

Appendix A.3

Industri-Plex Field Investigation Work Plan

**Toxicological Surface Water,
Sediments Sampling and
Fish Sampling Work Plan and
Quality Assurance Project Plan
For the Industri-Plex Site
Woburn, Massachusetts**

Prepared For:

**Industri-Plex Site
Remedial Trust**

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1.0 PROJECT DESCRIPTION

This "Toxicological Surface Water, Sediment, and Fish Sampling Work Plan and Quality Assurance Project Plan for the Industri-Plex Site, Woburn, Massachusetts" has been prepared as part of a planned sampling program for the Halls Brook Holding Area (HBHA) and other water bodies near the Industri-Plex Site (Site) in Woburn, Massachusetts. The purpose of this Work Plan/Quality Assurance Project Plan, termed "QAPP" throughout this document, is to ensure that all sample collection and data generation activities associated with Ecological and Human Health Risk Assessment Work Plans yield data that are of acceptable quality for their intended use. To eliminate the duplication of information, and for ease of review, the required components of the Field Sampling Plan have been incorporated into the QAPP in Section 4. This format was agreed upon with Joe LeMay, the Remedial Project Manager (RPM) for the U.S. Environmental Protection Agency (USEPA).

The purpose of the sampling and analysis activities, supported by this QAPP, is to fill data gaps of previous investigations and to augment existing data for use in the ecological and human health risk assessments. In particular, USEPA raised a number of questions related to the design, implementation, and interpretation of past ecological studies and the ecological risk assessment performed as part of the Ground-Water/Surface-Water Investigation Plan (GSIP) Phase 2 Remedial Investigation (RI). These questions led eventually to a request for additional work and this project. The project has evolved over the past several months through discussions with USEPA. However, the primary tasks to be accomplished were set forth by USEPA in Section 2.3.1 and 2.3.2 of the final Groundwater/Surface water Investigation Plan (GSIP) Statement of Work issued by the Agency on August 25, 1998. Sections 2.3.1 and 2.3.2 are included below:

Section 2.3.1 Toxicological Surface Water and Sediment Sampling (extracted from USEPA August 25, 1998 letter)

EPA is requiring that comprehensive sediment and surface water toxicity data be collected for the site to properly assess ecological impacts related to site-related contaminated sediments and surface water. EPA's triad sediment sampling analysis approach shall be applied for each of the thirteen sediment samples collected from locations shown on Figure 5. Analytical parameters for sediment samples will be VOCs, metals, and SVOCs, as well as PCBs and pesticides. In addition, macro-invertebrate samples shall be collected at each of these sediment locations and analyzed qualitatively for species and quantitatively for contaminant concentrations. Qualitative analysis will identify type of organisms/species, and number of organisms/species at each of the 13 sediment sample locations. Quantitative benthic analysis will also be conducted at each of the 13 sediment sampling locations, and analyzed for metals at a experienced, certified laboratory. Acute and chronic toxicity testing will be performed on Hyalella and chironomids as the indicator species at each of the 13 sediment-sampling locations. A copy of the chronic toxicity Standard Operating Procedures for Hyalella is attached. The data collected will be applied to

human health and ecological risk assessments, and utilized in food chain models to evaluate the impact to the mallard duck.

Section 2.3.2 Fish Sampling (extracted from the USEPA's August 25, 1998 letter)

Additional fish samples shall be collected to further evaluate the impacts to fish from the site-related contaminants qualitatively and quantitatively. Previous fish sampling activities have illustrated a depleted fish population in the HBHA Pond. This depletion appears to be associated with the presence of site related contaminants in the HBHA Pond and contaminant plume discharges into the HBHA Pond. This additional sampling will be conducted in four ponds near the Site (two downgradient and two upgradient) and the data will be applied to the human health and ecological risk assessments. These Ponds are identified as North Pond, Phillips Pond, HBHA Pond, and HBHA Wetland pond 3 at Mishawum Road. See figure 5 for fish sampling locations.

