for this species[17] and depending on shed stage.

To satisfy HHRA and ERA data needs, four blue crab tissue types will be collected as shown in Table 11-1: 1) combined muscle and hepatopancreas, 2) carcass (i.e., non-edible soft tissue), 3) muscle-only, and 4) hepatopancreas-only. For the ERA, reconstituted whole-body concentrations will be derived by combining the analytical results for individual tissue type samples (i.e., combined muscle and hepatopancreas tissue and remaining carcass tissue), and adjusting for the relative weight of each fraction. For the HHRA, combined muscle and hepatopancreas tissue samples and muscle-only tissue samples will be collected. Per USEPA request, a limited number of samples will also be collected for analysis of blue crab hepatopancreas-only tissue. Per agreement with USEPA, the purpose of these data is to qualitatively compare hepatopancreas-only tissue concentrations with muscle-only tissue concentrations in the uncertainty section of the HHRA and show the relative difference in bioaccumulation potential in the two tissue types.

Because crayfish is relevant only to the ecological CSM, samples of this organism will be analyzed on a whole-body basis.[18] The targeted size range for crayfish is ≥ 2 in. total body length.

[17] The legal minimum is 3 in. for shedders, 3.5 in. for softshell, and 4.5 in. for hardshell (http://www.scottsbt.com/fishids/regsrecs/regsNJ.htm).

[18] If there are no other alternatives,for crayfish, it may be necessary to composite across species, which may be acceptable given their similar life histories, if sufficient tissue mass is not available after five attempts have been made, or if the individuals cannot be identified to the species level.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

Total body lengths for fish and crayfish and carapace widths for blue crab will be measured as specified in USEPA (2000b).

In addition to fish and decapod crustacean tissue samples, fish egg samples will be collected for lipid content analysis, and fish stomach samples will be collected for stomach content (taxonomy) analysis. Fish egg composite samples will be processed in the field laboratory. Eggs will be extracted from gravid females and retained for lipid analysis. Stomach content samples from individual fish will also be processed in the field laboratory. The stomach and GI tract contents will be extracted and retained for taxonomic analysis.

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

The data will be used to support decisions about the magnitude and spatial distribution of risks to human and ecological health. The data will be used to better define risk decisions for discrete endpoints. The data may also be used to support initial investigations of potential remedial options. Consequently, the data need to be collected with a design that specifically addresses the questions that are being posed (see above, "What will the data be used for"). The conceptual framework of the design is more important than the actual number of samples collected because it is this framework that will be used to extrapolate from the data that are collected in order to draw conclusions about risks at the site.

It is inevitable that some tissue-sediment relationships will be highly variable, while others will not. However, if the data have been collected with a logical design to cover the range of variation in the controlling physical factors at the site, the interpretation of the results is more straightforward, even when the variance of relationships is high. Because a number of assumptions will be made when assessing risks, the data must be collected in a way that makes the evaluation of assumptions possible and allows assessments of the remaining uncertainty to be conducted in a way that enables decision makers to weigh the costs and benefits of proceeding with remedial action decisions.

A data usability memorandum describing the data acceptability requirements for use in the HHRA and ERA will be written. This memorandum will reference USEPA's Risk Assessment Guidance for Superfund and also include an evaluation of data qualifiers and how qualifiers may affect data usability in the risk assessments.

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

The overall approach to estimate the number of samples to represent tissue types for target receptors in each zone was based on

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

the following steps:

- Existing fish and crab tissue data from the ESP (Tierra Solutions 2003) and CARP[19] datasets were evaluated for key contaminant groups (e.g., PCDDs/PCDFs, mercury, PCBs, PAHs, organochlorine pesticides) to help determine statistical characteristics (variability and skewness) of tissue residues in target receptors (where data were available).
- Parametric and non-parametric[20] statistical methods were used to compute sample sizes needed to achieve different levels of precision in the estimate of the mean tissue concentration for a given species (e.g., ability to precisely estimate within 50 to 100% of the true mean) based on the statistical characteristics of the existing tissue data.
    - Because mummichog and darter or killifish data will be used for multiple purposes, the sample design also considered the sample size needed to detect a relationship between sediment and tissue.
- Sample size requirements to calculate a 95% upper confidence limit on the mean (95% UCL) using ProUCL (Version 4.00.02) (USEPA 2007c) and the frequency of detection of the chemicals of potential concern (COPCs) were used to adjust the sample size estimates for each species.

Proposed sample sizes for fish and decapod tissue are summarized in Table 11-1 and are based on the agreement between CPG and USEPA as presented in the Sample Size Estimate Term Sheet (Attachment V). Additional details regarding the derivation of the sample sizes are provided in Attachment Q.

Depending on the availability of fish needed for chemistry analysis and the availability of gravid females, additional fish will be collected for fish egg tissue analysis. Fish egg composite samples will be submitted to the laboratory for lipid analysis only. An evaluation of fish community literature suggested that gravid mummichog and/or darter species may be present in late summer/early fall. Mummichog may spawn eight or more times in a season that begins in March and ends in the late summer or early autumn (July to September), and one species of killifish (striped killifish) spawns in New Jersey from June through August (Abraham 1985). Spawning occurs over a period of approximately 5 days on a semi-lunar cycle (during full or new moons) when tides are at their highest. Gravid females are expected to be present in the LPRSA in August when tissue sampling is anticipated to begin. Ten mummichog egg tissue composite samples will be collected in the estuarine zone, and ten darter egg tissue composite samples will be collected in the freshwater zone. This number of samples will be sufficient to determine site-specific egg lipid content to model/estimate fish egg exposure concentrations.

Depending on availability of fish needed for chemical analysis, additional fish will be collected for the collection of stomach content analysis. Fish stomach composite samples will also be collected for the invertivore/omnivore species (i.e., white perch and channel

[19] CARP data were collected within the New York/New Jersey Harbor, including the LPRSA. Data are available at: http://www.carpweb.org/main.html. Only those data from the LPRSA were used in the sample size estimates.

[20] Non-parametric sample size calculations based on Chebyshev's inequality and bootstrapping.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

catfish/brown bullhead) and carnivore/piscivore species (i.e., American eel and largemouth bass) in the estuarine and freshwater zones respectively. This is a qualitative evaluation to identify the prey items of these fish species. A target of 5 to 10 stomach content samples from each species (within its respective zone) will be collected.

Additional fish will be collected during the tissue sampling and first community survey event for a fish health evaluation. Gross internal and external pathological observations and examination results will be recorded electronically on the Specimen Data Form (Attachment C) in the field laboratory. These data will be used to assist in the interpretation of results in terms of fish population health. Up to five individuals per species collected (including target and non-target species), or the total number of individuals as agreed to with USEPA, will be sacrificed for the evaluation of gross internal and external pathological condition. Analyzing target fish species for tissue chemistry will be prioritized over sacrificing these species for the health evaluation.

Fish community survey observations will be compiled over three seasonal events. During the first survey (which coincides with the tissue sampling effort), community survey observations will be compiled for all fish caught. A subset of locations sampled during the first community survey will be revisited as part of the subsequent community surveys. A minimum of two sampling locations from each 2-mile reach will be reoccupied over a 2-to-3-week survey effort. The targeted locations and sampling methods (e.g., trotlines, gillnets) to be used during the subsequent surveys will be dependent on the catch results of the first sampling event and survey. The results of the three community surveys will be reviewed to determine if additional community survey events are needed.

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

Per the agreements that resulted from the January 14-15, 2009, FSP2 meetings between USEPA and the CPG, the general sampling design divides the LPRSA into two zones according to surface water salinity: the estuarine zone and the freshwater zone. Consistent with the preliminary salinity reaches defined in the PFD (Windward and AECOM 2009), the estuarine zone includes both the brackish and transition river segments from RM 0 to RM 10, and the freshwater zone includes the freshwater river segment from RM 10 to RM 17.4. Each zone will then be divided into 2-mile river reaches, with the exception of the uppermost freshwater reach, which will extend from RM 14 to RM 17.4, and sampling locations will be allocated among these reaches. In general, samples will be randomly collected within known or likely habitat areas in each 2-mile river reach identified based on prior field sampling events (Tierra Solutions 1999), on ecological benchmarking surveys (Shisler et al. 2008), and on the 2007 field reconnaissance (described in Worksheet No. 10 of this QAPP). At least three target bank-specific sampling locations have been identified in each reach, and possible target locations are described in Worksheet No. 18 of this QAPP; however, not all target locations will be sampled, and additional sampling areas may be added during sampling based on field conditions and *in situ* observations. Target sampling areas for mummichog will be located in intertidal mudflat areas in the five estuarine reaches; darter/killifish target sampling areas will be located in any available shallow water habitats (mud or sandflats; vegetated shallows) in the three freshwater reaches. The target sampling areas for all species will focus on localized habitat areas (i.e., areas with a radius of approximately 50 ft). This size sampling area is consistent with the ecology of small-home-range fish such as mummichog (Abraham 1985), with the approximate area of sampling locations specified in FSP2 (Malcolm Pirnie et al. 2006), and with EPA's comments (USEPA 2008b) and guidance

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

(USEPA 2000b).

- Inasmuch as it may not be possible to collect adequate tissue mass at each specified sampling location to constitute a full analytical sample, the following sampling design considerations will be implemented in coordination with USEPA during sampling to ensure that the QAPP elements are satisfied or whether they need to be adjusted (see Worksheet No. 18 for details on sampling locations).
- Crabs and crayfish: three traps will be placed at each target sampling location within each 2-mile reach (a minimum of three target sampling areas were identified per reach) for a total of at least three replicated sampling locations per reach. Target sampling locations may be relocated within the 2-mile reach based on catch success after each retrieval. Fish (except mummichog and darter/killifish): one gillnet and multiple eel traps and trotlines will be placed and/or two electrofishing passes will be attempted, where each method is appropriate within the LPRSA, at each target sampling location within each 2-mile reach (a minimum of three target sampling areas were identified per reach) for a total of at least three replicated sampling locations per method per reach. Target sampling locations may be relocated within the 2-mile reach based on catch success after each retrieval. Each fishing method will be attempted up to five times at each target sampling location (where that method is appropriate) within each 2-mile reach. Mummichog and darter/killifish: multiple minnow traps will be placed and/or two electrofishing passes will be attempted, where each method is appropriate within the LPRSA, at each bank-specific target sampling location within each 2-mile reach (a minimum of three target sampling areas were identified per reach) for a total of at least three replicated sampling locations per method per reach. Mummichog and darter/killifish will be collected per bank-specific mudflat sampling location and within the localized habitat area bounds as described above (i.e., area with a radius of approximately 50 ft). Additional mudflat locations within that 2-mile reach may be sampled based catch success for that reach. Each fishing method will be attempted up to five times at each target sampling location (where that method is appropriate) within each 2-mile reach.
- If insufficient tissue is collected, alternative species (i.e., summer flounder, white catfish, Atlantic tomcod, northern pike, carp[21]) may be analyzed, depending on the catch. Tissue from different species will not be combined.
- If insufficient tissue is collected after five attempts, a chemical prioritization scheme may be employed for analysis of the volume of tissue collected. The prioritization is presented in Worksheet No. 10 of this QAPP.

Per agreement between USEPA and CPG, flow charts documenting the general decision process that will be implemented during the collection of samples in the field have been prepared and are in Attachment W.

The number of samples targeted for collection from each zone varies based on agreements between CPG and USEPA and are provided in the Estimated Sample Size Term Sheet (Attachment V). The number of samples per species and tissue type are provided in Table 11-1. If individual fish collected from the field are of a sufficient size to meet analytical mass requirements (and QC

[21] Per agreement with USEPA, all carp caught will be retained for chemical analysis, even if incidentally caught.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

requirements and splits), these fish will be analyzed as separate samples, as requested by USEPA. Details on the compositing scheme and preparation of tissue samples are provided in Attachment O.

The number of samples per species (and per tissue type) is presented in Table 11-1 and is based on the agreement between CPG and USEPA as presented in the Sample Size Estimate Term Sheet (Attachment V). Additional details on the statistical sample design are presented in Attachment Q. This effort for tissue sampling and the first community survey will be conducted in late summer-early fall of 2009 (i.e., August-September). The second fish community survey is planned for winter 2009/2010, and the third fish community survey is planned for spring 2010. All changes to the proposed plan due to field conditions or lack of species availability will be communicated between USEPA and CPG technical coordinators or PMs.

Who will collect and generate the data?

As described in Worksheet No. 7, Windward will provide the field sampling coordination and most of the field personnel required to conduct the tissue collection efforts and provide laboratory coordination and support.

How will the data be reported?

Daily catch results will be communicated (e.g., telephone conversation, e-mail) to CPG Project Managers and Project Coordinators.

An electronic database that includes the coordinates for the collection of each individual fish or fish trap will be provided. The database will include time of trap deployment and retrieval; time of fish collection; depth of collection or trap location; and species, length, weight, and (if determinable) gender of all individual fish collected for analysis. The electronic database will be updated daily and available for USEPA on a daily basis.

A data report summarizing the abundance and diversity of fish species collected will be provided within 90 days after completion of the each fish community survey. A summary of lengths and weights by species and dominance by catch effort will also be presented. In addition, these reports will include a map that presents the locations and corresponding information on habitat type, if available. The data reports will summarize any modifications to the proposed sampling plan as outlined in this QAPP.

A data report summarizing the tissue collection and analysis results will be provided 90 days after receipt of validated chemical data. In addition, this report will include a map that presents the tissue collection locations.

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 by Windward's main office in Seattle, Washington. Similarly, the data reports will be issued and then archived electronically and as hard copies. The analytical results will also be provided, as electronic data deliverables (EDDs), to the project database. Multimedia electronic data deliverables (MEDDs) will be provided to USEPA Region 2 by de maximis Data Management Solutions, Inc. (ddms) in their required format.

Table 11-1. Summary of sample design for fish and decapod crustacean tissue collection

Feeding Guild[a]	Target Species	Zone[b]	Type of Sample	Target Size (total length)[c]	No. of Locations per Zone	No. of Samples per Location	No. of Samples per Zone[d]	Total No. of Analytical Samples
Benthic omnivore forage fish	Mummichog	Estuarine	Whole body	≤ 5 in.	13	3	39[e]	39
	Darter or killifish species	Freshwater			14	3	42[e]	42
Invertivore/ omnivore	White perch	Estuarine	Skin-on fillet and carcass[f]	≥ 8 in.[g]	12	2	24[h]	48
	Channel catfish or brown bullhead	Freshwater	Skinless fillet and carcass with skin[f]	≥ 12 in. or ≥ 8 in.[g]	13	2	26[h]	52
Carnivore/ piscivore	American eel	Estuarine	Skinless fillet and carcass with skin[f]	≥ 12 in.	12	2	24[h]	48
	Largemouth bass	Freshwater	Skin-on fillet and carcass[f]	≥ 12 in.	13	2	26[h]	52

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

Feeding Guild[a]	Target Species	Zone[b]	Type of Sample	Target Size (total length)[c]	No. of Locations per Zone	No. of Samples per Location	No. of Samples per Zone[d]	Total No. of Analytical Samples
Epibenthic omnivore	Blue crab	Estuarine	Muscle/ hepatopancreas combined[i]	≥ 3 – 4.5 in.[j]	12	Field determined[k]	24[e, h, l]	63
			Carcass[i]	≥ 3 – 4.5 in.[j]	12	Field determined[k]	24[e, h, l]	
			Muscle only[i]	≥ 3 – 4.5 in.[j]	12	Field determined[k]	12[h]	
			Hepatopancreas only[i]	≥ 3 – 4.5 in.[j]	3	Field determined[k]	3	
		Freshwater	Muscle/hepatopancreas combined[i]	≥ 3 – 4.5 in.[j]	9	Field determined[k]	17	30
			Muscle only[i]	≥ 3 – 4.5 in.[j]	9	Field determined[k]	9	
			Hepatopancreas only[i]	≥ 3 – 4.5 in.[j]	4	Field determined[k]	4	
	Crayfish	Freshwater	Whole body	≥ 2 in.	9	3	27[e, h]	27
Total								**401**

Note: Details on the compositing scheme and preparation of tissue samples are provided in Attachment O.

[a] Target species are organized according feeding guild designated for the ERA. The target demersal (bottom-dwelling) species for HHRA are blue crab (estuarine), American eel (estuarine) and channel catfish/brown bullhead (freshwater). The target pelagic species for HHRA are white perch (estuarine) and largemouth bass (freshwater).

[b] Zones represent the estuarine (RM 0 to RM 10) and freshwater (RM 10 to RM 17.4) habitats within the LPRSA.

[c] Target sizes were selected to be representative of potential prey size for those species that are only relevant to the ERA (i.e., benthic omnivore forage fish and crayfish) and representative of the minimum legal catch sizes (NJDEP 2009) and expected size preference for white perch and brown bullhead, which do not have a minimum legal catch size, for those species that are relevant to both the ERA and the HHRA (e.g., invertivore/omnivore, carnivore/piscivore, and blue crab). During field sampling, however, all individuals will be retained regardless of target size, in the event that sufficient numbers of individuals that meet the target size requirements cannot be obtained.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements (cont.)

[d] A minimum pre-homogenization target analytical mass of 150 g (130 g post-homogenization) is required for each sample. Based on the estimated mass of targeted species, all samples will likely be composite samples, inasmuch as sufficient mass to meet analytical mass requirements is not expected from individual organisms. The sizes of all fish and decapod crustaceans collected for each sample will be evaluated prior to compositing (if necessary), and individuals included in a given composite will be of similar size so that the smallest individual in a composite is no less than 75% of the length of the largest individual (USEPA 2000b). This target size requirement will be evaluated during the sampling event in conjunction with USEPA to determine if the range of individual sizes included in a composite needs to be increased or decreased to accommodate the level of effort of the sampling event. When possible, composites will be composed of approximately equal portions of each gender. The estimated number of individuals for each species per composite sample is provided in Attachment O (Table 1) and was obtained from known biology and previous sampling efforts by Tierra Solutions (2002c).

[e] Blue crab, crayfish, mummichog, and darter or killifish samples will be co-located with sediment samples collected as part of the benthic invertebrate QAPP in order to derive site-specific biota-sediment accumulation factors. In addition to chemical residues for these samples, lipid content for tissues and organic carbon content for sediment will be analyzed.

[f] Carcass tissue will be composed of the remaining (non-fillet) portion. Tissue type concentrations will be combined mathematically (proportionally to their average weights in each species) to calculate whole-body concentrations.

[g] There is no legal minimum catch size designated for white perch or brown bullhead. Therefore, this target size of 8 in. is based on an assumed meaningful target size for human consumption and the results of the 2000-2001 creel/angler survey (i.e., 44 white perch ranging in size from 4 to 10 in. were reportedly caught and kept by LPR anglers) (Desvousges et al. 2001).

[h] Sample size adjusted to address ProUCL (Version 4.00.02) requirements, assuming a minimum detection frequency of 60%.

[i] Blue crab muscle/hepatopancreas combined and muscle-only tissue samples are to satisfy HHRA data needs; carcass (i.e., non-edible soft tissue) and muscle/hepatopancreas combined tissue samples will be combined mathematically to yield total soft tissue concentrations for the ERA. If collected, softshell blue crab will be analyzed with the shell on. Because crayfish is the target ERA species for the freshwater zone, carcass tissue samples are not required for this zone. The HHRA will use data from combined blue crab muscle/hepatopancreas samples as the basis for quantitatively evaluating the RME of individuals under current and future exposure scenarios for both cancer and non-cancer health effects, following USEPA Superfund guidance, guidelines, and policies. Risks associated with the consumption of hepatopancreas-only and muscle-only tissue will be discussed qualitatively in the uncertainty section of the HHRA.

[j] Target size is dependent on “shed stage” of blue crab, for which the legal minimum is 3 in. for shedders, 3.5 in. for softshell, and 4.5 in. for hardshell (http://www.scottsbt.com/fishids/regsrecs/regsNJ.htm).

[k] Three crab traps will be deployed per location in both the estuarine zone and the freshwater zone. However, the number of samples collected per location will vary for all blue crab tissue sample types based on the number of crabs that are collected and on analytical tissue mass requirements.

[l] Target sample size (n = 24) is based on blue crab collected from the estuarine zone. Additional blue crab samples may be collected from the freshwater zone if sufficient blue crab are encountered in the freshwater zone.

RM – river mile

QAPP Worksheet No. 12. Measurement Performance Criteria Table

Matrix	Tissue				
Analytical Group[a]	PCB – Congeners				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**Data Quality Indicators (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)**
Attachments J, L, N, and O	USEPA 1668A/ T2	Accuracy/bias – contamination	a) When detected, the concentration should be less than the reporting limit or < 10 times the highest concentration found in the batch of samples; b) signal-to-noise ratio should be > 10 for the extraction standard; c) detection level should be ≤ 4 times the limit of detection; d) recoveries of the extraction standard should be 25% minimum or meet c and d.	Method blank	A
	USEPA 1668A/ T2	Accuracy/bias – contamination	Signal-to-noise ratio should be > 2.5:1 for the 1 pg/μL selected PCB congeners peak to verify absence of bad injection. To verify absence of carryover, there should be no target analyte peak with signal-to-noise ratio > 2.5:1 or if above, the response should be less than 1% of the target analyte in the batch control spike.	Spiked solvent blank	A
	USEPA 1668A/ T2	Accuracy/bias – contamination	a) When detected, the concentration should be less than the reporting limit or < 10 times the highest concentration found in the batch of samples; b) signal-to-noise ratio should be > 10 for the extraction standard; c) detection level should be ≤ 4 times the limit of detection; d) recoveries of the extraction standard should be 25% minimum or meet c and d.	Equipment rinsate blanks[d]	S & A

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	PCB – Congeners
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
	USEPA 1668A/ T2	Accuracy/bias, precision	PD between the relative response factor of the batch control spike and the initial calibration should be ≤ 20% for target species and ≤ 30% for extraction standard/cleanup standard; RPD between the beginning and ending batch control spike should be ≤10% for target species and ≤ 20% for extraction standard/cleanup standard.	Batch control spike	A
	USEPA 1668A/ T2	Accuracy/bias	Percent recovery = 30 – 140%.	Extraction standard	A
	USEPA 1668A/ T2	Accuracy/bias	PD of certified target analytes should be within 25% of consensus values when within the ICAL. Long-term RSD should be ≤ 20%.	CRM	A
	USEPA 1668A/ T2	Precision	RPD should be ≤ 20% when within the curve and the sample is a true laboratory duplicate.	MD[e]	S & A
	USEPA 1668A/ T2	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No. 15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

EML – estimated minimum level
ICAL – initial calibration
MD – matrix duplicate
MRL – method reporting limit
MS – matrix spike
MSD – matrix spike duplicate
PCB – polychlorinated biphenyl
PD – percent difference
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
RRF – relative response factor
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	PCB Aroclors
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA SW-846 8082/T8	Accuracy/bias – contamination	No target compound > QL	Method blank/instrument blank	A
	USEPA SW-846 8082/T8	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA SW-846 8082/T8	Accuracy/bias	Compound-specific (see SOP)	LCS	A
	USEPA SW-846 8082/T8	Accuracy/bias, precision	Percent recovery is compound-specific (see SOP) RPD ≤ 50%	MS[e]/MSD[e]	S & A
	USEPA SW-846 8082/T8	Precision	RPD ≤ 50% for target compounds > 5 x QL	MD[e]	S & A
	USEPA SW-846 8082/T8	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No. 15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
PCB – polychlorinated biphenyl
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue				
Analytical Group[a]	PCDDs/PCDFs				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**Data Quality Indicators (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)**
Attachments J, L, N and O	USEPA 1613B/ T3	Accuracy/bias – contamination	a) No target compound should be detected above signal-to-noise ratio > 2.5:1; b) when detected, the concentration should be less than the reporting limit or <10 times the highest concentration found in the batch of samples; c) signal-to-noise ratio should be > 10:1 for extraction standard (isotopically labeled standard added before extraction); d) detection level should be ≤ 4 times limit of detection; e) recoveries of the extraction standard should be 40% minimum or meet c and d.	Method blank	A
	USEPA 1613B/ T3	Accuracy/bias – contamination	No target analyte peak should have a signal-to-noise ratio > 2.5:1, or, if above 2.5:1, the response should be < 1% of the target analyte in the batch control spike.	Spiked solvent blank	A
	USEPA 1613B/T3	Accuracy/bias – contamination	No target compound should be detected above signal-to-noise ratio > 2.5:1; when detected, the concentration should be less than the reporting limit or <10 times the highest concentration found in the batch of samples.	Equipment rinsate blanks[d]	S & A
	USEPA 1613B/T3	Accuracy/bias, precision	PD between the relative response factor of the batch control spike and the initial calibration should be ≤ 20% for target species and ≤ 30% for extraction standard/sample standard/cleanup	Batch control spike	A

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	PCDDs/PCDFs
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
			standard; RPD between the beginning and ending batch control spike should be ≤ 10% for target species and ≤ 20% for extraction standard/sample standard/cleanup standard.		
	USEPA 1613B/T3	Accuracy/bias	Compound-specific (see SOP)	Extraction standard	A
	USEPA 1613B/T3	Accuracy/bias	PD of certified target analytes should be within 25% consensus values when within the ICAL. Long-term RSD should be < 20%; 11of the 11 different CDD are within the 90% confidence; 11of the 11 different CDD are within the 50% of the 90% confidence; 14 of the 14 different CDF are within the 90% confidence; 14 of the 14 different CDF are within the 50% of the 90% confidence.	CRM	A
	USEPA 1613B/T3	Precision	RPD ≤ 20% when within the calibration curve and the sample is a true laboratory duplicate.	MD[e]	S & A
	USEPA 1613B/T3	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No. 15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CDD – chlorinated dibenzo-*p*-dioxin
CDF – chlorinated dibenzofuran
MSD – matrix spike duplicate
PCDD – polychlorinated dibenzo-*p*-dioxin
QC – quality control
QL – quantitation limit

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	PCDDs/PCDFs
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)

CRM – certified reference material
ICAL – initial calibration
MD – matrix duplicate
MS – matrix spike
PCDF – polychlorinated dibenzofuran
PD – percent difference
QAPP – quality assurance project plan
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	PAHs
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S & A)
Attachments J, L, N and O	CARB 429 Mod./T4	Accuracy/bias – contamination	No target compound > EML	Method blank/instrument blank	A
	CARB 429 Mod./T4	Accuracy/bias – contamination	No target compound >EML	Equipment rinsate blanks[d]	S & A
	CARB 429 Mod./T4	Accuracy/bias	50 – 150%	LCS	A
	CARB 429 Mod./T4	Accuracy/bias	Recovery within limits set by CRM manufacturer	CRM	A
	CARB 429 Mod./T4	Accuracy/bias	Compound-specific (see SOP)	Pre-extraction internal standards	A
	CARB 429 Mod./T4	Precision	RPD ≤ 50% if both samples are > 5 x QL	MD[e]	S & A
	CARB 429 Mod./T4	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CARB – California Air Resources Board
CRM – certified reference material
EML – estimated minimum level
LCS – laboratory control sample
MDL – method detection limit
MD – matrix duplicate
NA – not available
PAH – polycyclic aromatic hydrocarbon
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
RL – reporting limit
SOP – standard operating procedure

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Alkylated PAHs
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S & A)
Attachments J, L, N and O	USEPA SW-846 8270D/T26, T27	Accuracy/bias – contamination	No target compound > QL	Method blank	A
	USEPA SW-846 8270D/T26, T27	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blank[d]	S & A
	USEPA SW-846 8270D/T26, T27	Accuracy/bias – contamination	Percent recovery = 50 – 150%	LCS	A
	USEPA SW-846 8270D/T26, T27	Precision	RPD ≤ 30% for target compound > 5 x QL	MD[e]	S & A
	USEPA SW-846 8270D/T26, T27	Accuracy/bias, precision	Percent recovery = 50 – 150%, RPD ≤ 30%	MS[e]/MSD[e]	S & A
	USEPA SW-846 8270D/T26 T27	Accuracy/bias	Percent recovery = 65 – 135%	CRM	A
	USEPA SW-846 8270D/T26 T27	Accuracy/bias	50 – 200% of the daily CCV area for the internal standards	Pre-extraction internal standards	A
	USEPA SW-846 8270D/T26 T27	Precision	RPD ≤ 50% if both samples are > 5 x QL	Field duplicate	S & A
	USEPA SW-846 8270D/T26 T27	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet 15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CCV – continuing calibration verification
CRM – certified reference material
EML – estimated minimum level
LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
PAH – polycyclic aromatic hydrocarbon
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Organochlorine Pesticides
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Accuracy/bias – contamination	No target compound > QL	Method blank	A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, ST7	Accuracy/bias	Compound-specific (see SOP)	Ongoing precision and recovery sample (or LCS)	A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Accuracy/bias	Recovery within limits set by CRM manufacturer	CRM	A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Accuracy/bias	Recovery 10 – 200% per laboratory SOP	Pre-extraction internal standards	A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Precision	RPD ≤ 25% if both samples are > 5 x QL	MD[e]	S & A
	USEPA 1699 Mod.(NYSDEC HRMS-2)/ T5, T6, T7	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
NYSDEC – New York State Department of Environmental Conservation
RPD – relative percent difference

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

LCS – laboratory control sample
HRMS – high-resolution mass spectrometry
MD – matrix duplicate
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Metals (ICP/MS)
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA SW-846 6020/T9, T10	Accuracy/bias – contamination	No target compound > QL	Method blank	A
	USEPA SW-846 6020/T9, T10	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA SW-846 6020/T9, T10	Accuracy/bias	Percent recovery = 75 –125%	LCS	A
	USEPA SW-846 6020/T9, T10	Accuracy/bias	Percent recovery = 75 – 125%	MS[e]	S & A
	USEPA SW-846 6020/T9, T10	Precision	RPD ≤ 30%	MD[e]	S & A
	USEPA SW-846 6020/T9, T10	Accuracy/bias	Percent recovery = 70 – 130%	CRM	A
	USEPA SW-846 6020/T9, T10	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
ICP/MS – inductively coupled plasma/mass spectrometry
LCS – laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
MS – matrix spike
PCB – polychlorinated biphenyl
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
RRF – relative response factor
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Metals (ICP)
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA SW-846 6010B/T9, T11	Accuracy/bias – contamination	No target compound > QL	Method blank	A
	USEPA SW-846 6010B/T9, T11	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA SW-846 6010B/T9, T11	Accuracy/bias	Percent recovery = 75 –125%	LCS	A
	USEPA SW-846 6010B/T9, T11	Accuracy/bias	Percent recovery = 70 – 130%	MS[e]	S & A
	USEPA SW-846 6010B/T9, T11	Precision	RPD ≤ 30%	MD[e]	S & A
	USEPA SW-846 6010B/T9, T11	Accuracy/bias	Recovery within limits set by CRM manufacturer	CRM	A
	USEPA SW-846 6010B/T9, T11	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No. 15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
LCS – laboratory control sample
ICP – inductively coupled plasma
MD – matrix duplicate
MS – matrix spike
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Metals (Selenium)
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA SW-846 7742/T9, T12	Accuracy/bias – contamination	No target compound > QL	Method blank	A
	USEPA SW-846 7742/T9, S12	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA SW-846 7742/T9, T12	Accuracy/bias	Percent recovery = 75 –125%	LCS	A
	USEPA SW-846 7742/T9, T12	Accuracy/bias	Percent recovery = 60 – 130%	MS[e]	S & A
	USEPA SW-846 7742/S9, T12	Accuracy/bias	Recovery within limits set by CRM manufacturer	CRM	A
	USEPA SW-846 7742/T9, T12	Precision	RPD ≤ 30%	MD[e]	S & A
	USEPA SW-846 7742/T9, T12	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
LCS – laboratory control sample
MB – method blank
MD – matrix duplicate
MDL – method detection limit
MRL – method reporting limit
MS – matrix spike
PD – percent difference
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Inorganic Arsenic
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA 1632/T13	Precision	RPD ≤ 35%	MD[d]	S & A
	USEPA 1632/T13	Accuracy/bias	Percent recovery = 65 – 135%, RPD ≤ 35%	MS[d]/MSD[d]	S & A
	USEPA 1632/T13	Accuracy/bias	Percent recovery = 65 – 135%	CRM	A
	USEPA 1632/T13	Contamination	Average < 1/10 of associated samples	Method blank	A
	USEPA 1632/T13	Contamination	≤ MRL	Equipment rinsate blank[e]	A
	USEPA 1632/T13	Completeness	> 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] May be omitted if sample mass is limited.
[e] Rinsate blank will be created from the tissue homogenization equipment.

CRM – certified reference material
MD – matrix duplicate
MDL – method detection limit
MRL – method reporting limit
MS – matrix spike
MSD – matrix spike duplicate
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Total Mercury
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA 1631/ T14, T15	Accuracy/bias – contamination	Average MB < 2 x method detection limit and standard deviation < 0.67 x MDL or < 0.1 x the concentration of project samples	Method blank	A
	USEPA 1631/ T14, T15	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA 1631/ T14, T15	Accuracy/bias	Percent recovery = 75 – 125%	CRM	A
	USEPA 1631/ T14, T15	Accuracy/bias, precision	Percent recovery = 70 – 130%, RPD ≤ 30%	MS[e]/MSD[e]	S & A
	USEPA 1631/ T14, T15	Precision	RPD ≤ 30%	MD[e]	S & A
	USEPA 1631/ T14, T15	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
MB – method blank
MD – matrix duplicate
MDL – method detection limit
MRL – method reporting limit
MS – matrix spike
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
RRF – relative response factor
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Methylmercury
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	USEPA 1630/T16	Accuracy/bias – contamination	MB ≤ 2 x MDL, standard deviation ≤ 2/3 MDL or 1/10 of associated samples	Method blank	A
	USEPA 1630/T16	Accuracy/bias – contamination	No target compound > QL	Equipment rinsate blanks[d]	S & A
	USEPA 1630/T16	Accuracy/bias	Within 35% of certified value	CRM	A
	USEPA 1630/T16	Accuracy/bias, precision	Percent recovery 65 – 135%, RPD ≤ 35%	MS[e]/MSD[e]	S & A
	USEPA 1630/T16	Precision	RPD ≤ 35% or ±2 x MRL if samples < 5 x MRL	MD[e]	S & A
	USEPA 1630/T16	Completeness	≥ 90%	Data completeness check	S & A

[a] . Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
MB – method blank
MD – matrix duplicate
MDL – method detection limit
MRL – method reporting limit
MS – matrix spike
MSD – matrix spike duplicate
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	SVOCs
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S & A)
Attachments J, L, N and O	USEPA SW-846 8270C/ T17, T18, T19, T20	Accuracy/bias – contamination	No target compound > QL, no common lab contaminants > 5 x QL	Method blank/instrument blank	A
	USEPA SW-846 8270C/ T17,T18, T19, T20	Accuracy/bias – contamination	No target compound > QL, no common lab contaminants > 5 x QL	Equipment rinsate blanks[d]	S & A
	USEPA SW-846 8270C/ S17, S18, S19, S20	Accuracy/bias	Compound-specific (see SOP)	LCS	A
	USEPA SW-846 8270C/ R17, R18, R19, R20	Accuracy/bias	Compound-specific (see SOP)	MS[e]/MSD[e]	S & A
	USEPA SW-846 8270C/ T17, T18, T19, T20	Accuracy/bias	Percent recovery = 40 – 140%	CRM	A
	USEPA SW-846 8270C/ T17, T18, T19, T20	Accuracy/bias	Compound-specific (see SOP)	Surrogates	A
	USEPA SW-846 8270C/ T17, T18, T19, T20	Precision	Compound-specific (see SOP)	MD[e]	
	USEPA SW-846 8270C/ T17, T18, T19, T20	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

CRM – certified reference material
LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SVOC – semivolatile organic compound
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Butyltins
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	Krone et al (1989)/ T21, T22	Accuracy/bias – contamination	No target compound >QL	Method blank	A
	Krone et al (1989)/ T21, T22	Accuracy/bias – contamination	No target compound >QL	Equipment rinsate blanks[d]	S & A
	Krone et al (1989)/ T21, T22	Accuracy/bias	Compound-specific (see SOP)	LCS	A
	Krone et al (1989)/ T21, T22	Accuracy/bias, precision	RPD ≤ 40%	MD[e]	S & A
	Krone et al (1989)/ T21, T22	Precision	Recovery is compound-specific (see SOP), RPD ≤ 40%	MS[e]/MSD[e]	
	Krone et al (1989)/ T21, T22	Completeness	≥ 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group..
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] Rinsate blank will be created from the tissue homogenization equipment.
[e] May be omitted if sample mass is limited.

ICAL – initial calibration standard
LCS – laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
PD – percent difference
QAPP – quality assurance project plan
MS – matrix spike
MSD – matrix spike duplicate
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue
Analytical Group[a]	Lipids
Concentration Level	Low

Sampling Procedure[b]	Analytical Method/SOP[c]	Data Quality Indicators (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)
Attachments J, L, N and O	Bligh-Dyer/T23	Precision	RPD ≤ 20%	MD[d]	S & A
	Bligh-Dyer/T23	Contamination	≤ MRL	Method blank	A
	Bligh-Dyer/T23	Accuracy	Recovery within limits set by CRM manufacturer	CRM	A
	Bligh-Dyer/T23	Completeness	> 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] May be omitted if sample mass is limited.

CRM – certified reference material
MD – matrix duplicate
MRL – method reporting limit
NA – not available
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
SM – standard method
SOP – standard operating procedure

QAPP Worksheet No. 12. Measurement Performance Criteria Table (cont.)

Matrix	Tissue				
Analytical Group[a]	Percent Moisture				
Concentration Level	NA				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**Data Quality Indicators (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)**
Attachments J, L, N and O	SM2540G Mod./T24	Precision	RPD ≤ 20%	MD[d]	S & A
	SM2540G Mod./T24	Completeness	> 90%	Data completeness check	S & A

[a] Refer to QAPP Worksheet No.15 for a complete list of analytes for each analytical group.
[b] Reference number from QAPP Worksheet No. 21.
[c] Reference number from QAPP Worksheet No. 23.
[d] May be omitted if sample mass is limited.

MD – matrix duplicate
MRL – method reporting limit
PCB – polychlorinated biphenyl
QAPP – quality assurance project plan
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure

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

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Fish community survey data	Tierra Solutions. Passaic River Study Area fish community data. September 18, 2002 (Tierra Solutions 2002c)	Tierra Solutions. Passaic River Study Area fish community data. Data were collected in fall 1999 and spring 2000.	Fish community survey data was used to inventory the fish populations in the LPRSA and to select the species appropriate for tissue-residue analysis.	Tierra Solutions fish community survey only covered RM 1 to RM 6; results from a concurrent fish community survey for RM 7 to RM 17.4 will be used to supplement Tierra Solutions data.
	NJDEP, fish IBI report: 2004 sampling, (NJDEP 2006)	NJDEP, stream fish assemblages monitoring data. Data were collected in summer and fall 2004.		NJDEP assemblage data for the LPRSA is limited to station at Saddle River, a tributary to the LPR at ~RM 15.5.
	USEPA, fish abundance data for New Jersey, 2000, available online at (http://oaspub.epa.gov/coastal/coast.search) (USEPA 2007b)	USEPA Coastal Assessment program data. Data were collected in August 2000.		USEPA collected only two individuals from the upstream reach of the LPR near Bellevue-Lyndhurst (RM 9.9).
	USACE, Flood Protection Feasibility: Main Stem Passaic River Volume III. Phase I – General Design Memorandum: Appendix B – Natural Resources (USACE 1987).	USACE, fish community survey data. Data were collected spring and summer 1981.		USACE fish community survey only targeted anadromous fish.
	Princeton Aqua Science, Biocommunities Study, Passaic Valley Sewerage Commission Combined Sewer Overflow Facilities Plan. Appendix H. In: Passaic River Sediment Study, Volume II. (Princeton Aqua Science 1982)	Princeton Aqua Science, Fish community survey data. Data were collected in 1981 and 1982.		Princeton Aqua Science collected only one fish species, mummichog, at three sampling stations up to ~ RM 9.

QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table (cont.)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Fish Tissue Data	Tierra Solutions. Passaic River Study Area ESP Biota Sampling Program, 1999-2001. (PREmis project database created January 21, 2006)	Tierra Solutions, Passaic River Study Area ESP Biota Sampling Program. Data were collected in autumn 1999, spring 2000 and late summer 2001.	Fish tissue chemistry data was used to select the species appropriate for tissue-residue analysis.	Tierra Solutions Biota Sampling Program collected biota from RM 1 to RM 7.
	NJDEP, PCBs, chlordane, and DDTs in Selected Fish and Shellfish From New Jersey Waters, 1986 – 1987: Results From New Jersey's Toxics in Biota Monitoring Program (NJDEP 1990); NJDEP, PCBs, chlordane, and DDTs in Selected Fish and Shellfish From New Jersey Waters, 1988 – 1991: Results From New Jersey's Toxics in Biota Monitoring Program (NJDEP 1993); NJDEP, A study of dioxin (2,3,7,8-tetrachlorodibenzo-*p*-dioxin) contamination in select finfish, crustaceans and sediments of New Jersey waterways (Belton et al. 1985); Final report: routine monitoring program for toxics in fish (Horwitz et al. 2005); 2004 monitoring program for chemical contaminants in fish from the State of New Jersey: second year of routine monitoring program, final report. No. 06-04F (Horwitz et al. 2006); NJDEP 2004 Routine Monitoring Program for Toxics in Fish: Year 2 – Estuarine and Marine Waters (crab data), available online at (http://www.state.nj.us/dep/dsr/2004data.htm).	NJDEP, fish and crab tissue data. Data were collected from 1986 to 2004.		NJDEP collected tissue for four species (i.e., American eel, carp, striped bass and blue crab at limited locations in the LPRSA (Newark Bay and Monroe Street Bridge [RM 16]).

QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table (cont.)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
	CARP – Contaminant Assessment and Reduction Program, available online at (http://www.carpweb.org/main.html)	CARP, fish tissue data collection from 2000 to2004.		CARP only collected fish and invertebrate tissue for seven species (i.e., American eel, mummichog, white perch, blue crab, opossum shrimp, ribbed mussel and seven spine bay shrimp) at RM 2.6 in the LPRSA. A total of 109 tissue samples were analyzed for PCDDs/PCDFs, metals, PAHs, PCBs, and organochlorine pesticides.
	NJDEP 2004 Routine Monitoring Program for Toxics in Fish: Year 2 – Estuarine and Marine Waters. NJDEP Crab Monitoring Program available online at (http://www.state.nj.us/dep/dsr/2004data.htm).	NJDEP Crab Monitoring Program collected crab tissue.		Sampling dates and locations are unknown. Only 20 crab samples were collected and analyzed for PCDDs/PCDFs, DDTs, PCBs, organochlorine pesticides, and conventional parameters.
	USEPA Environmental Monitoring and Assessment Program (EMAP) and Regional Environmental Monitoring and Assessment Program (REMAP), National Coastal Assessment-Northeast/New Jersey Coast, available online at http://www.epa.gov/emap/nca/html/about.html).	USEPA EMAP and REMAP, fish tissue chemistry data, 2002		Limited to two species (white perch and blue crab) at two locations in the LPRSA. Only one composite sample per species was analyzed for metals, DDTs, PCBs, and organochlorine pesticides.
	PREmis database (created January 21, 2006; available online at http://www.ourpassaic.org)	NYSDEC, fish and invertebrate tissue, 1993		Limited to blue crab, oyster, and three fish species (all fillet samples) at one location near the mouth of the LPR (RM 0.1).

QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table (cont.)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
		Passaic 1995 Biological Sampling Program		Limited to three species (blue crab, mummichog, and striped bass) collected at locations in the estuarine zone only (RM 1.1 to RM 4.5).
Predicted tide tables	NOAA online tide data available at (http://tidesandcurrents.noaa.gov/tides09/)	NOAA, tide predictions, 2009	Tide predictions will be used to determine how much line slack will be needed for placement of baited traps, and for identifying possible areas that may be exposed for seine netting efforts.	Raw tidal elevation data obtained from the NOAA website have not been subjected to the National Ocean Service's QC or QA procedures and do not meet the criteria and standards of official National Ocean Service data. They are released for limited public use as preliminary data to be used only with appropriate caution.
Sediment texture maps	Malcolm Pirnie. 2006. Lower Passaic River Restoration Project. Draft geochemical evaluation (Step 2). Prepared for USEPA Region 2 and USACE. Malcolm Pirnie, Inc., White Plains, NY.	AquaSurvey, Inc.; vector digital data, April 21, 2005, to June 16, 2005, as cited in Malcolm Pirnie (2006)	Sediment texture maps will be used in the data report to help identify general sediment characteristics of habitats where fish are caught.	Side scan sonar survey data are limited to general grain size characterization. Sediment texture map coverage ends at ~RM 16.1.

QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table (cont.)

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Sediment chemistry data	CPG. RI Low-Resolution Coring/Sediment Sampling data (no report to date – data delivered to USEPA)	CPG. Sediment chemistry data, July 2008 to December 2008	The LRC program analyte list is used as the basis for the development of the proposed analyte list for the fish and decapod tissue.	None.
Bathymetry maps	CPG, Multi-beam and Single-beam Bathymetry,(No report to date – data delivered to USEPA)	CPG. Multi-beam and single beam survey performed by Gahagan and Bryant (subcontractor to ENSR) in August to September 2007	Bathymetry maps will be used to help identify suitable areas for netting, trapping and electrofishing for fish.	Single beam – coverage limited to project RM 0.5 to RM 8.2 and RM 14.3 to RM 16.5. Current only as of the date of survey, August 2007. Multi-beam – coverage limited to RM 0 to RM 14.4, and to channel area in RM 0 to RM 0.9. Current only as of the date of survey, August 2007.

CARP – Contaminant Assessment and Reduction Program
CPG – Cooperating Parties Group
EMAP – Environmental Monitoring and Assessment Program
ESP – ecological sampling plan
IBI – index of biota integrity
LPR – Lower Passaic River
LRC – low-resolution sediment core
NOAA – National Oceanic and Atmospheric Administration
NJDEP – New Jersey Department of Environmental Protection
NYSDEC – New York State Department of Environmental Conservation
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
QC – quality control
REMAP – Regional Environmental Monitoring and Assessment Program
RI – remedial investigation
RM – river mile
USACE – US Army Corps of Engineers
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 14. Summary of Project Tasks

Project Area: LPRSA	
Sampling Tasks:	Beginning in August 2009, three seasonal fish community surveys, using gillnets, electrofishing, and baited trotlines, eel/minnow and crab/crayfish traps (see Worksheet No. 17), as allowable, will be conducted in 2-mile reaches, in the estuarine (RM 0 to RM 10) and freshwater (RM 10 to RM 17.4) zones of the LPRSA (Figure 3). The schedule for community surveys is presented on Worksheet No. 16. Concurrent with the August 2009 community survey, fish and decapod crustacean tissue will be collected from the same sampling locations. In the estuarine zone, the target fish species for tissue collection are mummichog, white perch, American eel, and blue crab. In the freshwater zone, the target species are darter or killifish species, channel catfish or brown bullhead, largemouth bass, blue crab (if possible), and crayfish. Tissue types per species are outlined on Worksheet No. 11, Table 11-1. Sampling locations are specified on Worksheet No. 18. SOPs applicable to the field sampling effort are presented in Attachments G through P. Surface sediment that is co-located with mummichog, darter/killifish, blue crab, and crayfish sampling locations will be sampled and undergo chemistry analysis as part of the benthic invertebrate sampling effort (presented in the benthic invertebrate QAPP [Windward, in preparation]). The August 2009 community survey and fish/decapod crustacean tissue sampling will be conducted for up to 8 weeks. The winter 2009/2010 and spring 2010 fish community surveys will be conducted for up to 3 weeks.
Analysis Tasks:	At each sampling site, location measurements (e.g., coordinates, depth, and any other relevant observations such as habitat type) will be recorded on the Location Data Form (Attachment B). Fish, crab and crayfish lengths and weights will be also measured; and species and sex will be documented (if possible). Gross external and internal pathological observations will be made and electronically recorded on the Specimen Data Form (Attachment C) during the tissue sampling event and first community survey on up to five individuals per fish species collected, or the total number of individuals as agreed to with USEPA. Analyzing target fish species for tissue chemistry will be prioritized over sacrificing these species for the health evaluation. Up to 10 fish egg (composite) samples will be collected from each of the targeted benthic omnivore fish species in the estuarine and freshwater zones; and 5 to 10 stomach content samples will be collected from each of the targeted invertivore/omnivore and carnivore/piscivore fish species, if available. The substrate at each sampling location will be grossly characterized using the sediment texture maps provided in FSP2 (Malcolm Pirnie et al. 2006). Following the tissue collection, samples will be shipped to the analytical laboratory for filleting, compositing (if necessary), homogenization, and analysis. Details on the compositing scheme and tissue sample preparation are presented in Attachment O. Tissue samples will be analyzed for the chemicals listed in Worksheet No. 10; fish egg samples will only be analyzed for lipid content; and fish stomach content samples will only be analyzed for taxonomy.

QAPP Worksheet No. 14. Summary of Project Tasks (cont.)

Project Area: LPRSA	
QC Tasks:	All field notes and forms completed during the field sampling task will be checked daily by the FC. The FC will also communicate daily with the Task QA/QC Manager to confirm PQOs are being met. As part of the QC process to assess the accuracy of species identification, specimens of each captured species will be collected and independently verified by a fish biologist (Matt Luxon, Windward) who is not associated with the field task. Lengths and weights will be compiled in a table and reviewed as a QC step. Any lengths and weights that appear to be anomalous will be verified by a second team member by re-measuring. Sample identifications will be similarly verified. Electronic sampling equipment (e.g., scale, 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). The analytical laboratories will follow QC procedures outlined in this QAPP (see Worksheet Nos. 20, 24, and 25), their SOPs for the analytical methods being conducted (see Worksheet No. 23), and their quality management plan. Chemical data will be validated according to procedures outlined in this QAPP (see Worksheet Nos. 35 and 36).
Secondary Data:	Other community and chemistry data that are summarized in Worksheet Nos. 10 and 13 will also be reviewed and potentially used to accomplish project objectives.
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 plan in accordance with Technical Committee (TC) data rules. The overall project data management plan will be developed by the data management contractor in collaboration with Windward. As part of the transition of performance of the RI/FS to the CPG, an overall data management plan will be developed prior to the initiation of data collection. This plan will detail internal data management protocols as well as procedures for transfer of data for upload to the PREmis database. 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 the laboratory reports, merged with corresponding field data, and updated based on validation. Subsequently, the spatial data will be mapped for the data report.

QAPP Worksheet No. 14. Summary of Project Tasks (cont.)