The fish samples collected at the reference stations should reflect species collected at the downgradient ponds (HBHA Pond and HBHA Wetland Pond 3). Therefore, fish should be collected from the downgradient ponds first. All fish sampling activities shall comply with EPA's Guidelines for Fish Tissue Preparation and Analyses" (1995). If possible, a minimum of five fish from each of three trophic species (predator, forager, and bottom feeder) should be collected. The variety of species should be representative of different trophic levels. Prior to preparing the fish for tissue analysis, the fish will be examined for histological effects from potential contaminant exposure. The USFWS, with assistance from the Contractor, will collect the fish species, and assist in documenting qualitative fish observations (species; number of fish collected of each species; age; length; weight; visual observation, such as tumors, sores, lesions, etc; fish collecting technique; other environmental observations surrounding sampling area; etc.). Documentation will also include photographing the fish species. A log will be kept by the USFWS and the Contractor to document these observations. The Contractor shall quantitatively prepare the fish for laboratory analysis. The fish will be analyzed for tissue analysis as follows:

*Small fish: analyze whole fish for metals
Medium fish: analyze offal and fillet for metals
Large fish: analyze target organs (liver and kidneys) for metals*

Some modifications of this scope have occurred through discussions with the USEPA and as a result of a Reconnaissance Survey conducted in April 1999 (see Section 4 and Appendix A). This work is being performed for the Industri-Plex Site Remedial Trust (ISRT) under the direction of USEPA Region I.

4.0 ECOLOGICAL ASSESSMENT FIELD SAMPLING PLAN

4.1 Study Area

The study area includes the HBHA Pond, HBHA Wetlands, a segment of the Aberjona River downstream of Mishawum Road, and several water bodies that will serve as Reference Locations for the study (Halls Brook, Northern Branch of the Aberjona River, Phillips Pond, and North Pond.) The water body referred to, as South Pond is located just north of the berm that forms the northern boundary of the Site (Figure 4-1).

The HBHA Pond is characterized by a relatively narrow and flat littoral zone (typically less than three feet deep) along the western, northern, and southern edges of the pond. In some places this littoral "lip" extends to a few feet from shore while in others (e.g., along the western shore) it extend to approximately 40 feet. Most of the pond consists of a dug basin with depths of 8 to 15 feet. The demarcation between the shallow littoral lip and deep basin is sharp and occurs over horizontal distances of a few feet. The deeper locations of HBHA Pond have been observed to stratify vertically, and anoxic conditions can develop beneath the thermocline. At such times, animals that require oxygen (e.g., fish and benthic invertebrates) cannot make use of this zone as habitat. The HBHA Pond and HBHA Wetlands are separated from the downstream portion of the Aberjona watershed by a weir at Mishawum Road. Therefore, the HBHA Pond and HBHA Wetlands can be considered a small-scale pond/wetland system. HBHA Pond is 4.2 acres in size. Vegetation occurs along the banks of the HBHA Pond and HBHA Wetlands and these bordering areas are known to support birds and some wildlife.

4.2 Field Sampling Rationale and Sampling Locations

The plan for sampling to support the risk assessments (ERA and HERA) is based on the August 25, 1998 letter from the USEPA, discussions that have occurred among scientists and managers at the U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), and representatives for the ISRT including its consultant Menzie-Cura & Associates. A number of questions and issues raised during these discussions were addressed by conducting an Ecological Reconnaissance Field Survey (Reconnaissance Survey) in April 1999. The USEPA is also checking the physical characteristics of certain potential sediment sampling locations and this information will be used to finalize the locations. The Main Sampling Program is planned for June 14 – June 23 1999.

Table 4-1 lists the sample locations for the 13 sampling stations. Tables 4-2 through 4-9 list number of samples, sample preservation, containers and holding times for all media and all analyses. Table 4-10 lists the sample preservation, container, and holding time requirements for the field and trip blanks.

4.2.1 Reconnaissance Survey Objectives and Results

The Reconnaissance Survey was performed on April 29-30, 1999. The objectives of the Survey were to:

1. Select a downstream sampling location in the Aberjona River that exhibited depositional characteristics;
2. Visit potential Reference Locations and select locations appropriate for comparison to Halls Brook Holding Area (HBHA) and HBHA Downstream locations (including Ponds 1-3);
3. Field-test sediment sampling equipment to determine what will be needed for the main sampling event;
4. Field-test de-watering methods for sediment sample collection;
5. Evaluate modifications of analytical methods including the use of freeze-drying techniques; and
6. Qualitatively evaluate biological conditions and physical habitat structure with respect to the collection of benthic invertebrates (for assessment and for tissue analysis), emergent and submergent vegetation (for tissue analysis), and fish (for assessment and tissue analysis).