Project Area: LPRSA	
Documentation and Records:	It is important that field activities be documented in an organized, chronologically accurate manner. All field activities will be recorded in an 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. Procedures for documentation are presented in Attachment P. All relevant forms and records are presented on Worksheet No. 29. In general, the following information must be recorded: • The identities and affiliation of the personnel conducting field activities. • Model numbers and serial numbers of instruments and/or equipment being used, will, to the extent available, be recorded in the field log. • A description of the type of field work being conducted and the equipment used • The date and time the 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) • The site where the field activities were conducted and also any locations within that site where work was performed (e.g., specific sampling sites, coordinates, and depths) • The general methodology used to conduct the activities • Communications with project managers and personnel regarding field activities • Field collected data (e.g., GPS measurements, catch totals) • Daily health and safety briefings • Deviations from QAPP, SOP, or project health and safety plan (HSP) (Attachment R), reason for change, and any corrective actions taken. Corrective actions will be electronically documented on the Protocol Modification Form (Attachment A) • Photos will be taken to document gross external abnormalities on trapped fish. Photos will be taken of all fish species collected. When photos associated with sampling locations, field activities, or samples are taken, they will be documented in the field logbook, including the date, time, photographer, and brief description. All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate. The Location Data Form (Attachment B) and Specimen Data Form (Attachment C) will also be filled out electronically by field personnel to document sampling location information and gross external and internal pathological observations of collected fish. A daily tally of all species that are caught will also be recorded in the Specimen Tally Form (Attachment D), and Non-Target Species Tally Form (Attachment E). All fish, crab and

QAPP Worksheet No. 14. Summary of Project Tasks (cont.)

Project Area: LPRSA	
	crayfish tissue samples that will be analyzed will be recorded electronically in the Composite Sample Form (Attachment F) by field laboratory personnel or the project chemist. 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.
Assessment/Audit Tasks	The Field Coordinator 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. 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. As part of data report preparation, chemical data will be reviewed to determine if differences related to species and/or location are evident. In addition, the data report will also undergo a senior and peer review process before the final draft is submitted to USEPA (see Worksheet Nos. 34 through 37 for relevant procedures).
Deliverables:	Following each fish community survey, fish community data collected during the community survey event will be summarized in a data report, including fish species diversity and abundance, metrics (e.g., length, weight), substrate, catch per unit effort and gross internal and external pathological conditions of a subset of the captured fish (collected during the first community survey and tissue sampling event). A map illustrating the actual sampling locations will also be prepared. A data report summarizing the sampling effort will be provided to USEPA within 90 days after completion of each fish community survey. A tissue chemistry data report will be prepared once the chemistry results have been validated. This data report will be provided to USEPA after 90 days of receipt of validated data and will include validation results.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation

Matrix: Tissue

Analytical Group, Method, and Laboratory: PCBs – Congeners, USEPA1668A, Analytical Perspectives, Wilmington, NC

SOP from Worksheet 23: T2

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCBs by Congener							
PCB 1	2051-60-7	0.00158[d]	0.00158	8.0E-06	2.0E-05	1.59E-6	4.20E-6
PCB 2	2051-61-8	0.00158[d]	0.00158	4.0E-07	1.0E-06	1.56E-6	4.05E-6
PCB 3	2051-62-9	0.00158[d]	0.00158	9.0E-06	2.0E-05	1.56E-6	4.05E-6
PCB 4	13029-08-8	0.00158[d]	0.00158	1.7E-05	5.0E-05	2.85E-6	7.21E-6
PCB 5	16605-91-7	0.00158[d]	0.00158	1.E-06	5.E-06	3.02E-6	7.95E-6
PCB 6	25569-80-6	0.00158[d]	0.00158	1.E-06	5.E-06	3.12E-6	8.20E-6
PCB 7	33284-50-3	0.00158[d]	0.00158	2.E-06	5.E-06	2.97E-6	7.82E-6
PCB 8	34883-43-7	0.00158[d]	0.00158	1.2E-05	5.0E-05	3.10E-6	8.16E-6
PCB 9	34883-39-1	0.00158[d]	0.00158	2.E-06	5.E-06	3.09E-6	8.14E-6
PCB 10	33146-45-1	0.00158[d]	0.00158	2.E-06	5.E-06	2.88E-6	7.63E-6
PCB 11	2050-67-1	0.00158[d]	0.00158	1.0E-05	2.0E-05	3.16E-6	8.36E-6
PCB 12	2974-92-7	0.00158[d]	0.00158	3.E-06	1.0E-05	3.19E-6	8.43E-6
PCB 13	2974-90-5	0.00158[d]	0.00158	3.E-06	1.0E-05	3.19E-6	8.43E-6
PCB 14	34883-41-5	0.00158[d]	0.00158	3.E-06	1.0E-05	2.97E-6	7.82E-6
PCB 15	2050-68-2	0.00158[d]	0.00158	1.8E-05	5.0E-05	3.11E-6	8.16E-6
PCB 16	38444-78-9	0.00158[d]	0.00158	4.E-06	1.0E-05	1.48E-6	3.68E-6
PCB 17	37680-66-3	0.00158[d]	0.00158	9.E-06	2.0E-05	1.49E-6	3.81E-6
PCB 18	37680-65-2	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.49E-6	3.82E-6
PCB 19	38444-73-4	0.00158[d]	0.00158	4.E-06	1.0E-05	1.48E-6	3.73E-6
PCB 20	38444-84-7	0.00158[d]	0.00158	1.9E-05	5.0E-05	2.08E-6	5.39E-6
PCB 21	55702-46-0	0.00158[d]	0.00158	5.E-06	2.0E-05	2.10E-6	5.49E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 22	38444-85-8	0.00158[d]	0.00158	9.E-06	2.0E-05	2.08E-6	5.37E-6
PCB 23	55720-44-0	0.00158[d]	0.00158	5.E-06	2.0E-05	2.08E-6	5.40E-6
PCB 24	55702-45-9	0.00158[d]	0.00158	5.E-06	2.0E-05	1.51E-6	3.95E-6
PCB 25	55712-37-3	0.00158[d]	0.00158	5.E-06	2.0E-05	2.09E-6	5.45E-6
PCB 26	38444-81-4	0.00158[d]	0.00158	8.E-06	2.0E-05	2.09E-6	5.44E-6
PCB 27	38444-76-7	0.00158[d]	0.00158	6.E-06	2.0E-05	1.50E-6	3.89E-6
PCB 28	7012-37-5	0.00158[d]	0.00158	1.9E-05	5.0E-05	2.08E-6	5.39E-6
PCB 29	15862-07-4	0.00158[d]	0.00158	8.E-06	2.0E-05	2.09E-6	5.44E-6
PCB 30	35693-92-6	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.49E-6	3.82E-6
PCB 31	16606-02-3	0.00158[d]	0.00158	1.5E-05	5.0E-05	2.10E-6	5.51E-6
PCB 32	38444-77-8	0.00158[d]	0.00158	8.E-06	2.0E-05	1.52E-6	3.98E-6
PCB 33	38444-86-9	0.00158[d]	0.00158	5.E-06	2.0E-05	2.10E-6	5.49E-6
PCB 34	37680-68-5	0.00158[d]	0.00158	7.E-06	2.0E-05	2.08E-6	5.36E-6
PCB 35	37680-69-6	0.00158[d]	0.00158	8.E-06	2.0E-05	2.07E-6	5.31E-6
PCB 36	38444-87-0	0.00158[d]	0.00158	8.E-06	2.0E-05	2.09E-6	5.43E-6
PCB 37	38444-90-5	0.00158[d]	0.00158	1.3E-05	5.0E-05	2.07E-6	5.29E-6
PCB 38	53555-66-1	0.00158[d]	0.00158	8.E-06	2.0E-05	2.09E-6	5.42E-6
PCB 39	38444-88-1	0.00158[d]	0.00158	9.E-06	2.0E-05	2.09E-6	5.42E-6
PCB 40	38444-93-8	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.64E-6	1.53E-6
PCB 41	52663-59-9	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.65E-6	1.54E-6
PCB 42	36559-22-5	0.00158[d]	0.00158	6.E-06	2.0E-05	0.65E-6	1.55E-6
PCB 43	70362-46-8	0.00158[d]	0.00158	9.E-06	2.0E-05	0.68E-6	1.60E-6
PCB 44	41464-39-5	0.00158[d]	0.00158	1.9E-05	5.0E-05	0.64E-6	1.54E-6
PCB 45	70362-45-7	0.00158[d]	0.00158	5.E-06	2.0E-05	0.62E-6	1.50E-6
PCB 46	41464-47-5	0.00158[d]	0.00158	1.0E-05	2.0E-05	0.63E-6	1.50E-6
PCB 47	2437-79-8	0.00158[d]	0.00158	1.9E-05	5.0E-05	0.64E-6	1.54E-6
PCB 48	70362-47-9	0.00158[d]	0.00158	8.E-06	2.0E-05	0.63E-6	1.54E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 49	41464-40-8	0.00158[d]	0.00158	1.1E-05	5.0E-05	0.63E-6	1.55E-6
PCB 50	62796-65-0	0.00158[d]	0.00158	6.E-06	2.0E-05	0.61E-6	1.49E-6
PCB 51	68194-04-7	0.00158[d]	0.00158	5.E-06	2.0E-05	0.61E-6	1.48E-6
PCB 52	35693-99-3	0.00158[d]	0.00158	1.9E-05	5.0E-05	0.64E-6	1.54E-6
PCB 53	41464-41-9	0.00158[d]	0.00158	6.E-06	2.0E-05	0.61E-6	1.49E-6
PCB 54	15968-05-5	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.48E-6	1.17E-6
PCB 55	74338-24-2	0.00158[d]	0.00158	1.2E-05	5.0E-05	1.11E-6	2.7E-6
PCB 56	41464-43-1	0.00158[d]	0.00158	1.0E-05	2.0E-05	1.11E-6	2.73E-6
PCB 57	70424-67-8	0.00158[d]	0.00158	1.2E-05	5.0E-05	1.11E-6	2.77E-6
PCB 58	41464-49-7	0.00158[d]	0.00158	1.3E-05	5.0E-05	1.11E-6	2.71E-6
PCB 59	74472-33-6	0.00158[d]	0.00158	6.E-06	2.0E-05	0.63E-6	1.58E-6
PCB 60	33025-41-1	0.00158[d]	0.00158	1.3E-05	5.0E-05	1.11E-6	2.77E-6
PCB 61	33284-53-6	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.11E-6	2.75E-6
PCB 62	54230-22-7	0.00158[d]	0.00158	6.E-06	2.0E-05	0.63E-6	1.58E-6
PCB 63	74472-34-7	0.00158[d]	0.00158	1.4E-05	5.0E-05	1.12E-6	2.82E-6
PCB 64	52663-58-8	0.00158[d]	0.00158	7.E-06	2.0E-05	0.63E-6	1.61E-6
PCB 65	33284-54-7	0.00158[d]	0.00158	1.9E-05	5.0E-05	0.64E-6	1.54E-6
PCB 66	32598-10-0	0.00158[d]	0.00158	1.6E-05	5.0E-05	1.11E-6	2.73E-6
PCB 67	73575-53-8	0.00158[d]	0.00158	1.5E-05	5.0E-05	1.11E-6	2.76E-6
PCB 68	73575-52-7	0.00158[d]	0.00158	1.5E-05	5.0E-05	1.11E-6	2.76E-6
PCB 69	60233-24-1	0.00158[d]	0.00158	1.1E-05	5.0E-05	0.63E-6	1.55E-6
PCB 70	32598-11-1	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.11E-6	2.75E-6
PCB 71	41464-46-4	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.64E-6	1.53E-6
PCB 72	41464-42-0	0.00158[d]	0.00158	1.6E-05	5.0E-05	1.11E-6	2.75E-6
PCB 73	74338-23-1	0.00158[d]	0.00158	1.6E-05	5.0E-05	0.63E-6	1.56E-6
PCB 74	32690-93-0	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.11E-6	2.75E-6
PCB 75	32598-12-2	0.00158[d]	0.00158	6.E-06	2.0E-05	0.63E-6	1.58E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 76	70362-48-0	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.11E-6	2.75E-6
PCB 77	32598-13-3	0.00024[e]	0.00024	1.7E-05	5.0E-05	1.11E-6	2.68E-6
PCB 78	70362-49-1	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.12E-6	2.72E-6
PCB 79	41464-48-6	0.00158[d]	0.00158	1.7E-05	5.0E-05	1.11E-6	2.77E-6
PCB 80	33284-52-5	0.00158[d]	0.00158	1.8E-05	5.0E-05	1.11E-6	2.76E-6
PCB 81	70362-50-4	0.0000809[e]	0.0000809	1.8E-05	5.0E-05	1.11E-6	2.7E-6
PCB 82	52663-62-4	0.00158[d]	0.00158	1.3E-05	5.0E-05	0.8E-6	1.87E-6
PCB 83	60145-20-2	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.77E-6	1.81E-6
PCB 84	52663-60-2	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.77E-6	1.82E-6
PCB 85	65510-45-4	0.00158[d]	0.00158	1.0E-05	2.0E-05	0.75E-6	1.8E-6
PCB 86	55312-69-1	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 87	38380-02-8	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 88	55215-17-3	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.77E-6	1.81E-6
PCB 89	73575-57-2	0.00158[d]	0.00158	1.9E-05	5.0E-05	0.77E-6	1.82E-6
PCB 90	68194-07-0	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.75E-6	1.8E-6
PCB 91	68194-05-8	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.75E-6	1.83E-6
PCB 92	52663-61-3	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.78E-6	1.83E-6
PCB 93	73575-56-1	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.76E-6	1.80E-6
PCB 94	73575-55-0	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.77E-6	1.81E-6
PCB 95	38379-99-6	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.75E-6	1.81E-6
PCB 96	73575-54-9	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.42E-6	1.01E-6
PCB 97	41464-51-1	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 98	60233-25-2	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.78E-6	1.84E-6
PCB 99	38380-01-7	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.75E-6	1.80E-6
PCB 100	39485-83-1	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.76E-6	1.80E-6
PCB 101	37680-73-2	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.75E-6	1.80E-6
PCB 102	68194-06-9	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.75E-6	1.81E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 103	60145-21-3	0.00158[d]	0.00158	2.3E-05	5.0E-05	0.75E-6	1.82E-6
PCB 104	56558-16-8	0.00158[d]	0.00158	2.3E-05	5.0E-05	0.42E-6	1.01E-6
PCB 105	32598-14-4	0.000809[e]	0.000809	1.1E-05	2.0E-06	0.73E-6	1.76E-6
PCB 106	70424-69-0	0.00158[d]	0.00158	1.4E-05	5.0E-05	0.75E-6	1.81E-6
PCB 107	70424-68-9	0.00158[d]	0.00158	2.7E-05	1.0E-04	0.75E-6	1.81E-6
PCB 108	70362-41-3	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 109	74472-35-8	0.00158[d]	0.00158	1.0E-05	2.0E-05	0.75E-6	1.86E-6
PCB 110	38380-03-9	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.75E-6	1.81E-6
PCB 111	39635-32-0	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.75E-6	1.83E-6
PCB 112	74472-36-9	0.00158[d]	0.00158	2.5E-05	1.0E-04	0.75E-6	1.80E-6
PCB 113	68194-10-5	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.75E-6	1.80E-6
PCB 114	74472-37-0	0.000809[e]	0.000809	1.2E-05	5.0E-05	0.72E-6	1.71E-6
PCB 115	74472-38-1	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.76E-6	1.87E-6
PCB 116	18259-05-7	0.00158[d]	0.00158	1.0E-05	2.0E-05	0.75E-6	1.80E-6
PCB 117	68194-11-6	0.00158[d]	0.00158	1.0E-05	2.0E-05	0.76E-6	1.85E-6
PCB 118	31508-00-6	0.000809[e]	0.000809	1.9E-05	5.0E-05	0.69E-6	1.65E-6
PCB 119	56558-17-9	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 120	68194-12-7	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 121	56558-18-0	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.75E-6	1.84E-6
PCB 122	76842-07-4	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.72E-6	1.72E-6
PCB 123	65510-44-3	0.000809[e]	0.000809	1.5E-05	5.0E-05	0.74E-6	1.79E-6
PCB 124	70424-70-3	0.00158[d]	0.00158	2.7E-05	1.0E-04	0.75E-6	1.81E-6
PCB 125	74472-39-2	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.75E-6	1.81E-6
PCB 126	57465-28-8	2.43E-07[e]	2.43E-07	1.4E-05	5.0E-05	1.43E-6	3.66E-6
PCB 127	39635-33-1	0.00158[d]	0.00158	2.8E-05	1.0E-04	0.73E-6	1.78E-6
PCB 128	38380-07-3	0.00158[d]	0.00158	1.2E-05	5.0E-05	1.26E-6	3.26E-6
PCB 129	55215-18-4	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.45E-6	1.12E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 130	52663-66-8	0.00158[d]	0.00158	1.4E-05	5.0E-05	0.49E-6	1.19E-6
PCB 131	61798-70-7	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.45E-6	1.12E-6
PCB 132	38380-05-1	0.00158[d]	0.00158	1.2E-05	5.0E-05	0.45E-6	1.12E-6
PCB 133	35694-04-3	0.00158[d]	0.00158	1.7E-05	5.0E-05	0.45E-6	1.12E-6
PCB 134	52704-70-8	0.00158[d]	0.00158	1.3E-05	5.0E-05	0.5E-6	1.22E-6
PCB 135	52744-13-5	0.00158[d]	0.00158	1.1E-05	5.0E-05	0.45E-6	1.11E-6
PCB 136	38411-22-2	0.00158[d]	0.00158	9.E-06	2.0E-05	0.37E-6	0.90E-6
PCB 137	35694-06-5	0.00158[d]	0.00158	3.0E-05	1.0E-04	0.45E-6	1.11E-6
PCB 138	35065-28-2	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.45E-6	1.12E-6
PCB 139	56030-56-9	0.00158[d]	0.00158	2.0E-05	5.0E-05	0.45E-6	1.11E-6
PCB 140	59291-64-4	0.00158[d]	0.00158	2.0E-05	5.0E-05	0.45E-6	1.11E-6
PCB 141	52712-04-6	0.00158[d]	0.00158	9.E-06	2.0E-05	0.45E-6	1.12E-6
PCB 142	41411-61-4	0.00158[d]	0.00158	3.1E-05	1.0E-04	0.47E-6	1.16E-6
PCB 143	68194-15-0	0.00158[d]	0.00158	1.3E-05	5.0E-05	0.46E-6	1.12E-6
PCB 144	68194-14-9	0.00158[d]	0.00158	1.7E-05	5.0E-05	0.46E-6	1.13E-6
PCB 145	74472-40-5	0.00158[d]	0.00158	3.2E-05	1.0E-04	0.35E-6	0.86E-6
PCB 146	51908-16-8	0.00158[d]	0.00158	1.8E-05	5.0E-05	0.45E-6	1.12E-6
PCB 147	68194-13-8	0.00158[d]	0.00158	1.8E-05	5.0E-05	0.45E-6	1.11E-6
PCB 148	74472-41-6	0.00158[d]	0.00158	3.2E-05	1.0E-04	0.45E-6	1.11E-6
PCB 149	38380-04-0	0.00158[d]	0.00158	1.8E-05	5.0E-05	0.45E-6	1.11E-6
PCB 150	68194-08-1	0.00158[d]	0.00158	3.3E-05	1.0E-04	0.35E-6	0.87E-6
PCB 151	52663-63-5	0.00158[d]	0.00158	1.1E-05	5.0E-05	0.45E-6	1.11E-6
PCB 152	68194-09-2	0.00158[d]	0.00158	2.4E-05	1.0E-04	0.35E-6	0.86E-6
PCB 153	35065-27-1	0.00158[d]	0.00158	1.3E-05	5.0E-05	0.44E-6	1.10E-6
PCB 154	60145-22-4	0.00158[d]	0.00158	1.1E-05	5.0E-05	0.44E-6	1.10E-6
PCB 155	33979-03-2	0.00158[d]	0.00158	3.4E-05	1.0E-04	0.35E-6	0.87E-6
PCB 156	38380-08-4	0.000809[e]	0.000809	1.3E-05	5.0E-05	1.74E-6	4.50E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 157	69782-90-7	0.000809[e]	0.000809	1.3E-05	5.0E-05	1.74E-6	4.50E-6
PCB 158	74472-42-7	0.00158	0.00158	1.1E-05	2.0E-05	0.44E-6	1.11E-6
PCB 159	39635-35-3	0.00158[d]	0.00158	3.5E-05	1.0E-04	1.27E-6	3.29E-6
PCB 160	41411-62-5	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.45E-6	1.11E-6
PCB 161	74472-43-8	0.00158[d]	0.00158	3.5E-05	1.0E-04	0.44E-6	1.10E-6
PCB 162	39635-34-2	0.00158[d]	0.00158	3.5E-05	1.0E-04	1.27E-6	3.33E-6
PCB 163	74472-44-9	0.00158[d]	0.00158	2.1E-05	5.0E-05	0.45E-6	1.12E-6
PCB 164	74472-45-0	0.00158[d]	0.00158	1.4E-05	5.0E-05	0.44E-6	1.11E-6
PCB 165	74472-46-1	0.00158[d]	0.00158	3.6E-05	1.0E-04	0.45E-6	1.11E-6
PCB 166	41411-63-6	0.00158[d]	0.00158	1.2E-05	5.0E-05	1.26E-6	3.26E-6
PCB 167	52663-72-6	0.000809[e]	0.000809	1.1E-05	5.0E-05	1.27E-6	3.29E-6
PCB 168	59291-65-5	0.00158[d]	0.00158	1.3E-05	5.0E-05	0.44E-6	1.10E-6
PCB 169	32774-16-6	8.09E-07[e]	8.09E-07	1.6E-05	5.0E-05	1.82E-6	4.80E-6
PCB 170	35065-30-6	0.00158[d]	0.00158	1.6E-05	5.0E-05	1.28E-6	3.18E-6
PCB 171	52663-71-5	0.00158[d]	0.00158	3.7E-05	1.0E-04	1.1E-6	2.69E-6
PCB 172	52663-74-8	0.00158[d]	0.00158	3.8E-05	1.0E-04	1.1E-6	2.67E-6
PCB 173	68194-16-1	0.00158[d]	0.00158	3.7E-05	1.0E-04	1.1E-6	2.69E-6
PCB 174	38411-25-5	0.00158[d]	0.00158	1.9E-05	5.0E-05	1.1E-6	2.69E-6
PCB 175	40186-70-7	0.00158[d]	0.00158	3.8E-05	1.0E-04	1.1E-6	2.70E-6
PCB 176	52663-65-7	0.00158[d]	0.00158	3.9E-05	1.0E-04	0.37E-6	0.90E-6
PCB 177	52663-70-4	0.00158[d]	0.00158	1.4E-05	5.0E-05	1.10E-6	2.67E-6
PCB 178	52663-67-9	0.00158[d]	0.00158	2.2E-05	5.0E-05	0.48E-6	1.20E-6
PCB 179	52663-64-6	0.00158[d]	0.00158	2.3E-05	5.0E-05	0.43E-6	1.04E-6
PCB 180	35065-29-3	0.00158[d]	0.00153	1.4E-05	5.0E-05	1.11E-6	2.76E-6
PCB 181	74472-47-2	0.00158[d]	0.00158	4.0E-05	1.0E-04	1.11E-6	2.75E-6
PCB 182	60145-23-5	0.00158[d]	0.00158	4.0E-05	1.0E-04	1.11E-6	2.74E-6
PCB 183	52663-69-1	0.00158[d]	0.00158	4.0E-05	1.0E-04	1.12E-6	2.81E-6

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
PCB 184	74472-48-3	0.00158[d]	0.00158	4.0E-05	1.0E-04	0.42E-6	1.04E-6
PCB 185	52712-05-7	0.00158[d]	0.00158	4.0E-05	1.0E-04	1.11E-6	2.78E-6
PCB 186	74472-49-4	0.00158[d]	0.00158	4.1E-05	1.0E-04	0.45E-6	1.11E-6
PCB 187	52663-68-0	0.00158[d]	0.00158	1.9E-05	5.0E-05	1.11E-6	2.73E-6
PCB 188	74487-85-7	0.00158[d]	0.00158	2.3E-05	5.0E-05	0.39E-6	0.95E-6
PCB 189	39635-31-9	0.000809[e]	0.000809	1.8E-05	5.0E-05	0.75E-6	1.75E-6
PCB 190	41411-64-7	0.00158[d]	0.00158	2.3E-05	5.0E-05	1.29E-6	3.27E-6
PCB 191	74472-50-7	0.00158[d]	0.00158	4.2E-05	1.0E-04	1.10E-6	2.73E-6
PCB 192	74472-51-8	0.00158[d]	0.00158	4.2E-05	1.0E-04	1.10E-6	2.69E-6
PCB 193	69782-91-8	0.00158[d]	0.00158	1.4E-05	5.0E-05	1.11E-6	2.76E-6
PCB 194	35694-08-7	0.00158[d]	0.00158	1.7E-05	5.0E-05	0.73E-6	1.69E-6
PCB 195	52663-78-2	0.00158[d]	0.00158	4.3E-05	1.0E-04	0.73E-6	1.70E-6
PCB 196	42740-50-1	0.00158[d]	0.00158	4.3E-05	1.0E-04	0.36E-6	0.83E-6
PCB 197	33091-17-7	0.00158[d]	0.00158	2.5E-05	1.0E-04	0.36E-6	0.87E-6
PCB 198	68194-17-2	0.00158[d]	0.00158	2.0E-05	1.0E-04	0.37E-6	0.83E-6
PCB 199	52663-75-9	0.00158[d]	0.00158	2.0E-05	1.0E-04	0.37E-6	0.83E-6
PCB 200	52663-73-7	0.00158[d]	0.00158	2.5E-05	1.0E-04	0.36E-6	0.84E-6
PCB 201	40186-71-8	0.00158[d]	0.00158	4.4E-05	1.0E-04	0.36E-6	0.85E-6
PCB 202	2136-99-4	0.00158[d]	0.00158	4.4E-05	1.0E-04	0.35E-6	0.84E-6
PCB 203	52663-76-0	0.00158[d]	0.00158	4.4E-05	1.0E-04	0.36E-6	0.83E-6
PCB 204	74472-52-9	0.00158[d]	0.00158	4.5E-05	1.0E-04	0.36E-6	0.84E-6
PCB 205	74472-53-0	0.00158[d]	0.00158	4.5E-05	1.0E-04	0.69E-6	1.62E-6
PCB 206	40186-72-9	0.00158[d]	0.00158	4.5E-05	1.0E-04	1.55E-6	3.49E-6
PCB 207	52663-79-3	0.00158[d]	0.00158	4.5E-05	1.0E-04	1.19E-6	2.77E-6
PCB 208	52663-77-1	0.00158[d]	0.00158	4.6E-05	1.0E-04	1.19E-6	2.73E-6
PCB 209	2051-24-3	0.00158[d]	0.00158	1.5E-05	5.0E-05	0.48E-6	1.13E-6

[a] DQLs based on the lower of 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or crab decapod thresholds based on tissue-residue TRVs. See Attachment S for

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)

human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors. For PCBs, the MDL and QL are based on extraction of 10 grams per sample. The laboratory detection limit will be based on the sample specific EDL. Actual EDLs will vary based on sample-specific factors, including sample mass.

[d] Based on risk for total PCBs (high risk)

[e] Identified as one of the 12 PCDD-like PCB congeners in the WHO 2005 scheme Van den Berg et al. (2006).

CAS – Chemical Abstract Service
DQL – data quality level
EDL – estimated detection limit
MDL – method detection limit
NA – not available
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
RBC – risk-based concentration
QL – quantitation limit
TEQ – toxic equivalent (as calculated following Van den Berg, et al. (2006))
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
WHO – World Health Organization
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: PCBs - Aroclors, USEPA SW-846 8082, Alpha Analytical, Mansfield, MA

SOP from Worksheet 23: T8

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)
Aroclor 1016	12674-11-2	NA	0.004	NA	NA	0.001	0.004
Aroclor 1221	11104-28-2	NA	0.004	NA	NA	0.002	0.004
Aroclor 1232	11141-16-5	NA	0.004	NA	NA	0.002	0.004
Aroclor 1242	53469-21-9	NA	0.004	NA	NA	0.001	0.004
Aroclor 1248	12672-29-6	NA	0.004	NA	NA	0.001	0.004
Aroclor 1254	11097-69-1	NA	0.004	NA	NA	0.001	0.004
Aroclor 1260	11096-82-5	NA	0.004	NA	NA	0.002	0.004
Aroclor 1262	37324-23-5	NA	0.004	NA	NA	0.002	0.004
Aroclor 1268	11100-14-4	NA	0.004	NA	NA	0.002	0.004

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or crab decapod thresholds based on tissue-residue TRVs (if available). If no toxicity thresholds were available, the DQL was determined to be not available. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available(NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors. Tissue MDLs and QLs are based on sediment MDLs and QLs. The laboratory conducts MDL studies with spikes that go through the extraction and analytical process; therefore, dry weight or wet weight units do not apply.

CAS – Chemical Abstract Service
DQL – data quality level
NA – not available
QL – quantitation limit
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)

MDL – method detection limit TRV – toxicity reference value

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: PCDDs/PCDFs, USEPA 1613B, Analytical Perspectives, Wilmington, NC

SOP from Worksheet 23: T3

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits (29 ± 5 g Sample)		Achievable Laboratory Limits (10 g Sample)[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
1,2,3,4,6,7,8-HpCDD	35822-46-9	2.43E-06[d]	2.43E-06	NA	5.00E-06	7.E-08	1.9E-07	2.10E-07	5.70E-07
1,2,3,4,6,7,8-HpCDF	67562-39-4	2.43E-06[d]	2.43E-06	NA	5.00E-06	2.9E-08	7.0E-08	8.70E-08	2.10E-07
1,2,3,4,7,8-HxCDD	39227-28-6	2.43E-07[d]	2.43E-07	NA	5.00E-06	9.1E-08	2.2E-07	**2.73E-07**	**6.60E-07**
1,2,3,4,7,8-HxCDF	70648-26-9	2.43E-07[d]	2.43E-07	NA	5.00E-06	2.6E-08	6.3E-08	7.80E-08	1.89E-07
1,2,3,4,7,8,9-HpCDF	55673-89-7	2.43E-06[d]	2.43E-06	NA	5.00E-06	4.2E-08	1.0E-07	1.26E-07	3.00E-07
1,2,3,6,7,8-HxCDD	57653-85-7	2.43E-07[d]	2.43E-07	NA	5.00E-06	9.1E-08	2.2E-07	**2.73E-07**	**6.60E-07**
1,2,3,6,7,8-HxCDF	57117-44-9	2.43E-07[d]	2.43E-07	NA	5.00E-06	2.5E-08	6.0E-08	7.50E-08	1.80E-07
1,2,3,7,8,9-HxCDD	19408-74-3	2.43E-07[d]	2.43E-07	NA	5.00E-06	9.4E-08	2.3E-07	**2.82E-07**	**6.90E-07**
1,2,3,7,8,9-HxCDF	72918-21-9	2.43E-07[d]	2.43E-07	NA	5.00E-06	3.2E-08	7.7E-08	9.60E-08	2.31E-07
1,2,3,7,8-PeCDD	40321-76-4	2.43E-08[d]	2.43E-08	NA	5.00E-06	**7.3E-08**	**1.77E-07**	**2.19E-07**	**5.31E-07**
1,2,3,7,8-PeCDF	57117-41-6	8.09E-07[d]	8.09E-07	NA	5.00E-06	6.6E-08	1.63E-07	1.98E-07	4.89E-07
2,3,4,6,7,8-HxCDF	60851-34-5	2.43E-07[d]	2.43E-07	NA	5.00E-06	2.7E-08	6.7E-08	8.10E-08	2.01E-07
2,3,4,7,8-PeCDF	57117-31-4	8.09E-08[d]	8.09E-08	NA	5.00E-06	5.9E-08	**1.47E-07**	**1.77E-07**	**4.41E-07**
2,3,7,8-TCDD	1746-01-6	2.43E-08[d]	2.43E-08	NA	1.00E-06	**3.3E-08**	**7.0E-08**	**9.90E-08**	**2.10E-07**
2,3,7,8-TCDF	51207-31-9	2.43E-07[d]	2.43E-07	NA	1.00E-06	4.0E-08	9.8E-08	1.20E-07	**2.94E-07**
OCDD	3268-87-9	8.09E-05[d]	8.09E-05	NA	1.00E-05	1.2E-07	3.2E-07	3.60E-07	9.60E-07
OCDF	39001-02-0	8.09E-05[d]	8.09E-05	NA	1.00E-05	1.2E-07	3.0E-07	3.60E-07	9.00E-07

[a] DQLs are based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits (29 ± 5 g Sample)		Achievable Laboratory Limits (10 g Sample)[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)

health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors. For PCDDs/PCDFs, the MDL and QL are based on extraction of 29 ± 5 g and 10 grams/sample, respectively. The laboratory detection limit will be based on the sample specific EDL. Actual EDLs will vary based on sample-specific factors, including sample mass.

[d] DQLs for individual PCDDs and PCDFs calculated by dividing the 2,3,7,8-TCDD DQL by its respective mammal toxic equivalence factor (Van den Berg et al. 2006).

CAS – Chemical Abstract Service
DQL – data quality level
EDL – estimated detection limit
HpCDD – heptachlorodibenzo-*p*-dioxin
HpCDF – heptachlorodibenzofuran
HxCDD – hexachlorodibenzo-*p*-dioxin
HxCDF – hexachlorodibenzofuran
MDL – method detection limit
NA – not available
OCDD – octachlorodibenzo-*p*-dioxin
OCDF – octachlorodibenzofuran
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
PeCDD – pentachlorodibenzo-*p*-dioxin
PeCDF – pentachlorodibenzofuran
QL – quantitation limit
RBC – risk-based concentration
TCDD – tetrachlorodibenzo-*p*-dioxin
TCDF – tetrachlorodibenzofuran
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: PAHs, CARB 429 Mod., Maxxam Analytics, Mississauga, ON

SOP from Worksheet 23: T4

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
2-Methylnaphthalene	91-57-6	0.541	0.541	NA	NA	0.0001216	0.001
Acenaphthene	83-32-9	0.24	0.24	NA	NA	0.0001186	0.001
Acenaphthylene	208-96-8	0.24[d]	0.24	NA	NA	0.0001331	0.001
Anthracene	120-12-7	0.24	0.24	NA	NA	0.0000792	0.001
Fluorene	86-73-7	0.24	0.24	NA	NA	0.0003043	0.001
Naphthalene	91-20-3	0.24	0.24	NA	NA	0.0001165	0.001
Phenanthrene	85-01-8	0.24[e]	0.24	NA	NA	0.0001246	0.001
Benzo[a]anthracene	56-55-3	0.00432	0.00432	NA	NA	0.0001307	0.001
Benzo[a]pyrene	50-32-8	0.000432	0.000432	NA	NA	0.0002381	**0.001**
Benzo[b]fluoranthene	205-99-2	0.00432	0.00432	NA	NA	0.0002573	0.001
Benzo[e]pyrene	192-97-2	0.24[f]	0.24	NA	NA	0.0000994	0.001
Benzo[g,h,i]perylene	191-24-2	0.24[f]	0.24	NA	NA	0.0001359	0.001
Benzo[k]fluoranthene	207-08-9[g]	0.0432	0.0432	NA	NA	0.0001935	0.001
Chrysene	218-01-9	0.432	0.432	NA	NA	0.0002475	0.001
Dibenzo[a,h]anthracene	53-70-3	0.000432	0.000432	NA	NA	0.0001729	**0.001**
Fluoranthene	206-44-0	0.24	0.24	NA	NA	0.0003043	0.001
Indeno-[1,2,3c,d]pyrene	193-39-5	0.00432	0.00432	NA	NA	0.0002026	0.001
Perylene	198-55-0	0.24[f]	0.24	NA	NA	0.0001281	0.001
Pyrene	129-00-0	0.24	0.24	NA	NA	0.0002738	0.001
1-Methylnaphthalene	90-12-0	0.11	0.11	NA	NA	0.0001152	0.001
1-Methylphenanthrene	832-69-9	40.60	40.60	NA	NA	0.0000721	0.001
2,3,5-Trimethylnaphthalene	2245-38-7	NA	NA	NA	NA	0.0001275	0.001
2,6-Dimethylnaphthalene	581-42-0	NA	NA	NA	NA	0.0001006	0.001

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Dibenzothiophene	132-65-0	NA	NA	NA	NA	0.0001031	0.001

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available). See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available(NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors. Tissue RL and MDL is based on sediment RL and MDL.

[d] The DQL for this analyte was based on the acenaphthene DQL.

[e] The DQL for this analyte was based on the anthracene DQL.

[f] The DQL for this analyte was based on the pyrene DQL.

[g] Benzo[k]fluoranthene will be reported by the laboratory with a “C” qualifier, indicating that it co-elutes with benzo[j]fluoranthene.

CARB – California Air Resources Board
CAS – Chemical Abstract Service
DQL – data quality level
HRGC/HRMS – high-resolution gas chromatography/high-resolution mass spectrometry
MDL – method detection limit
NA – not available
RBC – risk-based concentration
QL – quantitation limit
TRV – toxicity reference value
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Alkylated PAHs, USEPA SW-846 8270D, Alpha Analytical, Mansfield, MA

SOP from Worksheet 23: T25, T27

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)
C2-Alkylnaphthalenes	NA	0.24	0.24	NA	NA	0.00009	0.001
C3-Alkylnaphthalenes	NA	0.24	0.24	NA	NA	0.00009	0.001
C1-Benzanthracene/chrysenes	NA	0.00432	0.00432	NA	NA	0.00016	**0.001**
C1-Dibenzothiophenes	NA	NA	NA	NA	NA	0.00016	0.001
C1-Fluorenes	NA	0.24	0.24	NA	NA	0.00008	0.001
C1-Phenanthrene/anthracenes	NA	0.24	0.24	NA	NA	0.00012	0.001
C1-Pyrene/fluoranthenes	NA	0.24	0.24	NA	NA	0.00017	0.001
C2-Benzanthracene/chrysenes	NA	0.00432	0.00432	NA	NA	0.00016	0.001
C2-Dibenzothiophenes	NA	NA	NA	NA	NA	0.00006	0.001
C2-Fluorenes	NA	0.24	0.24	NA	NA	0.00008	0.001
C2-Naphthalenes	NA	0.24	0.24	NA	NA	0.00016	0.001
C2-Phenanthrene/anthracenes	NA	0.24	0.24	NA	NA	0.00016	0.001
C3-Benzanthracene/chrysenes	NA	0.00432	0.00432	NA	NA	0.00016	0.001
C3-Dibenzothiophenes	NA	NA	NA	NA	NA	0.00016	0.001
C3-Fluorenes	NA	0.24	0.24	NA	NA	0.00008	0.001
C3-Naphthalenes	NA	0.24	0.24	NA	NA	0.00016	0.001
C3-Phenanthrene/anthracenes	NA	0.24	0.24	NA	NA	0.00012	0.001
C4-Benzanthracene/chrysenes	NA	0.00432	0.00432	NA	NA	0.00016	0.001
C4-Dibenzothiophenes	NA	NA	NA	NA	NA	0.00016	0.001
C4-Naphthalenes	NA	0.24	0.24	NA	NA	0.00016	0.001
C4-Phenanthrenes/anthracenes	NA	0.24	0.24	NA	NA	0.00016	0.001

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available). See Attachment

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)

S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available (NA). DQLs for alkylated PAHs were based on the parent PAHs presented in Worksheet 15. When two compounds were present, the more conservative parent DQL was used.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors. The MDL and QLs are the MDLs and QLs for the parent compound. Tissue MDLs and QLs are based on sediment MDLs and QLs. The laboratory conducts MDL studies with spikes that go through the extraction and analytical process; therefore, dry weight or wet weight units do not apply.

[d] A DQL or project quantitation limit goal could not be established because no toxicity thresholds were available.

AET – apparent effects threshold
CAS – Chemical Abstract Service
DQL – data quality level
ERL – effects range – low
HRGC/HRMS – high-resolution gas chromatography/high-resolution mass spectrometry
MDL – method detection limit
NA – not available
NJDEP – New Jersey Department of Environmental Protection
NOAEL – no-observed-adverse-effect level
PRG – preliminary remediation goal
RBC – risk-based concentration
QL – quantitation limit
SW – solid waste
TEL – threshold effects level
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Organochlorine pesticides, USEPA 1699 Mod. (NYSDEC HRMS-2), Maxxam Analytics, Mississauga, ON

SOP from Worksheet 23: T5, T6, T7

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
2,4'-DDD	53-19-0	0.0131[d]	0.0131	NA	NA	0.0000604	0.0001
2,4'-DDE	3424-82-6	0.00928[d]	0.00928	NA	NA	0.0000376	0.0001
2,4'-DDT	789-02-6	0.00928[d]	0.00928	NA	NA	0.0000113	0.0001
4,4'-DDD	72-54-8	0.0131	0.0131	NA	NA	0.0000197	0.0001
4,4'-DDE	72-55-9	0.00928	0.00928	NA	NA	0.0000200	0.0001
4,4'-DDT	50-29-3	0.00928	0.00928	NA	NA	0.0000156	0.0001
Aldrin	309-00-2	0.000186	0.000186	NA	NA	0.0000151	0.0001
alpha-BHC	319-84-6	0.000501	0.000501	NA	NA	0.0000152	0.0001
beta-BHC	319-85-7	0.00175	0.00175	NA	NA	0.0000177	0.0001
cis-Chlordane	5103-71-9	0.00901[e]	0.00901	NA	NA	0.0000525	0.0001
cis-Nonachlor	5103-73-1	0.00901[e]	0.00901	NA	NA	0.0000655	0.0001
delta-BHC	319-86-8	0.000501[f]	0.000501	NA	NA	0.0000221	0.0001
Dieldrin	60-57-1	0.000197	0.000197	NA	NA	0.0000338	0.0001
Endosulfan I	959-98-8	0.031[g]	0.031	NA	NA	0.0000939	0.0001
Endosufan II	33213-65-9	0.031[g]	0.031	NA	NA	0.0000661	0.0002
Endosulfan sulfate	1031-07-8	0.031[g]	0.031	NA	NA	0.0000170	0.0001
Endrin	72-20-8	0.010	0.010	NA	NA	0.0000307	0.0001
Endrin aldehyde	7421-93-4	0.010[h]	0.010	NA	NA	0.0000531	0.0001
Endrin ketone	53494-70-5	0.010[h]	0.010	NA	NA	0.0000296	0.0001
gamma-BHC (Lindane)	58-89-9	0.00287	0.00287	NA	NA	0.0000123	0.0001
Hexachlorobenzene	118-74-1	0.00197	0.00197	NA	NA	0.0000049	0.0001
Heptachlor	76-44-8	0.000701	0.000701	NA	NA	0.0000124	0.0001

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Heptachlor epoxide	1024-57-3	0.000347	0.000347	NA	NA	0.0000267	0.0001
Methoxychlor	72-43-5	0.05	0.05	NA	NA	0.0005619	0.0001
Oxychlordane	27304-13-8	0.00901[e]	0.00901	NA	NA	0.0000190	0.0001
trans-Chlordane	5103-74-2	0.00901[e]	0.00901	NA	NA	0.0000283	0.0001
trans-Nonachlor	3734-49-4	0.00901[e]	0.00901	NA	NA	0.0000409	0.0001

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

[d] The DQL for this analyte was based on the 4,4'-DDD, 4,4'-DDE or 4,4'-DDT DQL.

[e] The DQL for this analyte was based on the chlordane DQL.

[f] The DQL for this analyte was based on the alpha-BHC DQL.

[g] The DQL for this analyte was based on the endosulfan DQL.

[h] The DQL for this analyte was based on the endrin DQL.

BHC – benzene hexachloride
CAS – Chemical Abstract Service
DQL – data quality level
HRMS – high resolution mass spectrometry
MDL – method detection limit
NYSDEC – New York State Department of Environmental Conservation
RBC – risk-based concentration
QL – quantitation limit
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Metals (ICP/MS), USEPA SW-846 6020, Columbia Analytical Services, Kelso, WA

SOP from Worksheet 23: T9, T10

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Aluminum	7429-90-5	135	135	NA	NA	0.2	2
Antimony	7440-36-0	0.0541	0.0541	NA	NA	0.02	0.05
Arsenic (total)	7440-38-2	0.0021[d]	0.00210	NA	NA	**0.08**	**0.5**
Barium	7440-39-3	27.0	27.0	NA	NA	0.03	0.05
Beryllium	7440-41-7	0.270	0.270	NA	NA	0.007	0.02
Cadmium	7440-43-9	0.135	0.135	NA	NA	0.02	0.02
Cobalt	7440-48-4	0.0406	0.0406	NA	NA	0.003	0.02
Copper	7440-50-8	5.41	5.41	NA	NA	0.08	0.1
Lead	7439-92-1	1.5	1.5	NA	NA	0.008	0.02
Manganese	7439-96-5	18.9	18.9	NA	NA	0.006	0.05
Nickel	7440-02-0	2.70	2.70	NA	NA	0.04	0.2
Silver	7440-22-4	0.676	0.676	NA	NA	0.008	0.02
Thallium	7440-28-0	0.00876	0.00876	NA	NA	0.005	0.02
Titanium	7440-32-6	NA	NA	NA	NA	0.7	2
Zinc	7440-66-6	12.7	12.7	NA	NA	0.09	0.5

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available). See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available(NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

[d] The DQL for this analyte is based on the inorganic arsenic DQL.

CAS – Chemical Abstract Service
DQL – data quality level
ICP/MS – inductively coupled plasma/mass spectrometry
MDL – method detection limit
NA – not available
RBC – risk-based concentration
QL – quantitation limit
SW – solid waste
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Metals (ICP), USEPA SW-846 6010B, Columbia Analytical Services, Kelso, WA

SOP from Worksheet 23: T9, T11

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Calcium	7440-70-2	NA[d]	NA	NA	NA	3	10
Chromium	7440-47-3	0.406[e]	0.406	NA	NA	0.07	0.2
Iron	7439-89-6	94.6	94.6	NA	NA	0.7	2
Magnesium	7439-95-4	NA[d]	NA	NA	NA	0.9	2
Potassium	7440-09-7	NA[d]	NA	NA	NA	10	30
Sodium	7440-23-5	NA[d]	NA	NA	NA	5	20
Vanadium	7440-62-2	0.946	0.946	NA	NA	0.09	0.3

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available). See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available(NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

[d] Essential nutrient.

[e] Value for chromium VI.

CAS – Chemical Abstract Service
DQL – data quality level
ICP – inductively coupled plasma
MDL – method detection limit
NA – not available
RBC – risk-based concentration
QL – quantitation limit
SW – solid waste
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Metals (selenium), USEPA SW-846 7742, Columbia Analytical Services, Kelso, WA

SOP from Worksheet 23: T9, T12

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Selenium	7782-49-2	0.34	0.34	NA	NA	0.02	0.1

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
RBC – risk-based concentration
QL – quantitation limit
SW – solid waste
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Inorganic arsenic, USEPA 1632, Brooks Rand Labs, LLC, Seattle, WA

SOP from Worksheet 23: T13

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Arsenic (inorganic)	7440-38-2	0.00210	0.00210	NA	NA	**0.005**	**0.010**

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
QL – quantitation limit
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Total mercury, USEPA 1631, Brooks Rand Labs, LLC, Seattle, WA

SOP from Worksheet 23: T14, T15

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Mercury	7439-97-6	0.0086	0.0086	NA	NA	0.00004	0.0001

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
QL – quantitation limit
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Methylmercury, USEPA 1630, Brooks Rand Labs, LLC, Seattle, WA

SOP from Worksheet 23: T16

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Methylmercury	22967-92-6	0.0086	0.0086	NA	NA	0.001	0.003

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs. See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project.

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
QL – quantitation limit
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue
Analytical Group, Method, and Laboratory: SVOCs, USEPA 8270C; Alpha Analytical, Mansfield, MA
SOP from Worksheet 23: T17, T18, T19, T20
Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limit[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)
1,1'-Biphenyl	92-52-4	6.76	6.76	NA	NA	0.2	0.4
2,2'-Oxybis (1-Chloropropane)	108-60-1	NA	NA	NA	0.660	0.2	0.4
2,4,5-Trichlorophenol	95-95-4	13.5	13.5	NA	0.66	0.2	0.4
2,4,6-Trichlorophenol	88-06-2	0.135	0.135	NA	0.660	**0.2**	**0.4**
2,4-Dichlorophenol	120-83-2	0.406	0.406	NA	0.660	0.4	**0.8**
2,4-Dimethylphenol	105-67-9	2.70	2.70	NA	0.660	0.2	0.4
2,4-Dinitrophenol	51-28-5	0.270	0.270	NA	3.3	**0.8**	**1.6**
2,4-Dinitrotoluene	121-14-2	0.270	0.270	NA	0.660	0.2	**0.4**
2,6-Dinitrotoluene	606-20-2	0.135	0.135	NA	0.660	**0.2**	**0.4**
2-Chloronaphthalene	91-58-7	10.8	10.8	NA	0.660	0.2	0.4
2-Chlorophenol	95-57-8	0.676	0.676	NA	0.660	0.2	0.4
2-Methylnaphthalene[d]	91-57-6	0.541	0.541	NA	0.66	0.2	0.4
2-Methylphenol	95-48-7	6.76	6.76	NA	0.660	0.2	0.4
2-Nitroaniline	88-74-4	0.0406	0.0406	NA	3.30	**0.2**	**0.4**
2-Nitrophenol	88-75-5	40.6[e]	40.6	NA	0.66	0.2	0.4
3,3'-Dichlorobenzidine	91-94-1	0.00701	0.00701	NA	1.30	**0.2**	**0.4**
3-Nitroaniline	99-09-2	0.0406	0.0406	NA	3.3	**0.2**	**0.4**
4,6-Dinitro-2-methylphenol	534-52-1	0.0135	0.0135	NA	3.30	**0.2**	**0.4**
4-Bromophenyl-phenylether	101-55-3	NA	NA	NA	0.66	0.2	0.4
4-Chloro-3-methylphenol	59-50-7	NA	NA	NA	1.3	0.2	0.4
4-Chloroaniline	106-47-8	0.0584	0.0584	NA	1.3	**0.2**	**0.4**
4-Chlorophenyl-phenyl ether	7005-72-3	NA	NA	NA	0.66	0.2	0.4

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limit[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)
4-Methylphenol	106-44-5	0.676	0.676	NA	0.66	0.2	0.4
4-Nitroaniline	100-01-6	0.0150	0.0150	NA	NA	**0.2**	**0.4**
4-Nitrophenol	100-02-7	40.6	40.6	NA	3.3	0.2	0.4
Acenaphthene[d]	83-32-9	0.24	0.24	NA	0.660	0.2	**0.4**
Acenaphthylene[d]	208-96-8	0.24	0.24	NA	0.660	0.2	**0.4**
Acetophenone	98-86-2	13.5	13.5	NA	NA	0.2	0.4
Anthracene[gd]	120-12-7	0.24	0.24	NA	0.660	0.2	**0.4**
Atrazine	1912-24-9	0.0137	0.0137	NA	NA	**0.2**	**0.4**
Benzaldehyde	100-52-7	13.5	13.5	NA	NA	0.2	0.4
Benzo(a)anthracene[d]	56-55-3	0.00432	0.00432	NA	0.660	**0.2**	**0.4**
Benzo(a)pyrene[d]	50-32-8	0.000432	0.000432	NA	0.660	**0.2**	**0.4**
Benzo(b)fluoranthene[d]	205-99-2	0.00432	0.00432	NA	0.660	**0.2**	**0.4**
Benzo(g,h,i)perylene[d]	191-24-2	0.24	0.24	NA	0.660	0.2	**0.4**
Benzo(k)fluoranthene[d]	207-08-9	0.0432	0.0432	NA	0.660	**0.2**	**0.4**
bis-(2-Chloroethoxy)methane	111-91-1	0.406	0.406	NA	0.660	0.2	0.4
bis-(2-Chloroethyl)ether	111-44-4	0.00287	0.00287	NA	0.660	**0.2**	**0.4**
bis(2-Ethylhexyl)phthalate	117-81-7	0.225	0.225	NA	0.660	0.2	**0.4**
Butylbenzylphthalate	85-68-7	1.24	1.24	NA	0.660	0.2	0.4
Caprolactam	105-60-2	67.6	67.6	NA	NA	0.2	0.4
Carbazole	86-74-8	NA	NA	NA	NA	0.2	0.4
Chrysene[d]	218-01-9	0.24	0.24	NA	0.660	0.2	**0.4**
Dibenzo(a,h)-anthracene[d]	53-70-3	0.000432	0.000432	NA	0.660	**0.2**	**0.4**
Dibenzofuran	132-64-9	NA	NA	NA	0.660	0.2	0.4
Diethylphthalate	84-66-2	1.24	1.24	NA	0.660	0.2	0.4
Dimethylphthalate	131-11-3	NA	NA	NA	0.660	0.2	0.4
Di-n-butylphthalate	84-74-2	0.5	0.5	NA	NA	0.2	0.4
Di-n-octylphthalate	117-84-0	1.24[f]	1.24	NA	0.660	0.2	0.4

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limit[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg)	QL (mg/kg)
Fluoranthene[d]	206-44-0	0.24	0.24	NA	0.660	0.2	**0.4**
Fluorene[d]	86-73-7	0.24	0.24	NA	0.660	0.2	**0.4**
Hexachlorobenzene[g]	118-74-1	0.00197	0.00197	NA	0.660	**0.2**	**0.4**
Hexachlorobutadiene	87-68-3	0.0404	0.0404	NA	0.660	**0.2**	**0.4**
Hexachloroethane	67-72-1	0.135	0.135	NA	0.660	**0.2**	**0.4**
Hexchlorocyclopentadiene	77-47-4	0.811	0.811	NA	0.660	0.2	0.4
Indeno(1,2,3-cd)-pyrene[d]	193-39-5	0.00432	0.00432	NA	0.660	**0.2**	**0.4**
Isophorone	78-59-1	3.32	3.32	NA	0.660	0.2	0.4
Naphthalene[d]	91-20-3	0.24	0.24	NA	0.660	0.2	**0.4**
Nitrobenzene	98-95-3	0.0676	0.0676	NA	0.660	**0.2**	**0.4**
n-Nitroso-di-n-propylamine	621-64-7	0.000451	0.000451	NA	0.660	**0.2**	**0.4**
n-Nitrosodiphenylamine	86-30-6	0.644	0.644	NA	0.660	0.2	0.4
Pentachlorophenol	87-86-5	0.0263	0.0263	NA	3.30	**0.2**	**0.4**
Phenanthrene[d]	85-01-8	0.24	0.24	NA	0.660	0.2	**0.4**
Phenol	108-95-2	40.6	40.6	NA	0.660	0.2	0.4
Pyrene[d]	129-00-0	0.24	0.24	NA	0.660	0.2	**0.4**

[a] DQLs are based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available.). See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available (NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.The laboratory conducts MDL studies with spikes that go through the extraction and analytical process; therefore, dry weight or wet weight units do not apply.

[d] Analyte will also be reported from PAH HRGC/HRMS method, the results of the PAH HRGC/HRMS will take precedence over these results. The analytes 1-methylnaphthalene,1-methylphenanthrene, 2,3,5-trimethylnaphthalene, 2,6-dimethylnaphthalene, benzo(e)pyrene, dibenzothiophene, and perylene, originally listed under this method, will be reported by the PAH HRGC/HRMS method only.

[e] The DQL for this analyte is based on the phenol DQL.

[f] The DQL for this analyte is based on the di-n-butyl phthalate DQL.

[g] Analyte will also be reported from the organochlorine pesticide HRGC/HRMS method, the results from the HRGC/HRMS will take precedence over these results.

CAS – Chemical Abstract Service
DQL – data quality level
HRGC – high-resolution gas chromatography
HRMS – high-resolution mass spectrometry
MDL – method detection limit
NA – not available
QL – quantitation limit
SVOC – semivolatile organic compound
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

Bold indicates chemicals for which the achievable laboratory limits exceed the project quantitation limit goal.

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Butyltins, Krone, et al. (1989), Columbia Analytical Services, Kelso, WA

SOP from Worksheet 23: T21, T22

Concentration Level: Low

Analyte	CAS Number	DQL (mg/kg ww)[a]	Project Quantitation Limit Goal (mg/kg ww)	Analytical Method[b]		Achievable Laboratory Limit[c]	
				MDL (mg/kg ww)	Method QL (mg/kg ww)	MDL (mg/kg ww)	QL (mg/kg ww)
Dibutyl tin	14488-53-0	0.0406[d]	0.0406	NA	NA	0.000091	0.001
Monobuyltin	78763-54-9	0.0406[d]	0.0406	NA	NA	0.00020	0.001
Tetrabutyltin	1461-25-2	0.0406[d]	0.0406	NA	NA	0.00018	0.001
Tributyltin	36643-28-4	0.0406	0.0406	NA	NA	0.00033	0.001

[a] DQLs based on the lower of: 1) USEPA Region 3 fish tissue screening levels, May 2008 (USEPA 2008a), 2) ecological wildlife thresholds back-calculated from dietary TRVs, or 3) ecological fish or decapod thresholds based on tissue-residue TRVs (if available.). See Attachment S for human health consumption-based or ecological-based (for benthos, fish, and wildlife) thresholds (and methods) used to derive DQLs. The Region 3 Fish Tissue Screening Levels were derived using a fish consumption rate of 54 g per day and are based on a target risk level of 1E-06 for potential carcinogens; the Fish Tissue Screening Levels for non-carcinogenic compounds have been divided by 10 (hazard quotient of 0.1) to account for potential additive effects. DQLs (including human health and ecological thresholds presented in Attachment S) are very conservative, generic analytical goals used solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or preliminary remediation goals. These values will be developed in subsequent phases of the project. If no toxicity thresholds were available, the DQL and/or project quantitation limit goal was determined to be not available(NA).

[b] Analytical MDLs and QLs are those documented in validated methods. When the method did not publish a value for either the MDL or QL, the value was determined to be not available (NA).

[c] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual MDLs and QLs will vary based on sample-specific factors.

[d] The DQL for this analyte was based on the tributyltin DQL.

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
RBC – risk-based concentration
QL – quantitation limit
TRV – toxicity reference value
USEPA – US Environmental Protection Agency
ww – wet weight

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Percent moisture, SM2540G Mod., Alpha Analytical, Mansfield, MA

SOP from Worksheet 23: T24

Concentration Level: NA

Analyte	CAS Number	DQL (%)	Project Quantitation Limit Goal (%)	Analytical Method		Achievable Laboratory Limit	
				MDL (%)	Method QL (%)	MDL (%)	QL (%)
Percent moisture	NA	NA	NA	NA	NA	NA	NA

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
QL – quantitation limit
TRV – toxicity reference value
SM – standard method
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 15. Data Quality Levels and Analytical Methods Evaluation (cont.)

Matrix: Tissue

Analytical Group, Method, and Laboratory: Lipids, Bligh-Dyer, Columbia Analytical Services, Kelso, WA

SOP from Worksheet 23: T23

Concentration Level: NA

Analyte	CAS Number	DQL (%)	Project Quantitation Limit Goal (%)	Analytical Method		Achievable Laboratory Limit	
				MDL(%)	Method QL (%)	MDL (%)	QL (%)
Lipids	NA	NA	NA	NA	NA	NA	NA

CAS – Chemical Abstract Service
DQL – data quality level
MDL – method detection limit
NA – not available
QL – quantitation limit
SM – standard methods
TRV – toxicity reference value
USEPA – US Environmental Protection Agency

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	01/16/09	05/01/09	QAPP	05/01/09
Fish community surveys	Windward	08/10/09, 01/18/10, 05/01/10	09/25/09, 02/05/10, 05/20/10	See below for data report deliverable	See below
Preparation and delivery of the fish community survey data report to USEPA	Windward	Upon completion of each sampling event	90 days after sampling complete	Fish community survey data report	90 days after sampling complete
Fish and decapod crustacean tissue collection	Windward	08/10/09	10/03/09	See below for data report deliverable	See below
Preparation and delivery of the tissue chemistry data report to USEPA	Windward	Upon completion of sampling event	90 days after receipt of validated data	Tissue chemistry data report	90 days after receipt of validated data

Note: The projected tissue chemistry data report date is based on the assumption that an individual and composite sample analysis memorandum is approved shortly after completion of the sampling event, and that the analytical data will be available for validation 40 days after the the memorandum is approved.

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 2009 fish community survey and fish and decapod crustacean tissue 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 the PFD (Windward and AECOM 2009). Specific tasks and goals of this effort include the following:

- Collect target fish and decapod crustacean receptor tissues throughout the LPRSA for chemical analyses.
- Conduct three seasonal fish community surveys.
- Perform gross internal/external pathological examinations on fish based on (Hunn 1988) and (USGS 2002) procedures to assist in the interpretation of the health of the fish population in the LPRSA.
- Collect fish eggs for lipid content analysis. These data will be used to evaluate fish egg exposure concentrations, estimated from whole-body tissue concentration, whole-body lipid content, and egg lipid content.
- Collect stomach content samples to identify prey organisms (to the lowest taxonomic level possible) in order to determine the trophic feeding level of each receptor in the LPRSA and to assist in the development of a food web exposure model for higher-trophic-level organisms.

The general sampling design uses two zones based on the preliminary salinity reaches defined in the PFD (Windward and AECOM 2009): the estuarine zone (RM 0 to RM 10) and the freshwater zone (RM 10 to RM 17.4). Each zone is subdivided into 2-mile river reaches, with the exception of the uppermost freshwater reach, which will extend from RM 14 to RM 17.4, and sampling locations are allocated among these reaches. In general, samples will be randomly collected within known or likely habitat areas in each 2-mile river reach identified based on prior field sampling events (Tierra Solutions 1999), on ecological benchmarking surveys (Shisler et al. 2008), and on the 2007 field reconnaissance (described in Worksheet No. 10 of this QAPP).

At least three target bank-specific sampling locations have been identified in each reach (described in Worksheet No. 18); however, additional sampling areas may be identified in the field in order to collect sufficient numbers of fish to meet the tissue mass requirements of the recommended number of samples. Target sampling areas for mummichog will be located in intertidal mudflat areas in the five estuarine reaches; darter/killifish target sampling areas will be located in any available shallow water habitats (mud or sandflats; vegetated shallows) in the three freshwater reaches. The target sampling areas for all species will focus on localized habitat areas (i.e., areas with a radius of approximately 50 ft). This size sampling area is consistent with the ecology of small-home-range fish species such as mummichog (Abraham 1985), with the area of sampling locations specified in FSP2 (Malcolm Pirnie et al. 2006), and EPA's comments (USEPA 2008b), and guidance (USEPA 2000b).

QAPP Worksheet No. 17. Sampling Design and Rationale (cont.)

The number of samples per species (and per tissue type) is presented in Table 11-1 (Worksheet No. 11). Details on the compositing scheme and tissue sample preparation are provided in Attachment O. Details of the sampling approach rationale and sample number calculation are provided in Attachment Q. As requested by USEPA (April 6, 2009), individual fish collected from the field of a size sufficient to meet analytical mass requirements (and QC requirements and splits) will be analyzed as separate samples.

Depending on availability of fish needed for chemistry analysis, additional fish will be collected for the collection of fish eggs. Fish egg composite samples will be submitted to the laboratory for lipid analysis only. An evaluation of fish community literature suggested that gravid mummichog and/or darter species may be present in late summer/early fall. Mummichog may spawn eight or more times in a season that begins in March and ends in the late summer or early autumn (July to September), and one species of killifish (striped killifish) spawns in New Jersey from June through August (Abraham 1985). Mummichog spawning occurs over a period of approximately 5 days on a semi-lunar cycle (during full or new moons) when tides are at their highest. Gravid females are expected to be present in the LPRSA in August when tissue sampling is anticipated to begin. Ten mummichog egg tissue composite samples will be collected in the estuarine zone, and 10 darter/killifish egg tissue composite samples will be collected in the freshwater zone. This number of samples will be sufficient to determine site-specific egg lipid content to model fish egg exposure scenarios.

Depending on availability of fish needed for chemical analysis, additional fish will be collected for the stomach content analysis. Fish stomach composite samples will also be collected for the invertivore/omnivore species (i.e., white perch and channel catfish/brown bullhead) and carnivore/piscivore species (i.e., American eel and largemouth bass) in the estuarine and freshwater zones, respectively. This is a qualitative evaluation to identify the prey items of these fish species. A target of 5 to 10 stomach samples from each species (within its respective zone) will be collected.

Additional fish will be collected during the tissue sampling and first community survey event for the evaluation of fish health evaluation. Gross internal and external pathological observations and examination results will be recorded electronically on the Specimen Data Form (Attachment C) in the field laboratory. Up to five individuals per species collected (including target and non-target species), or the total number of individuals as agreed to with USEPA, will be sacrificed for evaluation of gross internal and external pathological condition. Analyzing target fish species for tissue chemistry will be prioritized over sacrificing these species for the health evaluation. Fish community survey observations will be compiled over three seasonal events. During the first survey and analytical sampling effort, community survey observations will be compiled for all fish caught. A subset of locations sampled during the first community survey will be revisited as part of the second and third (winter and spring) community surveys. A minimum of two sampling locations from each 2-mile reach will be reoccupied over a 2-to-3-week survey effort. The targeted locations and sampling methods (e.g., trotlines, gillnets) to be used during the second and third surveys will be dependent on the catch results of the first sampling event and survey. The results of all community surveys will be reviewed to determine if additional community survey events are needed.

QAPP Worksheet No. 17. Sampling Design and Rationale (cont.)

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 and critical 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 response ("Describe and provide a rationale for choosing the sampling approach"). The information presented here is primarily focused on the sampling protocol and methods that will be used throughout the LPRSA. Sampling locations, and the rationale for each location, are presented in Worksheet No. 18.

Methods to be used at the sampling stations and during the seasonal sampling events will vary depending on field conditions and on targeted species. Methods to be used at the sampling stations and during the seasonal sampling events should be consistent to allow for the direct comparison of fish abundance and density data. Given that sampling techniques favor collection of specific groups or species, multiple methods may need to be employed at each station.

The following protocol will be implemented, as practicable, for conducting fish surveys and collecting tissue, as described in further detail in Attachments J, L, N, and O (Worksheet No. 21). The surveys will be conducted using gillnets, baited eel/minnow and crab/crayfish traps, trotlines, and electrofishing gear. These sampling methods are appropriate for surveying the fish, crab, and crayfish species that inhabit the LPRSA. Gillnets and baited eel/minnow and crab/crayfish traps were used in the fall 1999 and spring 2000 community surveys by Tierra Solutions (2002b). Using trotlines is an effective method of capturing fish, and trotlines may be utilized in the LPRSA. Electrofishing may be used because it is the most efficient non-selective active fish sampling method available for freshwater water bodies. It is adaptable to different sampling conditions (e.g., boat, wading, and shorelines) and is useful at sites where other active methods cannot be used. Electrofishing may be used if the water conductivity is low enough (between 0.04 and 0.4 mS/cm) and the water temperature is not too warm (less than 18°C) for it to be practicable. Supplemental sampling methods, such as hoop nets, may be employed at certain locations depending on the success of the primary methods listed above and at the discretion of the field personnel.

Gillnets:

Gillnetting is a common and effective fishing method used to catch a variety of fish species and sizes. They can be set to fish at any height in the water column. The mesh sizes and shape of a gillnet may vary and can be highly selective for particular sizes of fish. Fish that are smaller than the mesh of the net are able to pass through unhindered, while those that are too large to push their heads through the mesh as far as their gills are not retained. To reduce the size selectivity, which will skew towards specific-sized fish, each gillnet used in field sampling will consist of several mesh sizes.

Gillnets will be deployed suspended at least 1 foot above the river bottom, and placed perpendicular to the shoreline wherever feasible. The nets will be anchored with appropriate weights, and buoy lines will be rigged within 1 to 2 feet of taut with respect to the next predicted high tide following deployment. To comply with federal boating regulations for navigable waterways, buoys will not be

QAPP Worksheet No. 17. Sampling Design and Rationale (cont.)

set in navigation channels of the river. This requirement may influence the actual location of the gillnet deployments. Gillnets will be deployed during the late afternoon to early evening hours and retrieved the following morning, as practicable. Generally, fish activity increases during the night, and the catch retrieved the following day will be more representative of species movement within the area.

Baited eel, minnow, crab and crayfish traps:

The primary goal of using these traps is to catch mummichogs and other small forage fish (e.g., darters, shiners, juvenile sunfish, topminnows), crab, and crayfish. Fish, crab and crayfish collected in these traps will be counted, identified, and examined for external and internal anomalies for the fish community survey and tissue sampling.

Baited eel/minnow traps and crab/crayfish traps will be deployed where ever feasible. The traps will be anchored with weights, and buoy lines will be rigged within 1 to 2 ft of taut, to allow for fluctuations with the next predicted high tide following deployment. Baited traps will be preferentially set during the day on incoming tides, based on the schedule of sampling during the day; traps will be deployed in the late afternoon to early evening hours and retrieved the following morning.

Trotlines:

Trotlines may be used to collect a variety of fish species and sizes. Each trotline will consist of a main line with baited size 4 to size 6 worm hooks. In addition, a variety of bait will be used such as cheese balls, worms, or dough balls. Trotlines will be equipped with anchor weights at each end, and buoy lines rigged within 1 to 2 ft of taut to allow for tidal fluctuations; they will be deployed from a boat and generally set perpendicular to the shore in the late afternoon to early evening and retrieved the following morning because fish activity generally increases at night. Multiple deployments will provide some indication of the variability in catch per unit effort.

Electrofishing:

The suitability of electrofishing will be assessed during the setting of baited traps in the freshwater zones of the LPRSA. If measured *in situ* site conditions such as conductivity and temperature permit it, electrofishing may be employed. Two types of electrofishing gear may be used, depending on the depth of the water. Backpack electrofishing equipment may be used in wadeable water where there are few obstructions (e.g., debris) and the substrate is stable; boat-mounted equipment may be used in deeper water. Electrofishing will be conducted after traps have been checked, during daylight hours, to minimize hazards and potential injuries to field personnel.

Backpack electrofishing equipment consists of a power source and a variable voltage pulsator (VVP) on a backpack frame with an anode and cathode (positive and negative electrodes, respectively) attached to the VVP. The VVP controls the output voltage, amperage, the pulse interval and the pulse duration. The VVP produces half waves so the fish are not exposed to a constant voltage.

QAPP Worksheet No. 17. Sampling Design and Rationale (cont.)

The voltage required is dependent upon the conductivity of the water. Waters with high conductivity or low resistance will require less voltage than will waters with low conductivity. A meter on the VVP will be used to monitor the current between the electrodes. Two types of currents can be used, direct current (DC) and alternating current (AC). Backpack electrofishing requires two certified field technicians. One technician will wear and operate the backpack electroshocker while the second technician will collect stunned fish in a net. At sampling locations where backpack equipment can be deployed, 100-ft segments on opposite banks will be sampled. The technician operating the electroshocker will hold the anode wand in one hand and drag the cathode in the water. The first technician will also be responsible for adjusting VVP settings. The second technician will follow with a fish net and collection bucket to collect the stunned fish and will determine whether the settings are appropriate based upon observed fish response. Initial pulse frequency, duration, and voltage should be on low settings and increased as needed based upon fish response. Any change in VVP settings will be recorded in the field notebook. Voltage will be determined based upon the conductivity of the water and observed fish behavior. All instances of stunned fish will be recorded in the field notebook, including date and time of encounter. The length of time spent at one particular location will also be recorded.

Boat electrofishing requires two certified field technicians working from the boat and a boat operator. Output current and pulse rate will be determined by the water conductivity and fish species and behavior. Field technicians will wear chest waders and electrical safety gloves aboard the boat while they wait for the stunned fish to rise to the surface of the water. Long dip nets will be used to collect the fish. A safety rail will keep the technicians from falling into the water during the electrofishing activities. All fish species stunned and captured will be immediately collected and placed in a collection bucket with site water and air pumps. Any fish that are stunned and observed but not captured/identified (i.e., swim away) will be counted and recorded, as possible, and if fish can be identified.

All fish collected during the first community survey event (which coincides with the tissue sampling event) will be identified in the field and released after examination, with the exception of specimens collected for chemistry analysis or those selected to be sacrificed for external and internal health assessments, stomach content taxonomy, and egg collection.

The fish and crustacean tissue collection effort and the first fish community survey will be conducted in late summer/early fall of 2009. Additional fish community survey events are planned for winter 2009/2010 and spring 2010.

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR1A, near RM 0.4, Kearney Point, east side	Depositional area characterized mostly by silt	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	USEPA requested; targeted mudflat area[e]
LPR1B, near RM 0.5, Kearney Point, east side						USEPA requested; near high total TEQ concentration in surface sediment from 2008 LRC program; targeted mudflat area[e]
LPR1C, near RM 1.25 east side						Targeted mudflat area[e]
LPR1D, near RM 1.25, west side						Targeted mudflat area,[e] reoccupy station sampled by Tierra Solutions in 1999-2000
LPR1E, near RM 1.3, east side						Targeted mudflat area[e]
LPR2A,[f] near RM 1.75, west side	Depositional area characterized mostly by silt, and silt and sand	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Re-occupy station sampled by Tierra Solutions in 1999-2000
LPR2B, near RM 2.3, south side						USEPA requested; targeted mudflat area[e]
LPR2C, near RM 3.1, south side						USEPA requested; near Diamond Alkali site; targeted mudflat area,[e] near station sampled by Tierra Solutions in 1999-2000
LPR2D, near RM 3.25, north side						Re-occupy station sampled by Tierra Solutions in 1999-2000
LPR2E, near RM 3.8, north side						Targeted mudflat area,[e] near station sampled by Tierra Solutions in 1999-2000

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR3 A, near RM 4.75, west side	Depositional area characterized mostly by silt, and sand	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Re-occupy station sampled by Tierra Solutions in 1999-2000
LPR3 B, near RM 5.5, west side						Re-occupy station sampled by Tierra Solutions in 1999-2000
LPR3 C, near RM 4.2, east side						Targeted mudflat area,[e] near station sampled by Tierra Solutions in 1999
LPR3 D, near RM 4.5, east side						Targeted mudflat area[e]
LPR3E, near RM 5.8, east side						USEPA requested; targeted mudflat area[e]
LPR4A, near RM 6.3, east side	Depositional area characterized mostly by silt	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), electrofishing (< 10-ft depth), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Above the uppermost station sampled by Tierra Solutions in 1999-2000; within the predicted transition zone between estuarine and freshwater; represents typical depositional area for this section of the river; targeted mudflat area[e]
LPR4B, near RM 7.3, Riverbank Park, east side						Above the uppermost station sampled by Tierra Solutions in 1999-2000; within the predicted transition zone between estuarine and freshwater; represents typical depositional area for this section of the river; targeted mudflat area[e]
LPR4C, near RM 6.1, west side						Re-occupy station sampled by Tierra Solutions in 1999-2000
LPR4D, near RM 6.9, west side						Targeted mudflat area[e]
LPR4E, near RM 7.7, west side						USEPA requested; targeted mudflat area[e]

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR5 A, near RM 8.7, east side	Depositional area characterized mostly by silt	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), electrofishing (< 10-ft depth), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Represents likely beginning of the freshwater portion of the LPRSA; represents typical depositional area for this section of the river; provides shallow water habitat; potential good sampling area based on observed fish activity during 2007 reconnaissance
LPR5 B, near RM 9.8, east side						Represents likely beginning of the freshwater portion of the LPRSA; represents typical depositional area for this section of the river; provides shallow water habitat; potential good sampling area based on observed fish activity during 2007 reconnaissance; targeted mudflat area[e]
LPR5 C, near RM 8.1, west side						Represents likely beginning of the freshwater portion of the LPRSA near Second River confluence; targeted mudflat area[e]
LPR5D[g], near RM 10.1, east side						Targeted mudflat area[e]

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR6A, near RM 10.7, east side	Depositional area characterized mostly by gravel and sand, and silt and sand	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), electrofishing (< 10-ft depth), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Near the MPI 2005 high-resolution core location; targeted mudflat area[e]
LPR6B, near RM 10.9, east side						Near the MPI 2005 high-resolution core location; targeted mudflat area[e]
LPR6C, near RM 11.2, west side						Represents typical substrate and aquatic habitat for this section of the river; complex habitat with pilings present; near Third River confluence; potential good fish habitat and sampling area observed during the 2007 reconnaissance
LPR6D, near RM 11.4, west side						Represents typical substrate and aquatic habitat for this section of the river; complex habitat with pilings present; above Third River confluence; potential good fish habitat and sampling area observed during the 2007 reconnaissance; targeted mudflat area[e]
LPR6E, near RM 11.7, west side						Represents typical substrate and aquatic habitat for this section of the river; complex habitat with pilings present; above Third River confluence; potential good fish habitat and sampling area observed during the 2007 reconnaissance; targeted mudflat area[e]

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR7 A, near RM 12.5, west side	Depositional area characterized mostly by silt and sand	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), electrofishing (< 10-ft depth), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Represents one of the few depositional areas in this stretch of the river that includes silt; potential good fish habitat and sampling area observed during the 2007 reconnaissance
LPR7B, near RM 12.5, east side						Represents one of the few depositional areas in this stretch of the river that includes silt
LPR7C, near RM 13.2, west side						Represents one of the few depositional areas in this stretch of the river that includes silt; potential good fish habitat and sampling area observed during the 2007 reconnaissance
LPR7D, near RM 13.7, east side						Represents one of the few depositional areas in this stretch of the river that includes silt; potential good fish habitat and sampling area observed during the 2007 reconnaissance

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR8 A, near RM 14.2, east side	Depositional area characterized mostly by gravel and sand	Baited eel/minnow and crab and crayfish traps (oriented on the river bottom), trotlines (oriented on river bottom), electrofishing (< 10-ft depth), and gillnets (deployed > 3-ft depth)	PCDDs/PCDFs, metals (including inorganic arsenic and butyltins), PCB congeners, organochlorine pesticides, PCB Aroclors, PAHs, alkylated PAHs, SVOCs (including phthalates), percent lipids, percent moisture, total mercury, and methylmercury	Varies[d]	1 – 10	Represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel; targeted mudflat area[e]
LPR8 B, near RM 15.2, east side						Represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel
LPR8 C, near RM 15.6, west side						Represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel; near Saddle River confluence
LPR8D, near RM 16.1, west side						USEPA requested location, which will be refined in the field under oversight guidance; represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel
LPR8E, near RM 16.7, east side						USEPA requested location, which will be refined in the field under oversight guidance; represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table (cont.)

Sampling Location/ID Number[a]	Substrate[b]	Fishing Method	Analytical Group(s)	Number of Samples	Sampling SOP Reference[c]	Rationale for Sampling Location
LPR8F, near RM 17, west side						USEPA requested location, which will be refined in the field under oversight guidance; represents typical substrate and aquatic habitat for this section of the river; represents beginning of transition in substrate type to more gravel and sand mix with areas of rock and coarse gravel

[a] Target coordinates for each of the 39sampling locations are provided in Attachment J. Additional sampling locations in each sampling area may be added based on field conditions and *in situ* observations, and targeted species for collection may not be collected from all proposed target sampling locations. All sampling locations are bank-specific.

[b] Substrate type is based on Malcolm Pirnie (2006); substrate classification of stations that are not re-occupying previously sampled locations may be uncertain.

[c] Refer to Project Sampling SOP References table (Worksheet No. 21).

[d] For benthic omnivores and other feeding guilds, the number of samples will be collected within each zone varies. Refer to Table 11-1 in Worksheet No. 11 for details.

[e] Targeted mudflat areas (or shallow water habitats), where available, will be targeted for the collection of benthic omnivores (i.e., target species are mummichog in the estuarine zone and darter or killifish species in the freshwater zone).

[f] Sampling station is located in Reach 1 but is part of the mudflat area in Reach 2. Samples collected will be included with those in Reach 2.

[g] Sampling station is located in Reach 6 but is part of the mudflat area in Reach 5. Samples collected will be included with those in Reach 5.

ID – identification
LPRSA – Lower Passaic River Study Area
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
RM – river mile
SOP – standard operating procedure
SVOC – semivolatile organic compound

QAPP Worksheet No. 19. Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	SOP Reference	Sample Size[a]	Containers (number, size, and type) [b]	Preservation Requirements (chemical, temperature, light protected) [c]	Maximum Holding Time (preparation/ analysis)[d]
Tissue	PCBs – congeners	Low	T2	10 g minimum	One 2oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis at laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	PCBs – Aroclors	Low	T8	10 g minimum	One 2 oz WM glass jar	Frozen in the dark at < 0°C until analysis at laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	PCDDs/PCDFs	Low	T3	30 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis at laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	PAHs	Low	T4	10 g minimum	One 2oz. WM clear or amber glass jar	Frozen in the dark at <0°C until analysis at laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	Alkylated PAHs	Low	T26, T27	10 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis at laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	Organochlorine pesticides	Low	T5, T6, T7	10 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year to extract, 40 days to analysis
Tissue	Metals	Low	T9, T10, T11, T12	10 g minimum	One 2 oz. WM glass or plastic jar, clear or amber	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen

QAPP Worksheet No. 19. Analytical SOP Requirements Table (cont.)

Matrix	Analytical Group	Concentration Level	SOP Reference	Sample Size[a]	Containers (number, size, and type)[b]	Preservation Requirements (chemical, temperature, light protected)[c]	Maximum Holding Time (preparation/ analysis)[d]
Tissue	Inorganic arsenic	Low	T13	5 g minimum	One 2 oz. WM glass or plastic jar, clear or amber	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen
Tissue	Total mercury	Low	T14, T15	5 g minimum	One 2 oz. WM glass or plastic jar, clear or amber	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen
Tissue	Methylmercury	Low	T16	5 g minimum	One 2 oz. WM glass or plastic jar, clear or amber	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen
Tissue	SVOCs	Low	T17, T18, T19, T20	10 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	Butyltins	Low	T21, T22	5 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year to extract if frozen, 40 days to analysis
Tissue	Lipids	Low	T23	5 g minimum	One 2 oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen
Tissue	Percent moisture	Low	T24	5 g minimum	One 2oz. WM clear or amber glass jar	Frozen in the dark at < 0°C until analysis in laboratory and during shipment	1 year if frozen

[a] Sample sizes may not allow for re-extractions if necessary, or required batch QC samples. Smaller sample sizes may be analyzed resulting in higher reporting limits and detection limits.

QAPP Worksheet No. 19. Analytical SOP Requirements Table (cont.)

[b] Only one sample container will be submitted to each laboratory. When multiple analyses are conducted at any given laboratory, the aliquots for each analysis will be taken from the single sample container. Container size may be modified at the discretion of the laboratory to accommodate small sample masses.. 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.

[c] Tissue samples for chemical analyses will be frozen upon collection and thawed or partially thawed for processing and homogenization. After homogenization, tissues will be refrozen in containers for shipment to the analytical laboratories. Tissues will remain frozen until extraction/preparation for analysis.When frozen samples for chemical analysis are couriered and the transit time is guaranteed to be less than 24 hours, wet ice may be used as a preservative. Based on communications between USEPA and CPG, ice requirements will be agreed upon prior to shipment of homogenates from Alpha Analytical to the other laboratories via overnight delivery.

[d] Holding times are in calendar days. Any remaining tissue mass will be archived frozen.

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

PCDD – polychlorinated dibenzo-*p*-dioxin

PCDF – polychlorinated dibenzofuran

SOP – standard operating procedure

WM – wide mouth

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

Matrix	Analytical Group	Conc. Level	SOP Reference[a]	No. of Samples	No. of Matrix Duplicates[b]	No. of MS/MSD	No. of Rinsate Blanks[c]	Certified Reference Material	Total No. of Samples to Lab
Tissue	PCB congeners	Low	T2	401	18	0/0	10	20	449
Tissue	PCB Aroclors	Low	T8	401	18	18/18	10	0	465
Tissue	PCDDs/PCDFs	Low	T3	401	18	0/0	10	20	449
Tissue	Butyltin compounds	Low	T21, T22	401	18	18/18	10	0	465
Tissue	PAHs	Low	T4	401	18	0/0	10	20	449
Tissue	Alkylated PAHs	Low	T26, T27	401	18	18/18	10	20	485
Tissue	SVOCs	Low	T17, T18, T19, T20	401	18	18/18	10	20	485
Tissue	Metals	Low	T9, T10, T11, T12	401	18	18/0	10	20	467
Tissue	Inorganic arsenic	Low	T13	401	36	36/36	10	20	539
Tissue	Methylmercury	Low	T16	401	36	36/36	10	20	539
Tissue	Total mercury	Low	T14, T15	401	36	36/36	10	20	539
Tissue	Organochlorine pesticides	Low	T5, T6, T7	401	18	0/0	10	20	449
Tissue	Lipids	Low	T23	401 + 20 egg composites	18	0/0	0	21	460
Tissue	Percent moisture	Low	T24	401	18	0/0	0	0	419

Note: Trip blanks will not be collected because they are not applicable to solid samples.

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

[b] After homogenization, sample masses will be reviewed, and samples will be selected for USEPA splits and matrix-specific QC samples (MD, MS, and MSD). Matrix-specific QC samples will be analyzed at a rate of approximately one sample per 20 per matrix type (unless the

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

analytical method requires more) as sample mass permits. In order to have enough mass for QC samples, sample mass must be at least three times the post-homogenization minimum target mass.

[c] Matrix-specific QC will not be required for rinsate samples. Rinsate samples will be collected at a rate of one per 40 samples.

MD – matrix duplicates
MS – matrix spikes
MSD – matrix spike duplicates
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
QC – quality control
SVOC – semivolatile organic compound

QAPP Worksheet No. 21. Project Sampling SOP References Table

SOP Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	Locating Sample Points Using a Hand-Held Global Positioning System (GPS) SOP, (July 2007), Revision 0	Windward	hand-held GPS unit	N	Attachment G; for use with backpack electrofishing gear and boat operations
2	Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS) (July 2007), Revision 0	Windward	Trimble Geo XT (or similar unit) with related cable and power supply	N	Attachment H; for use with boat-based operations
3	Procedures to Decontaminate Biological Sampling Equipment SOP (July 2007), Revision 0	Windward	nets and traps, fish boards, scales, and any equipment that comes into contact with fish, crab or crayfish	N	Attachment I
4	Fish Surveys, Collection, and Tissue Sampling. SOP (July 2007), Revision 0	Windward	sampling vessel, trotlines and minnow and crayfish traps	N	Attachment J
5	Management and Disposal of Investigation-Derived Waste SOP (July 2007), Revision 0	Windward	open-top drums, storage racks, and insulated coolers	N	Attachment K
6	Fish Collection by Backpack and Boat Electrofishing SOP (July 2007), Revision 0	Windward	electrofishing unit	N	Attachment L
7	Procedures for Chain-of-Custody (COC) Tracking and Sample Shipping SOP (July 2007), Revision 0	Windward	COC forms, custody seals, sample containers, packaging supplies and coolers	N	Attachment M
8	Crab and Crayfish Collection and Tissue Sampling SOP (July 2007), Revision 0	Windward	sampling vessel, crab and crayfish traps and supplies	N	Attachment N

QAPP Worksheet No. 21. Project Sampling SOP References Table (cont.)

SOP Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
9	Laboratory Processing of Fish and Decapod Tissue Composites and Homogenization (April 2002), Revision 0	Alpha Analytical	Scalpel, tissue grinder, glove box	N	Attachment O
10	Documenting Field Activities SOP (March 2009), Revision 0	Windward	Wireless recording device (e.g., laptop), bound waterproof logbooks, electronic field data forms, camera	N	Attachment P

QAPP Worksheet No. 22. Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Attachment[a]
GPS receiver	The GPS receiver is calibrated automatically, using satellite signals, each time it is powered on.	Keep one set of fresh batteries available at all times. Keep dirt and dust away from GPS receiver.	Vessel will be stationed at the check point to verify GPS position with known land-survey coordinates.	Confirm there are no cracks in the unit and that the antenna has not been damaged.	Each time unit is powered on	GPS receiver is suitable for use if it is reporting coordinates, indicating it is receiving signals from three independent GPS satellites.	If unit will not obtain a coordinate lock, move to an unobstructed location. If no unobstructed location is available, consider recording position at nearby unobstructed location and measuring horizontal offset which can be used to correct the measured position later.	FC or designee	G, H
Eel/minnow traps	Not applicable	Decontami-nation	Not applicable	Inspect for physical damage that may compromise effectiveness of traps	Daily, prior to use	Trap is undamaged	Repair damage, if possible, or replace trap as necessary	FC or designee	I, J
Trotlines and hooks	Not applicable	Decontami-nation	Not applicable	Inspect for physical damage that may compromise effectiveness of trotline	Daily, prior to use	Lines and hooks are undamaged	Repair damage, if possible, or replace as necessary	FC or designee	I, J

QAPP Worksheet No. 22. Field Equipment Calibration, Maintenance, Testing, and Inspection Table (cont.)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Attachment[a]
Crab/crayfish traps	Not applicable	Decontami-nation	Not applicable	Inspect for physical damage that may compromise effectiveness of traps	Daily, prior to use	Trap is undamaged	Repair damage, if possible, or replace trap as necessary	FC or designee	I, N
Electrofishing equipment	Calibration is performed by the manufacturer	For backpack electrofishing unit, recharge batteries at the end of each day, and have back-up batteries on hand; for boat-mounted equipment, ensure sufficient fuel is available for sustained operation (refer to SOP Section V)	Confirm that all gauges are operating correctly (refer to SOP Section IV)	Visually inspect all external wiring, cables, and connectors for physical damage before each use (refer to SOP Section VII)	Daily, prior to use	Unit may be used if there is no obvious physical damage and gauges are operating correctly.	If equipment is not operating correctly, repair if possible, or suspend electrofishing operations until repairs can be made	FC or designee (backpack equipment) or boat operator (boat-mounted equipment)	L
Fish measuring board	Not applicable	Decontami-nation	Not applicable	Verify that measurement markings are not worn away and remain legible	Daily, prior to use	Measure to 1 mm accuracy	Replace illegible fish boards as necessary	FC or designee	I, J

QAPP Worksheet No. 22. Field Equipment Calibration, Maintenance, Testing, and Inspection Table (cont.)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Attachment[a]
Electronic scale	Calibrate scale using calibration weights; calibration weights will bracket the expected fish or crayfish weights	Decontami-nation; keep one set of fresh batteries available at all times.	Not applicable	Inspect for physical damage that may compromise accuracy	Daily, prior to use	Measure to 1 g accuracy	If scale cannot be calibrated, install new batteries and recalibrate. If scale can still not be calibrated, continue with planned fish community sampling and obtain a new scale at the earliest opportunity.	FC or designee	I, J

[a] Refer to Project Sampling SOP References table (Worksheet No. 21).

FC – Field Coordinator

GPS – global positioning system

SOP – standard operating procedure

QAPP Worksheet No. 23. Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T1	OP-003, Tissue Preparation and Homogenization, Revision 0.0, 4/25/02	N/A	N/A	Glass or polyethylene cutting board; Black & Decker food processor with titanium small blade; Osterizer® blender with large stainless steel blades; ceramic, stainless steel, or titanium knives; Omni-GLH grinding unit with stainless steel or titanium saw tooth probes; Janke & Kunkel IKA tissuemizer	Alpha Analytical	N
T2	AP-CM-7, High Resolution Mass Spectrometry, Method 1668A for Solid/Air/Aqueous/Tissue Matrices, Revision 7, 2/14/05	Definitive	PCBs	Micromass Autospec Ultima high-resolution mass spectrometers	Analytical Perspectives	N
T3	AP-CM-5, Polychlorinated dibenzo dioxin/furans, USEPA Methods 8290, 1613, 23, 0023A, & TO-9A, Revision 12-5, 1/7/09	Definitive	PCDDs/PCDFs	Micromass Autospec Ultima high-resolution mass spectrometers	Analytical Perspectives	N
T4	BRL SOP-00423, PAH Compounds by HRGC/HRMS in Food Products, Sediments, and Water, 4/13/09	Definitive	PAHs	VG Autospec high-resolution mass spectrometer or Autospec Ultima Hewlett Packard 5890 Series II gas chromatograph or HP 6890 gas chromatograph autosampler	Maxxam Analytics	N
T5	BRL SOP-00003, Cleanup of Sample Extract Using Gel Permeation Chromatography, 4/13/09	Definitive	Pesticides	Gel permeation chromatograph autoprep and Model 1002B or J2Scientific AccuPrep MPS GPC system	Maxxam Analytics	N
T6	BRL SOP-00010, Extraction Organochlorine Pesticides from Liquids and Solids, 4/13/09	Definitive	Pesticides	Cal-Glass LG-6900 Soxhlet (or equivalent), Cal-Glass LG-6901-122 thimble, and 500 mL round-bottom flask	Maxxam Analytics	N

QAPP Worksheet No. 23. Analytical SOP References Table (cont.)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T7	BRL SOP-00415, OC Pesticides by HRMS, 4/13/09	Definitive	Pesticides	Hewlett Packard high-resolution gas chromatograph, Model: 6890A, 6890, 6890D, 6890N, 5690 Series II, or 6890A Plus; with an HR mass spectrometer Micromass Autospec Ultima or VG AutoSpec "S"	Maxxam Analytics	N
T8	SOP No. O-012, Determination of Polychlorinated Biphenyls (PCBs) as Aroclors or Congeners By Gas Chromatography/Electron Capture Detection (GC-ECD), Revision 2.0, 2/11/08	Definitive	PCB – Aroclors	Hewlett Packard HP 5890 Series II Gas Chromatograph, HP 6890 Puls or similar, HP 6890 series autosampler with controller or equivalent	Alpha Analytical	N
T9	MET-TDIG, Standard Operating Procedure for Sample Preparation of Biological Tissue for Metals Analysis by GFAA, ICP-OES, and ICP-MS, Revision 1, 2/27/2002	Definitive	Total metals	Teflon® Closed Vessel Microwave or conventional oven	CAS, Kelso	N
T10	MET-6020, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS); EPA Method 6020, Revision 12, 9/26/2008	Definitive	Total metals	Thermo ICP/MS (VG PQ-S or ExCell or X-Series model)	CAS, Kelso	N

QAPP Worksheet No. 23. Analytical SOP References Table (cont.)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T11	MET-ICP, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP), Revision 20, 9/26/2008	Definitive	Total metals	Thermo Jarrell ash atomic emission spectrometer (ICAP-61 or IRIS model)	CAS, Kelso	N
T12	MET-7742, Standard Operating Procedure for Selenium by Borohydride Reduction Atomic Absorption, Revision 2, 1/6/2006	Definitive	Total metals	Varian SpectrAA-20 atomic absorption spectrometer	CAS, Kelso	N
T13	SOP No.BR-0021, BRL Procedure for the Analysis of Water, Sediment, and Tissue by EPA Method 1632, Revision A (1/01): Chemical Speciation of Arsenic in Water and Tissue by Hydride Generation Quartz Furnace Atomic Absorption Spectrometry, Revision 004, 1/19/09	Definitive	Inorganic arsenic	Perkin Elmer 703 atomic absorption spectrometer	Brooks Rand Labs	Y, modified to exclude method blank correction
T14	SOP No.BR-002, BRL Procedure for EPA Method 1631, Appendix: Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation by Cold Vapor Atomic Fluorescence Spectrophotometry (CVAFS), Revision 010a, 9/08/08	Definitive	Total mercury	BRL Model III cold vapor atomic fluorescence spectrophotometer	Brooks Rand Labs	N

QAPP Worksheet No. 23. Analytical SOP References Table (cont.)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T15	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 004, 8/08/08	Definitive	Total mercury	BRL Model III cold vapor atomic fluorescence spectrophotometer	Brooks Rand Labs	N
T16	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 012a, 9/5/08	Definitive	Methyl-mercury	BRL Model III cold vapor atomic fluorescence spectrophotometer	Brooks Rand Labs	N
T17	SOP No.OP-016, Microscale Solvent Extraction (MSE), Revision 2, February 12, 2008	Definitive	SVOCs	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	N
T18	SOP No.OP-006, Gel Permeation Chromatography Method 3640A, Revision 1.0, February 11, 2008	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	N

QAPP Worksheet No. 23. Analytical SOP References Table (cont.)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T19	SOP No.OP-014, Silica Gel Cleanup Procedure (Automated and Manual), Revision 1.1, May 2, 2008	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	N
T20	SOP No.O-006, Method 8270, Semivolatile Organic Compounds by GC/MS, Revision 4.0, February 11, 2008	Definitive	SVOCs	Agilent 6890 GC with Agilent 5973 detector	Alpha Analytical	N
T21	SOP No.SOC-OSWT, Extraction of Organotins in Sediment, Water, and Tissue Matrices, Revision 5, 1/20/06	Definitive	Butyltins	Nitrogen evaporator, centrifuge, Kuderna-Danish apparatus, vacuum pump and manifold, water bath, vortex and tumbler for VOA vials	CAS, Kelso	N
T22	SOP No.SOC-BUTYL, Butyltins, Revision 8, 7/31/07	Definitive	Butyltins	Hewlett Packard 5890 gas chromatograph with a flame photometric detector	CAS, Kelso	N
T23	SOP No. SOC-LIPID, Percent Lipids in Tissue, Revision 1, April 30, 2007	Definitive	Lipids	Analytical balance capable of weighing to the nearest 0.0001 g	CAS, Kelso	N
T24	SOP No.W-001, Percent Solids Determination, Revision 3, 5/4/07	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	N
T25	SOP No. G-003, Balance Calibration and Maintenance	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	N

QAPP Worksheet No. 23. Analytical SOP References Table (cont.)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T26	SOP No. O-008. Analysis of Parent and Alkylated Polynuclear Aromatic Hydrocarbons, Selected Heterocyclic Compounds, Steranes, Triterpanes, and Triaromatic Steroids by GC/MS – SIM, Revision 4, 10/08/08	Definitive	Alkylated PAHs	GC Model Agilent/HP6890 or equivalent, Mass spectrometer Agilent/HP5973 or equivalent	Alpha Analytical	N
T27	SOP OP-009. Alumina Column Cleanup of Organic Extracts, Revision 1.0 4/17/08	Definitive	Alkylated PAHs	Glass preparation column, muffle furnace, top-loading balance of weighing to the nearest 0.01 g	Alpha Analytical	N

CAS – Columbia Analytical Services, Inc.
N/A – not applicable
PAH – polycyclic aromatic hydrocarbon
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
SOP – standard operating procedure
SVOC – semivolatile organic compound
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]
HRGC/HRMS – PCB congeners	Refer to Analytical Perspectives SOP No.AP-CM-7.	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met; CCV daily at beginning of 12-hour analytical batch	ICAL: %RSD ≤ 20% for target analytes calculated by isotope dilution or ≤ 35% for target analytes calculated by internal standard. CCV: ≤ 20% drift for toxic congeners or ≤ 50% drift for non-toxic congeners	Inspect system; correct problem; rerun calibration and affected samples.	Bryan Vining (or alternate analyst), Analytical Perspectives	T2
HRGC/HRMS – PCDDs/PCDFs	Refer to Analytical Perspectives SOP No.AP-CM-5.	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met; CCVs daily at beginning and end of 12 hour analytical batch	Initial Calibration: %RSD $\underline{<}$ 10% for native standards or $\underline{<}$ 20% for extraction standards CCV: Refer to Method 1613	Inspect system; correct problem; rerun calibration and affected samples.	Bryan Vining (or alternate analyst), Analytical Perspectives	T3
HRGC/HRMS – PAHs	Refer to Maxxam Analytics BRL SOP-00423	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met; CCV daily at beginning of 24 hour analytical batch	ICAL: %RSD ≤ 30% for unlabeled standards and internal standards CCV: ≤ 30% drift	Inspect system; correct problem; rerun calibration and affected samples.	Owen Cosby (or alternate analyst), Maxxam Analytics	T4
HRGC/HRMS – organochlorine pesticides	Refer to Maxxam BRL SOP-00415	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met; CCV daily at beginning of 12 hour analytical batch	ICAL: %RSD ≤ 35% CCV: ≤ 50% drift	Inspect system; correct problem; rerun calibration and affected samples	Owen Cosby (or alternate analyst), Maxxam Analytics	T7

QAPP Worksheet No. 24. Analytical Instrument Calibration Table (cont.)

Instrument/ Chemical	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[a]
GC/ECD (PCB-Aroclors)	Refer to Alpha Analytical SOP O-012	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met; CCV daily at beginning of 12-hour analytical batch	Initial calibration: %RSD ≤ 20% CCV: ≤15% drift	Inspect system; correct problem; rerun calibration and affected samples	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	T8
GC/MS-SIM – alkylated PAHs	Refer to Alpha Analytical SOP O-008.	Initial calibration before analysis of sample extracts, initial calibration check standard (CCC) following calibration curve; CCV at the beginning and end of every analytical sequence and every 24 hours within the sequence	ICAL: 25% RSD for 90% of all target compounds, with the exception for 10% between 25% RSD and 25% RSD CCC: ± 20% of true values CCV: Compare the CCV resulting response against the average response for the initial calibration for each calibrated PAH; the percent difference for each calibrated PAH must be < 25%, with no more than 10% of all compounds > 25% but < 35%	Inspect system, correct problem, rerun calibration and affected samples	Analyst or Susan O'Neil or Andrew Cram, Alpha Analytical	T26
ICP/MS –metals	Refer to CAS-Kelso Method MET-6020	Calibration and ICV daily; CCV at beginning and end of analytical batch and once every 10 samples	CRA: % recovery ±100% ICV: 90 – 110% recovery CCV: 90 – 110% recovery	Inspect system; correct problem; re-run calibration and affected samples	Jeff Coronado (or alternate analyst), CAS Kelso	T10
ICP –metals	Refer to CAS-Kelso Method MET-ICP	Calibration and ICV daily; CCV at beginning and end of analytical batch and once every 10 samples	CRA: % recovery ±100% ICV: 90 – 110% recovery CCV: 90 – 110% recovery	Inspect system; correct problem; re-run calibration and affected samples	Jeff Coronado (or alternate analyst), CAS Kelso	T11

QAPP Worksheet No. 24. Analytical Instrument Calibration Table (cont.)