In addition to the above objectives, USEPA personnel collected sediment for the analysis of acid volatile sulfides and simultaneously extracted metals (AVS/SEM). Personnel from the US Fish and Wildlife Service (USFWS) and the National Oceanographic and Atmospheric Administration (NOAA) examined sites for electroshocker boat access and for use as fish Reference Locations.

Sediments collected from each of the 13 locations were sampled for physical parameters including total organic carbon (TOC), percent solids, and grain size distribution. These collections were made to obtain information for judging the comparability of stations. In particular, the information is used to establish whether stations are depositional (i.e., characterized by higher percentages of silt and clay as well as total organic carbon.) These analyses are also used to evaluate the relative effectiveness of de-watering in the field and freeze drying for increasing solids content of sediments; this was identified as an important issue for achieving adequate detection levels.

Sediments from two locations, HBHA Pond Deep and SD-3, were collected in duplicate for chemical analysis including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, PCBs, and metals (including arsenic species III and V). These collections were made to evaluate proposed modifications to analytical methods and to evaluate the effect of freeze drying on chemical analytes.

Sediment sample aliquots were split for freeze-drying preparation to compare the accuracy of the methods for analysis of these chemicals from freeze-dried sediment vs. non-freeze dried sediments. The goal of the freeze-drying protocol is to elevate the percent solids of the samples, without altering the chemistry, and therefore improve the achievable sediment reporting limits on a dry-weight basis.

For VOCs, both low-level (sodium bisulfate preserved) and high-level (methanol preserved) sediment samples were collected to evaluate the method 5035 options for these sediments in meeting the project DQOs. Additionally, a low-level modification (5ml VOA-free water preserved) was performed.

The analytical and observational results of the Survey are provided in Appendix A. Information from the survey is incorporated into the planning of the Main Sampling Program and is included as part of the rationale sections for certain elements of the program. Chemical results from the analytical laboratory were provided to the USEPA Region I, RPM and QAO for review and comment.

4.2.2 Main Sampling Program

The Main Sampling Program is scheduled for June 14 – 23, 1999 and consists of:

- Collection of sediment samples at 13 locations for chemical and physical analyses for use in the Ecological Risk Assessment (ERA) and as part of the sediment triad approach;
- Collection of sediment samples at 13 locations for sediment toxicity tests for use in the ERA and as part of the sediment triad approach;
- Collection of benthic invertebrates at 13 locations for analysis of community structure for use in the ERA and as part of the sediment triad approach;
- Collection of benthic invertebrates for chemical analyses of tissues for use in assessing effects on these organisms and in the food chain models used in the ERA;
- Collection of surface water samples at 13 locations. Three of these locations are deep (> 8') and surface and deeper water samples (above the bottom) will be sampled. This yields 16 water samples for chemical analysis for use in the ERA and to evaluate the source of arsenic (i.e., by examining speciation of arsenic);
- Collection of fish samples for chemical analysis for use in the ERA and for the Human Health Risk Assessment (HERA);
- Observations on the fish community and their habitat for use in the ERA

- Collection of vegetation for chemical analysis for use in bird and mammal food chain models used in the ERA;

All of the above sampling and analysis activities will be performed under the direction of Menzie-Cura and Associates, with the exception of the fish sampling which will be performed by USFWS. Menzie-Cura and USFWS will coordinate during this activity and Menzie-Cura will select fish for tissue analyses. The selection of these fish will be guided by discussions between USFWS, USEPA, and Menzie-Cura. USEPA will also participate in various sampling activities and will provide on-site Agency oversight. USEPA and Menzie-Cura will perform evaluations of benthic habitats. The USFWS will evaluate the habitat for sustainability of fish.

The type (media) of samples to be collected and the chemical, physical, and toxicity analyses to be performed in support of the Main Sampling Program for this Industri-Plex Site investigation are summarized in Section 1, Tables 1-2 through 1-4.

Types and frequencies of field quality control (QC) samples, including Field Duplicates, Field Rinsate Blanks and sample volumes for matrix QC (MS/MSD/MD) are described in Section 3 of this QAPP. Analytical methods to be used for analyses are presented in Section 7 of this QAPP.

4.2.3 Sample Locations

Sample locations for the Main Sampling program are listed in Table 4-1 and shown on Figure 4-1. These locations were initially identified by USEPA and confirmed during the Reconnaissance Survey (Appendix A). Navigational coordinates for all sampling locations are established in the field using a Geographical Positioning System (GPS) as well as by line-of-sight.