Instrument/ Chemical	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[a]
AAS – selenium	Refer to CAS-Kelso Method MET-7742	Calibration and ICV daily; CCV at beginning and end of analytical batch and once every 10 samples	Correlation coefficient of standard curve $\geq$ 0.995 ICV: 90 – 110% recovery CCV: 90 – 110% recovery	Inspect system; correct problem; re-run calibration and affected samples	Jeff Coronado (or alternate analyst), CAS Kelso	T12
AAS – inorganic arsenic	Refer to USEPA Method 1632 Revision A	Calibration and ICV daily; CCV at beginning and end of analytical batch and once every 10 samples	ICAL: RSD of response factors ≤ 20% ICV: 80 – 120% recovery CCV: 80 – 120% recovery for As^{3+} and MMA; 70 – 130% recovery for DMA	Inspect system, correct problem. Recalibrate and rerun affected samples.	Michela Powell (or alternate analyst), Brooks Rand	T13
CVAFS – total mercury and methylmercury	Refer to Brooks Rand Labs SOPs, No.BR-0002, and No.BR-0011	Calibration and ICV daily; CCV at beginning and end of analytical batch and once every 10 samples	ICAL: RSD of response factors ≤15%; low standard % recovery 75 – 125% for total mercury or 65 – 135% for methylmercury ICV: 85 – 115% recovery for total mercury or 80 – 120% recovery for methylmercury CCV: 77 – 123% recovery for total mercury or 67 – 133% recovery for methylmercury	Inspect system, correct problem. Recalibrate and rerun affected samples.	Annie Carter, (or alternate analyst) Brooks Rand Labs	T14 and T16

QAPP Worksheet No. 24. Analytical Instrument Calibration Table (cont.)

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 No.O-006.	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met.	ICAL: ≤ 15% RSD for all target analytes or linear/quadratic curve r value ≥ 0.990, ≤ 30% for CCC's (allowed 20% of remaining compounds > 30% and the average of 15% for all compounds except CCCs). ICV: ±20% recovery of the true values. Sporadic marginal failures accepted CCV: ≤ 30%D for target analytes, ≤ 20% for CCCs; SPCC minimum avg. RF.	Inspect system; correct problem; rerun calibration and affected samples.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	T20
GC/FPD – butyltins	Refer to CAS SOP No.SOC-BUTYL.	Initial calibration and ICV daily; CCV at beginning of analytical batch (unless ICAL begins 12 hour analytical batch), every 12 hours, and/or every 10 samples, whichever is more frequent; closing CCV required when butyltins are detected in project samples	ICAL: ≤ 20% RSD for all target analytes or linear/quadratic curve r value ≥ 0.990 ICV: ±25% recovery of the true values CCV: ±25% drift for target analytes	Inspect system; correct problem; rerun calibration and affected samples.	Jeff Grindstaff (or alternate analyst), CAS Kelso	T22
Analytical balance –percent moisture	Refer to Alpha Analytical SOP No.G-003	Calibrate monthly, check calibration daily	0.1% of true value	Clean, level, and tare the balance; repeat procedure; if acceptance criteria is not met, balance must not be used for project samples; correct problem in consultation with laboratory QA staff	Nancy Rose (or alternate analyst), Alpha Analytical	T25

QAPP Worksheet No. 24. Analytical Instrument Calibration Table (cont.)

Instrument/ Chemical	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[a]
Top-loading balance – percent moisture	Refer to Alpha Analytical SOP No.G-003	Calibrate monthly, check calibration daily	1% of true value	Clean, level, and tare the balance; repeat procedure; if acceptance criteria is not met, balance must not be used for project samples; correct problem in consultation with laboratory QA staff	Nancy Rose (or alternate analyst), Alpha Analytical	T25
Analytical balance –percent lipids	Refer to CAS SOP No. SOC-LIPID	Calibration checks are performed daily for each day analyses are performed.	0.1% of true value	Clean, level, and tare the balance; repeat procedure; if acceptance criteria is not met, balance must not be used for project samples; correct problem in consultation with laboratory QA staff	Greg Salata (or alternate analyst), CAS Kelso	T23

[a] From Analytical SOP References table (Worksheet No. 23).

As^{3+} – arsenite
AAS – atomic absorption spectrometer
CCC – continuing calibration criteria
CCV – continuing calibration verification
CVAFS – cold vapor atomic fluorescence spectrometer
DMA – dimethylated arsenic
GC-ECD – gas chromatograph/electron capture detector
GC/MS – gas chromatograph/mass spectrometer
GC/FID – gas chromatograph/flame ionization detector
HRGC/HRMS – high-resolution gas chromatograph/high-resolution mass spectrometer
ICAL – initial calibration
ICV – initial calibration verification
ICP – inductively coupled plasma
MMA – monomethylated arsenic
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
RF – response factor
RSD – relative standard deviation
SIM – selective ion monitoring
SVOC – semivolatile organic compound

QAPP Worksheet No. 25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HRGC/HRMS	Clean sources; maintain vacuum pumps	See SOP	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Bryan Vining (or alternate analyst), Analytical Perspectives, Owen Cosby (or alternate analyst), Maxxam Analytics	T2, T3, T7
GC/MS	Clean sources and quadrupole rods; maintain vacuum pumps	See SOP	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Owen Cosby, (or alternate analyst) Maxxam Analytics	T4
GC/ECD	Change septa, clean injectors, change or trim columns, install new lines	See SOP	Instrument performance and sensitivity	Daily or as needed	See SOP	See SOP	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	T8
ICP/MS	Cone removal and cleaning, clean ICP glassware and fittings, clean RF contact strips, clean air and oil mist filters, check rotary pump oil, clean extraction lens and ion lens stack, check electron multiplier.	See SOP	Check connections	Daily or as needed	See SOP	See SOP	Jeff Coronado, (or alternate analyst) CAS Kelso	T10

QAPP Worksheet No. 25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (cont.)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP	Clean torch, nebulizer and spray chamber. Clean instrument and water filters.	See SOP	Check connections	Daily or as needed	See SOP	See SOP	Jeff Coronado (or alternate analyst), CAS Kelso	T11
AAS	Clean the nebulizer and burner head, clean the gas liquid separator, inspect hollow cathode and deuterium lamps.	See SOP	Check connections	Daily or as needed	See SOP	See SOP	Jeff Coronado (or alternate analyst), CAS, Kelso	T12
AAS	Replace disposables, flush lines	See SOP	Check connections	Daily or as needed	See SOP	See SOP	Annie Carter (or alternate analyst), Brooks Rand Labs	T13
CVAFS	Replace disposables, flush lines	See SOP	Check connections	Daily or as needed	See SOP	See SOP	Annie Carter (or alternate analyst), Brooks Rand Labs	T14
GC/MS	Clean sources and quadrupole rods; maintain vacuum pumps	See SOP	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	T20
GC/MS	Clean sources and quadrupole rods; maintain vacuum pumps	See SOP	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Jeff Grindstaff (or alternate analyst), CAS, Kelso	T22

QAPP Worksheet No. 25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (cont.)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS-SIM	Clean sources and quadrupole rods; maintain vacuum pumps.	See SOP	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Susan O'Neil (or alternate analyst), Alpha Analytical	T26
Analytical balance – percent moisture	Calibrate	See SOP	Instrument performance and sensitivity	Calibrate monthly, check calibration daily	See SOP	See SOP	Nancy Rose (or alternate analyst), Alpha Analytical	T25
Analytical balance – percent lipids	Calibration check	See SOP	Instrument performance and sensitivity	Check calibration daily	See SOP	See SOP	Greg Salata (or alternate analyst), CAS, Kelso	T23

AAS – atomic absorption spectrometer
CAS – Columbia Analytical Services
CVAFS – cold vapor atomic fluorescence spectrometer
GC/ECD – gas chromatograph/electron capture detection
GC-FID – gas chromatograph- flame ionization detector
GC/MS – gas chromatograph/mass spectrometer
HRGC/HRMS – high-resolution gas chromatograph/high-resolution mass spectrometer
ICP – inductively coupled plasma
RF – response factor
SIM – selective ion monitoring
SOP – standard operating procedure

QAPP Worksheet No. 26. Sample Handling System

Sample Collection, Packaging, and Shipment	**Tissue samples**
Sample collection (personnel/organization):	Thai Do or designee/Windward
Sample packaging (personnel/organization):	Thai Do or designee/Windward
Coordination of shipment (personnel/organization):	Thai Do or designee/Windward
Type of shipment/carrier:	Alpha Analytical courier from field to processing laboratory; overnight carrier (FedEx, UPS or equivalent) to other subcontracted laboratories
Sample Receipt and Analysis	
Sample receipt (personnel/organization):	Contact at appropriate laboratory
Sample custody and storage (personnel/organization):	Contact at appropriate laboratory
Sample preparation (personnel/organization):	Contact at appropriate laboratory
Sample determinative analysis (personnel/organization):	Contact at appropriate laboratory
Sample Archiving	
Field sample storage (No. of days from sample collection):	Contact at appropriate laboratory
Sample extract/digestate storage (No. of days from extraction/digestion):	1 year until Windward authorizes disposal
Biological sample storage (No. of days from sample collection):	Contact at appropriate laboratory
Sample Disposal	
Personnel/organization:	Jennifer Parker/Windward
Number of days from analysis:	1 year until Windward authorizes disposal

QAPP Worksheet No. 27. Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Fish, crab and crayfish tissue specimens will be collected and logged in the field facility. Fish, crab, and crayfish specimens including archive tissue samples will be identified, measured, weighed, labeled, wrapped in aluminum foil, sealed in plastic bags, and stored on wet ice in the field until they are processed and frozen at the field facility. The SOPs for collecting and processing the fish, crab, and crayfish tissue samples are discussed in further detail in Attachments J, L, N, and O (Worksheet No. 21). The SOPs for documenting field sample custody are discussed in further detail in Attachment M (Worksheet No. 21).

Samples for processing will be transported to Alpha Analytical with the original COCs generated in the field. Once the individual specimen and compositing scheme is approved by USEPA and CPG, Windward will oversee the initial process and compositing at Alpha Analytical. The Composite Sample Form provided in Attachment F will be completed by Windward and Alpha Analytical. Alpha Analytical will process samples according to their SOP in Attachment O. After samples are processed and/or composited, new COC forms will be generated by Alpha Analytical and accompany all sample shipments. When frozen samples for chemical analysis are couriered and the transit time is guaranteed to be less than 24 hours, wet ice may be used during transit. Based on communications between USEPA and CPG, ice requirements will be agreed upon prior to the shipment of homogenates for chemical analysis from Alpha Analytical to the other laboratories via overnight delivery. Windward will send preserved taxonomy samples via overnight delivery to the taxonomy laboratory. Samples will be shipped in batches of 20 samples per delivery group for chemical analyses. The appropriate signed COC forms will be placed in a sealable plastic bag, sealed, and taped to the inside lid of the cooler. Fiber tape will be wrapped completely around the cooler. On each side of the cooler a “This Side Up” arrow label will be attached; a “Handle with Care” label will be attached to the top of the cooler, and the cooler will be sealed with a custody seal in two locations. An example COC form and custody seal are provided in Attachment M.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Whole fish, crab, and crayfish tissue samples will be shipped frozen to the appropriate analytical laboratories. When frozen samples for chemical analysis are couriered and the transit time is guaranteed to be less than 24 hours, wet ice may be used during transit. Based on communications between USEPA and CPG, ice requirements will be agreed upon prior to the shipment of homogenates for chemical analysis from Alpha Analytical to the other laboratories via overnight delivery. Fish stomach content samples will be preserved in 10% buffered formalin and shipped to the taxonomy laboratory. All field-collected data and documentation will be retained under Windward’s custody.

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

- Each laboratory must have a designated sample custodian who accepts custody of the samples at the time of delivery to the laboratory and verifies that the information on the sample labels matches the information on the COC. The sample

QAPP Worksheet No. 27. Sample Custody Requirements Table (cont.)

custodian must sign and date all appropriate receiving documents and note any discrepancies in sample documentation as well as the condition of the samples at the time of receipt.

- Once the samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with laboratory custody and security requirements as outlined in the laboratory QMP.
- To ensure traceability of samples during the analytical process the laboratory will assign a sample ID number based on procedures outlined in the laboratory QMP or laboratory SOP.
- The following procedures, at a minimum, must be documented by the laboratory:
  - Tissue processing (Alpha Analytical only)
  - Sample extraction/preparation
  - Sample analysis
  - Data reduction
  - Data reporting

Laboratory personnel are responsible for sample custody until the samples are returned to the sample custodian.

When sample analysis and QC procedure are completed, any remaining sample must be stored in accordance with contractual terms. A minimum of 30 days notice must be provided before the disposal of any sample. Data sheets, custody documents, and all other laboratory records must be retained in accordance with contractual agreements.

Final Evidence Files

Laboratory records including all field- and laboratory-initiated COCs and other sample receiving records, sample preparation and analysis records, and the final data package become part of the laboratory final evidence file and must be retained as required by the contractual agreement. An original copy of the data package and associated electronic deliverable must be provided to Windward in accordance with the contractual agreement and will be retained by Windward along with associated field records and other related correspondence.

Sample Identification Procedures:

Fish, crab, and crayfish tissue samples will be identified with the site name, tissue type, species identification, time, date, sampling location, and field crew initials. Unique alphanumeric identification (ID) numbers will be assigned to each individually wrapped fish, crab, or crayfish specimen in the field and recorded on the Specimen Tally Form (Attachment D). Organisms that are not retained will be recorded on the Non-Target Species Tally Form (Attachment E) and no individual specimen ID will be assigned.

Each retained individual specimen will be initially assigned a unique specimen ID number until a tissue type designation (such as whole-body, fillet, carcass, or blue crab tissue types) is assigned. The sample identification scheme is as follows:

QAPP Worksheet No. 27. Sample Custody Requirements Table (cont.)

- The first five characters will be "LPR" to identify the project area (Lower Passaic River), the 2-mile reach (1 to 8) and target area (e.g., A, B, C)..
- The next set of alphanumeric characters will identify the fish or decapod crustacean species by its scientific (Latin binomial) name and a three-digit sequential number of the specimen captured within the sampling area.
- For example, the first mummichog (*Fundulus heteroclitus*) collected from target area A of sampling area 2 (RM 2 to RM 4) would be identified as "LPR2A-FH001."

For individual specimens that will be processed for whole-body tissue analysis (mummichog, darter or killifish species, and crayfish only), the sample identification scheme is as follows:

- Following the location characters and alphanumeric characters identifying by species and the sequential number of the specimen captured (described above), the specimen identification will include "WB" to identify the whole-body tissue type.
- For example, the first mummichog (*Fundulus heteroclitus*) collected from target area A in sampling area 2 (RM 2 to RM 4) would be identified as "LPR2A-FH001WB."

For individual specimens that will be retained for additional processing by tissue type (e.g., for fillet tissue, carcass tissue, blue crab tissue types) before chemical analysis, the sample identification scheme is as follows:

- Following the location characters and alphanumeric characters identifying by species and the sequential number of the specimen captured (described above), the specimen identification will include the component tissue type with one of the following codes: "FT" for fillet tissue, "CT" for carcass tissue, "ST" for (all) soft tissue, "MH" for muscle/hepatopancreas combined tissue, "HT" for hepatopancreas tissue (if included separate from soft tissue), or "MT" for (edible) muscle tissue.
- For example, the fillet tissue and carcass tissue sample processed from the largemouth bass (*Micropterus salmoides*) collected from target area A of sampling area 2 would be identified as "LPR2A-MS001FT" and "LPR2A-MS001CT," respectively.

All relevant information for each individually wrapped and labeled target specimen, including specimen ID, length, weight, gender (if it can be determined without dissection), sample date, time, location number and collection method will be recorded on the Location Data Forms and Specimen Tally Form (Attachments B and C, respectively), and included as an appendix in the final data report. Therefore, all pertinent data associated with each individual fish or decapod crustacean specimen can be tracked.

For whole-body, fillet, carcass, and blue crab tissue type composite samples, the sample identification scheme is as follows:

- The first five characters will be "LPR" to identify the project area (Lower Passaic River) and compositing area (i.e., the 2-mile reach [1 to 8] and, if relevant, target area [e.g., A, B, C]).
- The next set of alphanumeric characters will identify the fish or decapod crustacean species by its scientific (Latin binomial) name and tissue type.

QAPP Worksheet No. 27. Sample Custody Requirements Table (cont.)

- The next set of alphanumeric characters will be "Comp" to identify the composite sample, followed by a two-digit sequential number within the sampling area.
- For example, the first largemouth bass fillet tissue composite sample from sampling area 2 would be identified as "LPR2-MSFT-Comp01."

For stomach content and egg tissue composite samples, which will collected on a zone-wide (e.g., estuarine vs. freshwater) basis from sacrificed fish, the sample identification scheme is as follows:

- The first three characters will be "LPR" to identify the project area (Lower Passaic River).
- The next set of alphanumeric characters will identify the fish or decapod crustacean species by its scientific (Latin binomial) name and tissue type. Tissue types will be one of the following codes: "SC" for stomach content or "ET" for egg tissue.
- For stomach content samples:
    - The tissue type code of "SC" will be followed by a two-digit sequential number (stomach-content samples will be collected and analyzed on an individual-fish basis).
    - For example, the second stomach-content sample for white perch (*Morone americana*) would be identified as "LPR-MASC02."
- For egg tissue samples:
    - The next set of alphanumeric characters will be "Comp" to identify the composite sample (egg tissue samples will be composited), followed by a two-digit sequential number within the zone.
    - For example, the first mummichog egg tissue composite sample collected would be identified as "LPR-FHET-Comp01."

All relevant information for each tissue sample (i.e., whole-body, fillet, carcass, blue crab tissue types, stomach content, and egg tissue samples) will be recorded electronically on the Composite Sample Form (Attachment F) and included as an appendix in the final data report.

Chain-of-custody Procedures:

COC procedures are documented in detail in Attachment M (Worksheet No. 21) and summarized briefly below. Samples are considered to be in custody if they are: 1) in the custodian's possession or view; 2) in a secured place (under lock) with restricted access; or 3) in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Custody procedures as defined in Attachment M will be used for all samples throughout the collection and transport process. Custody procedures will be initiated during sample collection. An electronic COC form will accompany samples to the analytical laboratory. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left

QAPP Worksheet No. 27. Sample Custody Requirements Table (cont.)

unattended unless properly secured.

The FC will be responsible for all sample tracking and custody procedures for samples in the field. The FC will be responsible for final sample inventory and will maintain sample custody documentation. The FC will also complete COC forms prior to removing samples from the sampling area. At the end of each day, and prior to transfer, COC entries will be made for all samples. Information on the labels will be checked against sample log entries, and samples will be recounted. COC forms will accompany all samples. The COC forms will be signed at each point of transfer. Copies of all COC forms will be retained and included as appendices to QA/QC reports and data reports. Samples will be shipped in sealed coolers.

Windward will ensure that COC forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the COC forms. Windward will contact the FC and Project Task QA/QC Manager immediately if discrepancies are discovered between the COC forms and the sample shipment upon receipt.

QAPP Worksheet No. 28. QC Samples Table

Matrix	Tissue
Analytical Group	PCB – Congeners
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/ SOP Reference	USEPA 1668A/T2
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Analytical Perspectives
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per prep batch of 20 samples or fewer	a) When detected, the concentration should be less than the reporting limit or < 10 times the highest concentration found in the batch of samples; b) signal-to-noise ratio should be > 10 for the extraction standard; c) detection level should be ≤ 4 times the limit of detection; d) recoveries of the extraction standard should be 25% minimum or meet c and d.	Analytical data is accepted (with a data qualifier) if the amount found in the MB is less than one tenth of the level found in the associated samples. Otherwise, the samples are re-extracted and re-analyzed. Use the EMLs in Method 1668A for guidance only. Use the "B" data qualifier when a specific congener is found at a level above the RL or when at a level that is not "significantly" different than the one found in the field sample even if below the RL.	Bryan Vining (or alternate analyst), Analytical Perspectives	Contamination	Laboratory control limits

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Spiked solvent blank	Always follows the analysis of the front-end batch control spike, may also be used before the ending batch control spike sample	Signal-to-noise ratio should be > 2.5:1 for the 1 pg/μL selected PCB congeners peak to verify absence of bad injection. To verify absence of carryover, there should be no target analyte peak with signal-to-noise ratio > 2.5:1, or, if above, the response should be less than 1% of the target analyte in the batch control spike.	Injector maintenance	Bryan Vining (or alternate analyst), Analytical Perspectives	Accuracy	Laboratory control limits
Extraction standard	Spiked into every sample and QC sample	Percent recovery =30 – 140%	Refer to SOP for corrective action.	Bryan Vining (or alternate analyst), Analytical Perspectives	Accuracy	Laboratory % recovery control limits
MD	1 per 20 samples per matrix type (mass permitting)	RPD ≤20% when within curve and the sample is a true laboratory duplicate.	Identify source of variance before implementing corrective action. Assess impact on sample data reliability and consider re-extraction and reanalysis of samples if necessary for generating reliable data as sample mass permits.	Bryan Vining (or alternate analyst), Analytical Perspectives	Precision	Laboratory PD control limit
Batch control spike	Minimum 1 per extraction batch, analyzed at the beginning and end of 12-hour analytical sequence	PD between the relative response factor of the batch control spike and the initial calibration: ≤ 20% for target species, ≤ 30% for extraction standard/cleanup standard; RPD between the beginning and ending batch control spike: ≤10% for target species, ≤ 20% for extraction standard/cleanup standard.	Refer to SOP for corrective actions.	Bryan Vining (or alternate analyst), Analytical Perspectives	Precision and accuracy	Laboratory RPD control limit and percent difference

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
CRM	Minimum of 1 per batch of 20 samples	PD of certified target analytes should be within 25% of consensus values when within the ICAL. Long-term RSD should be ≤ 20%.	Identify source of variance before implementing corrective action. In all cases. assess impact on sample data reliability and consider re-extraction and reanalysis of samples if necessary for generating reliable data as sample mass permits.	Bryan Vining (or alternate analyst), Analytical Perspectives	Accuracy	Laboratory control limits

CRM – certified reference material
DQI – data quality indicator
EML – estimated minimum level
ICAL – initial calibration
MD – matrix duplicate
PCB – polychlorinated biphenyl
PD – percent difference
QC – quality control
RL – reporting limit
RPD – relative percent difference
RSD – relative standard deviation
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	PCB – Aroclors
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/ SOP Reference	USEPA SW-846 8082/T8
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Analytical Perspectives
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per prep batch of 20 samples or fewer	No target compounds > RL	Identify and eliminate source of contamination. Determine extent of contamination and impact on sample data. Report results if sample results > 20 times blank result or sample results ND. Contact project manager and client to determine further corrective action. Corrective action may include re-extraction and reanalysis of sample, if sufficient sample is available and within holding time requirements. If insufficient sample is available, qualify data.	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	Contamination	Laboratory control limits
LCS	1 per prep batch of 20 samples or fewer	Refer to test method for control limits	Reanalyze affected samples. Qualify data as needed.	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	Precision and accuracy	Laboratory RPD control limit and percent drift
MD	1 per 20 samples per matrix type (mass permitting)	RPD ≤ 50% for target compounds > 5 x QL	Qualify data as needed.	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	Precision	Laboratory RPD control limit

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	1 per 20 samples or fewer	Recovery is compound specific (see SOP), RPD ≤ 50%	Flag associated results.	Cindy McQueen or Jolanta Scieglinska (or alternate analyst), Alpha Analytical	Precision and accuracy/bias	Laboratory RPD control limits

DQI – data quality indicator
EML – estimated minimum level
LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
ND – not detected
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	PCDDs/PCDFs
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA 1613B/T3
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Analytical Perspectives
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 samples	a) No target compound should be detected above signal-to-noise ratio > 2.5:1; b) when detected, the concentration should be less than the reporting limit or < 10 times the highest concentration found in the batch of samples; c) signal to noise should be > 10:1 for extraction standard (isotopically labeled standard added before extraction); d) detection level should be ≤ 4 times limit of detection; e) recoveries of the extraction standard should be 40% minimum or meet c and d.	A B-qualifier is applied to any specific analyte found in the sample when its presence is detected in the laboratory method blank at a concentration above the reporting limit, or the level detected in the blank that is statistically significant relative to that found in the associated sample. An invalid method blank requires re-extraction and re-analysis of the samples.	Bryan Vining (or alternate analyst), Analytical Perspectives	Contamination	Laboratory control limits

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Spiked solvent blank	Always follows the analysis of the front-end batch control spike, can also be used before the ending batch control spike	No target analyte peak should have signal-to-noise ratio > 2.5:1 or if above 2.5:1, the response should be < 1% of the target analyte in the batch control spike.	Refer to SOP.	Bryan Vining (or alternate analyst), Analytical Perspectives	Contamination	Laboratory control limits
MD	1 per batch of 20 samples per matrix type (mass permitting)	RPD ≤20% when within the curve and the sample is a true laboratory duplicate	Identify the source of variation before implementing corrective action. Assess impact on sample data reliability and consider re-extraction and re-analysis of samples if necessary for generating reliable data as mass permits.	Bryan Vining (or alternate analyst), Analytical Perspectives	Precision and accuracy	Laboratory RPD control limit
Batch control spike	A minimum of 1 per extraction batch, analyzed at the beginning and end of the 12-hour analytical period	PD between the relative response factor of the batch control spike and the initial calibration should be ≤ 20% for target species and ≤ 30% for extraction standard/sample standard/cleanup standard; RPD between the beginning and ending batch control spike should be ≤ 10% for target species and ≤ 20% for extraction standard/sample standard/cleanup standard.	Refer to SOP	Bryan Vining (or alternate analyst), Analytical Perspectives	Precision and accuracy	Laboratory RPD control limit and percent difference

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
CRM	1 per batch of 20 samples	PD of certified target analytes within 25% consensus values when within the ICAL. Long-term RSD should be $\leq$ 20%; 11of the 11 different CDD are within the 90% confidence; 11 of the 11 different CDD are within the 50% of the 90% confidence; 14 of the 14 different CDF are within the 90% confidence; 14 of the 14 different CDF are within the 50% of the 90% confidence.	Identify source of variance before implementing corrective action. In all cases. assess impact on sample data reliability and consider re-extraction and reanalysis of samples if necessary for generating reliable data as sample mass permits	Bryan Vining (or alternate analyst), Analytical Perspectives	Accuracy	Laboratory control limits

CDD – chlorinated dibenzo-*p*-dioxins
CDF – chlorinated dibenzofurans
CRM – certified reference material
DQI – data quality indicator
ICAL – initial calibration
MRL – method reporting limit
MS – matrix spike
MSD – matrix spike duplicate
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
PD – percent difference
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	PAHs
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	CARB 429 Mod./T4
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Maxxam Analytics
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 samples	No target compounds>EML	Determine extent of contamination and impact on sample data. Report results if sample results > 20 times blank result or sample results ND. Contact project manager and client to determine further corrective action. Corrective action may include re-extraction and reanalysis of sample, if sufficient sample is available. If insufficient sample is available qualify data.	Owen Cosby (or alternate analyst), Maxxam Analytics	Contamination	Laboratory control limits
MD	1 per batch of 20 samples per matrix type (mass permitting)	RPD ≤ 50% if samples are > 5 x QL	Flag associated results.	Owen Cosby (or alternate analyst), Maxxam Analytics	Precision	Laboratory RPD control limit
Pre-extraction internal standards	Spiked into every sample and QC sample	Compound-specific (see SOP)	Refer to SOP for corrective action.	Owen Cosby (or alternate analyst), Maxxam Analytics	Accuracy	Laboratory % recovery control limits
LCS	1 for every batch of samples up to a maximum batch size of 20 samples	50 – 150%	Reanalyze affected samples.	Owen Cosby (or alternate analyst), Maxxam Analytics	Precision and accuracy	Laboratory RPD control limit and percent drift

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
CRM	1 for every batch of samples up to a maximum batch size of 20 samples	Recovery within limits set by CRM manufacturer	Reanalyze sample to see if an analytical error has occurred. Qualify data as needed. Consider re-extraction and reanalysis of samples if necessary for generating reliable data as sample mass permits.	Owen Cosby (or alternate analyst), Maxxam Analytics	Accuracy	Laboratory % recovery control limits

CARB – California Air Resources Board
CRM – certified reference material
DQI – data quality indicator
EML – estimated minimum level
LCS – laboratory control sample
MD – matrix duplicate
ND – not detected
NA – not available
PAH – polycyclic aromatic hydrocarbon
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Alkylated PAHs
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA SW-846 8270D/T26, T27
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Alpha Analytical
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 samples	No target compounds > QL	Flag associated results if detected and/or greater than 1/10 of the amount found in samples.	Susan O'Neil (or alternate analyst), Alpha Analytical	Contamination	Laboratory control limits
MD	1 per batch of 20 samples per matrix type (mass permitting)	RPD ≤ 30% if target compounds are > 5 x QL	Flag associated results.	Susan O'Neil (or alternate analyst), Alpha Analytical	Precision	Laboratory recovery and RPD control limit
MS/MSD	1 per batch of 20 samples per matrix type (mass permitting)	Percent recovery = 50 – 150%, RPD ≤ 30%	Flag associated results.	Susan O'Neil (or alternate analyst), Alpha Analytical	Precision	Laboratory recovery and RPD control limit
Pre-extraction internal standard	Added to every sample and QC sample	50 – 200% of the daily CCV area for the internal standards	Refer to SOP for corrective action.	Susan O'Neil (or alternate analyst), Alpha Analytical	Accuracy	Laboratory recovery limits
CRM	1 per batch of 20 samples	Percent recovery = 65 – 135%	Repeat analysis and/or check to see if an analytical error has occurred. If recovery still exceeds control limits and the LCS and/or MS/MSD describe results.	Susan O'Neil (or alternate analyst), Alpha Analytical	Accuracy	Laboratory recovery limits

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	At the beginning and end of the 12 hour analytical period	Percent recovery = 50 – 150%	Reanalyze affected samples.	Susan O'Neil (or alternate analyst), Alpha Analytical	Precision/ accuracy	Laboratory RPD control limit and percent drift

CCV –continuing calibration verification
CRM – certified reference material
DQI – data quality indicator
LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
ND – not detected
PAH – polycyclic aromatic hydrocarbon
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Organochlorine Pesticides
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/ SOP Reference	USEPA 1699 Mod.(NYSDEC HRMS-2)/T5, T6, T7
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Maxxam Analytics
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per every batch, and a minimum of 1 for every 20 samples	No target compounds>MRL	All of the samples must be re-prepared and reanalyzed. If sufficient sample is not available then any positive sample data must be flagged as possibly contaminated to the level found in the method blank.	Owen Cosby (or alternate analyst), Maxxam Analytics	Contamination	Laboratory control limits
LCS	1 for every batch of samples up to a maximum batch size of 20 samples	Percent recovery = 50 – 200%	Check calculations and reanalyze if recoveries are outside of these limits. If the blank spike is outside of limits but the matrix spike is acceptable then the blank spike may have been spiked incorrectly. Review the data with the Team or Group Leader. All data may be accepted but must be flagged as exceeding acceptance criteria. If both the blank spike and the matrix spikes exceed their respective limits re-prepare and reanalyze the samples providing sufficient sample is available. If sufficient sample is not available the data must be flagged.	Owen Cosby (or alternate analyst), Maxxam Analytics	Accuracy/bias	Laboratory % recovery control limits

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MD	1 for every 20 samples per matrix type (mass permitting)	RPD ≤ 25% if both samples are > 5 x QL	Check calculation for errors. Check solid samples for homogeneity; if not homogeneous, flag data as appropriate. If sample is homogeneous, re-prepare and reanalyze sample.	Owen Cosby (or alternate analyst), Maxxam Analytics	Precision	Laboratory RPD control limit
Pre-extraction internal standards	Spiked into every sample and QC sample	Recovery = 10 – 200% per laboratory SOP	The data will still be acceptable provided that the signal is equal to or greater than ten times the noise level. This will be flagged in the Case Narrative section of the final report. The extract may be diluted and rerun. Complex matrices may mask or enhance the response of several compounds (Aldrin, methoxychlor, 4,4'-DDT). The sample may be re-extracted if nothing can be found to explain the low or high recoveries and no obvious interference is causing the problem.	Owen Cosby (or alternate analyst), Maxxam Analytics	Accuracy/bias	Laboratory % recovery control limits
CRM	1 for every batch of samples up to a maximum batch size of 20 samples	Recovery within limits set by CRM manufacturer	Reanalyze sample to see if an analytical error has occurred. Qualify data as needed. Consider re-extraction and reanalysis of samples if necessary for generating reliable data as sample mass permits.	Owen Cosby (or alternate analyst), Maxxam Analytics	Accuracy	Laboratory % recovery control limits

CRM – certified reference material
DQI – data quality indicator
HRMS – high resolution mass spectrometry
LCS – laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
NYSDEC – New York State Department of Environmental Conservation
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Metals (ICP/MS)
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/ SOP Reference	USEPA SW-846 6020/T9, T10
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	CAS, Kelso
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	Minimum of 1 per batch	Result < MRL	All samples associated with contaminated method blanks must be reanalyzed.	Jeff Coronado (or alternate analyst), CAS, Kelso	Contamination	Laboratory control limits
LCS	Minimum of 1 per batch	Percent recovery = 75 –125%	If recovery is outside of the control limit, then batch must be re-prepared and reanalyzed.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits
MD	Minimum of 1 per 20 client samples per matrix type (mass permitting)	RPD ≤ 30%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision	Laboratory RPD control limit
MS	Minimum of 1 per 20 client samples per matrix type (mass permitting)	Percent recovery = 75 – 125%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision and accuracy/bias	Laboratory % recovery control limits
CRM	Minimum of 1 per batch	Percent recovery = 70 – 130%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits

CAS – Columbia Analytical Services, Inc.
CRM – certified reference material
ICP/MS – inductively coupled plasma/ mass spectrometry
LCS – laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
MS – matrix spike
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Metals (ICP)
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA SW-846 6010B/T9, T11
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	CAS, Kelso
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	Minimum of 1 per batch of 20 samples	Result < MRL or < 1/20th sample result	All samples associated with contaminated method blanks must be reanalyzed.	Jeff Coronado (or alternate analyst), CAS, Kelso	Contamination	Laboratory control limits
LCS	Minimum of 1 per batch	Percent recovery = 75 –125%	If recovery is outside of the control limit, then batch must be re-prepared and reanalyzed.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits
MD	Minimum of 1 per 20 client samples per matrix type (mass permitting)	RPD ≤ 30%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision	Laboratory RPD control limit
MS	Minimum of 1 per 20 client samples per matrix type (mass permitting)	Percent recovery = 70 – 130%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision and accuracy/bias	Laboratory % recovery control limits
CRM	Minimum of 1 per batch of 20 samples	Recovery within limits set by CRM manufacturer	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits

CAS – Columbia Analytical Services, Inc.
CRM – certified reference material
ICP – inductively coupled plasma
LCS – laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
MS – matrix spike
PAH – polycyclic aromatic hydrocarbon
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Metals (Selenium)
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA SW-846 7742/T9, T12
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	CAS, Kelso
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	Minimum of 1 per batch	Result < MRL	All samples associated with contaminated method blanks must be reanalyzed.	Jeff Coronado (or alternate analyst), CAS Kelso	Contamination	No target analytes at MRL
MD	Minimum of 1 per 20 client samples per matrix type (mass permitting)	RPD ≤ 30%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision	Laboratory RPD control limit
MS	Minimum of 1 per 20 client samples per matrix type (mass permitting)	Percent recovery = 60 – 130%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Precision and accuracy/bias	Laboratory % recovery control limits
LCS	Minimum of 1 per batch	Percent recovery = 75 – 125%	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits
CRM	Minimum of 1 per batch	Recovery within limits set by CRM manufacturer	Either redigest the sample batch or flag the results, whichever is appropriate.	Jeff Coronado (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory % recovery control limits

CAS – Columbia Analytical Services
CRM – certified reference material
DQI – data quality indicator
LCS – Laboratory control sample
MD – matrix duplicate
MRL – method reporting limit
MS – matrix spike
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
SW – solid waste
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Inorganic Arsenic
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA 1632/T13
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Brooks Rand Labs
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MD	Minimum of 1 per 20 client samples per matrix type (mass permitting)	RPD ≤ 35%	Flag the results	Michela Powell (or alternate analyst), Brooks Rand Labs	Precision	Laboratory RPD control limit
MS/MSD	1 per 20 client samples per matrix type (mass permitting)	Percent recovery = 65 – 135%, RPD ≤ 35%	If recoveries are similar but fail recovery criteria, an interference is present in the sample, and the result must be qualified. If RPD criteria not met, then the system is not in control. Correct problem and reanalyze all associated samples.	Michela Powell (or alternate analyst), Brooks Rand Labs	Precision and accuracy/bias	Laboratory % recovery control limits
CRM	1 per batch	Percent recovery = 65 – 135%	Correct problem prior to continuing analysis, recalibrate if necessary.	Michela Powell (or alternate analyst), Brooks Rand Labs	Accuracy/bias	Laboratory % recovery control limits
Method blank	2 per batch	Average < 1/10 of associated samples	Reanalyze affected samples. Qualify data as needed.	Michela Powell (or alternate analyst), Brooks Rand Labs	Contamination	Laboratory control limits

CRM – certified reference material
DQI – data quality indicator
MB – method blank
MRL – method reporting limit
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Metals: Total Mercury
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/ SOP Reference	USEPA 1631 /T14, T15
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Brooks Rand Labs
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	3 per batch	Avg < 2 x MDL St Dev < 2/3rd of MDL or high MB < 1/10th of associated samples	Correct problem until criteria met. All samples associated with a contaminated method blank must be reanalyzed or qualified accordingly.	Annie Carter (or alternate analyst), Brooks Rand Labs	Contamination	Laboratory control limits
CRM	1 per 20 client samples	Percent recovery = 75 – 125%	Correct problem prior to continuing analysis.	Annie Carter (or alternate analyst), Brooks Rand Labs	Accuracy/bias	Laboratory % recovery control limits
MD	1 per 10 client samples per matrix (mass permitting)	RPD ≤ 30%	If RPD criteria not met, then the system is not in control. Correct problem and reanalyze all associated samples or qualify accordingly.	Annie Carter (or alternate analyst), Brooks Rand Labs	Precision	Laboratory RPD control limit
MS/MSD	1 per 10 client samples (mass permitting)	Percent recovery = 70 – 130% RPD ≤ 35%	If recoveries similar but fail recovery criteria, interference may be present in the sample and the result must be qualified. If RPD criteria not met, then the system is not in control. Correct problem and reanalyze all associated samples.	Annie Carter (or alternate analyst), Brooks Rand Labs	Precision and accuracy/bias	Laboratory % recovery control limits

CRM – certified reference material
DQI – data quality indicator
MB – method blank
MDL – method detection limit
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Metals: Methylmercury
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA 1630/T16
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Brooks Rand Labs, LLC
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	4 per batch	Avg ≤ 2 x MDL St Dev ≤ 2/3rd MDL or < 1/10th of associated samples	Correct problem. All samples associated with a contaminated method blank must be reanalyzed.	Annie Carter (or alternate analyst), Brooks Rand Labs	Contamination	No target analytes at MRL
CRM	1 per 20 client samples	Percent recovery = 65 – 135%	Correct problem prior to continuing analysis	Annie Carter (or alternate analyst), Brooks Rand Labs	Accuracy/bias	Laboratory % recovery control limits
MD	1 per 10 client samples per matrix type (mass permitting)	RPD ≤ 35% or ± 2x PQL if sample < 5x PQL	If RPD criteria not met, then the system is not in control. Correct problem and reanalyze all associated samples.	Annie Carter (or alternate analyst), Brooks Rand Labs	Precision	Laboratory RPD control limit
MS/MSD	1 per 10 client samples per matrix type (mass permitting)	Percent recovery = 65 – 135% RPD ≤35%	If recoveries similar but fail recovery criteria, an interference is present in the sample and the result must be qualified. If RPD criteria not met, then the system is not in control. Correct problem and reanalyze all associated samples.	Annie Carter (or alternate analyst), Brooks Rand Labs	Precision and accuracy/bias	Laboratory % recovery control limits

CRM – certified reference material
DQI – data quality indicator
MD – matrix duplicate
MDL – method detection limit
MS – matrix spike
MSD – matrix spike duplicate
PQL – practical quantitation limit
QC – quality control
RPD – relative percent difference
SOP – standard operating procedure
StD – standard deviation
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	SVOCs
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	USEPA SW-846 8270C/T17, T18, T19, T20
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Alpha Analytical
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per extraction batch (20 samples)	No target compounds > QL, no common lab contaminants > 5 x QL	If sufficient sample is available, re-extract and reanalyze samples. If insufficient sample is available, reanalyze extracts. Qualify data as needed. Report results if sample results >20 times blank result or sample results ND.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	Accuracy/bias and contamination	Laboratory control limits
Instrument blank	Once per 12 hours if method blank is not run	No target compounds > QL, no common lab contaminants > 5 x QL	Reanalyze extracts. Qualify data as needed. Report results if sample results >20 times blank result or sample results ND.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	Accuracy/bias and contamination	Laboratory control limits
LCS	1 per extraction batch (20 samples)	Compound-specific, see SOP	If sufficient sample is available, re-extract and reanalyze samples. If insufficient sample is available, reanalyze extracts. Qualify data as needed.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	Accuracy/bias	Laboratory % recovery control limits

QAPP Worksheet No. 28. QC Samples Table (cont.)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MD	1 per 20 samples per matrix type (mass permitting)	Variable, see SOP	Analysis must be repeated once to see if an analytical error has occurred. Qualify data as needed.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha	Precision	Laboratory RPD control limits
CRM	1 per extraction batch (20 samples)	Percent recovery = 40 – 140%	Reanalyze sample, if % recovery still exceeds the control limits and the LCS and MS/MSD pair are compliant, describe potential matrix interferences. Qualify data as needed.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	Accuracy/bias	Laboratory % recovery control limits
MS/MSD	1 per 20 samples per matrix type (mass permitting)	Compound-specific (see SOP)	Determine root cause; flag MS/MSD data; discuss in narrative.	Susan O'Neil or Julie DeSousa or alternate analyst), Alpha Analytical	Accuracy/bias/ precision	Laboratory % recovery and RPD control limits
Surrogates	Spiked into every sample and QC sample.	Compound-specific, see SOP	Check all calculations for error; ensure that instrument performance is acceptable; recalculate the data and/or reanalyze the extract if either of the above checks reveal a problem. Re-prepare and reanalyze the sample or flag the data as "Estimated Concentration" if none of the above resolves the problem. Re-preparation is not necessary if there is obvious chromatographic interference.	Susan O'Neil or Julie DeSousa (or alternate analyst), Alpha Analytical	Accuracy/bias	Laboratory % recovery control limits

CRM – certified reference material
DQI – data quality indicator
LCS – laboratory control sample
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
ND – non-detect
QC – quality control
QL – quantitation limit
RPD – relative percent difference
SOP – standard operating procedure
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Butyltins
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	Krone et al. (1989) /T21, T22
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	CAS, Kelso
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 samples	No target analytes at MRL	Reanalyze affected samples. Qualify data as needed.	Jeff Grindstaff (or alternate analyst), CAS, Kelso	Contamination	Laboratory control limit
MS/MSD	1 per batch of 20 sample per matrix type (mass permitting)s	Variable recovery, see SOP, RPD ≤ 40%	Reanalyze affected samples. Qualify data as needed.	Jeff Grindstaff (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory control limits
LCS	1 per batch of 20 samples	Variable, see SOP	Reanalyze affected samples. Qualify data as needed.	Jeff Grindstaff (or alternate analyst), CAS, Kelso	Accuracy/bias	Laboratory control limits
MD	1 per batch of 20 samples per matrix type (mass permitting)	RPD ≤ 40%	Reanalyze affected samples. Qualify data as needed.	Jeff Grindstaff (or alternate analyst), CAS, Kelso	Precision	Laboratory RPD control limits

CAS – Columbia Analytical Services
DQI data quality indicator
LCS – laboratory control sample
MRL – method reporting limit
MD – matrix duplicate
MS – matrix spike
MSD – matrix spike duplicate
QC – quality control
SOP – standard operating procedure

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Lipids
Concentration Level	Low
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	Bligh-Dyer/T23
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	CAS, Kelso
Number of Samples	401 (+20 fish eggs)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	1 per batch of 20 samples	No target analytes at MRL	Reanalyze affected samples. Qualify data as needed.	Greg Salata (or alternate analyst), CAS, Kelso	Contamination	Laboratory control limit
MD	1 per batch of 20 samples	RPD 20%	Reanalyze affected samples. Qualify data as needed.	Greg Salata (or alternate analyst), CAS, Kelso	Precision	Laboratory RPD control limit
CRM	1 per batch of 20 samples	Recovery within limits set by CRM manufacturer	Reanalyze and qualify data as needed.	Greg Salata (or alternate analyst), CAS, Kelso	Accuracy	Laboratory % recovery control limits

CRM – certified reference material
DQI – data quality indicator
MD – matrix duplicate
MRL – method reporting limit
RPD – relative percent difference
SM – standard method
QC – quality control
SOP – standard operating procedure

QAPP Worksheet No. 28. QC Samples Table (cont.)

Matrix	Tissue
Analytical Group	Percent Moisture
Concentration Level	NA
Sampling SOP	Attachments J, L, N and O
Analytical Method/SOP Reference	SM2540G Mod. /T24
Sampler's Name	Windward Field Staff
Field Sampling Organization	Windward Environmental LLC
Analytical Organization	Alpha Analytical
Number of Samples	401

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MD	1 per batch of 20 samples	RPD 20%	Reanalyze affected samples. Qualify data as needed.	Nancy Rose (or alternate analyst), Alpha Analytical	Precision	Laboratory RPD control limit

DQI – data quality indicator
MD – matrix duplicate
QC – quality control
RPD – relative percent difference
SM – standard method
SOP – standard operating procedure

QAPP Worksheet No. 29. Project Documents and Records Table

Sample Collection Documents and Records
On-Site Analysis Documents and Records
Field Logbook
Location Data Form
Specimen Data Form (for gross external and internal physical examinations)
Specimen Tally Form
Non-Target Species Tally Form
Composite Sample Form
Corrective Action Reports (Protocol Modification Forms)
Progress report, made daily or as scheduled by FC to Investigative Organization Project Manager and Task QA/QC Manager
Electronic GPS file
Off-Site Analysis Documents and Records
COC record of sample shipment to analytical laboratory
Corrective Action Reports (Protocol Modification Forms)
Composite Sample Form
Progress reports
Electronic Data Deliverables
Laboratory data report and supporting documentation
Data Assessment Documents and Records
Verification of GPS coordinates of surveyed locations by GIS database manager
Data validation reports
Data usability assessment
Deliverables
Fish community survey data reports
Fish/decapod crustacean chemistry data report

QAPP Worksheet No. 29. Project Documents and Records Table (cont.)

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

Project Document Control System

Project documents will be controlled by the QA/QC Manager who will maintain and manage hardcopies and electronic copies of all project-related documents. Electronic copies of all information relating to this project will be maintained on the project network files and backed up at least once daily; access to these files will be limited to authorized project personnel. All project data and information must be documented in a standard format that is usable by all project personnel.

Data Recording

Data generated during this project will be captured electronically (refer to SOP 10 or Attachment P). Computer-generated laboratory data will be managed using the laboratory information management system used by subcontracted laboratories, as described in their QA documentation.

Data Quality Assurance Procedures

Windward will monitor the progress of sample collection to verify that samples are collected as planned. The sample collection progress will be monitored through the documentation of samples collected and shipped each day. The participating laboratories must maintain a formal QA plan to which they will adhere and address all data-generating aspects of the daily operations. A policy of continuous improvement will allow all data generation processes to be reviewed and modified as necessary to meet project objectives. Periodic audits of field and laboratory operations will ensure that data collection, documentation, and QC procedures are followed.

Laboratory Data Transmittal

Laboratory data will be managed by the laboratories' information management systems beginning with the sample receiving process. Laboratories are required to provide data reports (sample results, QC summary information, and supporting raw data) including electronic data deliverables (EDDs) within the turnaround times specified in Worksheet No. 30. EDDs will be provided as specified in the Data Management Plan. All EDDs will be checked for errors prior to transmittal.

Data Storage and Retrieval

Completed field forms, field logbooks, photographs, data packages, and electronic files will be transmitted regularly to the QA/QC Manager. Each laboratory will maintain copies of all documents generated, as well as backup files of all electronic data relating to the analysis of samples. Raw data and electronic files of all field samples, QC analyses, and blanks must be archived from the date of generation and maintained by each laboratory for a minimum of 5 years in accordance with the terms of the contract between Windward and the laboratory. Project closeout will be conducted in accordance with contractual guidance. As required by the settlement agreement, all data and other project records will be made available to USEPA. Data transfer to USEPA will include a

QAPP Worksheet No. 29. Project Documents and Records Table (cont.)

multi-media EDD that conforms to the 2007 USEPA Region 2 MEDD format. The MEDD will include all qualified and rejected data (including the reported, numerical value for rejected data).

QAPP Worksheet No. 30. Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Tissue	Tissue processing and homogenization	not applicable	All	T1	4 – 6 weeks	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222
Tissue	PCBs –congeners	Low	All	T2	30 days	Analytical Perspectives 2714 Exchange Drive Wilmington, NC 28405 Kimberly Mace 910.794.1613, ext. 102	Maxxam Analytics 6740 Campobello Rd. Mississauga, ON L5N 2L8 Mike Challis 800.563.6266, ext. 5790 OR Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000
Tissue	PCB-Aroclors	Low	All	T8	30 days	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.430.7733
Tissue	PCDDs/PCDFs – homologs and 17 congeners	Low	All	T3	30 days	Analytical Perspectives 2714 Exchange Drive Wilmington, NC 28405 T Kimberly Mace 910.794.1613, ext. 102	Maxxam Analytics 6740 Campobello Rd. Mississauga, ON L5N 2L8 Mike Challis 800.563.6266, ext. 5790 OR CAS 19408 Park Row Suite 320 Houston, TX 77084 Jane Freemyer 281.994.2957

QAPP Worksheet No. 30. Analytical Services Table (cont.)

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Tissue	PAHs – HRGC/HRMS	Low	All	T4	30 – 45 days	Maxxam Analytics 6740 Campobello Rd. Mississauga, ON L5N 2L8 Mike Challis 800.563.6266, ext. 5790	Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000
Tissues	Alkylated PAHs	Low	All	T26, T27	30 days	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222
Tissue	OC Pesticides – HRGC/HRMS	Low	All	T7	30 – 45 days	Maxxam Analytics 6740 Campobello Rd. Mississauga, ON L5N 2L8 Mike Challis 800.563.6266, ext. 5790	Test America 880 Riverside Parkway West Sacramento, CA 95605 John Reynolds 865.291.3000
Tissue	Total metals	Low	All	T9, T10, T11,T12	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.430.7733	Analytical Resources, Inc. 4611 South 134th Place, Suite 100 Tukwila, WA 98168 Susan Dunnihoo 206.695.6207
Tissue	Inorganic arsenic	Low	All	T13	30 days	Brooks Rand Labs, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206.753.6125	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113
Tissue	Total mercury	Low	All	T14	30 days	Brooks Rand Labs, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206.753.6125	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222
Tissue	Methylmercury	Low	All	T16	30 days	Brooks Rand Labs, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206-632-6206	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222

QAPP Worksheet No. 30. Analytical Services Table (cont.)

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Tissue	SVOCs	Low	All	T20	30 days	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222
Tissue	Butyltins	Low	All	T22	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222	Analytical Resources, Inc. 4611 South 134th Place, Suite 100 Tukwila, WA 98168 Susan Dunnihoo 206.695.6207
Tissue	Lipids	Low	All	T23	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113
Tissue	Percent moisture	Low	All	T24	30 days	Alpha Analytical 320 Forbes Boulevard Mansfield, MA 02048 Peter Henriksen 508.844.4113	CAS 1317 South 13th Ave. Kelso, WA 98626 Lynda Huckestein 360.577.7222

[a] Calendar days from sample receipt.

CAS – Columbia Analytical Services, Inc.
GC/ECD – gas chromatograph/electron capture detector
HRGC – high-resolution gas chromatography
HRMS – high-resolution/mass spectroscopy
NA – not applicable
OC – organochlorine
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
SVOC – semivolatile organic compound
VOC – volatile organic compound

QAPP Worksheet No. 31. Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Review of field activities/sampling method compliance	Daily or as scheduled	Internal	Windward	**Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward)	**Thai Do** (FC, Windward) or designee	**Thai Do** (FC, Windward) or designee	**Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward)
Independent specimen review	As needed	Internal	Windward	**Matt Luxon** (Fish Biologist, Windward)	**Thai Do** (FC, Windward) or designee	**Thai Do** (FC, Windward) or designee	**Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward)
Review of laboratory analysis method compliance, audit reports	As needed	Internal	Windward	**Susan McGroddy** (Investigative Organization Project Chemist, Windward)	**Pete Henriksen** (Laboratory Project Manager, Alpha Analytical), **Kimberly Mace** (Laboratory Project Manager, Analytical Perspectives), **Misty Kennard-Mayer** (Laboratory Project Manager, Brooks Rand Labs), **Lynda Huckestein** (Laboratory Project Manager, Columbia Analytical Services, Inc.), **Mike Challis** (Laboratory Project Manager, Maxxam Analytics)	**Pete Henriksen** (Laboratory Project Manager, Alpha Analytical), **Kimberly Mace** (Laboratory Project Manager, Analytical Perspectives), **Misty Kennard-Mayer** (Laboratory Project Manager, Brooks Rand Labs), **Lynda Huckestein** (Laboratory Project Manager, Columbia Analytical Services, Inc.), **Mike Challis** (Laboratory Project Manager, Maxxam Analytics)	**Susan McGroddy** (Investigative Organization Project Chemist, Windward)

QAPP Worksheet No. 31. Planned Project Assessments Table (cont.)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Data usability	Once, at the end of the field survey	Internal	Windward	**Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward)	**Thai Do** (FC, Windward) or designee	**Thai Do** (FC, Windward) or designee	**Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward)

CA – corrective action
FC – field coordinator
QA – quality assurance
QC – quality control
TBD – to be determined

QAPP Worksheet No. 32. Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Onsite review of field activities/ sampling method compliance	Deficiencies will be documented in the field logbook	**Thai Do** (FC, Windward); **Lisa Saban** (Investigative Organization Project Manager, Windward); **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law**, (Project Coordinators, de maximis, inc.); **Susan McGroddy** (Investigative Organization Project Chemist, Windward); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)	Immediately	Corrective actions will be documented in the field logbook and Protocol Modification Forms (Attachment A)	**Thai Do** (FC, Windward); **Lisa Saban** (Investigative Organization Project Manager, Windward); **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.), **Susan McGroddy** (Investigative Organization Project Chemist, Windward); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)	By next field day
Internal laboratory audits	Deficiencies will be document as required by laboratory QA manual	**Laboratories** (Alpha Analytical, Analytical Perspectives, Brooks Rand Labs, Maxxam Analytics, Columbia Analytical Services, Inc.) as required by laboratory QA manual	As required by laboratory QA manual	As required by laboratory QA manual	**Laboratories** (Alpha Analytical, Analytical Perspectives, Brooks Rand Labs, Maxxam Analytics, Columbia Analytical Services, Inc.) as required by laboratory QA manual If project DQOs are affected: **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Susan McGroddy** (Investigative Organization Project Chemist, Windward)	As required by laboratory QA manual

QAPP Worksheet No. 32. Assessment Findings and Corrective Action Responses (cont.)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
External laboratory audits by ddms[a]	Written audit report	**Peter Henriksen**(Laboratory Project Manager, Alpha Analytical), **Kimberly Mace** (Laboratory Project Manager, Analytical Perspectives), **Mike Challis** (Laboratory Project Manager, Maxxam Analytics)	Major deficiencies communicated orally at exit meeting and written report within 3 weeks	Letter with possible reaudit	**Polly Newbold** (Chemist, ddms) **Jennifer Parker** (Investigative Organization Project Data Validation Coordinator, Windward)**Susan McGroddy** (Investigative Organization Project Chemist, Windward), **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.)	One month

[a] External laboratory audits consisted of interviews with laboratory staff, discussion of standard operating procedures, observations of techniques, examination of records, and inspection of the facility and equipment. The audits covered the following topics: 1) general quality assurance practices; 2) sample receiving, log-in, and storage practices; 3) sample preparation and analysis; 4) data reporting and deliverables; and 5) waste storage and disposal practices. External laboratory audits were completed prior to initial analyses conducted by the laboratories. The audit dates are as follows: Alpha Analytical – May 19, 2009; Analytical Perspectives – June 25, 2009; and Maxxam Analytics – July 16, 2009. Only those laboratories that were not audited for the Low-Resolution Coring Effort for the Lower Passaic River Restoration Project were audited.

CA – corrective action
DQO – data quality objective
ddms – de maximis Data Management Solutions, Inc.
FC – field coordinator
QA – quality assurance
QC – quality control

QAPP Worksheet No. 33. QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Progress report	Daily, or as practicable	Daily, beginning the day after the first field sampling day	**Thai Do** (FC, Windward) or designee	**Lisa Saban** (Investigative Organization Project Manager, Windward); **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.); **Susan McGroddy** (Investigative Organization Project Chemist, Windward); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)
Corrective action reports (protocol modification forms)	Monthly, or as necessary	Monthly, or as necessary	**Thai Do** (FC, Windward) or designee	**Lisa Saban** (Investigative Organization Project Manager, Windward); **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.); **Susan McGroddy** (Investigative Organization Project Chemist, Windward); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)
Data usability report	Once, following the field effort	With data report	**Tad Deshler** (Investigative Organization Task QA/QC Manager)	**Lisa Saban** (Investigative Organization Project Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)
Report on chemistry results	Daily, or as necessary	Daily, or as necessary	**Susan McGroddy** (Investigative Organization Project Chemist, Windward);	**Lisa Saban** (Investigative Organization Project Manager, Windward); **Tad Deshler** (Investigative Organization Task QA/QC Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer)
Audits of fish processing	Once, start of project	Start of project	**Polly Newbold** (Chemist, ddms)	**Tad Deshler** (Investigative Organization Task QA/QC Manager); **Lisa Saban** (Investigative Organization Project Manager, Windward); **Bill Potter/Robert Law** (Project Coordinators, de maximis, inc.); **Alice Yeh/Stephanie Vaughn** (USEPA Project Managers); **William Sy** (USEPA Project QA Officer); **Susan McGroddy** (Investigative Organization Project Chemist, Windward)

ddms – de maximis Data Management Solutions, Inc.
FC – field coordinator
QA – quality assurance
QAPP – quality assurance project plan
QC – quality control
USEPA – US Environmental Protection Agency

QAPP Worksheet No. 34. Sampling and Analysis Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Species identification	The species will be confirmed by a fish biologist working independently from the field efforts.	Internal	Matt Luxon, Windward
Field-collected coordinates	All field-collected coordinates will be downloaded from the GPS receiver and plotted in the GIS to verify they accurately represent locations that were sampled.	Internal	Linda Marsh, Windward
Fish, crab, and crayfish abundance, length, weight data	Data transfer from field logbooks and forms to a computer-based table will be checked by a second individual.	Internal	Thai Do, Windward
Sample and lab QC	Verify the proper packing, shipping, storage and QC procedures for the tissue samples are conducted.	Internal	Jennifer Parker, Windward
Laboratory data packages	Spot check transcriptions and calculations from the raw data. Verify that entry of qualifiers was correct and complete, reported analytes conform to target analytes in QAPP, samples were prepared/analyzed within the holding times specified in the QAPP, the measurement criteria specified in the QAPP were met (and, if not, that appropriate corrective action and notification were taken), and project QLs conformed to the QAPP and that deviations were justified.	External	Denise Shepperd, Trillium

GIS – geographic information system
GPS – global positioning system
QAPP – quality assurance project plan
QC – quality control
QL – quantitation limit

QAPP Worksheet No. 35. Sampling and Analysis 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.	Jennifer Parker, Windward/ Polly Newbold, ddms
IIa	Field records, database output	Verify transcription of field data from field forms to database.	Jennifer Parker, Windward/ Polly Newbold, ddms
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/ Polly Newbold, ddms
IIa	Methods, analytical data reports	Verify that samples were prepared/analyzed within method-specific holding times.	Jennifer Parker, Windward/ Polly Newbold, ddms
IIa	Laboratory EDDs	Verify that EDD conforms to USEPA Region 2 MEDD format.	Peter Henriksen, Alpha Analytical/ Kimberly Mace, Analytical Perspectives/ Misty Kennard-Mayer, Brooks Rand Labs/ Mike Challis, Maxxam Analytics/ Lynda Huckestein, 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 (Steps IIa and IIb) Process Table (cont.)

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	Analytical data reports	Verify that PE samples were analyzed at the frequency specified in the contractual documents.	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.	Jennifer Parker, Windward/ Polly Newbold, ddms
IIa	Analytical data reports	Verify that project QLs conformed to the contractual specifications and that 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 Region 2 validation SOPs (if available). Qualifiers will be applied based on the criteria in the Region 2 validation SOPs or QAPP, whichever are more stringent. Spot check transcriptions and calculations from the raw data.	Denise Shepperd, Trillium
IIa	Data validation reports, database output	Verify that entry of qualifiers was correct and complete.	Denise Shepperd, Trillium
IIb	Analytical data reports	Verify reported analytes conform to target analytes in QAPP.	Denise Shepperd, Trillium
IIb	QAPP, analytical data reports	Verify that samples were prepared/analyzed within the holding times specified in the QAPP.	Denise Shepperd, Trillium
IIb	QAPP, analytical data reports	Verify that samples were prepared/analyzed according to the procedures specified in the QAPP.	Denise Shepperd, Trillium
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.	Denise Shepperd, Trillium
IIb	QAPP, analytical data reports	Verify that project QLs conformed to the QAPP and that deviations were justified.	Denise Shepperd, Trillium

QAPP Worksheet No. 35. Sampling and Analysis Validation (Steps IIa and IIb) Process Table (cont.)

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.	Denise Shepperd, Trillium
IIb	QAPP, analytical data reports, validation guidance	Verify that the qualifiers applied during validation were in conformance with the QAPP and specified validation guidance.	Denise Shepperd, Trillium
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
PE – performance evaluation
QAPP – quality assurance project plan
QL – quantitation limit
SOP – standard operating procedure

QAPP Worksheet No. 36. Sampling and Analysis 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	Tissue	PCBs – congeners[b]	Low	Region 2 validation SOP HW-46	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	PCBs – congeners[b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	PCBs – Aroclors[c]	Low	Region 2 validation SOP HW-45	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	PCBs – Aroclors[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	PCDDs/PCDFs[b]	Low	Region 2 validation SOP HW-25	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	PCDDs/PCDFs[b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24,	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	OC pesticides [b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	OC pesticides [b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	PAHs [b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	PAHs [b]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Alkylated PAHs[c]	Low	QAPP Worksheets Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Alkylated PAHs[c]	Low	QAPP Worksheets Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Metals[c]	Low	Region 2 validation SOP HW-2	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Metals[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Inorganic arsenic[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Inorganic arsenic[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Total mercury[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium

QAPP Worksheet No. 36. Sampling and Analysis Validation (Steps IIa and IIb) Summary Table (cont.)

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria[a]	Data Validator (title and organizational affiliation)
IIb	Tissue	Total mercury[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Methylmercury[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Methylmercury[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	SVOCs[c]	Low	Region 2 validation SOP HW-22	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	SVOCs[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Butyltins[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Butyltins[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Lipids[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Lipids[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIa	Tissue	Percent moisture[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium
IIb	Tissue	Percent moisture[c]	Low	QAPP Worksheet Nos. 12, 15, 19, and 24	Denise Shepperd, Principal Validator, Trillium

[a] Validation follows the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA 1999), USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA 2002b), 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 (EPA Level 4).

[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 (EPA Level 2).

HRMS – high-resolution mass spectrometry
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
QAPP – quality assurance project plan
SOP – standard operating procedure
SVOC – semivolatile organic compound
SDG – sample delivery group

QAPP Worksheet No. 37. Usability Assessment

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

The fish and decapod crustacean tissue collection effort will result in chemical analysis of targeted fish and targeted decapod crustacean species at each selected tissue sampling location throughout the LPRSA. The third-party independent validator will validate all laboratory chemistry data in accordance with the protocols described in Worksheet No. 36. The Project QA Manager, in conjunction with the project team, will determine whether the analytical data meet the requirements for use in making decisions related to further actions at the site.

The first fish community survey data will be collected concurrently with the fish and decapod crustacean tissue collection effort. All observations made during the field effort will be considered usable as long as they were made according to the methods described in the applicable SOPs (Worksheet No. 21). No formal data usability assessment report will be prepared for the fish community surveys.

Any deviations from the SOPs will be documented appropriately in the field logbook and on the Protocol Modification Form (Attachment A) and also approved by USEPA or its authorized representative.

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

During the data validation process, the validator will use information confirming sample identification; sample preparation; analysis within holding time; instrument calibration data; and results of QC samples designed to assess blank contamination, analytical precision, and accuracy to identify any limitations in data use and, if known, data bias. The validator will apply qualifiers as needed to reflect any limitations on the use of specific data points and prepare a report detailing the information reviewed, data limitations, and overall usability. Patterns of data use limitations or anomalies that become apparent during the validation process will be reviewed with the Project QA Manager and the appropriate laboratory. Data that do not meet the quality acceptance limits of Worksheet No. 28, quality levels of Worksheet No. 15, or analytical performance criteria specified in Worksheet No. 12 will be clearly identified in the database so data users are aware of any limitations associated with data usability. Details of the problems identified during data validation and the bias in the data will be provided in the associated validation memorandum.

Identify the personnel responsible for performing the usability assessment:

Data validation will be performed by an independent third-party validator (Trillium) under the supervision of the Project QA Manager. The usability assessment will be performed jointly by the Windward and CPG project teams and will include input by field personnel, QA staff, and project management.

QAPP Worksheet No. 37. Usability Assessment (cont.)

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

The documentation generated during data validation will include a data validation report that describes the information reviewed (as well as the results of this review) and provides a recommendation on overall data usability and limitations on specific data points. The validation report and associated validation worksheets will provide information on the samples included in the review and the date they were collected; the condition of samples when received at the laboratory and any discrepancies noted during the receiving process; verification of sample preparation and analysis within the method-specified holding time; instrument calibration information; review of associated QC analyses including blanks, laboratory control samples, matrix spikes, and field and/or laboratory duplicates; and verification of selected reported values from raw data. As a result of this review, standard qualifiers will be entered into the database so that data users can readily identify any limitations associated with a specific data point.

The assessment of data usability will be performed using current USEPA Region 2 data validation guidance. The results of the data usability assessment will be summarized in the final project report. The following items will be assessed and conclusions drawn based on their results:

Holding Time: All sample data will be checked to verify that both sample preparation and analysis were performed within the method-required holding time.

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

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

Accuracy/Bias Overall: Reported values of laboratory control samples, performance samples, and matrix spikes will be evaluated against the spiked or certified concentration, and the percent recovery will be calculated and compared to the criteria specified in Worksheet No. 28. The percent recovery information will be used to assess the bias associated with the analysis. Recovery for matrix spikes in conjunction with the recovery reported for performance samples and laboratory control samples will provide information on the impact of the sample matrix on specific analyses. Average recoveries will be calculated and reported by analyte for each type of QC sample.

Precision: Results of the relative percent difference (RPD) will be calculated for each analyte in laboratory and field duplicates. These RPDs will be checked against measurement performance criteria presented on Worksheet No. 28; RPDs that exceed the stated criteria will be identified. In addition, the combined RPD of each analyte will be averaged across duplicate pairs for which the

QAPP Worksheet No. 37. Usability Assessment (cont.)

original and duplicate values are both greater than the quantitation limit (QL); and a combined overall RPD average will be determined for each analyte in both laboratory and field duplicates. This information will be used to draw conclusions about the precision of the analyses and, for field duplicates, the precision of sampling and analysis. Any limitations on the use of the data will also be described.

Sensitivity: Reporting limits will be checked against the criteria and QLs presented on Worksheet No. 15. Limitations on the use of the data and conclusions about the sensitivity of the analysis will be reported.

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

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

Completeness: Completeness for the analytical program will be calculated as the number of data points that are accepted as usable based on the validation process divided by the total number of data points for each analysis. Completeness will be reported for each analytical category, and an overall value will be reported. As shown in Worksheet No. 12, the analytical completeness goal is ≥ 90%. Completeness for the field program will be calculated as the number of samples successfully collected compared to the total number proposed in this QAPP. The completeness goal for the field sampling program is ≥ 95%. The usability assessment will also evaluate the effects of elevated detection limits, rejected data, and qualified data on the risk assessments.

References

Abraham BJ. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic): Mummichog and striped killifish. Biological Report 82-4 (11.40). Coastal Ecology Group, US Army Corps of Engineers, Vicksburg, MS and National Wetlands Research Center, US Fish and Wildlife Service, Slidell, LA.

Battelle. 2005. Lower Passaic River Restoration Project. Pathways analysis report. Prepared for US Environmental Protection Agency Region 2 and US Army Corps of Engineers. Battelle, Duxbury, MA.

Belton TJ, Hazen R, Ruppel BE, Lockwood K, Mueller R, Stevenson E, Post JJ. 1985. A study of dioxin (2, 3, 7, 8-tetrachlorodibenzo-p-dioxin) contamination in select finfish, crustaceans and sediments of New Jersey waterways. Office of Science and Research, New Jersey Department of Environmental Protection, Trenton, NJ.

Desvousges WH, Kinnell JC, Lievense KS, Keohane EA. 2001. Passaic River Study Area creel/angler survey: data report. Triangle Economic Research, Durham, NC.

ENSR, AECOM, Windward. 2008. Lower Passaic River restoration project. Quality assurance project plan: RI low resolution coring/sediment sampling. Revision 4. Prepared for Cooperating Parties Group. ENSR AECOM, Newark, NJ.

Hamas MJ. 1994. Belted kingfisher (*Ceryle alcyon*) [online]. In: Poole A, ed. The birds of North America online. Cornell Laboratory of Ornithology, Ithaca, NY. Available from: http://bna.birds.cornell.edu/bna/species/084.

Horwitz R, Ashley J, Overbeck P, Velinsky D. 2005. Final report: routine monitoring program for toxics in fish. Prepared for the New Jersey Department of Environmental Protection, report no. 04-06. Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA.

Horwitz R, Overbeck P, Ashley J, Velinsky D, Zadoudeh L. 2006. 2004 monitoring program for chemical contaminants in fish from the State of New Jersey: second year of routine monitoring program, final report. No. 06-04F. Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA.

Hunn JB. 1988. Field assessment of the effects of contaminants on fishes. Biological report 88(19). National Fisheries Contaminant Research Center, US Fish and Wildlife Service, Columbia, MO.

Iannuzzi TJ, Armstrong T, Thelen J, Ludwig D, Firstenberg C. 2004. Chemical contamination of aquatic organisms from an urbanized river in the New York/New Jersey Harbor Estuary. Human Ecol Risk Assess 10:389-413.

Krone CA, Brown DW, Burrows DG, Bogar RG, Chan S, Varanasi U. 1989. A method for analysis of butyltin species and measurement of butyltins in sediment and English sole livers from Puget Sound. Mar Environ Res 27:1-18.

Malcolm Pirnie. 2005. Lower Passaic River Restoration Project. Quality assurance project plan. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.

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.

Malcolm Pirnie. 2006. Lower Passaic River Restoration Project. Draft geochemical evaluation (step 2). Prepared for US Environmental Protection Agency Region 2 and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.

NJDEP. 1990. Polychlorinated biphenyls (PCBs), chlordane, and DDTs in selected fish and shellfish from New Jersey waters, 1986-1987: results from New Jersey's Toxics in Biota monitoring program. New Jersey Department of Environmental Protection, Division of Science and Research, Trenton, NJ.

NJDEP. 1993. Polychlorinated biphenyls (PCBs), chlordane, and DDTs in selected fish and shellfish from New Jersey waters, 1988-1991: results from New Jersey's Toxics in Biota Monitoring Program. Division of Science and Research, New Jersey Department of Environmental Protection, Trenton, NJ.

NJDEP. 2006. Fish IBI (index of biotic integrity) report: 2004 sampling. New Jersey Department of Environmental Protection, Trenton, NJ.

NJDEP. 2009. Division of Fish & Wildlife regulations: New Jersey Permanent Statute Title 23 - fish and game, wild birds and animals [online]. New Jersey Department of Environmental Protection, Trenton, NJ. Updated January 21, 2009. [Cited March 9 2009.] Available from: http://www.state.nj.us/dep/fgw/njregs.htm#fishing.

Princeton Aqua Science. 1982. Biocommunities study, Passaic Valley Sewerage Commission combined sewer overflow facilities plan. Princeton Aqua Science, New Brunswick, NJ.

Shisler JK, Iannuzzi TJ, Ludwig DF, Bluestein PJ. 2008. Ecological benchmarking in an urbanized estuarine river system. Ecol Restor 26(3):235-245.

Tierra Solutions. 1999. Passaic River Study Area ecological sampling plan. Work plan/field sampling plan. Volume 1 of 6. Tierra Solutions, Inc., Newark, NJ.

Tierra Solutions. 2002a. Passaic River Study Area benthic invertebrate community characterization. September 26, 2002. Tierra Solutions, Inc., Newark, NJ.

Tierra Solutions. 2002b. Passaic River Study Area fish community characterization. September 26, 2002. Tierra Solutions, Inc., Newark, NJ.

Tierra Solutions. 2002c. Passaic River Study Area fish community data. September 18, 2002. Tierra Solutions, Inc., Newark, NJ.

Tierra Solutions. 2003. Executive summary, Passaic River Study Area preliminary findings. Tierra Solutions, Inc., East Brunswick, NJ.

USACE. 1987. Passaic River Basin, New Jersey and New York. Phase I - general design memorandum: Flood protection feasibility, Main Stem Passaic River, main report and environmental impact statement. US Army Corps of Engineers, New York District, NY.

USEPA. 1989. Assessing human health risks from chemically contaminated fish and shellfish: a guidance manual. EPA/503-8-89-002. US Environmental Protection Agency, Washington, DC.

USEPA. 1999. USEPA contract laboratory program national functional guidelines for organic data review. EPA-540/R-99/008. Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC.

USEPA. 2000a. Bioaccumulation testing and interpretation for the purpose of sediment quality assessment: status and needs. EPA-823-R-00-001. Bioaccumulation Analysis Workgroup, US Environmental Protection Agency, Washington, DC.

USEPA. 2000b. Guidance for assessing chemical contaminant data for use in fish advisories. Volume 1: Fish sampling and analysis. Third ed. EPA 823-B-00-007. US Environmental Protection Agency, Washington, DC.

USEPA. 2002a. Guidance on choosing a sampling design for environmental data collection for use in developing a quality assurance project plan. USEPA QA/G-5S. EPA/240/R-02/005. Office of Environmental Information, US Environmental Protection Agency, Washington, DC.

USEPA. 2002b. USEPA contract laboratory program national functional guidelines for inorganic data review. EPA 540-R-01-008. Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC.

USEPA. 2007a. Administrative settlement agreement and order on consent for remedial investigation/feasibility study, Lower Passaic River Study Area portion of the Diamond Alkali Superfund site. US EPA Region 2 CERCLA docket no. 02-2007-2009. US Environmental Protection Agency, Region 2, New York, NY.

USEPA. 2007b. Fish abundance data for New Jersey, 2000. Downloaded from EPA's National Coastal Assessment Coastal Data Search Engine [online]. Environmental Monitoring and Assessment Program (EMAP), US Environmental Protection Agency, Washington, DC. [Cited 4/26/07.] Available from: http://oaspub.epa.gov/coastal/coast.search.

USEPA. 2007c. ProUCL Version 4.0. Statistical software for environmental applications for data sets with and without nondetect observations [online]. Technical Support Center for Monitoring and Site Characterization, US Environmental Protection Agency, Updated 6/14/07. Available from: http://www.epa.gov/nerlesd1/tsc/software.htm.

USEPA. 2008a. Region 3 fish tissue screening levels, May 2008. US Environmental Protection Agency, Washington, DC.

USEPA. 2008b. US EPA response to comments on field sampling plan volume 2. US Environmental Protection Agency Region 2, New York, NY.

USEPA, USDOD, USDOE. 2005. Evaluating, assessing, and documenting environmental data collection/use and technology programs. Part 1: UFP-QAPP manual. Version 1. EPA-505-B-04-900A. Intergovernmental Data Quality Task Force, Uniform Federal Policy for Quality Assurance Project Plans. US Environmental Protection Agency, US Department of Defense, and US Department of Energy, Washington, DC.

USGS. 2002. Illustrated field guide for assessing external and internal anomalies in fish. Information and technology report USGS/BRD/ITR-2002-0007 [online]. US Geological Survey, Washington, DC. Available from: http://www.cerc.usgs.gov/pubs/center/pdfDocs/ITR_2002_0007.pdf.

Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley M, Fiedler H, Hakansson H, Hanberg A, Haws L, Rose M, Safe S, Schrenk D, Tohyama C, Tritscher A, Tuomisto J, Tysklind M, Walker N, Peterson RE. 2006. The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Tox Sci 93(2):223-241.

Windward, AECOM. 2009. LPRSA human health and ecological risk assessment streamlined 2009 problem formulation. Draft. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA; AECOM, Inc., Westford, MA.

Attachment A: Protocol Modification Form

Project Name and Number: _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):

Reason for Change in Field Procedure or Analysis Variation: _____

Variation from Field or Analytical Procedure: _____

Special Equipment, Materials or Personnel Required: _____

Initiator's Name: _____ Date: _____

Project Manager: _____ Date: _____

QA Manager: _____ Date: _____

USEPA Authority: _____ Date: _____

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Attachment B: Location Data Form

Project Name: **Project No.:**

Field Crew Initials:

Deployment Date & Time	Retrieval Date & Time	Location ID	Trap ID	Collection Method	Coordinates[a]		Depth (ft)
					Easting (X)[b]	Northing (Y)[b]	

[a] Field-observed coordinates.

[b] NAD83 New Jersey State Plane (ft).

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Attachment C: Specimen Data Form

CHECKLIST FOR PHYSICAL EXAMINATION OF FISHES		
Collection Date:	Exam Date:	Examined by:
Digital photo record: Camera:	Photo numbers:	
Sex:	Frozen (Y/N)?	
Specimen ID:		
Tissue Sample ID:		
Tissue type: egg tissue stomach content	Fixative:	

EXTERNAL PHYSICAL EXAMINATION					
BODY FORM		ISTHMUS		BRONCHIAL CAVITY	
	Normal		Normal		Normal
	Emaciated		Enlarged		Growths
	Truncate		Hemorrhagic		Parasites
	Scoliosis	EYES		UROGENITAL OPENING	
	Lordosis		Normal		Normal
BODY SURFACE			Popeye		Inflamed
	Normal		Cloudy cornea	ANUS	
	Raised scales		Missing		Normal
	Swollen		Lens deformed		Inflamed
	Lesions		Lens parasites	LESIONS – Location(s)	
	Excess mucous		Lens cataract		Fins
	Reoriented scales	FINS			Head
	Growths		Normal		Eyes
	Parasites		Frayed – eroded		Mouth
	Wounds		Parasites		Peduncle
	Wounds – lamprey		Hemorrhagic		Ventral
LIPS AND JAWS			Gas Bubbles		Dorsal
	Normal	FINS – ERODED			Lateral
	Deformed		Dorsal		
	Growths		Pectoral		
SNOUT			Pelvic		
	Normal		Anal		
	Pugnose (Pughead)		Adipose		
	Growths		Caudal		
	Abrasions				

EXTERNAL PHYSICAL EXAMINATION – Continued					
BARBELS		GILLS		BEHAVIOR	
	Normal		Normal		Gasping
	Deformed		Bright red		Flashing
	Missing		Brown		Lethargic
OPERCLE			Gas bubbles		Fin twitching
	Normal		Parasites		Convulsions
	Incomplete	PSEUDOBRANCH			Head Up--Tail Down
			Normal		Head-tail whirling
			Enlarged		Pectoral fins folded forward
					Belly up
					Loss of balance
					Long axis whirling
				OTHER OBSERVATIONS	

INTERNAL PHYSICAL EXAMINATION					
BODY CAVITY		INTESTINES		OVARIES	
	Normal		Normal		Immature
	Fluid - clear		Flaccid		Mature
	Fluid - bloody		Mucous		Ripe
	Fluid - cloudy		Feces		Reabsorbing
	Adhesions		Fluid		Growth
MESENTERIC FAT			Hemorrhagic	MUSCLE	
	Normal		Parasites		Normal
	None	SPLEEN			Soft
	Excessive		Normal		Parasites
LIVER			Enlarged	TUMORS	
	Normal		Shrunken		Liver
	Discolored		Discolored		I Baumann
	Yellowish		Ceroid Pigment Centers		II Scale
	Pale	GAS BLADDER			III
	Enlarged		Normal		
	Growths		Fluid	PYLORIC CAECA	
	Parasites		Growths		Normal
GALL BLADDER		KIDNEY			Parasites
	Empty		Normal	TESTIS	
	Full		Pale		Immature
	Yellow		Swollen		Mature
	Green		Soft		Ripe
	Enlarged		Hemorrhagic		Constructed
	Parasites		Stones		Growth
STOMACH			Growths	OTHER OBSERVATIONS	
	Normal		Cysts		
	Empty		Parasites (urinary bladder)		
	Food				
	Mucous				
	Fluid				
	Hemorrhagic				

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Attachment D: Specimen Tally Form

Project Name: **Project No.:**

Species Sampled: **Field Crew Initials:**

COLLECTION DATE	COLLECTION TIME	TRAP ID	SPECIMEN ID NO.	LENGTH (mm)	WEIGHT (g)	GENDER	COMMENTS

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Attachment E: Non-Target Species Tally Form

Project Name: **Project No.:**

Field Crew Initials:

Collection Date	Collection Time	Trap ID	Species	Length Min (mm)	Length Max (mm)	Total Weight (g ww)	Count	Comments

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Attachment F: Composite Sample Form

Project Name: **Project No.**

Date Composited: **Composited By:**

TISSUE TYPE	COMPOSITE ID	SPECIMEN ID	TISSUE SAMPLE ID	WEIGHT (g ww)

Comments:

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Attachment G: SOP—Locating Sample Points Using a Hand-Held Global Positioning System (GPS)

I. Purpose

The purpose of this procedure is to provide reference information regarding the collection and documentation of sample coordinates for the Lower Passaic River Study Area (LPRSA) remedial investigation/feasibility study (RI/FS) using a global positioning system (GPS).

II. Definition

GPS provides navigation and positioning information from a constellation of GPS satellites, operated by the US Department of Defense. The system includes a control station and five monitoring locations that track each satellite. Information received by the monitoring stations is used to calculate satellite orbits and update the information sent to receivers. Satellite signals can be received by any GPS receiver on land or water or in the air. The system incorporates a minimum of 24 satellites, which are positioned around the world such that six satellites are available at a given location, 24 hours a day. The LPRSA RI/FS will use a hand-held GPS unit to collect and record sampling location coordinates. The signals received by the hand-held GPS will produce locations with sub-meter accuracy.

III. Equipment and Supplies

- A hand-held differential global positioning system (DGPS) unit or equivalent model such as the Trimble® ProXH™, with sub-foot accuracy
- An additional DGPS unit with equivalent accuracy as the primary unit (described above) to be carried as a back-up to the Trimble® unit in the case of malfunction or loss (if necessary, the back-up GPS unit will only be used temporarily until the primary unit can be replaced or repaired).
- AA or AAA batteries depending on the device
- USB port cable to download information

IV. Field Procedure

A. Power on the GPS unit and wait several minutes for the GPS to locate the initial position via satellite. Confirm that the date and time are correct.

B. Locate the coordinate system information in the main menu and verify the following settings:

1. Units = Feet
2. Coordinate system = New Jersey State Plane (easting and northing)
3. Map datum = NAD83
4. North reference = Magnetic north (Magnetic north will be used for navigational purposes; however, either magnetic or true north can be used to collect fixed coordinates. The north reference setting will be recorded in the field notebook.)

C. Confirm that the background map is set to North America. Record the date, time, and all relevant coordinate system information in the field notebook.

D. Once the unit has acquired the initial position and has indicated that it is ready, follow directions on the GPS to begin collecting sample coordinates.

E. At each sampling location, allow the GPS to receive satellite data for at least one minute before recording the sampling location. A minimum of three satellites is required for a three-dimensional reading, but four satellites are preferred. Save the location information at each sampling location. Record the date, time, and easting/northing (NAD 83 New Jersey State Plane) in feet for each location in the field notebook. Readings will be stored in the GPS unit for easy downloading and also to reduce error.

F. The manufacturer's user's manual will be reviewed and referenced to address technical difficulties and/or malfunctions with the unit.

V. Quality Control

The GPS has quality control features within the system that maintain reliable readings. The GPS will indicate the number of satellites available, the strength of each satellite signal and will not display coordinates for a given location if there is not a sufficient number of satellites available to take an accurate measurement. The GPS will also make sure that the satellite geometry is able to account for the three-dimensional position. The GPS averages data from satellites over time, thus waiting at least one minute before recording coordinates at each sampling location will provide a more accurate reading. To ensure the accuracy of the navigation system, a checkpoint will be located at a known point, such as a pier face, dock, piling, or similar structure that is accessible by the sampling vessel. At the beginning and end of each day, the vessel will be stationed at the check point, a GPS position reading will be taken, and the reading will be compared with the known land survey coordinates. The two position readings should agree, within the limits of survey vessel operational mobility, to within 1 ft.

Attachment H: SOP—Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS)

I. Purpose

The purpose of this procedure is to define the Standard Operating Procedure (SOP) for the documentation of sampling locations and for positioning vessels using a global positioning system (GPS) at the Lower Passaic River Restoration Project Superfund Site for boat-based field operations. This is based on Standard Operating Procedure (SOP) 2 of FSP2 (Malcolm Pirnie et al. 2006). Positioning will be conducted to locate the vessel(s) with sufficient accuracy and precision to meet project objectives during the fish sampling activities.

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to position fishing vessels. Specific information regarding proposed fish sampling locations is provided in the QAPP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the FC, CPG, and the USEPA Remedial Project Manager.

II. Procedures

Unless otherwise indicated, sampling activities described in this QAPP will be conducted from a vessel. In accordance with procedures outlined below, these vessels must be properly positioned and their position recorded before each activity can begin.

A. Equipment List

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

- Personal protective equipment (PPE) and other safety equipment, as required by the health and safety plan (Attachment R)
- Vessel(s) adequate for Newark Bay conditions
- 25 watt marine VHF radio
- Navigation charts and QAPP sampling location figure
- Differential global positioning system (DGPS) receivers (or equivalent model) with an accuracy of +/-1 foot
- DGPS external antennas
- Equipment user manuals
- Table of target sampling location coordinates
- Assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- Logbook and field forms
- Electronic wireless recording device (e.g., laptop)
- Permanent marker or grease pencil

B. Positioning Vessel

This section gives the step-by-step procedures for vessel positioning. Observations made during vessel positioning should be recorded on the field forms, and/or logbook, as appropriate.

A DGPS will be used to establish locations during implementation of activities specified in the QAPP. DGPS units will be required: one on board the vessel with a receiving antenna to be aligned with the deployment of the sampling apparatus, and the other at a known fixed location (monument or temporary benchmark) to provide corrections to the standard GPS signal.

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

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

1. Establishing a Position at a Location

   a. Preliminary Activities

      - Obtain the appropriate field form(s). Complete the field logbook.
      - Obtain the target sampling locations. For the sampling activities, these locations will have been selected prior to commencement of field activities, as described in the QAPP. The location of each target sampling location will be established in the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83).
      - Enter coordinates for the locations into the DGPS unit that will be on board the vessel as a waypoint.

   b. Field Activities

      - Establish a DGPS base station over a shore-based marker prior to sampling operations. The operation and horizontal/vertical accuracy of the vessel mounted DGPS will be verified at another shore-based marker by recording observed horizontal and vertical (XYZ) data and comparing these data to the published XYZ data for a given point. After initial DGPS system verification, a temporary benchmark may be established at a location convenient to the vessel to facilitate daily DGPS system performance verification. DGPS system performance verification will be conducted twice per day and documented in the log book and vessel data logger. The horizontal and vertical accuracy will be compared to shore-based markers to verify performance.
      - Verify receiving antenna is properly aligned with the sampling device.
      - Identify and approach actual sampling locations by using data from the DGPS unit in the navigation mode. The navigation mode provides information on heading, distance remaining, and time remaining. This

information is based on the selected waypoint location and the present location of the vessel.

- Anchor the vessel adjacent to the planned location, if desired.
- Once the vessel is on location and secured, note the coordinates from the DGPS unit and check the coordinates to verify that the vessel is within the pre-determined range of the target location. If not acceptable, adjust the vessel's location, and recheck the position. Repeat this process until the vessel's position is within acceptable range of the target. Record the final coordinates on the appropriate field form.
- Once the coordinates are acceptable, perform activity at the location. Record final location coordinates on the appropriate form. Plot locations onto a master chart or use computer-based, real-time software to verify location.
- At the end of the sampling day, check the data loaded onto the DGPS units to verify the existence of coring locations where data were collected.

III. Calibration, Maintenance and Use of Field Instruments

Prior to use, the DGPS unit will be inspected in accordance with Worksheet No. 22 of this QAPP. DGPS unit will be calibrated in accordance with Worksheet No. 22 of this QAPP, appropriate sections of the equipment user's manual, and as described in of this SOP. Maintenance and use of DGPS units should follow the appropriate sections of the equipment user's manual. Field personnel will have the manual available for reference. Equipment inspection and maintenance will be recorded in the logbook. Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites can still occur. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), vessel positioning will be achieved using land-based methods. If a land-based method is selected, Attachment G: Locating Sample Points Using a Hand-Held Global Positioning System (GPS), will be used.

IV. Quality Assurance

QA activities for positioning procedures include verification of the sample location by comparing the target coordinates specified in the QAPP with coordinates entered into the DGPS, and by plotting the coordinates on a master chart.

V. Documentation

Detailed positioning data will be recorded on the appropriate field. In addition, the following information will be recorded in a logbook (at a minimum):

- Notes on sampling location;
- Equipment calibration information; and
- Summary of vessel activities.

VI. Reference

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.

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Attachment I: SOP—Procedures to Decontaminate Biological Sampling Equipment

I. Introduction

This procedure describes the methods used to decontaminate biological sampling equipment and tools used at the site and is based on Standard Operating Procedure (SOP) 25 of FSP2 (Malcolm Pirnie et al. 2006). The procedures specifically address equipment used to collect biological samples for chemical analyses, which will be used in conjunction with Attachment K: SOP—Management and Disposal of Investigation-Derived Waste for the proper disposal of residual water and used chemicals from decontamination procedures.

II. Equipment and supplies

The following equipment may be used to decontaminate equipment and tools used to collect biological samples:

- Pump system (intake/pump/hoses) for handling site water for cleaning and rinsing equipment
- Tap water for cleaning and rinsing equipment
- De-ionized water for final equipment rinse
- Non-phosphate detergent (e.g., Alconox™) for cleaning equipment
- Solvents for equipment rinse (e.g., 10% nitric acid, acetone, methanol and hexane)
- Personal protective equipment (PPE), including disposable gloves (nitrile preferred), safety glasses, disposable wipes, eye wash system, first aid kit, and waterproof outerwear, as well as a personal flotation device if necessary
- Teflon® squirt bottles for water, alcohol, and solvents
- Brushes for cleaning equipment
- Field notebook and digital camera to document decontamination procedures

The following equipment will be used to collect biological samples and may require decontamination:

- Eel traps
- Minnow traps
- Crayfish traps
- Crab traps
- Gillnets
- Trotlines and hooks
- Dip nets
- Measuring board
- Ceramic knives, forceps, scissors

III. Guidelines

All sample collection equipment that contacts the organisms of interest will be decontaminated in accordance with the following procedures.

A. Fish collection nets

1. Remove all inert and organic debris from the net.
2. Brush mud off net.
3. Rinse with site water or tap water.
4. If the net is oiled or contaminated with material that is not removed with site water or tap water, scrub the soiled area with a brush, site or tap water and non-phosphate detergent, followed by another site or tap water rinse.
5. Store the net in a covered container (e.g., trash can or plastic bag), protected from contamination from the vessel, atmospheric fallout, and other field operations until the next deployment.

B. Invertebrate and/or fish collection traps

1. Remove any bait containers and discard the bait into the trash.
2. Remove all inert and organic debris from the trap.
3. Brush mud from the trap.
4. Rinse the trap with site water or tap water.
5. If the trap is oiled or contaminated with material that is not removed with site water or tap water, scrub the soiled area with a brush, site or tap water, and non-phosphate detergent.
6. If the bait does not completely wash out of the bait container with site or tap water, use a brush to remove the remaining bait and rinse with site or tap water.
7. Store the trap and bait container in a covered container (e.g., trash can or plastic bag), protected from contamination from the vessel, atmospheric fallout, and other field operations until the next deployment.
8. Inspect the trap prior to the next deployment; confirm the trap is clean from debris.

C. Tissue Sample Processing Equipment

Samples may be processed at some level on the vessel, depending on the quality assurance project plan (QAPP) or field sampling plan (FSP) specifications. If utensils and equipment come in contact with tissue samples, they will be decontaminated as follows:

1. Rinse each item with site or tap water to remove tissue, fluids (e.g., blood) and/or other visually present material.
2. Scrub the item with a brush and soapy water, using non-phosphate detergent.
3. Rinse the item with site or tap water to remove all residual soap.
4. Rinse with 10% nitric acid, ultrapure. This rinse may be omitted if metals samples are not collected.

5. Rinse with de-ionized water.
6. Rinse with acetone only or with methanol followed by hexane. This rinse may be omitted if organics samples are not collected.
7. Rinse the item with de-ionized or analyte-free water and allow to air dry. The volume of water used in the final rinse should be at least five times the volume of solvent used in the previous step (No. 6).
8. Wrap the item(s) in aluminum foil to protect it until it is used again.

IV. Reference

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.

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Attachment J: SOP—Fish Surveys, Collection, and Tissue Sampling

I. Introduction

This procedure, based on Standard Operating Procedure (SOP) 29 of FSP2 (Malcolm Pirnie et al. 2006), defines the procedures to be followed when conducting fish surveys and collecting fish tissue samples, where appropriate, from the Lower Passaic River Study Area (LPRSA). The fish surveys and collections will be performed, as practicable, using baited eel and minnow traps and trotlines, gillnets, and electrofishing. Although the details of sample collection will be influenced by site-specific conditions, certain aspects of sample collection can be standardized for fish sampling and collection. These procedures give descriptions of equipment, field procedures, and the documentation necessary to conduct fish population surveys and tissue sampling. Other SOPs may be used with this SOP and are addressed in the project-specific quality assurance project plan (QAPP). All data, including information on individual fish collected for analysis, as well as fishing coordinates, depths, and times will be included in an electronic database, which will be provided to USEPA.

II. Preparations for Sampling

The QAPP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the QAPP prior to conducting field activities and ensuring that all field equipment, including sample containers and preservatives, are available and in acceptable condition.

III. Equipment and Supplies

Equipment to be used during fish surveys and the collection of fish tissue samples may include, but is not limited to the following:

- Sampling vessel
- Eel traps and bait
- Minnow traps and bait
- Trotlines, hooks, and bait
- Gillnet
- Weights and buoys (or floats)
- Ceramic knives
- Fish measuring board
- Electronic scale
- Specimen Data Form
- Field guides and taxonomic keys
- Plastic buckets and/or steel washtubs
- Sample containers
- Bubble wrap
- Ice (wet and dry)
- Insulated coolers
- Sample identification labels/tags

- Waterproof marking pens
- Ziplock bags
- Personal protective equipment (PPE) as required (e.g., disposable gloves, safety glasses)
- Tissue processing equipment
- Camera

IV. Equipment Decontamination Procedures

Decontamination of fish tissue sampling equipment will be performed between samples collected from each location/event in accordance with procedures outlined in the Decontamination of Biological Sampling Equipment SOP (Attachment I). Personnel decontamination procedures are described separately in the health and safety plan (Attachment R).

V. Location of Sampling Stations

The position and depth of the sampling station will be established. The positioning procedures are described in Attachments G and H: Locating Sample Points Using a Hand-Held Global Positioning System (GPS) and Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS), respectively. The depth of the sampling station will be determined using either a fathometer or weighted demarcated line. Proposed sampling locations are presented on Figure 3 of the QAPP and summarized on Worksheet No. 18. Additional sampling locations may be selected in the field, based on *in situ* conditions and observations. The coordinates of each proposed sampling location are presented in Table 1.

Table 1. Proposed target coordinates

Location ID	Easting (X)[a]	Northing (Y)[a]
LPR1A	598877	686181
LPR1B	598085	686693
LPR1C	597795	689405
LPR1D	597397	690459
LPR1E	598080	690843
LPR2A	597944	693101
LPR2B	596716	695182
LPR2C	593046	695048
LPR2D	592154	695234
LPR2E	590055	692989
LPR3A	588668	692734
LPR3B	587362	692530
LPR3C	585609	693327
LPR3D	584604	697313
LPR3E	585099	699247
LPR4A	584913	699733

Location ID	Easting (X)[a]	Northing (Y)[a]
LPR4B	585420	701319
LPR4C	586709	704181
LPR4D	587645	705789
LPR4E	588124	707278
LPR5A	589402	709079
LPR5B	590270	712390
LPR5C	592038	717728
LPR5D	592177	718812
LPR6A	592580	722395
LPR6B	593258	723231
LPR6C	594283	723843
LPR6D	595226	724159
LPR6E	596225	725184
LPR7A	596540	729148
LPR7B	596636	729372
LPR7C	596682	732848
LPR7D	597489	734993
LPR8A	597542	737926
LPR8B	600909	737821
LPR8C	600574	739432
LPR8D	599016	741812
LPR8E	597855	744561
LPR8F	596872	745762

[a] NAD83 New Jersey State Plane (ft).

VI. Fish Surveys

The following protocol shall be implemented, as practicable, for conducting fish surveys and collecting fish tissue samples from the LPRSA at the appropriate sampling stations as described the QAPP.

A. Baited eel and minnow traps

Bait used in traps will not be analyzed for contaminant concentrations. To prevent ingested bait from impacting the anticipated tissue-residue analyses, traps will use bait contained in bait bags or perforated containers to prevent the consumption of bait. Baited traps will be deployed at three locations at each of the sampling stations during the late summer/early fall sampling. Baited traps may be deployed in conjunction with the gillnet sets. The primary goal of using these traps is to catch adult American eel, mummichogs, and darters for the tissue-residue analysis; but as a secondary goal, the traps are also likely to catch other small forage fish. Not all fish collected in these traps will be kept for tissue analysis; however, all fish collected will be counted and identified for the fish community survey.

For non-target fish that will not be retained for chemical analysis, a subsample of 10 to 15 fish may be used to generate weight and length (total) data for each species size class as part of the fish community data collection. Length, weight, and, if practicable, gender will be recorded for all individual fish retained for tissue analysis. When gender cannot be identified, gender will be recorded as "indeterminate." Each trap is made of reinforced aluminum mesh (1/4 in.) and can be buoyed with a small flotation device. Baited minnow traps for collecting mummichogs and darters will be preferentially set during the day on incoming tides to the extent possible based on the schedule of sampling activities. If sampling activities do not allow for the deployment of baited minnow traps during the day, traps will be deployed in the late afternoon to early evening hours and retrieved the following morning in the same manner as the eel traps and gillnets.

1. Place the bait into the mesh bag or on the hook attached to the center bow of the trap. Attach a float or buoy to the end of the minnow trap line.
2. Lower the trap into the water from the side of the boat, making sure that the trap is securely anchored and oriented on the river bottom. A buoy should be clearly visible on the water surface so that the minnow trap can be easily retrieved.
3. Note the time and location of deployment and retrieval and any pertinent sampling location and condition descriptions in the field logbook.
4. Retrieve traps.
5. Empty each trap into an individual clean holding container (e.g., insulated cooler) by slowly pulling the two ends of the trap apart.
6. All trapped fish will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages and recorded on the Specimen Data Form (Attachment C).

B. Trotlines

Trotlines may be used to collect a variety of fish species and sizes. Each trotline will consist of a main line with baited size 4 to 6 worm hooks. Trotlines will be deployed from a boat and generally set perpendicular to the shore. To comply with federal boating regulations for navigable waterways, buoys will not be set in navigation channels. If practicable, a minimum of one trotline will be set per sampling zone. An anchor and float line will be attached to each end of the main line, and the trotline will be set overnight. Field observations will be made on the presence of bait material in the gullet of the collected fish to be retained for analysis, when possible.

1. After baiting the hooks, place the trotlines into the water from the side of the boat, making sure that the line is taut from beginning to end. An attached buoy should be clearly visible on the water surface so that the trotlines can be easily retrieved.
2. Set trotlines perpendicular to the shore.
3. Note the time and location of deployment and retrieval and any pertinent sampling location and condition descriptions in field logbook.
4. Retrieve trotlines.
5. Unhook any fish caught on the trotlines into a clean holding container.

6. Fish removed from the trotlines will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages, and recorded on the Specimen Data Form (Attachment C).
7. Hooks will be left in during field collection but noted for the laboratory where samples will be prepared.

C. Gillnets

Multiple gillnets approximately 150 ft long and made up of six 6 x 24-ft panels with mesh sizes of 1.0 in., 1.5 in., 2.5 in., 3.0 in., 3.5 in., and 4.0 in. will be used. Each net consists of six different mesh types in order to capture various sizes of fish. Each net is equipped with lead weights and floats designed to hold the net vertically in the water column (i.e., after deployment, the bottom of the net will be suspended at least 1 ft above the bottom to avoid contact with bottom debris). The nets will be anchored with appropriate weights, and buoy lines will be rigged within 1 to 2 ft of taut with respect to the next predicted high tide following deployment. To comply with federal boating regulations for navigable waterways, buoys will not be set in navigation channels of the river. This requirement may influence the actual location of the gillnet deployments. These deployment techniques will ensure reasonable positioning of the net in the water column throughout the tidal cycle. If necessary, alternate sized gillnets may also be used under this sampling plan.

Gillnets will be deployed perpendicular to shore during the late afternoon or early evening hours and retrieved the following morning, as practicable. Generally, fish activity increases during the night, and the catch retrieved the following day will be more representative of species movement within the area. Fish caught in the gillnets may be used in the fish community survey and tissue sample collection. The following protocols will be followed, as practical, for collecting fish with gillnets.

1. Position the vessel at the site at which the gillnets are to be set.
2. Attach floats and anchor weights to surface float lines and bottom lead lines of gillnets.
3. Examine the bow of the vessel. Identify and cover with duct tape any cleats, exposed screws, and irregularities in deck rail where the net might become entangled during deployment.
4. Deploy gillnets perpendicular to shore/current from bow of vessel while vessel is in reverse. Note the time and location of deployment in field logbook.
5. Retrieve gillnets after the desired interval. Approach the net from the downwind end and slowly pull the net onto the boat.
6. Stack the gillnet into a cooler or wash tub in coils or figure eights, carefully removing fish as the net is pulled out of the water.
7. Place fish removed from the gillnets into a clean, labeled holding container (e.g., insulated cooler).
8. Fish removed from the gillnets will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages, and recorded on the Specimen Data Form (Attachment C).

VII. Fish Handling and Preservation

Fish collected only for identification or population surveys should be identified in the field and released. Fish collected for tissue analysis will be assessed for external abnormalities, weighed, and measured before being wrapped in aluminum foil and double bagged in clean polyethylene ziplock bags.

Sample bags will be labeled with the sample ID (described in the QAPP), sample date and time, and crew initials. They will then be placed on wet ice on the boat, transferred to the field laboratory for further processing and preparation if necessary before storage in a standard freezer at the staging area until shipment to the analytical laboratory. The field laboratory will be staffed by field personnel during the sampling effort.

A. Collection of Fish Eggs

Efforts will be made to limit egg collection to mature ripe eggs by focusing on large females with obvious gonad enlargement. One of two methods of dry spawning (stripping) will be used for egg removal. The following procedures will be followed when stripping eggs from fish.

General Process:

1. Wear appropriate PPE required by the health and safety plan (HSP) (Attachment R). Outer gloves should be changed between each sample.
2. Place appropriately labeled pre-cleaned egg sample container on a clean, stable working surface.
3. Remove container lid and place closure side up on clean, stable work surface.
4. Place appropriately labeled whole fish sample container on clean stable work surface.
5. If possible shield working area from direct sunlight, wind, and dust.
6. Obtain individual fish, identify to species level, measure and record length and weight.
7. Rinse fish clean of sediment and organic material with distilled de-ionized water. Containerize rinsate and follow disposal procedures specified in Attachment K: Management and Disposal of Investigation-Derived Waste.

Large Fish:

1. Large females are always handled by the head and tail, rather than by the tail only, to better control the live animal.
2. Position the vent over the open egg sample container and using a closed finger rocking motion from the tips of the fingers to the back of the hand stripping the eggs from the fish. This technique is thought to be less harmful to the fish, reduces scale loss and mucus production. Personnel with small hands may have difficulty using this technique.
3. Dispatch the fish with a clean knife or scalpel by severing the spinal cord just posterior to the brain.
4. Place the egg tissue in sample container and transfer to wet ice.
5. Repeat the procedure with additional gravid female fish until sufficient egg mass/volume is obtained to meet project requirements.

6. Record the time and date on labels, close containers, and freeze samples for transport to laboratory for further processing.

Small Fish:

1. Small fish are held firmly with one hand with the head and upper 1/3 of the fish entirely enclosed by the hand.
2. Position the vent over the open egg sample container. Using the free hand, gently press out the eggs with the thumb and forefingers, applying pressure just forward of the genital pore (near vent).
3. Dispatch the fish with a clean knife or scalpel by severing the spinal cord just posterior to the brain.
4. Place the egg tissue in sample container and transfer to wet ice.
5. Repeat the procedure with additional gravid female fish until sufficient egg mass/volume is obtained to meet project requirements.
6. Record the time and date on labels, close containers, and freeze samples for transport to laboratory for further processing.

B. Stomach Content Removal

After length and weight measurements have been recorded in the field laboratory notebook, the internal organs will be removed.

1. Wear appropriate PPE as required by the HSP. Outer gloves should be changed between each sample.
2. Rinse fish clean of sediment and organic material with distilled de-ionized water. Containerize rinsate and follow disposal procedures specified in Attachment K: Management and Disposal of Investigation-Derived Waste.
3. Carefully cut the fish open from the esophagus to the anus. Remove the internal organs and place them in a small clean aluminum pan.
4. The stomach will be carefully separated from the other organs in the aluminum pan and placed in an individual small clean aluminum pan. The fullness of the stomach will be recorded in the field laboratory notebook.
5. The stomach will then be cut open carefully, and a brief description of the contents will be recorded in the field laboratory notebook. The stomach contents will be scraped out, weighed (if possible), and placed in a tared glass jar. Stomach contents of different species will be separately jarred and evaluated. The weight of the stomach contents (if measured) will be recorded in the field laboratory notebook.
6. The jar will be reweighed when all fish have been processed. The tare weight and the final weight of the jar will be recorded in the laboratory notebook.
7. The stomach contents sample will be preserved in 10% buffered formalin until shipped to the laboratory for identification to the lowest taxonomic level possible.

VIII. Laboratory Sample Processing

Fish and invertebrate samples are processed in the laboratory according to laboratory-specific methods based on the laboratory equipment, the analysis requirements, and specific guidance provided in the QAPP and Attachment O,

Laboratory Processing of Fish and Decapod Tissue Composites and Homogenization. In general, operations will follow the steps detailed below.

1. The homogenizing device will be cleaned as specified in the appropriate laboratory SOP (Attachment O), and the manufacturer's manual.
2. Tissues will be thawed at room temperature, if frozen.
3. Either: 1) whole organisms will be placed in the homogenizing device, or 2) samples will be resected as specified by the QAPP (Worksheet No. 11, Table 11-1), and resected portions (e.g., fillet and remaining carcass portions) designated for analysis will be placed in the homogenizing device.
    - Resecting may include removing the organism's skin, scales, shell, or exoskeleton.
4. Sample will be homogenized.
5. Sample will be extracted (if required) and analyzed.

IX. Sample Preservation

Generally, fish will be placed on wet ice on the boat, transferred to a freezer at the staging area (or processed if logistically acceptable), and shipped frozen to the analytical laboratory.

X. Quality Control Samples

To help identify potential sample contamination sources and to evaluate potential error introduced by sample collection and handling, field quality control (QC) samples will be collected during the fish tissue sample collection and processing. All QC samples will be labeled and sent to the laboratory with the other samples for analysis, if fish tissue samples are processed in the field. QC samples for fish tissue collection, wherever done, in the field or at the laboratory, will include rinsate of homogenization equipment samples, field duplicate samples, and matrix spike/matrix spike duplicate samples, and will be collected at the frequency specified in the QAPP.

XI. Reference

Integral, Windward, Ellis Ecological Services. 2005. Portland Harbor RI/FS Appendix A: Standard operating procedures for fish dissection, tissue sample handling and processing. Prepared for Lower Willamette Group. Integral Consulting, Inc., Mercer Island, WA; Windward Environmental LLC, Seattle, WA; Ellis Ecological Services, OR.

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.

Tierra Solutions. 1999. Passaic River Study Area ecological sampling plan. Work plan/field sampling plan. Volume 1 of 6. Tierra Solutions, Inc., Newark, NJ.

Attachment K: SOP—Management and Disposal of Investigation-Derived Waste

I. Purpose

This procedure describes the methods used to manage, store, and dispose of investigation-derived waste (IDW) produced during environmental sampling for the Lower Passaic River Restoration Project. IDW that have come in contact with potentially contaminated materials during this sampling event may include the following: biological waste (e.g., fish tissue), water, solvents, personal protective equipment (PPE) and other disposable materials generated during field work at the Lower Passaic River Study Area (LPRSA). These procedures give descriptions of equipment, field procedures, disposal containers and documentation necessary to dispose of waste sediments, water, PPE, and other materials generated during activities at the LPRSA. It also covers the handling of these materials up to the time they are disposed of at an appropriate location.

II. Equipment and Supplies

Equipment to be used during the disposal of residuals may include but is not limited to the following:

- 55-gallon open-top drums (Department of Transportation [DOT] approved)
- 30-gallon (minimum) garbage bags
- Duct tape
- Storage racks
- Insulated coolers
- Large self-contained drum storage facility
- Waterproof marking pens
- Appropriate health and safety equipment

III. Residuals Management and Disposal Procedures

A. Solid and liquid IDW handling will be performed in a well ventilated area. Furthermore, skin and eyes will be protected from accidental exposure by wearing appropriate PPE. Care must be taken during cleaning not to allow contact cleaning solutions with clothing as much as possible.

B. Solids

Solids and residuals that will be generated during the investigation consist primarily of materials generated during the collection and processing of tissue samples, including aluminum foil, paper towels, and PPE (e.g., gloves, Tyvek®, boot covers). In addition, there may be minimal amounts of sediments or biological tissues generated from sample collection or homogenization procedures. These materials will be collected and placed in 55-gallon drums or bulk bags and stored temporarily until disposal either at a municipal solid waste landfill or hazardous waste disposal facility (i.e., if materials meet disposal facility and regulatory requirements). Drums and bags containing solids and residuals will be labeled and handled as described in Section D, below.

C. Liquid Wastes

Wastewater from sampling activities and processing will be collected and returned to the original sampling location. Used solvents and acids generated during the decontamination process will be collected and placed in appropriate containers. These containers will be stored temporarily until recycling or disposal of these liquids at a hazardous waste facility can be arranged.

D. Handling and Tracking of Solid Materials Containers

Solid waste materials will be placed in DOT-tested and approved 55-gallon drums or 30-gallon bags as they are generated during field activities. Solid waste materials that are initially placed in bags may be bulked into 55-gallon drums for storage. The following procedure will be followed for placing solid waste in these drums:

1. A drum number will be assigned to each drum by the field coordinator (FC) or his designee. The drum number will be marked on two sides of the drum before it is used.
2. A log will be kept for each drum, listing the materials placed in the drum.
3. All drums will be closed or covered at the end of the day's work.
4. Collection drums may be reused after emptying.
5. Drums containing solid materials will be stored in a secured temporary facility until proper offsite disposal at the end of the field activities.

E. Samples and Containers Returned from Offsite Laboratories

Upon completion of the required chemical analyses, the remaining sample material will be returned to the processing facility. The returned sample materials are under chain-of-custody (COC) procedures until disposal. Upon receipt of the samples, they will be logged in by designated staff members and the COC form signed. The condition of the containers in which the samples are returned will be checked and recorded on the log.

Samples will be separated into solid (i.e., sediment and tissue) and aqueous sample groups and disposed of according to the procedures described in Section III, Items B and C, respectively. Sample containers will be decontaminated, as appropriate, according to procedures outlined in Attachment I—Procedure to Decontaminate Biological Sampling Equipment, and placed in 55-gallon drums or bulk bags and stored temporarily until disposal either at a municipal solid waste landfill or hazardous waste disposal facility) as described for solid wastes in Section III, Item D. Hazardous waste disposal facilities must be approved by USEPA prior to their use and again periodically over the length of the project.

IV. Documentation

The CPM or designee will be responsible for documenting the handling or disposal of all containers filled with solids or liquids generated during site activities. Observations and data will be recorded which will include the following at a minimum:

- Responsible person's name
- Date and time of activity

- Information coordinating container numbers for drums or bags with origin of materials.

The information will be reviewed and checked for completeness by the quality assurance/quality control (QA/QC) officer or designee.

V. 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.

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Attachment L: SOP—Fish Collection by Backpack and Boat Electrofishing

I. Purpose

The purpose of this procedure is to provide reference information for the collection of fish using electrofishing equipment for the Lower Passaic River Restoration Project. Electrofishing is a fishing technique that employs electrical power to temporarily stun fish within an effective range. Ambient conductivity and the size and species of fish help determine the appropriate voltage to be selected for stunning the fish and increase the success of returning fish unharmed to the water. This sampling technique can be used in combination with other active or inactive sampling methods to determine the representation of the fish community in an aquatic environment.

II. Preparations for Sampling

The quality assurance project plan (QAPP) identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the FSP prior to conducting field activities and ensuring that all field equipment is available and in acceptable condition.

III. Definitions

A. Backpack electrofishing

Backpack electrofishing equipment is designed to sample wadeable streams and shallow waters effectively. Backpack electrofishing can only be done in the shallow hard-bottom areas within 1 mile of Dundee Dam. Backpack electrofishing equipment consists of a power source and a variable voltage pulsator (VVP) on a backpack frame with an anode and cathode (positive and negative electrodes, respectively) attached to the VVP. The backpack typically weighs between 30 and 50 pounds. Common power sources include a 12-volt battery or a small gas-powered generator. The VVP controls the output voltage, amperage, the pulse interval and the pulse duration. The VVP produces half waves so the fish are not exposed to a constant voltage. The voltage required is dependent upon the conductivity of the water. Waters with high conductivity or low resistance (expressed in ohms) require less voltage than waters with low conductivity. A meter on the VVP is used to monitor the current between the electrodes and typically expresses this current in terms of amps or watts. Two types of currents can be used: direct current (DC) and alternating current (AC). Direct current uses one negative electrode and at least one positive electrode to generate an electric field. Fish within the electrical field respond to the current by involuntarily swimming (termed galvanotaxis) towards the anode. However, before reaching the positive electrode, fish become narcotized and stupefied. Fish within the electrical field of alternating currents do not swim toward the anode but instead remain in a position between the two electrodes. Direct current is thought to be safer and less harmful to fish (Lyons 1992). Body color can also be affected by electrofishing due to pigment contractions. With time, fish will recover from the shock and are able to swim away (Ellis 2007).

B. Boat electrofishing

Boat electrofishing equipment is similar to backpack electrofishing equipment, but it is designed to sample deeper waters that require more powerful equipment. It is an

active method conducted along a bank of a river or shoreline of a lake to collect fish. In addition, this method is the most efficient and effective for surveying a variety of fish species because it is not selective and can easily be applied in areas that have obstructions or uneven river bottoms. However, it is ineffective and not commonly used for fish sampling in salt-water environments. To adequately power the boat electrofishing equipment, a gas generator that produces 2,000 watts or more should be used. The boat is the staging area for the electrofishing equipment, and the sampling locations are sampled from the boat. There are different configurations for setting up the electrical equipment, and the user's manual will help determine the best one to use. In addition, the sampling location, water depth, conductivity, and fish species will be evaluated to determine an appropriate setup on the boat. Normally, the VVP is positioned near or in the console of the boat. The electrical current from the water to the VVP travels through the flexible metal conduit. Often the front probes or wands are constructed of fiberglass with flexible metal conduit attached to their anterior ends (Ellis 2007). The boat operator is able to carefully position the boat and the wands to access areas with obstructions (e.g., large woody debris, beds of aquatic plants) because of the flexible nature of the metal conduit.

IV. Equipment and supplies

A. Backpack electrofishing

- Backpack electrofishing unit, including power source, VVP, anode and cathode
- Spare anode
- Large, long fiberglass handled dip nets
- Fish collection bucket
- Chest waders and electrical safety gloves
- Conductivity meter
- Fish scale and measuring board
- Polarized sunglasses

B. Boat electrofishing

- Boat with or without metal hull
- Portable electrofishing unit, including power source, an electronic pulsator, an anode, a cathode, cable and switches
- Large, long fiberglass-handled dip nets
- Fish collection bucket
- Chest waders and electrical safety gloves
- Conductivity meter
- Fish scale and measuring board
- Polarized sunglasses

C. Safety supplies

- Electrical safety gloves
- Fire extinguisher
- Personal flotation device(s)

V. Field Procedure

A. The following procedures will be applied for electrofishing using either a backpack or boat unit:

1. All electrofishing activities will be conducted during the day, which allows for safety and better visibility of fish behavior and river conditions. Substrate conditions (e.g., soft or unstable) may limit when backpack electrofishing can be safely used. If shoreline conditions appear unsafe or unsuitable, electrofishing activities will be abandoned at those sites.
2. If the size of the fish is less than 25 mm in length, the fish will not be collected or processed because electrofishing is an ineffective fishing technique for properly sampling smaller fish. In addition, smaller fish are difficult to identify.
3. No electrofishing will occur when water temperatures are above 18° C or are expected to increase above this temperature prior to concluding electrofishing activities.
4. Any change in VVP settings will be recorded in the field notebook.
5. Fish are expected to recover within 5 seconds of being shocked depending on the fish species. If fish do not recover as quickly as expected, the VVP settings should be reduced until fish recovery time is reduced (Smith-Root 2007c).
6. All instances of stunned fish will be recorded in the field notebook, including date and time of encounter. The length of time spent at one particular location will also be recorded.
7. The electrofishing unit's user's manual will be consulted to ensure proper operation techniques are employed.
8. After fish are sorted, identified, and measured, all fish species will be returned to the water, with the exception any sacrificed fish specimen that will be retained for tissue analysis, health assessments, egg tissue collection, or stomach content collection.

B. Backpack electrofishing

1. Backpack electrofishing requires two certified field technicians. One technician will wear and operate the backpack electroshocker while the second technician collects stunned fish in a net. The technician operating the electroshocker will hold the anode wand in one hand and drag the cathode in the water. The first technician will also be responsible for adjusting VVP settings.
2. The technician with the electroshocker will slowly pass the anode over desired areas, creating an electric field. At no time should either technician reach into the water while the electroshocker is turned on.
3. The second technician will follow with a fish net and collection bucket to collect the stunned fish. This technician will determine whether the settings are appropriate based upon the observed fish response.
4. Direct current will be used whenever possible but waters with a low conductivity may require an alternating current (Lyons 1992). Initial pulse frequency, duration, and voltage should be on low settings and increased as needed based upon observed fish response. A lower frequency is typically used for larger fish (Smith-Root 2007c).
5. Voltage for the backpack electrofishing unit will be determined based upon the conductivity of the water and fish behavior. A conductivity meter will be used to determine the following voltage settings:

Conductivity (mS/cm)	Voltage
Less than 100	900 to 1,100
100 to 300	500 to 800
Greater than 300	to 400

Source: *Regional Road Maintenance Endangered Species Act Program Guidelines*, Appendix E (WSDOT 2003)

C. Boat electrofishing

1. Boat electrofishing requires two certified field technicians working from the boat and a boat operator. All personnel will be aware of the kill switches for the electrofishing equipment and power sources. The boat operator will deliver the shock with an output current and pulse rate that will be determined by the water conductivity, fish species, and fish behavior. Generally, two 28 cm anodes and a voltage of 240 volts provide good fishing effectiveness in 0.4 mS/cm conductivity with a current of 3 to 4 amperes. In lower conductivities of 0.04 mS/cm, a current of 1 to 1.5 amperes is effective (Smith-Root 2007a). The user's manual will be reviewed and referenced for selecting the appropriate settings for electrofishing.
2. Both field technicians will wear chest waders and electrical safety gloves aboard the boat while they wait for the stunned fish to rise to the surface of the water. The technicians will be on positioned on opposite sides of the boat and will use long dip nets at the bow of the boat to collect the fish. A safety rail will border the bow of the boat to keep the technicians from falling into the water during the electrofishing activities and fish collection.
3. All fish species stunned will be immediately collected and placed in a collection bucket with site water and air pumps. One technician will sort, identify, weigh, and measure a subset of each fish species, while the other technician will record the information on the field sampling form. The technicians netting the fish will also stay inside the radius of the anode pole to remain clear of the voltage source.
4. Waters with a depth greater than 10 ft cannot be sampled effectively. In addition, flows greater than 5 ft per second produce poor electrofishing efficiencies.

VI. Maintenance

Maintenance procedures are based upon information from the following manuals:

- *Smith-Root User's Manual for the LR-20 and LR-24 Electrofisher* (Smith-Root 2007b, c)
- *Smith-Root User's Manual for the GPP 2.5,5.0,7.5 and 9.0 Portable Electrofisher* (Smith-Root 2007a)

A. Backpack electrofishing

1. Batteries should be recharged as soon as possible after electrofishing is complete, regardless of the level of discharge. The battery will be plugged into a charging device according to manual instructions and allowed to completely recharge before use. The battery should not be allowed to completely discharge

during use. If a battery is maintained properly, it should last from 3 to 5 years. If a battery is to be stored for an extended period of time, it should be completely recharged prior to storage and recharged every 3 to 4 months at 20°C. The battery may require additional charging if stored at higher temperatures, but storage above 20°C and below -30°C should be avoided. Batteries can also be stored on a maintenance charger to avoid periodic recharging. The recommended operation temperature is between 5°C and 35°C. Batteries are to be cleaned with soap and water and stored in foam packaging away from oils and solvents. All cords should be coiled for storage (Smith-Root 2007c).

2. Maintenance cleaning should be done with warm water and mild soap only. Equipment should be rinsed before being cleaned to remove any material that may scratch the display window. Anodes should be kept clean to avoid an oxide coating. Oxide coatings can be removed with fine steel wool (Smith-Root 2007b, c).
3. Electrodes can be tested according the user's manual instructions if a problem arises. If the anode pole does not pass the test, the pole should be replaced. If the pole passes the test and the problem remains, the electrofishing unit should be returned for repair. If a cathode test fails, the cable should be replaced (Smith-Root 2007c).

B. Boat electrofishing

1. Store the electrofishing unit in a dry area free from extreme temperatures.
2. Clean the front panel of the unit with a mild spray-on cleaner.
3. During transportation, keep the unit well secured and protected from coming into contact with other objects and from continuous vibration.
4. Regularly check the connectors, wires, and equipment for damage or corrosion.
5. Perform general maintenance of the generator, such as changing oil engine, spark plugs, fuel, etc.

VII. Calibration

Calibration is conducted and maintained by the manufacturer for both the backpack electrofishing and the boat electrofishing units.

VIII. Quality Control

During all electrofishing activities, fish behavior and response to the electrical settings will be monitored and the settings adjusted to minimize harm to the fish. All the equipment and supplies will be regularly inspected for dirt, corrosion, or damage that may prevent them from operating properly. The equipment and supplies will be cleaned and repaired to ensure they work correctly. In addition, the user's manuals will be reviewed for information on how to properly operate all the equipment and supplies.

IX. References

Ellis RH. 2007. Personal communication (e-mail to A. Rodriquez, Windward Environmental, regarding electroshocking fishing techniques and protocols, with two attachments). Ellis Ecological Services, Inc., Estacada, OR. April 26, 2007.

Lyons J. 1992. Using the index of biotic integrity (IBI) to measure environmental quality in warmwater streams of Wisconsin. General technical report NC-149. North

Central Forest Experiment Station, Forest Service, US Department of Agriculture, St. Paul, MN.

Smith-Root. 2007a. User's manual, GPP 2.5, 5.0, 7.5 and 9.0 portable electrofishers (Honda/Vanguard generators). Smith-Root, Inc., Vancouver, WA.

Smith-Root. 2007b. User's manual, LR-20 backpack electrofisher. Smith-Root, Inc., Vancouver, WA.

Smith-Root. 2007c. User's manual, LR-24 electrofisher. Smith-Root, Inc., Vancouver, WA.

WSDOT. 2003. Regional road maintenance Endangered Species Act program guidelines. Washington State Department of Transportation, Olympia, WA.

Attachment M: SOP—Procedure for Chain-of-Custody (COC) Tracking and Sample Shipping

I. Introduction

Chain-of-custody (COC) forms will be completed for each tissue sample to serve as a permanent record for the sample collected and retained. This guideline is to provide reference information on COC tracking and sample shipping procedures.

II. Definition

Sample custody is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to delivery of the sample results to the recipient.

III. Equipment and Supplies

- COC forms
- Custody seals
- Packing tape
- Coolers
- Shipping labels and forms
- Temperature blanks
- Wet or dry ice
- Bubble wrap or packing peanuts
- Plastic ziplock bags

IV. Procedures

A. Sample Identification

Each sample will be assigned a unique identification. Refer to the corresponding QAPP and/or sampling plan for the sample identification protocol.

B. Sample Labeling

A completed label will be included with each tissue sample. Waterproof labels are preferred. Completion of sample labels will occur at the time of sample collection. When practical, the project identification, sample identification code, sample date, sample time, and sampler initials will be included on the label. For samples that will be placed in containers (e.g., jars), the labels will be protected from moisture with clear packing tape. Labels will be applied to the container, not the lid, whenever possible.

C. COC Tracking

1. Samples are considered to be in custody if they are:
    - In the custodian's possession or view
    - In a secured place (under lock) with restricted access
    - In a container and secured with an official seal(s) (Figure 1), such that the sample cannot be reached without breaking the seal(s)

Figure 1: Example of Custody Seal

2. Custody procedures will be used for all samples throughout collection, transport, and the analytical process.
3. Custody procedures will be initiated during sample collection. A COC form (Figure 2) will accompany the samples at all times during the transportation or shipping to a field facility or analytical laboratory.
4. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Minimum documentation of sample handling and custody will include:
   - Sample location, project name, and unique sample identification number
   - Sample collection date and time
   - Sample matrix
   - Page number
   - Laboratory and laboratory contact names
   - Any special notations on sample characteristics or problems
   - Initials of the person collecting the sample
   - Date sample was sent to the laboratory
   - Shipping company name and waybill number
5. The field coordinator (FC) will be responsible for:
   - All sample tracking and custody procedures for samples in the field
   - Final sample inventory
   - Maintaining sample custody documentation
   - Completing COC forms prior to removing samples from the sampling area
6. At the end of each day, and prior to transfer, COC entries will be made for all samples. Information on the labels will be checked against sample log entries, and sample tracking forms and samples will be recounted. COC forms will be enclosed in a sealable plastic bag and accompany all samples. The COC forms will be signed at each point of transfer.
7. Copies of all COC forms will be retained by field personnel and additional copies will be distributed (e.g., faxed or emailed) to the FC or designee, data validator, and lab manager/client service representatives at each laboratory being used. Copies all COCs will be included as appendices to quality assurance/quality control (QA/QC) reports and data reports. Samples will be shipped in sealed coolers to the appropriate facility.
8. The facilities and/or laboratories will be responsible for:
   - Ensuring that COC forms are properly signed upon receipt of the samples

- Noting questions or observations concerning sample integrity on the COC forms, including measuring and recording the temperature of the coolers on the COC form
- Contacting the FC or project QA/QC manager immediately if discrepancies are discovered between the COC forms and the sample shipment upon receipt
- Ensuring that a sample-tracking record follows each sample through all stages of laboratory processing. The analytical laboratories will be responsible for completing the sample-tracking records, which will be made available to the FC or project QA/QC manager upon request. The sample-tracking record must contain, at a minimum, the name/initials of individuals responsible for performing the analyses, dates of sample extraction/preparation and analyses, and the types of analyses being performed
- Distributing (e.g., faxing or emailing) a completed copy of the COC form to the FC or designee, data validator, and field office.

V. Sample Shipping

A. Samples will be shipped overnight or couriered in the appropriate containers from the field to a facility or analytical laboratory. Prior to shipping, sample containers will be wrapped in bubble wrap and securely packed inside a container with wet or dry ice to ensure the integrity of the sample will not be compromised.

1. A temperature blank will be included in each cooler, as required by each analytical laboratory.
2. The original signed COC forms will be placed in a sealable plastic bag, sealed, and taped to the inside lid of the container.
3. Fiber tape will be wrapped completely around the container.
4. On each side of the container a “This Side Up” arrow label will be attached, a “Handle with Care” label will be attached to the top of the container, and the container will be sealed with a custody seal at a minimum of two locations.
5. The temperature inside the container(s) will be checked upon receipt of the samples. The facility or laboratory will specifically note any container that does not contain the appropriate packing material (e.g., ice packs) or that is not sufficiently cold (-20° ± 2°C) upon receipt to ensure the integrity of the samples will not be compromised.
6. All samples will be handled so as to prevent the contamination or loss of any sample.
7. Samples will be assigned a specific storage area within the facility or laboratory, and individual samples will be kept at the appropriate temperature until further instructions (e.g., compositing, homogenizing) are received. After all examinations (e.g., chemical analyses, taxonomic identification) of the samples have been completed, all remaining samples will be disposed of upon receipt of written notification from the project manager.

_____ *of* _____

CHAIN-OF-CUSTODY/TEST REQUEST FORM

Project/Client Name: _____ Ship to: _____

Project Number: _____ Attn: _____ Shipping Date: _____

Contact Name: _____ Shipper: _____ Airbill Number: _____

Sampled By: _____ Form filled out by: _____ Turnaround requested: _____

Sample Collection Date (m/d/y)	Time	Sample Identification	Volume of Sample / No. of Containers	Matrix	Test(s) Requested (check test(s) required)							Comments/Instructions [Jar tag number(s)]
Total Number of Containers				Purchase Order/Statement of Work No.								

1) Released by:	1) Rec'd by:	2) Released by:	2) Rec'd by:
Print name:		Print name:	
Signature:	Company:	Signature:	Company:
Company:		Company:	
Date/Time:	Date/Time:	Date/Time:	Date/Time:

* Distribution: White copies accompany shipment; yellow retained by consignor.

Wind Ward environmental LLC

200 West Mercer Street
Suite 401
Seattle, WA 98119
Tel: (206) 378-1364
Fax: (206) 217-9343

To be completed by Laboratory upon sample receipt:

Date of receipt:	Laboratory W.O. No.:
Condition upon receipt:	Time of receipt:
Cooler temperature:	Received by:

Figure 2: Example of Chain-of-Custody Form

Attachment N: SOP—Crab and Crayfish Collection and Tissue Sampling

I. Introduction

This standard operating procedure (SOP) is based on SOP 31 of FSP2 (Malcolm Pirnie et al. 2006) and defines the procedures for collecting crab and crayfish samples and tissues from the Lower Passaic River Study Area (LPRSA). These procedures describe equipment, field procedures, and documentation necessary to conduct crayfish tissue sampling.

II. Preparations for Sampling

The quality assurance project plan (QAPP) identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the FSP prior to conducting field activities and ensuring that all field equipment is available and in acceptable condition.

III. Equipment and Supplies

Equipment to be used when collecting crab, crayfish, and tissue samples may include but is not limited to the following:

- Sampling vessel
- Crayfish traps and bait
- Crab traps and bait
- Buoys (or floats) and associated line
- Wet and dry ice
- Insulated coolers
- Sample identification labels/tags
- Waterproof marking pens
- Portable scale
- Personal protective equipment (PPE) (e.g., personal flotation device, Tyvek® coveralls, disposable gloves, safety glasses) required by the health and safety plan (Attachment R)

IV. Equipment Decontamination Procedures

Decontamination of crab and crayfish tissue sampling equipment will be performed between each sampling location/event in accordance with procedures outlined in Attachment I: Procedures to Decontaminate Biological Sampling Equipment.

V. Location of Sampling Stations

The position and depth of the sampling station will be established based on the requirements of the QAPP. The positioning procedures are described in Attachments G and H: Locating Sample Points Using a Hand-Held Global Positioning System (GPS) and Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS), respectively. The depth of the sampling location will be determined using either a fathometer or a weighted, demarcated line.

VI. Crab and Crayfish Tissue Sample Collection

A. Crayfish Traps

Crayfish traps are made of coated wire and can be buoyed with a small floatation device. Because crayfish are generally more active at night, the traps will be deployed during the late afternoon to early evening hours and retrieved the following morning as practicable. However, crayfish traps may also be deployed and retrieved during a single sampling day.

A larger sampling area will be allowed if sufficient crayfish cannot be collected within the boundaries of one or more of the sampling stations.

The following protocol will then be implemented for collecting crayfish:

1. Bait used in traps will not be analyzed for contaminant concentration. To prevent ingested bait from impacting the anticipated tissue-residue analyses, traps will use either indigenous organisms whose contaminant body burdens are similar to those of the target species' prey or by preventing the captured organisms from ingesting the bait. Place the bait into the crayfish trap, accordingly. Attach a float or buoy to the end of the crayfish trap line.
2. Lower the crayfish trap into the water from the side of the boat, making sure that the trap is securely anchored and oriented on the river bottom. The buoy should be clearly visible on the surface of the water so that the crayfish trap can be easily retrieved.
3. Note the time and location of deployment and retrieval and any pertinent location conditions in the field logbook.
4. Retrieve crayfish trap at desired intervals.
5. Upon retrieval of the trap, place collected crayfish on ice in clean, labeled, holding containers (e.g., insulated coolers) designated for the specific sampling location.
6. All crayfish collected at each location should be examined and the sex, carapace length (rostrum to telson), and overall condition, including the presence of eggs on females, as well as any abnormalities, disease conditions, or missing appendages, recorded on the field data sheet. The catch per unit effort will also be recorded.

Any additional organisms collected should be identified and recorded in the field logbook.

B. Crab Traps

Crab pots, measuring approximately 3 ft x 2 ft x 1 ft, are made of coated wire and can be buoyed with a small floatation device. Because blue crabs are generally most active at night, the pots will be deployed during the late afternoon to early evening hours and retrieved the following morning as practicable. However, crab pots may also be deployed and retrieved during a single sampling day. A larger sampling area will be allowed if sufficient crabs cannot be collected within the boundaries of one or more of the sampling stations. The following protocol will then be implemented, as practicable, for collecting the crabs from the site:

1. Place the bait into the mesh bag or on the hook attached to the center bow of the crab pot. Attach a float or buoy to the end of the crab pot line.

2. Lower the crab pot into the water from the side of the boat, making sure that the pot is securely anchored and oriented on the river bottom. The buoy should be clearly visible on the surface of the water so that the crab pot can be easily retrieved.
3. Note the time and location of deployment in the field logbook.
4. Retrieve crab pots at desired intervals.
5. Upon retrieval of the pot, place crabs collected from the crab pots on ice in clean, labeled, holding containers (e.g., insulated coolers) designated for the specific sampling location.
6. All crabs collected at each location should be examined, and the sex, carapace width (horn to horn), and overall condition, including the presence of eggs on females, as well as any abnormalities, disease conditions, or missing appendages recorded on the Specimen Tally Form (if retained), or the Non-Target Species Tally Form (if released).

VII. Sample Preparation and Preservation

A. Methodology for Crayfish Sample Preparation

When possible, whole-body (total soft tissues, including egg tissue, and carapace) crayfish samples will be prepared from crayfish collected at each sampling area (as described in the QAPP). Preference should be given to compositing crayfish of similar relative size, as practicable. A sufficient number of crayfish will be used to meet the analytical sample volumes for each tissue type specified by the laboratory. Once the target tissue volume has been obtained, the sample will be composited (if necessary). The following protocols will be implemented to prepare crayfish tissue samples.

For each sampling area, the crayfish that are collected will be retained. Each crayfish selected will be examined, and the length, weight and sex (if possible) will be recorded on the Specimen Tally Form.

1. Rinse each crayfish with de-ionized water to remove any attached sediment. In addition, examine each crayfish for damage to the carapace, and discard crayfish that exhibit extensive damage (i.e., cracks or holes).
2. Dispatch the crayfish prior to processing, as required.
3. Place crab in a labeled ziplock plastic bag.
4. Place the bag on ice in an insulated cooler or in a freezer for storage until shipment.
5. Complete the appropriate chain-of-custody (COC) form for each sample container.
6. Ship sample in cooler containing wet or dry ice.

B. Methodology for Crab Sample Preparation

Separate samples of muscle (back fin and claw meat) and whole-body tissue (total soft tissues, including egg tissue, and, if collected during the soft shell stage, the carapace) of blue crab will be prepared from crabs collected at each sampling station (as described in Worksheet No. 11, Table 11-1). Preference should be given to compositing blue crabs of similar relative size, as practicable. A sufficient number

of crabs to meet the analytical sample volumes for each tissue type specified by the laboratory will be used. Once the target tissue volume has been obtained and the volatile organics sample has been obtained, the sample will be composited (if necessary). The following protocols will be implemented, as practicable, for preparing crab tissue samples.

For each sampling station, the crabs that are collected will be retained. Each crab selected will be examined and the sex and carapace width recorded. Individual crabs will be dissected in the laboratory to obtain separate samples of muscle and whole-body tissues (total soft tissue) according to the following protocols as practicable.

1. Rinse the crab with de-ionized water to remove any attached sediment. In addition, examine each crab for damage to the carapace; discard any crabs that exhibit extensive damage (i.e., cracks or holes).
2. Place crab in a labeled ziplock plastic bag.
3. Place the bag on ice in an insulated cooler or in a freezer for storage until shipment.
4. Complete the appropriate COC form for each sample container.
5. Ship sample in cooler containing wet or dry ice.

VIII. Sample Preservation

Whole crayfish and crab are to be placed in ziplock bags, placed on wet or dry ice, and shipped to the laboratory.

IX. Quality Control Samples

To help identify potential sample contamination sources and evaluate potential error introduced by sample collection and handling, field quality control (QC) samples may be collected during the crayfish tissue sample collection and processing. QC samples for crayfish tissue collection may include rinsate samples and field replicate samples and will be collected or analyzed at the frequency specified in the QAPP.

X. 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.

Tierra Solutions. 1999. Passaic River Study Area ecological sampling plan. Work plan/field sampling plan. Volume 1 of 6. Tierra Solutions, Inc., Newark, NJ.

Attachment O: SOP—Laboratory Processing of Fish and Decapod Tissue Composites and Homogenization

The laboratory procedure for tissue preparation and homogenization is presented in the attached SOP prepared by the Woods Hole Group Environmental Laboratories.

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Field Sampling Flow Chart – Benthic Omnivores (Small-Forage-Range Fish)

Addendum to Attachment O

I. Introduction

Attachment O presents the laboratory SOP for the processing and preparation of fish and decapod tissue samples for the Lower Passaic River Restoration Project (LPRRP). This addendum to Attachment O presents additional project-specific details on the process of how sample type (e.g., composite vs. individual) will be determined and additional details on preparing specific samples in the laboratory not specified in the laboratory SOP (Attachment O).

II. Summary of process for determining tissue samples for analysis

Figure 1 presents the general process of how samples will be collected and prepared for analysis.

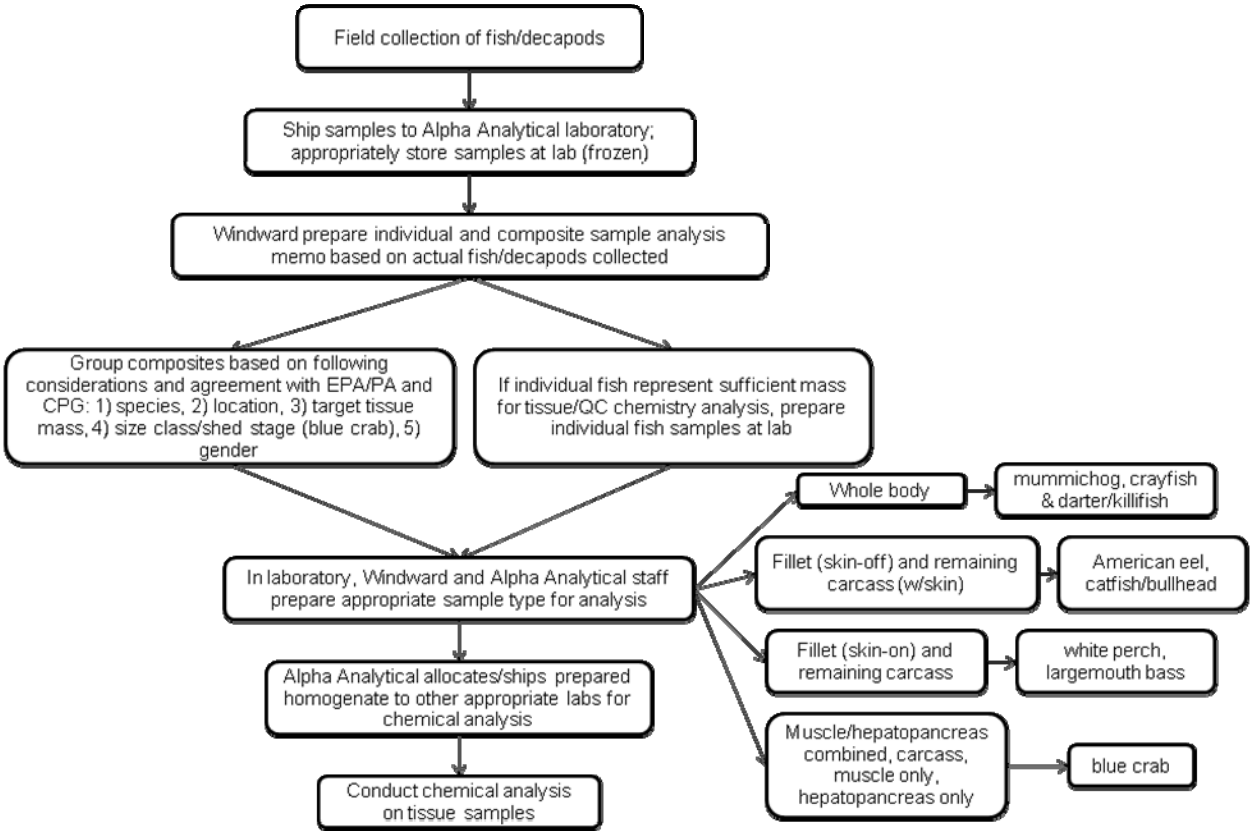


Figure 1. General process for preparing fish and decapod tissue samples for analysis

All sample preparation (e.g., compositing and homogenization) will occur at the analytical laboratory. Once the fish and decapods samples are all collected and submitted to the laboratory, Windward will prepare an individual and compositing sample analysis memorandum that will provide the plan for chemical analysis of the individuals collected. If necessary, composites will be done on a species-specific and reach-specific basis (where

possible). Also considered in the compositing design will be the size class (individuals included in a given composite will be of similar size so that the smallest individual in a composite is no less than 75% of the length of the largest individual (USEPA 2000b)), targeted tissue mass needed for chemistry/QC analysis, and gender of individual organisms. Per request of USEPA, individual fish that have sufficient mass for meeting analytical and QC requirements will be analyzed as individuals.

Any composite samples will follow the compositing design presented in Table 1. A summary of the targeted types of tissue to be collected per species is also presented in Table 1. Several species will be processed on a whole-body basis; however, some species will be separated into components (e.g., fish fillet and carcass and blue crab tissue components). The decision to analyze fish species as skin-on or skinless fillets is based on USEPA guidance and typical consumption practices (USEPA 2000). Scaled fish (including perch and largemouth bass) will be analyzed as skin-on fillets after removing scales. Scaleless fish (including catfish, brown bullhead, and eel) will be analyzed as skinless fillets.

The actual number of fish or decapods that will make up each sample will be determined in the laboratory based on the sizes and numbers of the organisms that are collected in the field. However, a balanced sample design is sought to optimize the statistical power of the tissue datasets. For all composites, multiple individuals per sample are targeted to meet the anticipated minimum sample mass requirements (150 g pre-homogenization and 130 g post-homogenization). Based on historical sampling, several individuals may be sufficient for most species to achieve sufficient tissue mass for analytical and QC requirements; however, for decapods and benthic omnivore fish (mummichog and darter or killifish), it is anticipated that a larger number of individuals per composite will be required. It should also be noted that additional tissue mass will be needed for certain samples to accommodate USEPA split sample objectives.

Once the individual and composite sampling analysis memorandum is approved by USEPA, sample homogenates will be prepared in the laboratory based on species-specific sample types as presented in Table 1. For whole-body, fillet, carcass, soft, or edible muscle tissue composite samples, the sample identification scheme is as follows (also described on QAPP Worksheet No. 27):

- The first five characters will be “LPR” to identify the project area (Lower Passaic River) and the reach (i.e., 1 to 8) and, if relevant, target area (e.g., A, B, C).
- The next set of alphanumeric characters will identify the fish or decapod crustacean species by its scientific (Latin binomial) name and tissue type. Tissue types will be one of the following codes: “WB” for whole-body tissue, “FT” for fillet tissue, “CT” for carcass tissue, “ST” for (all) soft tissue, “MH” for muscle/hepatopancreas combined tissue, “HT” for hepatopancreas tissue (if included separate from soft tissue), or “MT” for (edible) muscle tissue.
- The next set of alphanumeric characters will be “Comp” to identify the composite sample, followed by a two-digit sequential number within the sampling area.
- For example, the first largemouth bass (*Micropterus salmoides)* fillet tissue composite sample from sampling area 2 would be identified as “LPR2-MSFT-Comp01.”

The general sampling identifiers for each sample is presented in Table 1.

All relevant information for each composite and individual sample will be recorded electronically on the Composite Sample Form (Attachment F) and included as an appendix in the final data report.

Table 1. Summary of compositing per sample type for fish and decapod crustacean tissue collection

Feeding Guild[a]	Target Species	Zone[b]	Target Length (in.)[c]	Average Individual Length (in.)[d]	Average Individual Weight (g)[d]	Type of Sample	No. of Samples per Zone	Total No. of Analytical Samples	Estimated No. of Individuals per Sample[e]	Composite Sample Identification[f]	Alpha SOP Section Reference (Attachment O)
Benthic omnivore-forage fish	mummichog	estuarine	≤ 5	2.6 (67 mm; male), 2.8 (71 mm; female)	5 (male), 6 (female)	whole body	39	39	30	LPR“XX”-FHWB-Comp“XX”	14.2 (fish tissue preparation)
	darter or killifish species	fresh-water	≤ 5	ND	ND	whole body	42	42	30	LPR“XX”-“XX”WB-Comp“XX”	14.2 (fish tissue preparation)
Invertivore	white perch	estuarine	≥ 8[g]	8.1 (206 mm)	161	skin-on fillet (scales removed)	24	48	3	LPR“X”-MAFT-Comp“XX”	14.2 (fish tissue preparation); 14.4 (fillet)
						carcass[h]	24			LPR“X”-MACT-Comp“XX”	14.2 (fish tissue preparation)
	channel catfish or brown bullhead	fresh-water	≥ 12 or ≥ 8[g]	7.6 (193 mm) (catfish); 11 (279 mm) (bullhead)	78 (catfish); 321 (bullhead)	skinless fillet	26	52	6 (catfish) 2 (bullhead)	LPR“X”-“XX”FT-Comp“XX”	14.2 (fish tissue preparation); 14.3 (removal of skin); 14.4 (fillet)
						carcass with skin[h]	262			LPR“X”-“XX”CT-Comp“XX”	14.2 (fish tissue preparation)

Feeding Guild[a]	Target Species	Zone[b]	Target Length (in.)[c]	Average Individual Length (in.)[d]	Average Individual Weight (g)[d]	Type of Sample	No. of Samples per Zone	Total No. of Analytical Samples	Estimated No. of Individuals per Sample[e]	Composite Sample Identification[f]	Alpha SOP Section Reference (Attachment O)
Carnivore/ piscivore	American eel	estuarine	≥ 12	14 (366 mm)	120	skinless fillet	24	48	4	LPR"X"-ARFT-Comp"XX"	14.2 (fish tissue preparation); 14.4 (fillet)
						carcass with skin[h]	24			LPR"X"-ARCT-Comp"XX"	14.2 (fish tissue preparation)
	largemouth bass	fresh-water	≥ 12	ND	ND	skin-on fillet (scales removed)	26	52	2	LPR"X"-MSFT-Comp"XX"	14.2 (fish tissue preparation); 14.4 (fillet)
						carcass[h]	26			LPR"X"-MSCT-Comp"XX"	14.2 (fish tissue preparation)

Feeding Guild[a]	Target Species	Zone[b]	Target Length (in.)[c]	Average Individual Length (in.)[d]	Average Individual Weight (g)[d]	Type of Sample	No. of Samples per Zone	Total No. of Analytical Samples	Estimated No. of Individuals per Sample[e]	Composite Sample Identification[f]	Alpha SOP Section Reference (Attachment O)
Epibenthic omnivore	blue crab	estuarine	≥ 3 – 4.5[i]	4.7 (119 mm)	103	muscle/ hepato-pancreas combined[j]	24	63	8	LPR"XX"-CSMH-Comp"XX"	14.7 (crab tissue preparation); 14.7.6 (crab tissue); 14.7.7 (crab hepatopancreas tissue preparation)
						carcass[j]	24		9	LPR"XX"-MSCT-Comp"XX"	14.7 (crab tissue preparation); 14.7.6 (crab tissue)
						muscle only[j]	12		12	LPR"XX"-CSMT-Comp"XX"	14.7 (crab tissue preparation); 14.7.6 (crab tissue)
						hepato-pancreas only[j]	3		28	LPR"XX"-CSHT-Comp"XX"	14.7.7 (crab hepatopancreas tissue preparation)
	blue crab[k]	fresh-water	≥ 3 – 4.5[i]	4.7 (119 mm)	103	muscle/ hepato-pancreas combined[j]	17	30	8	LPR"XX"-CSMH-Comp"XX"	14.7 (crab tissue preparation); 14.7.6 (crab tissue); 14.7.7 (crab hepatopancreas tissue preparation)
						muscle only[j]	9		12	LPR"XX"-CSMT-Comp"XX"	14.7 (crab tissue preparation); 14.7.6 (crab tissue)
						hepato-pancreas only[j]	4		28	LPR"XX"-CSHT-Comp"XX"	14.7.7 (crab hepatopancreas tissue preparation)
	crayfish	fresh-water	≥2	ND	ND	whole body	27	27	38	LPR"XX"-"XX"WB-Comp"XX"	14.10 (macroinvertebrate preparation)

[a] Target species are organized according feeding guild designated for USERA. The target demersal (bottom-dwelling) species for HHRA are blue crab (estuarine), American eel (estuarine) and channel catfish/brown bullhead (freshwater). The target pelagic species for HHRA are white perch (estuarine) and largemouth bass (freshwater).

[b] Zones represent the estuarine and freshwater habitats within the LPRSA.

[c] Target sizes were selected to be representative of potential prey size for those species that are only relevant to the ERA (i.e., benthic omnivore forage fish and crayfish) and representative of the minimum legal catch sizes (NJDEP 2009) and expected size preference for white perch and brown bullhead, which do not have a minimum legal catch size, for those species that are relevant to both the ERA and the HHRA (e.g., invertivore, piscivore, and blue crab). During field sampling, however, all individuals will be retained regardless of target size in the event that sufficient numbers of individuals that meet the target size requirements cannot be obtained.

[d] Average weights and body lengths based on Tierra Solutions, PRSA Fish Community Data (dated 09/18/02) (Tierra Solutions 2002c).

[e] A minimum target pre-homogenization analytical mass of 150 g (130 g post-homogenization) is required for each sample. Based on the estimated mass of targeted species, all samples will likely be composite samples, inasmuch as sufficient mass is not expected from individual organisms to meet analytical mass requirements. This minimum target mass does not include additional mass required for QC or split samples. The sizes of all fish and decapod crustaceans collected for each sample will be evaluated prior to compositing (if necessary), and individuals included in a given composite will be of similar size so that the smallest individual in a composite is no less than 75% of the length of the largest individual (USEPA 2000b). This target size requirement will be evaluated during the sampling event in conjunction with USEPA to determine if the range of individual sizes included in a composite needs to be increased or decreased to accommodate the level of effort of the sampling event. When possible, composites will be composed of approximately equal portions of each gender. The estimated number of individuals required to obtain the minimum target tissue mass was calculated using regression equations, (if available), extracted from data collected under previous sampling efforts, or from other available information, and assumes that 30% of a fish is available for fillet. Available regression equations for estimating body weight (BW) based on body length (BL) (from BBL memo to Mark Harris and Cliff Firstenburg, March 7, 2001, except where noted):

Mummichog BW = $10^{-2.06 + 3.27 \log BL}$
Channel catfish BW = $10^{3.256 \times \log BL - 2.795}$
American eel BW = $10^{2.93 \times \log BL - 5.55}$
Blue crab:
a) Whole BW = 1.95 x BL – 188.76
b) Muscle weight = 1.36 x BL – 143.51
c) Hepatopancreas weight = 0.092 x BL – 5.23
d) Muscle + hepatopancreas weight: sum of muscle and hepatopancreas weights
b) Carcass weight: whole BW – muscle + hepatopancreas weight

[f] The six characters following “LPR” identify the two-digit code for the reach where the sample was located in the LPRSA, the two-digit code for the scientific (Latin binomial) name of the species, and the two-digit code for the tissue type. The composite number (followed by “comp” in the above table) will be assigned sequentially.

[g] There is no legal minimum catch size designated for white perch or brown bullhead. Therefore, this target size of 8 in. is based on an assumed meaningful target size for human consumption and the results of the 2000-2001 creel/angler survey (i.e., 44 white perch ranging in size from 4 to 10 in. were reportedly caught and kept by LPR anglers) (Desvousges et al. 2001).

[h] Carcass tissue will be composed of the remaining (non-fillet) portion. Tissue type concentrations will be combined mathematically (proportionally to their average weights in each species) to calculate whole-body concentrations.

[l] Target size is dependent on “shed stage” of blue crab, for which the legal minimum is 3 in. for shedders, 3.5 in. for softshell, and 4.5 in. for hardshell (http://www.scottsbt.com/fishids/regsrecs/regsNJ.htm).

[j] Blue crab muscle/hepatopancreas combined and muscle-only tissue samples are to satisfy HHRA data needs; carcass (i.e., non-edible soft tissue) and muscle/hepatopancreas combined tissue samples will be combined mathematically to yield all soft tissue concentrations for the ERA. Because crayfish is the target ERA species for the freshwater zone, carcass tissue samples are not required for this zone. The HHRA will use data from combined blue crab

muscle/hepatopancreas samples as the basis for quantitatively evaluating the RME of individuals under current and future exposure scenarios for both cancer and non-cancer health effects, following USEPA Superfund guidance, guidelines, and policies. Risks associated with the consumption of hepatopancreas-only and muscle-only tissue will be discussed qualitatively in the uncertainty section of the HHRA.

[k] Blue crab samples may be collected from the freshwater zone if sufficient blue crab are encountered in the freshwater zone.

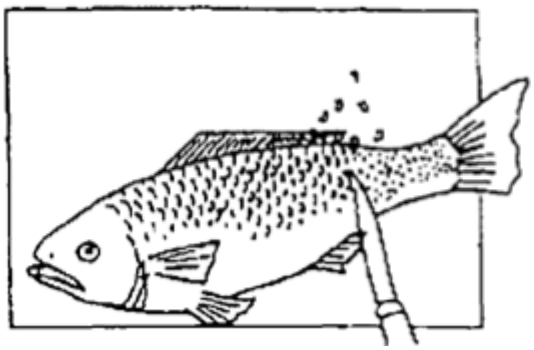
RM – river mile

ND – no data

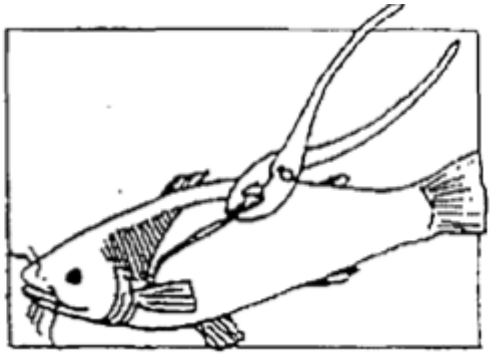
III. Additional details on fillet sample preparation

The laboratory procedure for tissue preparation and homogenization is presented in the Attachment O prepared by Alpha Analytical Laboratory. The project-specific SOP for decontamination procedures of equipment are presented in Attachment I. Fish fillet preparation procedures are presented in Figure 1 (Malcolm Pirnie et al. 2006). White perch and largemouth bass fillets will be prepared with skin remaining on but scales removed.

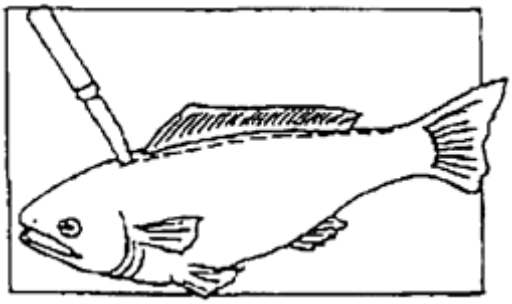
Figure 2: Fish Fillet Preparation Procedures



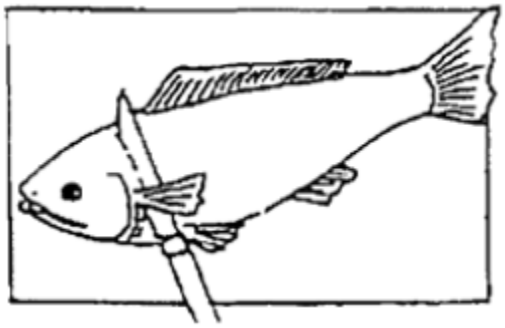
1. Scaled Fish: Remove the scales (by scraping with the edge of a knife) and rinse the fish.



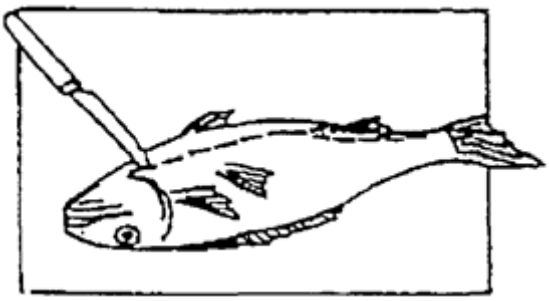
1b. Scaleless Fish: Grasp the skin at the base of the head (preferably with pliers) and pull toward the tail. Note: This step applies only to catfish and other scaleless fish.



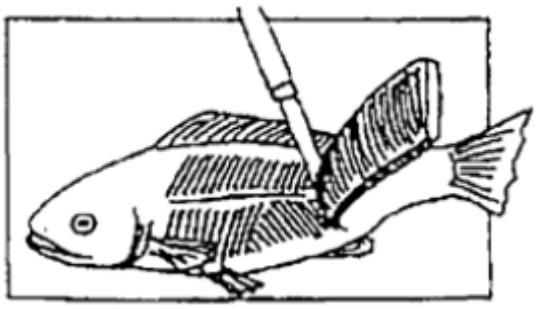
1. Make a shallow cut through the skin (on either side of the dorsal fin) from the top of the head to the base of the tail.



2. Make a cut behind the entire length of the gill cover, cutting through the skin and flesh to the bone.



3. Make a shallow cut along the belly from the base of the pectoral fin to the tail. A single cut is made from behind the gill to the anus and then a cut is made on both sides of the anal fin. Do not cut into the gut cavity as this may contaminate fillet tissue.

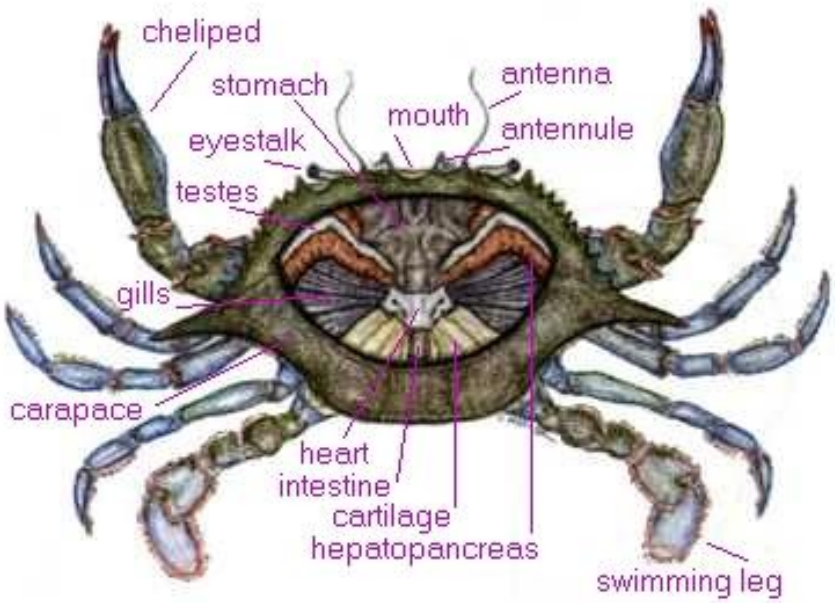


4. Remove the fillet.

IV. Additional details on blue crab sample preparation

The laboratory procedure for blue crab tissue preparation and homogenization is presented in the Attachment O prepared by Alpha Analytical Laboratory (Section 14.7 of Attachment O). Crab will be separated into several tissue type samples (Table 1). The anatomy of the blue crab is presented in Figure 3.

Figure 3. Anatomy of blue crab



Graphic courtesy of Virginia Sea Grant

Preference should be given to compositing male blue crabs of similar relative size, as practicable. A sufficient number of crabs will be utilized to meet the analytical sample volumes for each tissue type specified in Worksheet No. 10 of the QAPP.

The crab samples will be partially thawed before processing. The sample will be homogenized using a decontaminated glass blender with a stainless steel blade. The following protocols shall be implemented, as practicable, for preparing crab tissue samples.

Edible Tissue: For each sampling station, the crabs that are collected will be retained. Each crab selected will be examined and the sex and carapace width recorded. Individual crabs will be dissected to obtain separate samples of muscle and hepatopancreas (if analyzed) tissues according to the following protocols as practicable.

1. Prior to removal of tissues, each crab should be rinsed with de-ionized water to remove any attached sediment. In addition, each crab will be examined for damage to the carapace; crabs exhibiting extensive damage (i.e., cracks or holes) will be discarded.

2. Break off the chelipeds at the carapace and place claws aside for tissue removal. Lift the tail, place fingers into the body cavity of the crab and pull the top carapace off, exposing the internal organs.

3. Using a clean, decontaminated stainless steel spoon or knife, remove as much of the hepatopancreas from the upper and lower portions of the carcass

as possible, placing the tissue on a decontaminated glass plate. Care should be taken to allow calculation of other tissue types with the hepatopancreas.

4. Following removal of the hepatopancreas, remove the muscle tissue from the thoracic cavity, claws, legs, and abdomen portions of the crab using a clean, decontaminated stainless steel spoon or knife, placing it on a separate glass plate or metal sheet. The edible tissue can be removed from the claws by breaking open the cheliped and scraping or pulling out all muscle tissue.

5. The samples should be homogenized separately in a glass blender with a stainless steel or titanium blade, transferred to the appropriate sample bottles, wrapped with bubble wrap and placed into a labeled plastic bag.

6. Place the bag on ice in an insulated cooler, or in a freezer for storage until shipment.

7. Complete the appropriate chain-of-custody form for each sample container.

8. Ship sample in cooler containing wet or dry ice.

Remaining Soft Tissue Samples: Remaining soft tissue samples will be prepared for each location according to the procedures 1 through 8 described above for the edible tissue samples with the following exceptions: All obtainable soft tissues from the crabs will be combined and homogenized as one sample.

V. References

Desvousges WH, Kinnell JC, Lievense KS, Keohane EA. 2001. Passaic River Study Area creel/angler survey: data report. Triangle Economic Research, Durham, NC.

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. 2009. Division of Fish & Wildlife regulations: New Jersey Permanent Statute Title 23 - fish and game, wild birds and animals [online]. New Jersey Department of Environmental Protection, Trenton, NJ. Updated January 21, 2009. [Cited March 9 2009.] Available from: http://www.state.nj.us/dep/fgw/njregs.htm#fishing.

Tierra Solutions. 2002. Passaic River Study Area fish community data. September 18, 2002. Tierra Solutions, Inc., Newark, NJ.

USEPA. 2000. Guidance for assessing chemical contaminant data for use in fish advisories. Volume 1: Fish sampling and analysis. Third ed. EPA 823-B-00-007. US Environmental Protection Agency, Washington, DC.

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Attachment P: SOP—Documenting Field Activities

I. Introduction

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

LPRRP field data will be recorded in field logbook entries, standardized forms, annotated maps, or photos. This SOP provides general guidance on field recordkeeping; additional details for specific procedures (e.g., chain of custody) are provided in the SOPs for the individual task.

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

II. Guidelines

The documentation of field activities at uncontrolled hazardous waste sites is governed by a variety of legal guidelines that must be understood prior to the commencement of field activities. It is imperative that the personnel who will be conducting the field activities understand how the overall constitutional, statutory, and evidentiary legal requirements apply to the site inspection documentation and to the rights of potentially responsible parties.

The description of and observations made during field activities often provide the basis for technical site evaluations and other related written reports. All records and notes generated in the field will be considered controlled evidentiary documents and may be subject to scrutiny in litigation. Consequently, it is essential that the Field Coordinator (FC) or designee pay attention to detail and document to the greatest extent practicable every aspect of the inspection.

Personnel designated as responsible for the documentation of field activities must be aware that all notes taken may provide the basis for the preparation of responses to legal interrogatories.

Field documentation must provide sufficient information and data to enable the reconstruction of field activities. A wireless field application using standardized electronic data forms may provide the basic means for documenting field activities.

Control and maintenance of wireless field applications used in the documentation of field activities is the responsibility of the FC, and the transfer of responsibility (e.g., alternate FC) must be documented.

III. Equipment and Materials

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

- Standardized field data forms (electronic and printed copies)
- Site maps (electronic and printed copies)
- Clipboard
- Three-ring binder or equivalent
- Camera
- Time piece
- Hand-held electronic recording device (e.g., laptop)
- Bound field logbook
- Black, ballpoint pen or Sharpie® (or equivalent)

IV. Procedures

A. General Requirements

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

Pertinent field information will be recorded legibly in field logbook entries and/or in an appropriate standardized form (as described herein).

Logbook entries will be signed and dated. No erasures or obliterations will be made. A single line (i.e., strikeout) will be drawn through incorrect entries and the corrected entry typed next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

The field logbook will be a bound waterproof notebook with entries made in black ballpoint pen (or pencil, as necessary). All logbook entries will be electronically scanned at the end of each day and saved in the project files.

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

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

Field activities and other events pertinent to the field activities will be documented in chronological order. Times will be recorded using Eastern Standard Time (EST) or Eastern Daylight Savings Time (EDT) notation for each entry.

B. Field Logbook

The field logbook will be a bound waterproof notebook with entries made in black ballpoint pen (or pencil as necessary).

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

- Windward contact, Windward office location, and phone number
- The logbook entry number (corresponding to the number of days in the field event)
- Project name and number
- Start and end date and time of work covered by that logbook entry

A page header will appear on the first page of each logbook entry (i.e., the beginning of notes for each day's events), and activities for each day will be recorded as a new logbook entry. The page header will include:

- Name of author and other personnel on site (and affiliated organization if applicable)
- Date
- Time of arrival (military time)
- Proposed activity (task)
- Current weather and tidal conditions, and weather forecast for the day

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

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

- Names of visitor(s), including time of arrival and departure, the visitor's affiliation, and reason for visit
- Summary of project-related communications, including names of people involved and time
- Time daily work commences and ceases
- Start and stop times of new tasks
- Start and stop times of significant stand by time (work interruptions)
- Safety or other monitoring data, including units with each measurement
- Deviations from approved scope of work, including the necessary approvals
- Progress updates
- Problems/delays encountered
- Unusual events
- Initials of author on every page

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

In the case of equipment malfunction or other unforeseen events, additional bound waterproof field books will be carried by field personnel to serve as back-up documentation methods. LPRRP logbooks will be dedicated to the project and will not be used for any other project or purpose. Separate and dedicated logbooks will be kept for different operations running concurrently (e.g., sampling on board the vessel, processing at the field facility); individual tasks making up each operation will be maintained in the same logbook, if possible. The cover and binding of each logbook will be labeled to identify the operation and dates included with the logbook; each page in the logbook will be consecutively numbered. Pages will not be removed or torn out of the logbook. If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, and initialed and dated, leaving no room for additional entries. Logbook entries will be electronically scanned at the end of each day, or as frequently as possible, and electronically saved as described in Section F.

C. Standardized Forms

Standard forms for field data are provided in Attachments A through F and as Figure 2 in Attachments M. The information collected on any field forms will be collected and/or scanned and stored (if a printed form) electronically (described in Section F).

The following rules apply to the standardized forms:

- Each form will be printed (if electronic), signed, and dated by the person completing the form and stored as described in Section VI.
- There will be no blank spaces on the form – unused spaces will have "not applicable" or "not available" explanations.
- Field forms require similar header information as logbook entries (see Section B of this SOP).
- At the end of each day, or as frequently as possible, all forms completed will be saved as described in Section F.

D. Maps and Drawings

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

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

If notations are made on electronic map or drawing files, these will be referenced in the logbook as described above and initialed and dated by person who prepared them. Notations made by hand on maps and drawings will be electronically scanned at the end of each day, or as frequently as possible, and electronically saved as described in Section F.

E. Photographs and Other Photo Documentation

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

F. Electronic Files

Electronic recording devices may include data logging systems, personal digital assistants (PDAs), laptops, or tablet personal computers (PCs).

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

Files will be uniquely identified and will be stored in the project files. File names should include the date, a description of the file contents or a unique title, and a version number. For example, "YYYYMMDD_Name of documentV#." An unedited version of the file will be maintained, and all subsequent manipulations tracked.

V. Quality assurance / quality control

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

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

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

VI. Data and Records Management

Deviations to the procedures detailed in the SOP will be recorded in the field logbook.

Logbooks, field forms, chain-of-custody forms, and all other records associated with the activities described in this SOP will be ultimately maintained by the investigative organization.

Field logbook entries, field data forms, and chain-of-custody forms will be electronically stored once they have been completed and distributed (if necessary) at the end of each field day or as frequently as possible. Printed copies of these documents will be maintained in labeled three-ring binders or contained in some

other organized manner that prevents loss in the field facility. Bound waterproof field logbooks will be electronically scanned and saved in project files at the end of each day, or as frequently as possible, to mitigate against the loss of historical entries should the logbook be lost in the field.

Distribution of daily forms will be performed according to the needs of the project team and at the direction of the FC or designee.

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

VII. References

ENSR|AECOM. 2008. Standard Operating Procedure, Lower Passaic River Restoration Project: Field Records. Revision 1.

Malcom Pirnie, Inc. in conjunction with EarthTech, Inc. and 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.

Attachment Q: Memorandum: Fish/Decapod (Crab/Crayfish) Tissue Sampling Design for the Lower Passaic River Restoration Project

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Slipsheet for Fish/Decapod (Crab/Crayfish) Tissue Sampling Design Memo

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Attachment R: Health and Safety Plan

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Slipsheet for Health and Safety Plan

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Attachment S: Tissue Thresholds Used to Establish Data Quality Levels

The following tables present the ecological data quality levels (DQLs) for tissue. It should be noted that these DQLs are not risk assessment numbers and do not represent thresholds that will be used in the baseline ecological risk assessment (BERA) or human health risk assessment (HHRA) but are preliminary screening numbers used to help determine the adequacy and conservative nature of the analytical detection limits being used for tissue analyses.

Thresholds that will be used in the baseline ecological risk assessment (ERA) will be developed at a later date. Ecological DQLs were derived by back-calculating tissue thresholds from literature-based dietary no-observed-apparent-effect level (NOAEL) toxicity reference values (TRVs) using species-specific exposure parameters (i.e., body weight and sediment ingestion rate) for multiple avian and mammalian species representing various feeding guilds. NOAEL TRVs derived from toxicity studies were expressed as daily dietary doses normalized for body weight.

Table 1. Fish Tissue DQLs for Human Health Risk Assessment

Analyte	Human Health DQL (mg/kg)[a]	Notes
Metals		
Aluminum	1.35E+02	
Antimony	5.41E-02	
Arsenic, inorganic	2.10E-03	
Arsenic III	2.10E-03	value for inorganic arsenic
Arsenic V	2.10E-03	value for inorganic arsenic
Barium	2.70E+01	
Beryllium	2.70E-01	
Cadmium	1.35E-01	
Calcium	NA	essential nutrient
Chromium (total)	4.06E-01	value for chromium VI
Cobalt	4.06E-02	
Copper	5.41E+00	
Iron	9.46E+01	
Lead	1.50E+00	FDA action level for crustacea (FDA 1993)
Magnesium	NA	essential nutrient
Manganese	1.89E+01	
Mercury	1.35E-02	value for methylmercury
Methylmercury	1.35E-02	
Nickel	2.70E+00	
Potassium	NA	essential nutrient
Selenium	6.76E-01	
Silver	6.76E-01	
Sodium	NA	essential nutrient

Analyte	Human Health DQL (mg/kg)[a]	Notes
Thallium	8.76E-03	
Titanium	NA	
Vanadium	9.46E-01	
Zinc	4.06E+01	
SVOCs		
1,1'-Biphenyl	6.76E+00	
1,2,4,5-Tetrachlorobenzene	4.06E-02	
2,2'-Oxybis (1-chloropropane)	NA	
2,3,4,6-Tetrachlorophenol	4.06E+00	
2,4,5-Trichlorophenol	1.35E+01	
2,4,6-Trichlorophenol	1.35E-01	
2,4-Dichlorophenol	4.06E-01	
2,4-Dimethylphenol	2.70E+00	
2,4-Dinitrophenol	2.70E-01	
2,4-Dinitrotoluene	2.70E-01	
2,6-Dinitrotoluene	1.35E-01	
2-Chloronaphthalene	1.08E+01	
2-Chlorophenol	6.76E-01	
2-Methylnaphthalene	5.41E-01	
2-Methylphenol	6.76E+00	
2-Nitroaniline	4.06E-02	Due to structural similarities, the value for 3-nitroaniline is used.
2-Nitrophenol	4.06E+01	Due to structural similarities, the value for phenol is used.
3,3',-Dichlorobenzidine	7.01E-03	
3-Nitroaniline	4.06E-02	
4,6-Dinitro-2-methylphenol	1.35E-02	
4-Bromophenyl phenylether	NA	

Analyte	Human Health DQL (mg/kg)[a]	Notes
4-Chloro-3-methylphenol	NA	
4-Chloroaniline	5.84E-02	
4-Chlorophenyl phenylether	NA	
4-Methylphenol	6.76E-01	
4-Nitroaniline	1.50E-01	
4-Nitrophenol	4.06E+01	Due to structural similarities, the value for phenol is used.
Acenaphthene	8.11E+00	
Acenaphthylene	8.11E+00	Due to structural similarities, the value for acenaphthene is used.
Acetophenone	1.35E+01	
Anthracene	4.06E+01	
Atrazine	1.37E-02	
Benzaldehyde	1.35E+01	
Benzo(a)anthracene	4.32E-03	
Benzo(a)pyrene	4.32E-04	
Benzo(b)fluoranthene	4.32E-03	
Benzo(g,h,i)perylene	4.06E+00	Due to structural similarities, the value for pyrene is used.
Benzo(k)fluoranthene	4.32E-02	
bis-(2Chloroethoxy) methane	4.06E-01	
bis-(2Chloroethyl)ether	2.87E-03	
Bis(2Ethylhexyl)phthalate	2.25E-01	
Butylbenzylphthalate	1.66E+00	
Caprolactam	6.76E+01	
Carbazole	NA	
Chrysene	4.32E-01	
Dibenzo(a,h)anthracene	4.32E-04	
Dibenzofuran	NA	

Analyte	Human Health DQL (mg/kg)[a]	Notes
Diethylphthalate	1.08E+02	
Dimethylphthalate	NA	
Di-n-butylphthalate	1.35E+01	
Di-n-octylphthalate	NA	
Fluoranthene	5.41E+00	
Fluorene	5.41E+00	
Hexachlorobenzene	1.97E-03	
Hexachlorobutadiene	4.04E-02	
Hexachloroethane	1.35E-01	
Hexchlorocyclopentadiene	8.11E-01	
Indeno(1,2,3-cd)pyrene	4.32E-03	
Isophorone	3.32E+00	
Naphthalene	2.70E+00	
Nitrobenzene	6.76E-02	
N-Nitrosodi-n-propylamine	4.51E-04	
N-Nitrosodiphenylamine	6.44E-01	
Pentachlorophenol	2.63E-02	
Phenanthrene	4.06E+01	Due to structural similarities, the value for anthracene is used.
Phenol	4.06E+01	
Pyrene	4.06E+00	
PCB Congeners[b]		
PCB 1	1.58E-03	value for PCBs (high risk)
PCB 2	1.58E-03	value for PCBs (high risk)
PCB 3	1.58E-03	value for PCBs (high risk)
PCB 4	1.58E-03	value for PCBs (high risk)
PCB 5	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 6	1.58E-03	value for PCBs (high risk)
PCB 7	1.58E-03	value for PCBs (high risk)
PCB 8	1.58E-03	value for PCBs (high risk)
PCB 9	1.58E-03	value for PCBs (high risk)
PCB 10	1.58E-03	value for PCBs (high risk)
PCB 11	1.58E-03	value for PCBs (high risk)
PCB 12	1.58E-03	value for PCBs (high risk)
PCB 13	1.58E-03	value for PCBs (high risk)
PCB 14	1.58E-03	value for PCBs (high risk)
PCB 15	1.58E-03	value for PCBs (high risk)
PCB 16	1.58E-03	value for PCBs (high risk)
PCB 17	1.58E-03	value for PCBs (high risk)
PCB 18	1.58E-03	value for PCBs (high risk)
PCB 19	1.58E-03	value for PCBs (high risk)
PCB 20	1.58E-03	value for PCBs (high risk)
PCB 21	1.58E-03	value for PCBs (high risk)
PCB 22	1.58E-03	value for PCBs (high risk)
PCB 23	1.58E-03	value for PCBs (high risk)
PCB 24	1.58E-03	value for PCBs (high risk)
PCB 25	1.58E-03	value for PCBs (high risk)
PCB 26	1.58E-03	value for PCBs (high risk)
PCB 27	1.58E-03	value for PCBs (high risk)
PCB 28	1.58E-03	value for PCBs (high risk)
PCB 29	1.58E-03	value for PCBs (high risk)
PCB 30	1.58E-03	value for PCBs (high risk)
PCB 31	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 32	1.58E-03	value for PCBs (high risk)
PCB 33	1.58E-03	value for PCBs (high risk)
PCB 34	1.58E-03	value for PCBs (high risk)
PCB 35	1.58E-03	value for PCBs (high risk)
PCB 36	1.58E-03	value for PCBs (high risk)
PCB 37	1.58E-03	value for PCBs (high risk)
PCB 38	1.58E-03	value for PCBs (high risk)
PCB 39	1.58E-03	value for PCBs (high risk)
PCB 40	1.58E-03	value for PCBs (high risk)
PCB 41	1.58E-03	value for PCBs (high risk)
PCB 42	1.58E-03	value for PCBs (high risk)
PCB 43	1.58E-03	value for PCBs (high risk)
PCB 44	1.58E-03	value for PCBs (high risk)
PCB 45	1.58E-03	value for PCBs (high risk)
PCB 46	1.58E-03	value for PCBs (high risk)
PCB 47	1.58E-03	value for PCBs (high risk)
PCB 48	1.58E-03	value for PCBs (high risk)
PCB 49	1.58E-03	value for PCBs (high risk)
PCB 50	1.58E-03	value for PCBs (high risk)
PCB 51	1.58E-03	value for PCBs (high risk)
PCB 52	1.58E-03	value for PCBs (high risk)
PCB 53	1.58E-03	value for PCBs (high risk)
PCB 54	1.58E-03	value for PCBs (high risk)
PCB 55	1.58E-03	value for PCBs (high risk)
PCB 56	1.58E-03	value for PCBs (high risk)
PCB 57	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 58	1.58E-03	value for PCBs (high risk)
PCB 59	1.58E-03	value for PCBs (high risk)
PCB 60	1.58E-03	value for PCBs (high risk)
PCB 61	1.58E-03	value for PCBs (high risk)
PCB 62	1.58E-03	value for PCBs (high risk)
PCB 63	1.58E-03	value for PCBs (high risk)
PCB 64	1.58E-03	value for PCBs (high risk)
PCB 65	1.58E-03	value for PCBs (high risk)
PCB 66	1.58E-03	value for PCBs (high risk)
PCB 67	1.58E-03	value for PCBs (high risk)
PCB 68	1.58E-03	value for PCBs (high risk)
PCB 69	1.58E-03	value for PCBs (high risk)
PCB 70	1.58E-03	value for PCBs (high risk)
PCB 71	1.58E-03	value for PCBs (high risk)
PCB 72	1.58E-03	value for PCBs (high risk)
PCB 73	1.58E-03	value for PCBs (high risk)
PCB 74	1.58E-03	value for PCBs (high risk)
PCB 75	1.58E-03	value for PCBs (high risk)
PCB 76	1.58E-03	value for PCBs (high risk)
PCB 77	2.43E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 78	1.58E-03	value for PCBs (high risk)
PCB 79	1.58E-03	value for PCBs (high risk)
PCB 80	1.58E-03	value for PCBs (high risk)
PCB 81	8.09E-05	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 82	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 83	1.58E-03	value for PCBs (high risk)
PCB 84	1.58E-03	value for PCBs (high risk)
PCB 85	1.58E-03	value for PCBs (high risk)
PCB 86	1.58E-03	value for PCBs (high risk)
PCB 87	1.58E-03	value for PCBs (high risk)
PCB 88	1.58E-03	value for PCBs (high risk)
PCB 89	1.58E-03	value for PCBs (high risk)
PCB 90	1.58E-03	value for PCBs (high risk)
PCB 91	1.58E-03	value for PCBs (high risk)
PCB 92	1.58E-03	value for PCBs (high risk)
PCB 93	1.58E-03	value for PCBs (high risk)
PCB 94	1.58E-03	value for PCBs (high risk)
PCB 95	1.58E-03	value for PCBs (high risk)
PCB 96	1.58E-03	value for PCBs (high risk)
PCB 97	1.58E-03	value for PCBs (high risk)
PCB 98	1.58E-03	value for PCBs (high risk)
PCB 99	1.58E-03	value for PCBs (high risk)
PCB 100	1.58E-03	value for PCBs (high risk)
PCB 101	1.58E-03	value for PCBs (high risk)
PCB 102	1.58E-03	value for PCBs (high risk)
PCB 103	1.58E-03	value for PCBs (high risk)
PCB 104	1.58E-03	value for PCBs (high risk)
PCB 105	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 106	1.58E-03	value for PCBs (high risk)
PCB 107	1.58E-03	value for PCBs (high risk)
PCB 108	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 109	1.58E-03	value for PCBs (high risk)
PCB 110	1.58E-03	value for PCBs (high risk)
PCB 111	1.58E-03	value for PCBs (high risk)
PCB 112	1.58E-03	value for PCBs (high risk)
PCB 113	1.58E-03	value for PCBs (high risk)
PCB 114	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 115	1.58E-03	value for PCBs (high risk)
PCB 116	1.58E-03	value for PCBs (high risk)
PCB 117	1.58E-03	value for PCBs (high risk)
PCB 118	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 119	1.58E-03	value for PCBs (high risk)
PCB 120	1.58E-03	value for PCBs (high risk)
PCB 121	1.58E-03	value for PCBs (high risk)
PCB 122	1.58E-03	value for PCBs (high risk)
PCB 123	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 124	1.58E-03	value for PCBs (high risk)
PCB 125	1.58E-03	value for PCBs (high risk)
PCB 126	2.43E-07	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 127	1.58E-03	value for PCBs (high risk)
PCB 128	1.58E-03	value for PCBs (high risk)
PCB 129	1.58E-03	value for PCBs (high risk)
PCB 130	1.58E-03	value for PCBs (high risk)
PCB 131	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 132	1.58E-03	value for PCBs (high risk)
PCB 133	1.58E-03	value for PCBs (high risk)
PCB 134	1.58E-03	value for PCBs (high risk)
PCB 135	1.58E-03	value for PCBs (high risk)
PCB 136	1.58E-03	value for PCBs (high risk)
PCB 137	1.58E-03	value for PCBs (high risk)
PCB 138	1.58E-03	value for PCBs (high risk)
PCB 139	1.58E-03	value for PCBs (high risk)
PCB 140	1.58E-03	value for PCBs (high risk)
PCB 141	1.58E-03	value for PCBs (high risk)
PCB 142	1.58E-03	value for PCBs (high risk)
PCB 143	1.58E-03	value for PCBs (high risk)
PCB 144	1.58E-03	value for PCBs (high risk)
PCB 145	1.58E-03	value for PCBs (high risk)
PCB 146	1.58E-03	value for PCBs (high risk)
PCB 147	1.58E-03	value for PCBs (high risk)
PCB 148	1.58E-03	value for PCBs (high risk)
PCB 149	1.58E-03	value for PCBs (high risk)
PCB 150	1.58E-03	value for PCBs (high risk)
PCB 151	1.58E-03	value for PCBs (high risk)
PCB 152	1.58E-03	value for PCBs (high risk)
PCB 153	1.58E-03	value for PCBs (high risk)
PCB 154	1.58E-03	value for PCBs (high risk)
PCB 155	1.58E-03	value for PCBs (high risk)
PCB 156	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 157	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van

Analyte	Human Health DQL (mg/kg)[a]	Notes
		den Berg, et al., 2006)
PCB 158	1.58E-03	value for PCBs (high risk)
PCB 159	1.58E-03	value for PCBs (high risk)
PCB 160	1.58E-03	value for PCBs (high risk)
PCB 161	1.58E-03	value for PCBs (high risk)
PCB 162	1.58E-03	value for PCBs (high risk)
PCB 163	1.58E-03	value for PCBs (high risk)
PCB 164	1.58E-03	value for PCBs (high risk)
PCB 165	1.58E-03	value for PCBs (high risk)
PCB 166	1.58E-03	value for PCBs (high risk)
PCB 167	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 168	1.58E-03	value for PCBs (high risk)
PCB 169	8.09E-07	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 170	1.58E-03	Value for PCBs (high risk). This congener was not identified as a dioxin-like congener in the WHO 2005 scheme (Van den Berg, et al., 2006).
PCB 171	1.58E-03	value for PCBs (high risk)
PCB 172	1.58E-03	value for PCBs (high risk)
PCB 173	1.58E-03	value for PCBs (high risk)
PCB 174	1.58E-03	value for PCBs (high risk)
PCB 175	1.58E-03	value for PCBs (high risk)
PCB 176	1.58E-03	value for PCBs (high risk)
PCB 177	1.58E-03	value for PCBs (high risk)
PCB 178	1.58E-03	value for PCBs (high risk)
PCB 179	1.58E-03	value for PCBs (high risk)
PCB 180	1.53E-03	Value for PCBs (high risk). This congener was not identified as a dioxin-like congener in

Analyte	Human Health DQL (mg/kg)[a]	Notes
		the WHO 2005 scheme (Van den Berg, et al., 2006).
PCB 181	1.58E-03	value for PCBs (high risk)
PCB 182	1.58E-03	value for PCBs (high risk)
PCB 183	1.58E-03	value for PCBs (high risk)
PCB 184	1.58E-03	value for PCBs (high risk)
PCB 185	1.58E-03	value for PCBs (high risk)
PCB 186	1.58E-03	value for PCBs (high risk)
PCB 187	1.58E-03	value for PCBs (high risk)
PCB 188	1.58E-03	value for PCBs (high risk)
PCB 189	8.09E-04	identified as one of the 12 dioxin-like PCB congeners in the WHO 2005 scheme (Van den Berg, et al., 2006)
PCB 190	1.58E-03	value for PCBs (high risk)
PCB 191	1.58E-03	value for PCBs (high risk)
PCB 192	1.58E-03	value for PCBs (high risk)
PCB 193	1.58E-03	value for PCBs (high risk)
PCB 194	1.58E-03	value for PCBs (high risk)
PCB 195	1.58E-03	value for PCBs (high risk)
PCB 196	1.58E-03	value for PCBs (high risk)
PCB 197	1.58E-03	value for PCBs (high risk)
PCB 198	1.58E-03	value for PCBs (high risk)
PCB 199	1.58E-03	value for PCBs (high risk)
PCB 200	1.58E-03	value for PCBs (high risk)
PCB 201	1.58E-03	value for PCBs (high risk)
PCB 202	1.58E-03	value for PCBs (high risk)
PCB 203	1.58E-03	value for PCBs (high risk)
PCB 204	1.58E-03	value for PCBs (high risk)
PCB 205	1.58E-03	value for PCBs (high risk)

Analyte	Human Health DQL (mg/kg)[a]	Notes
PCB 206	1.58E-03	value for PCBs (high risk)
PCB 207	1.58E-03	value for PCBs (high risk)
PCB 208	1.58E-03	value for PCBs (high risk)
PCB 209	1.58E-03	value for PCBs (high risk)
PCB Homologues		
Monochlorobiphenyl	1.58E-03	value for PCBs (high risk)
Dichlorobiphenyl	1.58E-03	value for PCBs (high risk)
Trichlorobiphenyl	1.58E-03	value for PCBs (high risk)
Tetrachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Pentachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Hexachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Heptachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Octachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Nonachlorobiphenyl	1.58E-03	value for PCBs (high risk)
Decachlorobiphenyl	1.58E-03	value for PCBs (high risk)
PCDDs/PCDFs		
1,2,3,4,6,7,8-HpCDD	2.43E-06	
1,2,3,4,6,7,8-HpCDF	2.43E-06	
1,2,3,4,7,8-HxCDD	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,4,7,8-HxCDF	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,4,7,8,9-HpCDF	2.43E-06	value for 2,3,7,8-TCDD divided by a TEF of 0.01 (Van den Berg, et al., 2006)
1,2,3,6,7,8-HxCDD	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,6,7,8-HxCDF	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,7,8,9-HxCDD	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,7,8,9-HxCDF	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
1,2,3,7,8-PeCDD	2.43E-08	

Analyte	Human Health DQL (mg/kg)[a]	Notes
1,2,3,7,8-PeCDF	8.09E-07	
2,3,4,6,7,8-HxCDF	2.43E-07	value for 2,3,7,8-TCDD divided by a TEF of 0.1 (Van den Berg, et al., 2006)
2,3,4,7,8-PeCDF	8.09E-08	
2,3,7,8-TCDD	2.43E-08	
2,3,7,8-TCDF	2.43E-07	
OCDD	8.09E-05	
OCDF	8.09E-05	
PAHs		
1-Methylnaphthalene	1.09E-01	
1-Methylphenanthrene	4.06E+01	Due to structural similarities, the value for anthracene is used.
2,3,5-Trimethylnaphthalene	NA	
2,6-Dimethylnaphthalene	NA	
2-Methylnaphthalene	5.41E-01	
Acenaphthene	8.11E+00	
Acenaphthylene	8.11E+00	Due to structural similarities, the value for acenaphthene is used.
Anthracene	4.06E+01	
Fluorene	5.41E+00	
Naphthalene	2.70E+00	
Phenanthrene	4.06E+01	Due to structural similarities, the value for anthracene is used.
Benzo[a]anthracene	4.32E-03	
Benzo[a]pyrene	4.32E-04	
Benzo[b]fluoranthene	4.32E-03	
Benzo[e]pyrene	4.06E+00	Due to structural similarities, the value for pyrene is used.
Benzo[g,h,i]perylene	4.06E+00	Due to structural similarities, the value for pyrene is used.
Benzo[k]fluoranthene	4.32E-02	
Chrysene	4.32E-01	

Analyte	Human Health DQL (mg/kg)[a]	Notes
Dibenzo[a,h]anthracene	4.32E-04	
Dibenzothiophene	NA	
Fluoranthene	5.41E+00	
Indeno-[1,2,3c,d]pyrene	4.32E-03	
Perylene	4.06E+00	Due to structural similarities, the value for pyrene is used.
Pyrene	4.06E+00	
Organochlorine Pesticides		
2,4'-DDD	1.31E-02	Due to structural similarities, the value for 4,4'-DDD is used.
2,4'-DDE	9.28E-03	Due to structural similarities, the value for 4,4'-DDE is used.
2,4'-DDT	9.28E-03	Due to structural similarities, the value for 4,4'-DDT is used.
4,4'-DDD	1.31E-02	
4,4'-DDE	9.28E-03	
4,4'-DDT	9.28E-03	
Aldrin	1.86E-04	
alpha-BHC	5.01E-04	
beta-BHC	1.75E-03	
cis-Chlordane	9.01E-03	Due to structural similarities, the value for chlordane is used.
cis-Nonachlor	9.01E-03	Due to structural similarities, the value for chlordane is used.
delta-BHC	5.01E-04	Due to structural similarities, the value for alpha-BHC is used.
Dieldrin	1.97E-04	
Endosulfan I	8.11E-01	Due to structural similarities, the value for endosulfan is used.
Endosufan II	8.11E-01	Due to structural similarities, the value for endosulfan is used.
Endosulfan sulfate	8.11E-01	Due to structural similarities, the value for endosulfan is used.
Endrin	4.06E-02	
Endrin aldehyde	4.06E-02	Due to structural similarities, the value for endrin is used.
Endrin ketone	4.06E-02	Due to structural similarities, the value for endrin is used.

Analyte	Human Health DQL (mg/kg)[a]	Notes
gamma-BHC (Lindane)	2.87E-03	
Hexachlorobenzene	1.97E-03	
Heptachlor	7.01E-04	
Heptachlor epoxide	3.47E-04	
Methoxychlor	6.76E-01	
Oxychlordane	9.01E-03	Due to structural similarities, the value for chlordane is used.
Toxaphene	2.87E-03	
trans-Chlordane	9.01E-03	Due to structural similarities, the value for chlordane is used.
trans-Nonachlor	9.01E-03	Due to structural similarities, the value for chlordane is used.
Butyltins		
Dibutyltin	4.06E-02	
Monobutyltin	4.06E-02	Due to structural similarities, the value for dibutyltin and tributyltin is used.
Tetrabutyltin	4.06E-02	Due to structural similarities, the value for dibutyltin and tributyltin is used.
Tributyltin	4.06E-02	

[a] DQLs are analytical goals listed solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or PRGs and are not approved by the USEPA as the appropriate risk assessment criteria for this project. These values will be developed in subsequent phases of the project. USEPA RSLs for fish ingestion, as provided on USEPA Region 3 website (http://www.epa.gov/reg3hwmd/risk/human/fish/pdf), Region 3 Fish Tissue Screening Levels, September 2008. RSLs were derived using a fish consumption rate of 54 g/day and are based on a target risk level of 1E-06 for a potential carcinogen; RSLs for non-carcinogenic compounds have been divided by a factor of 10 (to adjust to a hazard quotient of 0.1) to account for potential additive effects.

[b] The individual and co-eluting PCB congeners reported will be identified with the analytical laboratory.

BHC – benzene hexachloride
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DQL – data quality level
HHRA – human health risk assessment
HpCDD – heptachlorodibenzo-*p*-dioxin
HpCDF – heptachlorodibenzofuran
HxCDD – hexachlorodibenzo-*p*-dioxin
HxCDF – hexachlorodibenzofuran
NA – not available
OCDD – octachlorodibenzo-*p*-dioxin
OCDF – octachlorodibenzofuran
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PCDD – polychlorinated dibenzo-*p*-dioxin
PCDF – polychlorinated dibenzofuran
PeCDD – pentachlorodibenzo-*p*-dioxin
PeCDF – pentachlorodibenzofuran
RSL – regional screening level
SVOCs – semivolatile organic compound
TCDD – tetrachlorodibenzo-*p*-dioxin
TCDF – tetrachlorodibenzofuran
TEF – toxic equivalency factor
USEPA – US Environmental Protection Agency
WHO – World Health Organization

Table 2. Ecological Thresholds Used to Select Ecological Tissue Data Quality Levels

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Metals						
Aluminum	NA	NA	NA	NA	-	
Antimony	NA	NA	NA	**9,297**	**9,297**	Hext et al. (1999)
Arsenic	**1.15**	NA	1.97	16.4	**1.15**	Lindsay and Sanders (1990)
Barium	NA	NA	179	**31.6**	**31.6**	Perry et al. (1983)[e]
Beryllium	NA	NA	NA	**4.12**	**4.12**	Schroeder and Mitchener (1975)[e]
Cadmium	1.29	NA	**0.63**	21.9	**0.63**	Leach et al. (1979)
Calcium	NA	NA	NA	NA	-	
Chromium	1.0	NA	**0.86**	9154	**0.86**	Haseltine et al. unpublished[e]
Chromium VI	NA	NA	NA	NA	-	
Cobalt	NA	NA	1.98	**0.62**	**0.62**	Chetty et al. (1979)
Copper	**34**	NA	40.3	113	**34**	Evans (1980)
Cyanide	NA	NA	NA	**429**	**429**	Tewe and Manor (1981)[e]
Iron	NA	NA	NA	NA	-	
Lead	66	NA	**1.72**	70.4	**1.72**	Edens et al. (1976)
Magnesium	NA	NA	NA	NA	-	
Manganese	NA	NA	838	**549**	**549**	Laskey et al. (1982)[e]
Mercury	1.64	0.2	**0.0086**	0.10	**0.0086**	Heinz (1975; 1979)
Methylmercury	NA	NA	NA	NA	-	
Nickel	NA	NA	66.4	**52.6**	**52.6**	Ambrose et al. (1976)
Potassium	NA	NA	NA	-	-	
Selenium	NA	NA	0.36	**0.34**	**0.34**	Halverson et al. (1966)
Silver	NA	NA	NA	NA	-	
Sodium	NA	NA	NA	NA	-	
Thallium	NA	NA	**0.41**	4.62	**0.41**	Hudson et al. (1984)
Titanium	NA	NA	NA	NA	-	
Vanadium	NA	NA	**1.03**	6.56	**1.03**	Ousterhout and Berg (1981)

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Zinc	**12.7**	NA	70.3	998	**12.7**	Mirenda (1986)
VOCs						
1,1,1-Trichloroethane	NA	NA	NA	**6,244**	**6244**	Lane et al. (1982)[e]
1,1-Dichloroethane	NA	NA	NA	NA	-	
1,1-Dichloroethene	NA	NA	NA	NA	-	
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	-	
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	-	
1,1,2-Trichloroethane	NA	NA	NA	NA	-	
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	-	
1,2-Dibromoethane	NA	NA	NA	NA	-	
1,2-Dichlorobenzene	NA	NA	NA	NA	-	
1,2-Dichloroethane	NA	NA	**81.9**	312	**81.9**	Alumot et al. (1976b)[e]
1,2-Dichloropropane	NA	NA	NA	NA	-	
1,2,3-Trichlorobenzene	NA	NA	NA	NA	-	
1,2,4-Trichlorobenzene	NA	NA	NA	**749**	**749**	Kitchin and Ebron (1983)
1,3-Dichlorobenzene	NA	NA	NA	NA	-	
1,4-Dichlorobenzene	212	NA	NA	**33.7**	**33.7**	Lake et al. (1997)
1,4-Dioxane	NA	NA	NA	**3.12**	**3.12**	Giavini et al. (1985)[e]
2-Butanone	NA	NA	NA	**11,057**	**11,057**	Sample et al. (1996)
2-Hexanone	NA	NA	NA	NA	-	
4-Methyl-2-pentanone	NA	NA	NA	**11,057**	**11,057**	Sample et al. (1996)
Acetone	NA	NA	**190**	1030	**190**	Hill et al. (1975)
Benzene	NA	NA	NA	**165**	**165**	Nawrot and Staples (1979)[e]
Bromochloromethane	NA	NA	NA	NA	-	
Bromodichloromethane	NA	NA	NA	NA	-	
Bromoform	NA	NA	NA	NA	-	
Bromomethane	NA	NA	NA	NA	-	
Carbon disulfide	NA	NA	NA	NA	-	
Carbon tetrachloride	NA	NA	NA	**99.9**	**99.9**	Alumot et al. (1976a)[e]
Chloroethane	NA	NA	NA	NA	-	

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Chloromethane	NA	NA	NA	NA	-	
cis-1,2-Dichloroethene	NA	NA	NA	NA	-	
cis-1,3-Dichloropropene	NA	NA	NA	NA	-	
Chlorobenzene	NA	NA	NA	NA	-	
Chloroform	NA	NA	NA	NA	-	
Cyclohexane	NA	NA	NA	NA	-	
Dibromochloromethane	NA	NA	NA	NA	-	
Dichorodifluoromethane	NA	NA	NA	NA	-	
Ethylbenzene	NA	NA	NA	NA	-	
Isopropylbenzene	NA	NA	NA	NA	-	
Methyl acetate	NA	NA	NA	NA	-	
Methylcyclohexane	NA	NA	NA	NA	-	
Methylene chloride	NA	NA	NA	NA	-	
Methyl tert-butyl ether	NA	NA	NA	NA	-	
Styrene	NA	NA	NA	NA	-	
Tetrachloroethene	NA	NA	NA	NA	-	
Toluene	NA	NA	NA	**162**	**162**	Nawrot and Staples (1979)[e]
trans-1,2-Dichloroethene	NA	NA	NA	NA	-	
trans-1,3-Dichloropropene	NA	NA	NA	NA	-	
Trichloroethene	NA	NA	NA	NA	-	
Trichlorofluoromethane	NA	NA	NA	NA	-	
m, p-Xylene	NA	NA	NA	NA	-	
o-Xylene	NA	NA	NA	NA	-	
Vinyl chloride	NA	NA	NA	**1.06**	**1.06**	Sample et al. (1996)
SVOCs						
1,1'-Biphenyl	NA	NA	NA	NA	-	
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	-	
1-Methylnaphthalene	NA	NA	NA	**937**	**937**	Murata et al. (1993)
1-Methyl-phenanthrene	NA	NA	NA	NA	-	
2,2'-Oxybis (1-Chloropropane)	NA	NA	NA	NA	-	

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
2,3,4,6-Tetrachlorophenol	NA	NA	NA	NA	-	
2,3,5-Trimethylnaphthalene	NA	NA	NA	NA	-	
2,4-Dichlorophenol	NA	NA	NA	NA	-	
2,4-Dimethylphenol	NA	NA	NA	**37.5**	**37.5**	Daniel et al. (1993)
2,4-Dinitrophenol	NA	NA	NA	NA	-	
2,4-Dinitrotoluene	NA	NA	NA	NA	-	
2,4,5-Trichlorophenol	NA	NA	NA	NA	-	
2,4,6-Trichlorophenol	NA	NA	NA	NA	-	
2,6-Dimethylnaphthalene	NA	NA	NA	NA	-	
2,6-Dinitrotoluene	NA	NA	NA	NA	-	
2-Chloronaphthalene	NA	NA	NA	NA	-	
2-Chlorophenol	NA	NA	NA	NA	-	
2-Methylnaphthalene	NA	NA	NA	**337**	**337**	Murata et al. (1997)
2-Methylphenol	NA	NA	NA	NA	-	
2-Nitroaniline	NA	NA	NA	NA	-	
2-Nitrophenol	NA	NA	NA	NA	-	
3,3'-Dichlorobenzidine	NA	NA	NA	NA	-	
3-Nitroaniline	NA	NA	NA	NA	-	
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	-	
4-Bromophenyl-phenylether	NA	NA	NA	NA	-	
4-Chloro-3-methylphenol	NA	NA	NA	NA	-	
4-Chloroaniline	NA	NA	NA	NA	-	
4-Chlorophenyl-phenyl ether	NA	NA	NA	NA	-	
4-Methylphenol	NA	**76.5**	NA	NA	**76.5**	Kaiser et al. (1984)
4-Nitroaniline	NA	NA	NA	NA	-	
4-Nitrophenol	NA	NA	NA	NA	-	
Acetophenone	NA	NA	NA	NA	-	
Acenaphthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Acenaphthylene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Atrazine	NA	NA	NA	NA	-	
Benzaldehyde	NA	NA	NA	NA	-	
Benzo(a)anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo(a)pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo(b)fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993
Benzo(e)pyrene	NA	NA	NA	NA	-	
Benzo(g,h,i)perylene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo(k)fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
bis-(2-Chloroethoxy)methane	NA	NA	NA	NA	-	
bis-(2-Chloroethyl)ether	NA	NA	NA	NA	-	
bis(2-Ethylhexyl)phthalate	NA	**0.39**	1.24	275	**0.39**	Mehrle and Mayer (1976)
Butylbenzylphthalate	NA	NA	**1.24**[g]	5188	**1.24**	Peakall (1974)
Caprolactam	NA	NA	NA	NA	-	
Carbazole	NA	NA	NA	NA	-	
Chrysene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Dibenzo(a,h)-anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Dibenzofuran	NA	NA	NA	NA	-	
Dibenzothiophene	NA	NA	NA	**293**	**293**	Leighton (1989)
Diethylphthalate	NA	NA	**1.24**[g]	11613	**1.24**	Peakall (1974)
Dimethylphthalate	NA	NA	**1.24**[g]	275	**1.24**	Peakall (1974)
Di-n-butylphthalate	**0.5**	NA	1.24	100	**0.5**	Laughlin et al. (1978)
Di-n-octylphthalate	NA	NA	**1.24**[g]	46827	**1.24**	Peakall (1974)
Fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Fluorene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Hexachlorobenzene	NA	468	0.21	**0.16**	**0.16**	Bleavins et al. (1984)
Hexachlorobutadiene	NA	20	**1.46**	12.5[f]	**1.46**	Schwetz et al. (1974)
Hexachloroethane	NA	NA	NA	**624**	**624**	Weeks et al. (1979)
Hexchlorocyclo-pentadiene	NA	NA	NA	NA	-	
Indeno(1,2,3-cd)-pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Isophorone	NA	NA	NA	NA	-	

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Phenanthrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Pentachlorophenol	NA	NA	**18.9**	25.0	**18.9**	Prescott et al. (1982)
Perylene	NA	NA	NA	NA	-	
Petroleum hydrocarbons (extractable)	NA	NA	NA	NA	-	
Petroleum hydrocarbons (purgeable)	NA	NA	NA	NA	-	
Phenol	NA	NA	NA	**375**	**375**	Argus Research Laboratories (1997), as cited in IRIS (EPA 2006)
Pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Naphthalene	NA	NA	**0.24**[f]	830	**0.24**	Hough et al. (1993)
Nitrobenzene	NA	NA	NA	NA	-	
n-Nitroso-di-n-propylamine	NA	NA	NA	NA	-	
n-Nitrosodiphenylamine	NA	NA	NA	NA	-	
TPH	NA	NA	NA	NA	-	
TPH -DRO	NA	NA	NA	NA	-	
PCBs						
Total PCBs	1.1	0.52	0.25	**0.0231**	**0.0231**	Restum et al. (1998)
PCB 077	NA	NA	**0.00024**[h]	0.027[h]	**0.00024**	Nosek et al. (1992)
PCB 081	NA	NA	**0.00012**[h]	0.0092[h]	**0.00012**	Nosek et al. (1992)
PCB 105	NA	NA	0.12[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 114	NA	NA	0.12[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 118	NA	NA	1.2[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 123	NA	NA	1.2[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 126	NA	NA	0.00012[h]	**0.000027**[h]	**0.000027**	Tillitt et al. (1996)
PCB 156	NA	NA	0.12[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 157	NA	NA	0.12[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 167	NA	NA	1.2[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)
PCB 169	NA	NA	0.012[h]	**0.000092**[h]	**0.000092**	Tillitt et al. (1996)
PCB 189	NA	NA	1.2[h]	**0.092**[h]	**0.092**	Tillitt et al. (1996)

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
PCDDs/PCDFs						
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin	NA	**0.00000195**	0.000012[h]	0.00000275[h]	**0.00000195**	Giesy et al. (2002)
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin	NA	NA	0.000012[h]	**0.00000275[h]**	**0.00000275**	Tillitt et al. (1996)
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin	NA	NA	0.00024[h]	**0.0000275[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin	NA	NA	0.0012[h]	**0.0000275[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin	NA	NA	0.00012[h]	**0.0000275[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin	NA	NA	0.012[h]	**0.000275[h]**	**0.000275**	Tillitt et al. (1996)
Octachlorodibenzo-p-dioxin	NA	NA	0.12[h]	**0.0092[h]**	**0.00916**	Tillitt et al. (1996)
2,3,7,8-Tetrachlorodibenzofuran	NA	NA	**0.000012[h]**	0.000027[h]	**0.000012**	Nosek et al. (1992)
1,2,3,7,8-Pentachlorodibenzofuran	NA	NA	0.00012[h]	**0.000092[h]**	**0.000092**	Tillitt et al. (1996)
2,3,4,7,8-Pentachlorodibenzofuran	NA	NA	0.000012[h]	**0.0000092[h]**	**0.0000092**	Tillitt et al. (1996)
1,2,3,4,7,8-Hexachlorodibenzofuran	NA	NA	0.00012[h]	**0.000027[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,6,7,8-Hexachlorodibenzofuran	NA	NA	0.00012[h]	**0.000027[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,7,8,9-Hexachlorodibenzofuran	NA	NA	0.00012[h]	**0.000027[h]**	**0.0000275**	Tillitt et al. (1996)
2,3,4,6,7,8-Hexachlorodibenzofuran	NA	NA	0.00012[h]	**0.000027[h]**	**0.0000275**	Tillitt et al. (1996)
1,2,3,4,6,7,8-Heptachlorodibenzofuran	NA	NA	0.0012[h]	**0.00027[h]**	**0.000275**	Tillitt et al. (1996)
1,2,3,4,7,8,9-Heptachlorodibenzofuran	NA	NA	0.0012[h]	**0.00027[h]**	**0.000275**	Tillitt et al. (1996)
Octachlorodibenzofuran	NA	NA	0.12[h]	**0.0092[h]**	**0.0092**	Tillitt et al. (1996)
PAHs						
1-Methylphenanthrene	NA	NA	NA	NA	-	
2,3,5-Trimethylnaphthalene	NA	NA	NA	NA	-	

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
2,6-Dimethylnaphthalene	NA	NA	NA	NA	-	
2-Methylnaphthalene	NA	NA	NA	**337**	**337**	Murata et al. (1997)
Acenaphthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Acenaphthylene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Fluorene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Naphthalene	NA	NA	**0.24**[f]	830	**0.24**	Hough et al. (1993)
Phenanthrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo[a]anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo[a]pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo[b]fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo[e]pyrene	NA	NA	NA	NA	-	
Benzo[g,h,i]perylene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Benzo[k]fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Chrysene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Dibenzo[a,h]anthracene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Dibenzothiophene	NA	NA	NA	**293**	**293**	Leighton (1989)
Fluoranthene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Indeno[1,2,3-c,d]-pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Perylene	NA	NA	NA	NA	-	
Pyrene	NA	NA	**0.24**[f]	12.5[f]	**0.24**	Hough et al. (1993)
Pesticides						
2,4'-DDD	**0.046**[i]	1.8[i]	0.154	1.62[i]	**0.154**	Nimmo et al. (1970)
2,4'-DDE	**0.046**[i]	1.8[i]	0.055	1.62[i]	**0.055**	Nimmo et al. (1970)
2,4'-DDT	0.046[i]	1.8[i]	**0.026**	1.62[i]	**0.026**	Stickel and Rhodes (1970)
4,4'-DDD	**0.046**[i]	1.8[i]	0.154	1.62[i]	**0.154**	Nimmo et al. (1970)
4,4'-DDE	**0.046**[i]	1.8[i]	0.055	1.62[i]	**0.055**	Nimmo et al. (1970)
4,4'-DDT	0.046[i]	1.8[i]	**0.026**	1.62[i]	**0.026**	Stickel and Rhodes (1970)
Aldrin	NA	5.3	**0.0069**	5.0	**0.0069**	DeWitt (1956)
alpha-Hexachlorocyclohexane	NA	NA	**1.37**[j]	38.1[j]	**1.37**	Chakravarty and Lahiri (1986)

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
alpha-Chlordane	**0.49**	0.71	NA	NA	**0.49**	Parrish et al. (1976)
beta-Hexachlorocyclohexane	NA	NA	**1.37**[j]	35.6	**1.37**	Chakravarty and Lahiri (1986)
delta-Hexachlorocyclohexane	NA	NA	**1.37**[j]	38.1[j]	**1.37**	Chakravarty and Lahiri (1986)
Dieldrin	NA	0.12	**0.057**	1.12	**0.057**	Mendenhall et al. (1983)
Endosulfan I	0.08[k]	**0.031**[k]	8.58[k]	5.24[k]	**0.031**	Schimmel et al. (1977)
Endosufan II	0.08[k]	**0.031**[k]	8.58[k]	5.24[k]	**0.031**	Schimmel et al. (1977)
Endosulfan sulfate	0.08	**0.031**	8.58	5.24	**0.031**	Schimmel et al. (1977)
Endrin	NA	0.0115	**0.010**	1.12	**0.010**	DeWitt (1956)
Endrin aldehyde	NA	0.0115[l]	**0.010**[l]	1.12[l]	**0.010**	DeWitt (1956)
Endrin ketone	NA	0.0115[l]	**0.010**[l]	1.12[l]	**0.010**	DeWitt (1956)
gamma-BHC (Lindane)	NA	6.13	**1.37**	38.1	**1.37**	Chakravarty and Lahiri (1986)
gamma-Chlordane	**0.49**[m]	0.71[m]	NA	NA	**0.49**	Parrish et al. (1976)
Heptachlor	NA	1.5	**0.086**	6.24	**0.086**	Hill et al. (1975)
Heptachlor epoxide	NA	0.8	**0.086**[n]	6.24	**0.086**	Hill et al. (1975)
Methoxychlor	<0.1	**0.05**	29.7	106	**0.05**	Oladimeji and Leduc (1975)
Total Chlordane	**0.49**	0.71	0.51	1.12	**0.49**	Parrish et al. (1976)
cis-Nonachlor	**0.49**[m]	0.71[m]	0.51[m]	1.12[m]	**0.49**	Parrish et al. (1976)
trans-Nonachlor	**0.49**[m]	0.71[m]	0.51[m]	1.12[m]	**0.49**	Parrish et al. (1976)
Oxychlordane	**0.49**[m]	0.71[m]	0.51[m]	1.12[m]	**0.49**	Parrish et al. (1976)
Butyltins						
Dibutyl tin	NA	NA	**1.2**[o]	23.7	**1.20**	Schlatterer et al. (1993)
Monobuyltin	NA	NA	**1.2**[o]	2.5[o]	**1.20**	Schlatterer et al. (1993)
Tetrabutyl tin	NA	NA	**1.2**[o]	2.5[o]	**1.20**	Schlatterer et al. (1993)
Tributyl tin	NA	**0.26**	1.2	2.5	**0.26**	Tsuda et al. (1990)
Nutrients						
Ammonia as N	NA	NA	NA	NA	-	
Chlorophyll a	NA	NA	NA	NA	-	
Nitrogen (total Kjeldahl)	NA	NA	NA	NA	-	
Phosphate	NA	NA	NA	NA	-	
Total Orthophosphate	NA	NA	NA	NA	-	

Analyte	Ecological Thresholds (mg/kg ww)				Selected Ecological DQL[d]	Selected Ecological DQL Source
	Decapod Tissue Threshold[a]	Fish Tissue Threshold[a]	Back-Calculated NOAEL Bird Threshold[b]	Back-Calculated NOAEL Mammal Threshold[c]		
Radionuclides						
Beryllium-7 (pCi/g)	NA	NA	NA	NA	-	

[a] Decapod and fish tissue DQLs based on lowest NOAEL or LOAEL TRVs from the literature.

[b] Bird DQLs derived by back-calculating tissue thresholds from literature based dietary NOAEL TRVs using species-specific exposure parameters (i.e., body weight and sediment ingestion rate). Bird DQL is the lowest of back-calculated threshold for shorebirds, eagle, merganser, or osprey. NOAEL TRVs derived from toxicity studies were expressed as daily dietary doses normalized for body weight. To convert these NOAEL TRVs to a concentration in ingested prey tissue, the following equation was used:

C_{Tis} = (Dose x BW) / DFC

where: C_{Tis} = concentration in prey tissue (mg/kg ww)
Dose = NOAEL TRV (mg/kg BW/day)
BW = body weight (kg)
DFC = daily food consumption rate (kg ww/day).

[c] Mammal DQLs derived by back-calculating tissue thresholds from literature based dietary NOAEL TRVs using species-specific exposure parameters (i.e., body weight and sediment ingestion rate). Mammal DQL is the lowest of back-calculated threshold for mink or river otter. NOAEL TRVs derived from toxicity studies were expressed as daily dietary doses normalized for body weight and converted to a concentration in ingested prey tissue using the equation presented in Footnote b.

[d] Selected ecological DQL based on the lowest decapod, fish, bird, or mammal threshold. Ecological DQLs are analytical goals listed solely for the purpose of evaluating laboratory analytical methods and achievable laboratory limits; these are not project-specific screening levels or PRGs and are not approved by the USEPA as the appropriate risk assessment criteria for this project. These values will be developed in subsequent phases of the project.

[e] Reference as cited in Sample et al. (1996).

[f] The DQL for this analyte was based on benzo(a)pyrene.

[g] The DQL for this analyte was based on bis(2-ethylhexyl)phthalate.

[h] Bird and mammal DQLs for individual dioxins, furans, and dioxin-like congeners calculated by dividing the 2,3,7,8-TCDD TRV by the respective bird TEF (Van den berg et al. 1998) or mammal TEF (Van den berg et al. 2006).

[i] The DQL for this analyte was based on total DDT (sum of all DDT metabolites).

[j] The DQL for this analyte was based on gamma-BHC (lindane).

[k] The DQL for this analyte was based on total endosulfan.

[l] The DQL for this analyte was based on endrin.

[m] The DQL for this analyte was based on chlordane.

[n] The DQL for this analyte was based on heptachlor.

[o] The DQL for this analyte was based on tributyltin.

CAS – Chemical Abstracts Service
COPEC – compound of potential ecological concern
DRO – diesel-range organic
DQL – data quality level
GRO – gasoline-range organic
LOAEL – lowest-observed-adverse-effect level
NA – not available
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SVOC – semivolatile organic compound
TEF – toxic equivalency factor
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons
TRV – toxicity reference value
VOC – volatile organic compound

References

Alumot E, Nachtomi E, Mandel E, Holstein P, Bonci A, Herzberg M. 1976a. Tolerance and acceptable daily intake of chlorinated fumigants in the rat diet. Food Cosmet Toxicol 14:105-110.

Alumot E, Meidler M, Holstein P. 1976b. Tolerance and acceptable daily intake of ethylene dichloride in the chicken diet. Food Cosmet Toxicol 14:111-114.

Ambrose AM, Larson PS, Borzelleca JF, Hennigar Jr GR. 1976. Long term toxicologic assessment of nickel in rats and dogs. J Food Sci Technol 13(4):181-187.

Bleavins MR, Aulerich RJ, Ringer RK. 1984. Effects of chronic dietary hexachlorobenzene exposure on the reproductive performance and survivability of mink and European ferrets. Arch Environ Contam Toxicol 13:357-365.

Chakravarty S, Lahiri P. 1986. Effect of lindane on eggshell characteristics and calcium level in the domestic duck. Toxicology 42:245-258.

Chetty KY, Rau S, Drummond L, Desaiah D. 1979. Cobalt induced changes in immune response and adenosine triphosphatase activities in rats. J Environ Sci Health B14(5):525-544.

Daniel FB, Robinson M, Olson GR, York RG, Condie LW. 1993. Ten and ninety-day toxicity studies of 2,4-dimethylphenol in Sprague-Dawley rats. Drug Chem Toxicol 16(4):351-368.

DeWitt JB. 1956. Chronic toxicity to quail and pheasants of some chlorinated insecticides. Agric Food Chem 4(10):863-866.

Edens FW, Benton E, Bursian SJ, Morgan GW. 1976. Effect of dietary lead on reproductive performance in Japanese quail, Coturnix coturnix japonica. Toxicol Appl Pharmacol 38:307-314.

EPA. 2006. Integrated Risk Information System (IRIS) database [online]. US Environmental Protection Agency, Washington, DC. [Cited 1/2006.] Available from: http://www.epa.gov/iris/.

Evans ML. 1980. Copper accumulation in the crayfish (Orconectes rusticus). Bull Environ Contam Toxicol 24:916-920.

FDA. 1993. Guidance document for lead in shellfish. Office of Seafood, US Food and Drug Administration, Washington, DC.

Giavini E, Vismara C, Broccia ML. 1985. Teratogenesis study of dioxane in rats. Toxicol Let 26:85-88.

Giesy JP, Jones PD, Kannan K, Newsted JL, Tillitt DE, Williams LL. 2002. Effects of chronic dietary exposure to environmentally relevant concentrations if 2,3,7,8-tetrachlorodibenzo-p-dioxin on survival, growth, reproduction and biochemical responses of female rainbow trout (Oncorhynchus mykiss). Aquat Toxicol 59:35-53.

Halverson AW, Palmer IS, Guss PL. 1966. Toxicity of selenium to post-weanling rats. Toxicol Appl Pharmacol 9:477-484.

Haseltine SD, Sileo L, Hoffman DJ, Mulhern BD. unpublished. Effects of chromium on reproduction and growth in black ducks. As cited in Sample BE, Opresko DM, Suter GW. 1996. Toxicological benchmarks for wildlife. 1996 revision. ES/ERM-86/R3. Office of Environmental Management, US Department of Energy, Washington, DC.

Heinz GH. 1975. Effects of methylmercury on approach and avoidance behavior of mallard ducklings. Bull Environ Contam Toxicol 13(5):554-564.

Heinz GH. 1979. Methylmercury: reproductive and behavioral effects on three generations of mallard ducks. J Wildl Manage 43(2):394-401.

Hext PM, Pinto PJ, Rimmel BA. 1999. Subchronic feeding study of antimony trioxide in rats. J Appl Toxicol 19:205-209.

Hill EF, Heath RG, Spann JW, Williams JD. 1975. Lethal dietary toxicities of environmental pollutants to birds. Wildlife no. 191. US Fish and Wildlife Service, Laurel, MD.

Hough JL, Baird MB, Sfeir GT, Pacini CS, Darrow D, Wheelock C. 1993. Benzo(a)pyrene enhances atherosclerosis in white carneau and show racer pigeons. Arterioscler Thromb 13:1721-1727.

Hudson RH, Tucker RK, Haegele MA. 1984. Handbook of toxicity of pesticides to wildlife. Resource publication 153. 2nd ed. US Fish and Wildlife Service, Washington, DC.

Kaiser KLE, Dixon DG, Hodson PV. 1984. QSAR studies on chlorophenols, chlorobenzenes and para-substituted phenols. In: Kaiser KLE, ed, QSAR in environmental toxicology. D. Reidel Publishing Co., Dordrecht, the Netherlands, pp 189-206.

Kitchin KT, Ebron MT. 1983. Maternal hepatic and embryonic effects of 1,2,4-trichlorobenzene in the rat. Environ Res 31:362-373.

Lake BG, Cunningham ME, Price RJ. 1997. Comparison of the hepatic and renal effects of 1,4-dichlorobenzene in the rat and mouse. Fund Appl Toxicol 39:67-75.

Lane RW, Riddle BL, Borzelleca JF. 1982. Effects of 1,2-dichloroethane and 1,1,1-trichloroethane in drinking water on reproduction and development in mice. Toxicol Appl Pharmacol 63:409-421.

Laskey JW, Rehnberg GL, Hein JF, Carter SD. 1982. Effects of chronic manganese (Mn3O4) exposure on selected reproductive parameters in rats. J Toxicol Environ Health 9:677-687.

Laughlin RB, Jr, Neff JM, Hrung YC, Goodwin TC, Giam CS. 1978. The effects of three phthalate esters on the larval development of the grass shrimp Paleomonetes pugio (Holthuis). Wat Air Soil Pollut 9:323-336.

Leach RM, Jr, Wang KW-L, Baker DE. 1979. Cadmium and the food chain: the effect of dietary cadmium on tissue composition in chicks and laying hens. J Nutr 109:437-443.

Leighton FA. 1989. Acute oral toxicity of dibenzothiophene for male CD-1 mice: LD50, lesions, and the effect of preinduction of mixed-function oxidases. Fund Appl Toxicol 12:787-792.

Lindsay DM, Sanders JG. 1990. Arsenic uptake and transfer in a simplified estuarine food chain. Environ Toxicol Chem 9:391-395.

Mehrle PM, Mayer FL. 1976. Di-2-ethylhexyl phthalate: residue dynamics and biological effects in rainbow trout and fathead minnows. Proceedings of University of Missouri's 10th Annual Conference on Trace Substances in Environmental Health, June 8-10, Columbia, MO, pp 519-524.

Mendenhall VM, Klaas EE, McLane MAR. 1983. Breeding success of barn owls (Tyto alba) fed low levels of DDE and dieldrin. Arch Environ Contam Toxicol 12:235-240.

Mirenda RJ. 1986. Acute toxicity and accumulation of zinc in the crayfish, Orconectes virilis (Hagen). Bull Environ Contam Toxicol 37:387-394.

Murata Y, Denda A, Maruyama H, Konishi Y. 1993. Chronic toxicity and carcinogenicity studies of 1-methylnaphthalene in B6C3F1 mice. Fund Appl Toxicol 21:44-51.

Murata Y, Denda A, Maruyama H, Nakae D, Tsutsumi M, Tsujiuchi T, Konishi Y. 1997. Chronic toxicity and carcinogenicity studies of 2-methylnaphthalene in B6C3F1 mice. Fund Appl Toxicol 36:90-93.

Nawrot PS, Staples RE. 1979. Embryofetal toxicity and teratogenicity of benzene and toluene in the mouse. Teratology 19(2):41a.

Nimmo DR, Wilson Jr AJ, Blackman RR. 1970. Localization of DDT in the body organs of pink and white shrimp. Bull Environ Contam Toxicol 5(4):333-341.

Nosek JA, Craven SR, Sullivan JR, Hurley SS, Peterson RE. 1992. Toxicity and reproductive effects of 2,3,7,8-tetrachlorodibenzo-p-dioxin in ring-necked pheasant hens. J Toxicol Environ Health 35:187-198.

Oladimeji AA, Leduc G. 1975. Effects of dietary methoxychlor on the food maintenance requirements of brook trout. Progr Wat Tech 7(3/4):587-598.

Ousterhout LE, Berg LR. 1981. Effects of diet composition on vanadium toxicity in laying hens. Poult Sci 60:1152-1159.

Parrish PR, Schimmel SC, Hansen DJ, Patrick Jr JM, Forester J. 1976. Chlordane: effects on several estuarine organisms. J Toxicol Environ Health 1:485-494.

Peakall DB. 1974. Effects of di-n-butylphthalate and di-2-ethylhexylphthalate on the eggs of ring doves. Bull Environ Contam Toxicol 12:698-702.

Perry Jr HM, Kopp SJ, Erlanger MW, Perry EF. 1983. Cardiovascular effects of chronic barium ingestion. In: Hemphill DD, ed, Proceedings of University of Missouri's 17th Annual Conference on Trace Substances in Environmental Health, June 1983, Columbia, MO. Environmental Trace Substances Research Center and Extension Division, University of Missouri, pp 155-164.

Prescott CA, Wilkie BN, Hunter B, Julian RJ. 1982. Influence of purified grade of pentachlorophenol on the immune response of chickens. Am J Vet Res 43(3):481-487.

Restum JC, Bursian SJ, Giesy JP, Render JA, Helferich WG, Shipp EB, Verbrugge DA. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink. 1. Effects on mink reproduction, kit growth and survival, and selected biological parameters. J Toxicol Environ Health 54(A):343-375.

Sample BE, Opresko DM, Suter GW. 1996. Toxicological benchmarks for wildlife. 1996 revision. ES/ERM-86/R3. Office of Environmental Management, US Department of Energy, Washington, DC.

Schimmel SC, Patrick Jr JM, Wilson Jr AJ. 1977. Acute toxicity to and bioconcentration of endosulfan by estuarine animals. In: Mayer FL, Hamelink JL, eds, Aquatic toxicology and hazard evaluation, ASTM STP 634. American Society for Testing and Materials, Philadelphia, PA, pp 241-252.

Schlatterer B, Coenen TMM, Ebert E, Grau R, Hilbig V, Munk R. 1993. Effects of bis(tri-n-butyltin) oxide in Japanese quail exposed during egg laying period: an interlaboratory comparison study. Arch Environ Contam Toxicol 24:440-448.

Schroeder HA, Mitchener M. 1975. Life-term studies in rats: effects of aluminum, barium, beryllium, and tungsten. J Nutr 105:421-427.

Schwetz BA, Norris JM, Kociba RJ, Keeler PA, Cornier RF, Gehring PJ. 1974. Reproduction study in Japanese quail fed hexachlorobutadiene for 90 days. Toxicol Appl Pharmacol 30:255-265.

Stickel LF, Rhodes LI. 1970. The thin eggshell problem. In: Gillett JW, ed, Proceedings of the symposium, The Biological Impact of Pesticides in the Environment. Oregon State University, Corvallis, OR, pp 31-35.

Tewe OO, Maner JH. 1981. Long-term and carry-over effect of dietary inorganic cyanide (KCN) in the life cycle performance and metabolism of rats. Toxicol Appl Pharmacol 58:1-7.

Tillitt DE, Gale RW, Meadows JC, Zajicek JL, Peterman PH, Heaton SN, Jones PD, Bursian SJ, Kubiak TJ, Giesy JP, Aulerich RJ. 1996. Dietary exposure of mink to carp from Saginaw Bay. 3. Characterization of dietary exposure to planar halogenated hydrocarbons, dioxin equivalents, and biomagnification. Environ Sci Technol 30:283-291.

Tsuda T, Aoki S, Kojima M, Harada H. 1990. Differences between freshwater and seawater-acclimated guppies in the accumulation and excretion of tri-n-butyltin chloride and triphenyltin chloride. Wat Res 24(11):1373-1376.

Van den Berg M, Birnbaum L, Bosveld ATC, Brunström B, Cook P, Feeley M, Giesy JP, Hanberg A, Hasegawa R, Kennedy S, Kubiak T, Larsen JC, van Leeuwen FXR, Djien Liem AK, Nolt C, Peterson RE, Poellinger L, Safe S, Schrenk D, Tillitt D, Tysklind M, Younes M, Waern F, Zacharewski T. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ Health Perspect 106(12):775-792.

Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley M, Fiedler H, Hakansson H, Hanberg A, Haws L, Rose M, Safe S, Schrenk D, Tohyama C, Tritscher A, Tuomisto J, Tysklind M,

Walker N, Peterson RE. 2006. The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Tox Sci 93(2):223-241.

Weeks MH, Angerhofer RA, Bishop R, Thomasino J, Pope CR. 1979. The toxicity of hexachloroethane in laboratory animals. Am Ind Hyg Assoc J 40:187-198.

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Attachment T: Laboratory SOPs

Title, Revision Date, and/or Number	Reference No.
SOP No. OP-003, Tissue Preparation and Homogenization, Revision 0.0, 4/25/02	T1
SOP No.AP-CM-7, High Resolution Mass Spectrometry, Method 1668A for Solid/Air/Aqueous/Tissue Matrices, Revision 7, 2/14/05	T2
SOP No.AP-CM-5, Polychlorinated dibenzo dioxin/furans, USEPA Methods 8290, 1613, 23, 0023A, & TO-9A, Revision 12-5, 1/7/09	T3
BRL SOP-00423, PAH Compounds by HRGC HRMS in Food Products, Sediments, and Water, 4/13/09	T4
BRL SOP-00003, Cleanup of Sample Extract Using Gel Permeation Chromatography, 4/13/09	T5
BRL SOP-00010, Extraction Organochlorine Pesticides from Liquids and Solids, 4/13/09	T6
BRL SOP-00415, OC Pesticides by HRMS, 4/13/09	T7
SOP No. O-012, Determination of Polychlorinated Biphenyls as Aroclors or Congeners by Gas Chromatography/Electron Capture Detection (GC/ECD), Revision 2.0, 2/11/08,	T8
MET-TDIG, Standard Operating Procedure for Sample Preparation of Biological Tissue for Metals Analysis by GFAA, ICP-OES, and ICP-MS, Revision 1, 2/27/2002	T9
MET-6020, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS); EPA Method 6020, Revision 12, 9/26/2008	T10
MET-ICP, Standard Operating Procedure for Determination of Metals and Trace Elements by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP), Revision 20, 9/26/2008	T11
MET-7742, Standard Operating Procedure for Selenium by Borohydride Reduction Atomic Absorption, Revision 2, 1/6/2006	T12
SOP No.BR-0021, BRL Procedure for the Analysis of Water, Sediment, and Tissue by EPA Method 1632, Revision A (1/01): Chemical Speciation of Arsenic in Water and Tissue by Hydride Generation Quartz Furnace Atomic Absorption Spectrometry, Revision 003, 10/7/08	T13
SOP No.BR-002, BRL Procedure for EPA Method 1631, Appendix: Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation by Cold Vapor Atomic Fluorescence Spectrophotometry (CVAFS), Revision 010, 4/9/08	T14
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 004, 8/31/07	T15

Title, Revision Date, and/or Number	Reference No.
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 012, 4/1/08	T16
SOP No.OP-016, Microscale Solvent Extraction (MSE), Revision 2, February 12, 2008	T17
SOP No.OP-006, Gel Permeation Chromatography Method 3640A, Revision 1.0, February 11, 2008	T18
SOP No.OP-014, Silica Gel Cleanup Procedure (Automated and Manual), Revision 1.1, May 2, 2008	T19
SOP No.O-006, Method 8270, Semivolatile Organic Compounds by GC/MS, Revision 4.0, February 11, 2008	T20
SOP No. SOC-OSWT, Extraction of Organotins in Sediment, Water, and Tissue Matrices, Revision 5, 1/20/06	T21
SOP No. SOC-BUTYL, Butyltins, Revision 8, 7/31/07	T22
SOP No.SOC-LIPID, Percent Lipids in Tissue, Revision 1, 4/30/07	T23
SOP No.W-001, Percent Solids Determination, Revision 3, 5/4/07	T24
SOP No.G-003, Balance Calibration and Maintenance, Revision 2.0, 1/31/08	T25
SOP No. O-008. Analysis of Parent and Alkylated Polynuclear Aromatic Hydrocarbons, Selected Heterocyclic Compounds, Steranes, Triterpanes, and Triaromatic Steroids by GC/MS – SIM, Revision 4, 10/08/08	T26
SOP OP-009. Alumina Column Cleanup of Organic Extracts, Revision 1.0 4/17/08	T27

Attachment U: Laboratory Certifications

Laboratory	Accreditation	Year	Reference No.
Alpha Analytical	State of Louisiana, National Environmental Laboratories Accreditation Program	2008-2009	U1
	New Jersey Department of Environmental Protection	2008-2009	U2
Analytical Perspectives	State of Florida, National Environmental Laboratories Accreditation Program	2008-2009	U3
	New Jersey Department of Environmental Protection	2008-2009	U4
Brooks Rand Labs	State of Florida, National Environmental Laboratories Accreditation Program	2009	U5
	New Jersey Department of Environmental Protection	2008-2009	U6
Columbia Analytical Services, Inc.	New Jersey Department of Environmental Protection	2008-2009	U7
Maxxam Analytics	New Jersey Department of Environmental Protection	2008-2009	U8
	Standard Council of Canada	2009-2010	U9

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Attachment V: Sample Size Estimate Term Sheet

Fish/Decapod Tissue QAPP (May 1, 2009)
Revised CPG Sample Size Estimate Term Sheet
July 16, 2009

The CPG proposes to amend the sample size estimates presented in the May 1, 2009, Fish/Decapod Tissue QAPP (Tissue QAPP) in the following manner:

1. Table 5 of Appendix P of the Tissue QAPP (sample design memorandum) forms the technical basis for decisions on sample sizes for the fish and decapods tissue samples based on discussions with R. Basso/EPA and G. Grubbs/CPG on July 13, 2009.
2. Target precision percent of mean preferred by EPA is approximately 50%. Table 5 provides a lookup matrix to determine sample size given a preferred precision goal and an expected coefficient of variation (CV) for the tissue data.
3. Revised sample numbers reflect the number of tissue samples required to meet the target precision of approximately 50% precision for all target species groups, depending upon the CV for the target species.
4. Site-specific CVs are available from the Tierra studies (Table 3 of Attachment P of the Tissue QAPP presents ranges of CVs per chemical and per species). Median CVs for each of the receptor groups listed in Table 3 of Attachment P of the Tissue QAPP ranged from 0.67 (for mummichog) to 0.32 (for blue crab). CPG's goal is to develop sample sizes in which the sample size selected resulted in a CV that was lower than the majority of the chemical specific CVs for each species. For setting sample sizes we compared our sample size and CV to a sample size and CV of 0.5, which is higher than the CV for a number of chemicals per species. These result in the following:
    - Proposed sample numbers for large foraging fish (median CVs between 0.43 and 0.56 for multiple species), will at least meet the target precision of 50%.
    - Crabs sample numbers will more than meet the target precision range of 50%; crayfish chemical concentrations in the freshwater are assumed to be similar for the purposes of these sample size estimates.
    - For mummichog, the proposed number of samples, assuming a median CV of 0.67, will result in a precision between 50% and 75%.
5. The proposed increase in mummichog samples is 3 times the original proposed sample size. In addition, the increase to 39-42 samples per zone is responsive to EPA's preference for multiple samples (i.e., 3 samples/mudflat/zone) as discussed on July 8.

Table 1: Comparison of Proposed Sample Number to Precision Goal

Species	Fish/Crab Tissue QAPP Sample Estimates 100% precision	Sample Size (assuming CV of 0.5 at 50% precisions from Table 5)	Predicted Precision (Proposed Sample Size)	Comments
Small-foraging-range fish (e.g., mummichog)	13	19	Approximately 50-75% (sample size = 39 in estuarine zone; 42 in freshwater zone)	Proposed sample size is 3 x greater than original
Large-foraging-range fish (e.g., perch)	12	19	Better than 50% (sample size = 24 in estuarine zone; 26 in freshwater zone)	Includes perch, bullhead, eel, bass
Crab	12	19	Better than 50% (sample size = 24 estuarine and 17 fresh water)	For RME tissue type (muscle + hepatopancreas)
Crayfish	12	19	Better than 50% sample size = 27 – freshwater-only	Assumed to be similar to crab

6. The level of effort (5 attempts per target area) remains the same as defined in Worksheets 11 and 17 of the Tissue QAPP. Following completion of chemical analyses of the tissue in Q3 and Q4 of CY 2009, a preliminary data assessment will be conducted to determine the variability and sample mean precision of the tissue data. If there is a sound technical justification (e.g., increase precision of the sample means), additional data collection will be considered following this evaluation for the Q2/Q3 2010 field season following approval by the EPA.
7. This Revised CPG Sample Size Estimate Term Sheet accepted by EPA will be added as an addendum to the Tissue QAPP. The current CPG sample design memo, Attachment P of the QAPP, will not be changed since it provides the underlying statistical rationale, however the sample number tables within the QAPP will be changed to reflect these new sample numbers and this Term Sheet will be referenced.

Table 2: Summary of Proposed Sample Numbers per Species and Tissue Type

Species	Zone	Tissue Type	Number of Samples in 5/1 QAPP	Proposed Number of Samples
Mummichog	RM 0-10	whole body	13	39
Darter	RM10-17.4	whole body	13	42
Perch	RM 0-10	skin-on fillet	12	24
Perch	RM 0-10	carcass	12	24
Bullhead	RM10-17.4	skinless fillet	12	26
Bullhead	RM10-17.4	carcass	12	26
Eel	RM 0-10	skinless fillet	12	24
Eel	RM 0-10	carcass	12	24
Bass	RM10-17.4	skin-on fillet	12	26
Bass	RM10-17.4	carcass	12	26
Crab	RM 0-10	muscle+hepato	12	24
Crab	RM 0-10	carcass	12	24
Crab	RM 0-10	muscle only	12	12
Crab	RM 0-10	hepatopancreas	3	3
Crab	RM10-17.4	muscle+hepato	8	17
Crab	RM10-17.4	muscle only	8	9
Crab	RM10-17.4	hepatopancreas	3	4
Crayfish	RM10-17.4	whole body	12	27
Subtotal			**192**	**401**
10% QC			**19**	**40**
Total			**211**	**441**

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Attachment W: Field Sampling Flow Charts

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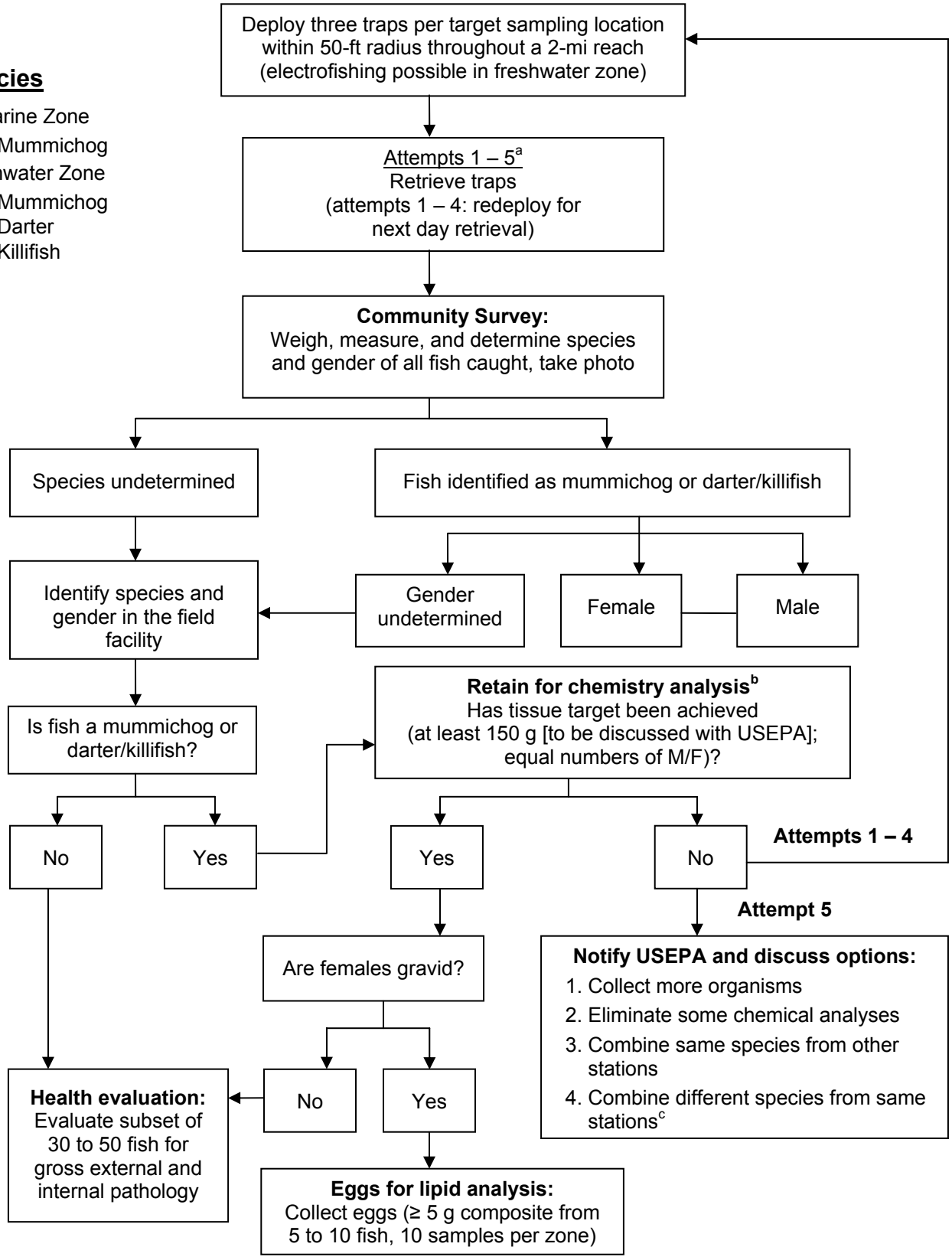
Field Sampling Flow Chart – Benthic Omnivores (Small-Forage-Range Fish)

Species

Estuarine Zone
- Mummichog

Freshwater Zone
- Mummichog
- Darter
- Killifish



[a] Catch results (e.g., species, weights) will be posted or sent to USEPA on a daily basis.
[b] Individual fish will be labeled with a unique ID to enable tracking from the field to the analytical laboratory.
[c] It may be necessary to composite across species (for darters or killifish), which may be acceptable given their similar life histories, if sufficient tissue mass is not available after 5 attempts or if the individuals cannot be identified to the species level.

Field Sampling Flow Chart – Invertivore/Omnivore and Piscivore (Large-Forage-Range Fish)

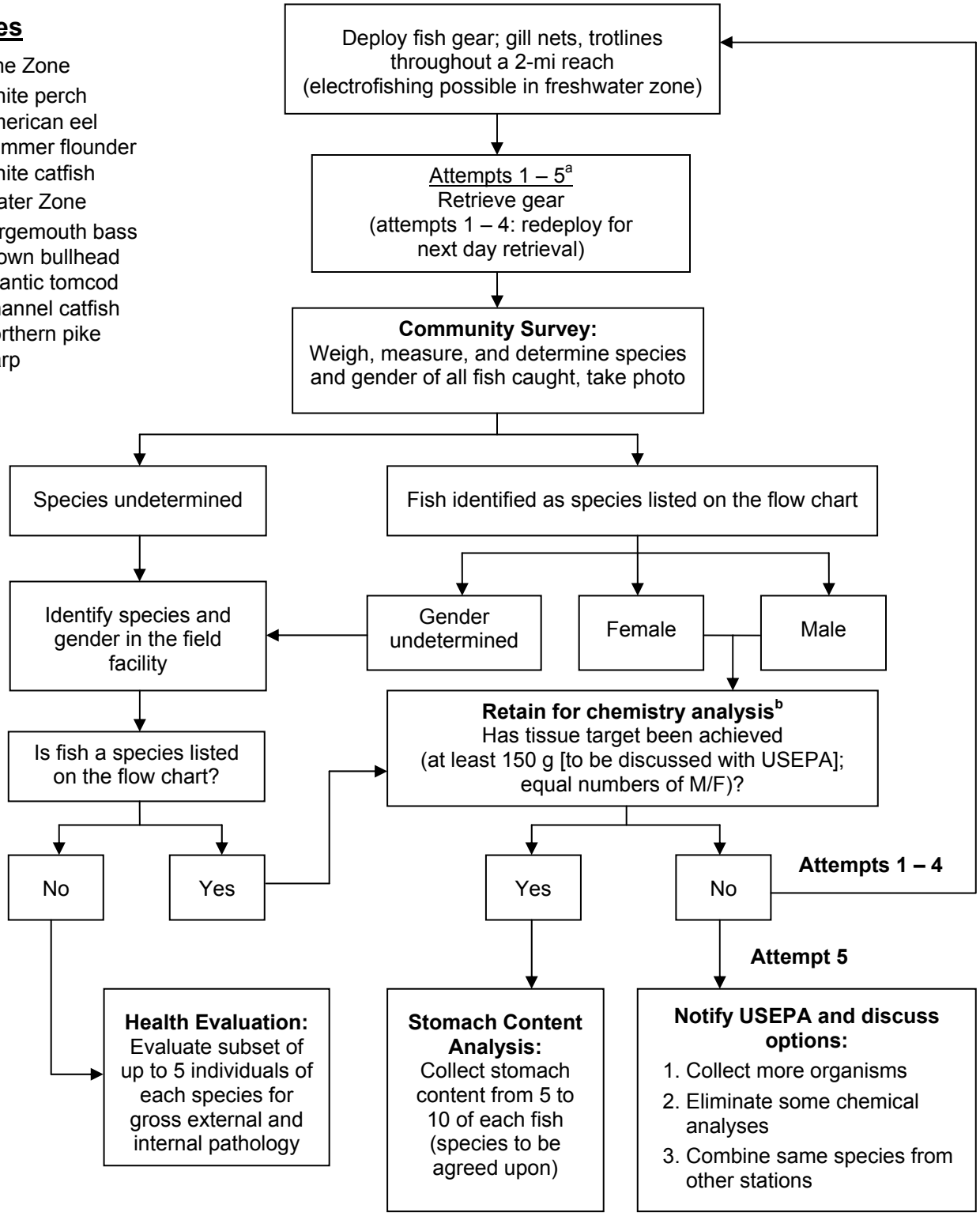
Species

Estuarine Zone

- White perch
- American eel
- Summer flounder
- White catfish

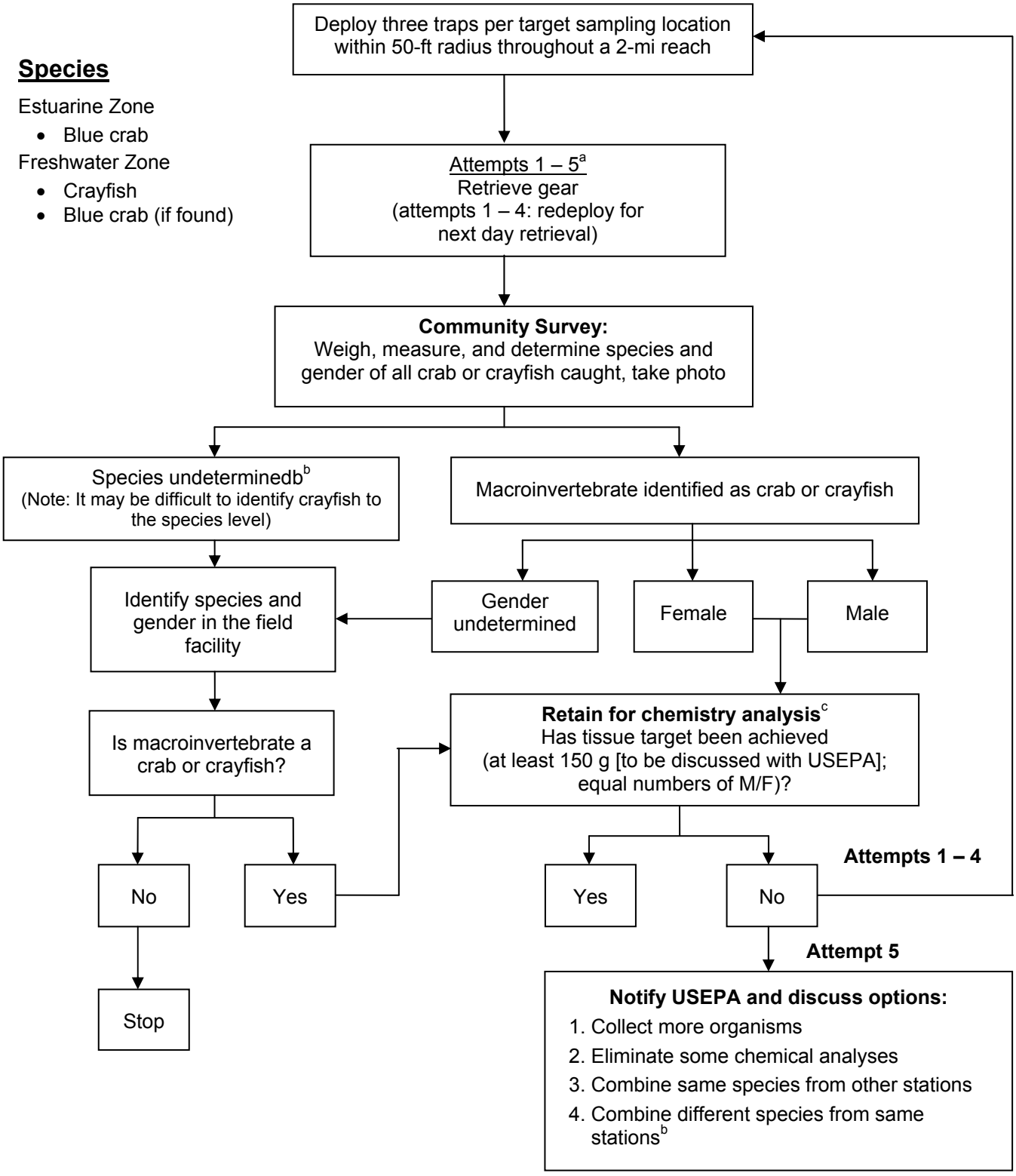
Freshwater Zone

- Largemouth bass
- Brown bullhead
- Atlantic tomcod
- Channel catfish
- Northern pike
- Carp



[a] Catch results (e.g., species, weights) will be posted or sent to USEPA on a daily basis.
[b] Individual fish will be labeled with a unique ID to enable tracking from the field to the analytical laboratory.

Field Sampling Flow Chart – Epibenthic Omnivore (Macroinvertebrates)



[a] Catch results (e.g., species, weights) will be posted or sent to USEPA on a daily basis.
[b] It may be necessary to composite across species (for crayfish), which may be acceptable given their similar life histories, if sufficient tissue mass is not available after 5 attempts or if the individuals cannot be identified to the species level.
[c] Individual macroinvertebrates will be labeled with a unique ID to enable tracking from the field to the analytical laboratory.

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Oversize Figures