Table 4-1. Locations of the 13 Sampling Stations for Surface Water and Sediment

Location	Longitude (from GPS)	Latitude (from GPS)
SD-01 (S. Branch of Aberjona east of Acadia St.)	71 07 24.0538 W	42 31 44.5577 N
SD-02 (South Pond)	71 08.6546 W	42 31.3426N
SD-03 (Phillips Pond)	71 07.9605 W	42 31.0135 N
SD-04 (Halls Brook Reference Location)	71 08 52.727023489 W	42 30 47.270006017 N
SD-05 (deep station at northern end of HBHA Pond)	71 08 28.291937546 W	42 30 46.710953435 N
SD-06 (west side of HBHA Pond, below Halls Brook)	71 08.4734 W	42 30.7551 N
SD-07 (deep station at southern end of HBHA Pond)	71 08.4254 W	42 30.6925 N
SD-08 (Stream segment in HBHA Wetland)	71 08 18.404373293 W	42 30 31.545846368 N
SD-09 (HBHA Wetland Pond #1)	71 08.3002 W	42 30.4131 N
SD-10 (stream segment in HBHA Wetland)	71 08.2272 W	42 30.2839 N
SD-11 (Pond 3 in HBHA Downstream)	71 08 07.044307109 W	42 30 14.902602803 N
SD-12 (Halls Brook Reference Location upstream of SD-04)	71 08.9418 W	42 30.7507 N
SD-13 (Aberjona north of Olympia)	71 08 03.409536975 W	42 29 57.463215787 N

Based on the results of the Reconnaissance Survey, several potential sampling locations were found to be non-depositional. During conversations with Joe LeMay and Patti Tyler of USEPA in May and early June, options for re-allocation of these stations were discussed. The Agency is also checking the physical characteristics of sediments at a few locations in Halls Brook, Phillips Pond and HBHA to help reach a final decision about sample locations. The current strategy and options for establishing the remaining stations are as follows.

1. Because the Reconnaissance Survey indicated that shallow locations in HBHA Pond (< 3' depth) are relatively sandy and non-depositional, the Agency has decided that there should be two deep locations and one shallow location (rather than two shallow and one deep location as initially proposed). Station SD-5 was established as a deep location during the Reconnaissance Survey. The second deep location will be identified as SD-6 and is established at the southern (down current) end of HBHA Pond in a deeper location of the pond as indicated by a bathymetric map of the pond. Water depths in this general area were checked during the Reconnaissance Survey and found to be approximately 12'. Sediments at this location are known to be depositional "soupy mud".
2. A shallow station (SD-7) will be established in HBHA Pond following USEPA's sediment survey.
3. Two locations in HBHA downstream (SD-8 and SD-10) are located in stream segments. Examination of the tentative location for SD-8 indicated that it is in a segment characterized by firm silty-sand sediment. This probably reflects the effects of faster water currents flowing over this location. USEPA requested that SD-8 and SD-10 be located in as depositional an area as possible within these stream segments. This will require additional examination of these locations and USEPA's contractor is examining these reaches for possible sampling locations. Additional data on the sediment characteristics are expected to be available from USEPA around June 9, 1999 and will be used to finalize locations for SD-8 and SD-10. USEPA will communicate this information to Menzie-Cura and will participate in the Main Sampling Program to insure that the correct locations are sampled.
4. If USEPA's examination of conditions in shallow areas of HBHA Pond and HBHA Wetland indicate that it is prudent to have a reference location that has a higher sand content, the Agency will consider the following: a) request the ISRT to consider an additional Reference Location (increasing the station number from 13 to 14), b) moving one of the non-reference stations (probably SD-12 located in the tributary to HBHA) to a Reference Location. To this end, the Agency is examining locations in Phillips Pond and Halls Brook that are less depositional.

4.3 Surface Water Sampling

4.3.1 Water Sample Collection

Surface water samples will be collected at the 13 Site locations identified in Table 4-1. Water depths at SD-1, SD-2, SD-4, SD-7, SD-8, SD-9, SD-10, SD-11, SD-12, and SD-13 are relatively shallow ranging between 0.5 and 3.5'. At these locations, a single water sample will be collected at mid-depth to represent water column conditions. Three sample locations – SD-3 in Phillips Pond and SD-5 and SD-6 in HBHA Pond – are deeper locations with water depths of 8' and greater. At these three locations a water sample will be collected at the surface and an additional water sample will be collected within 2 feet above the bottom (~ 7 - 10' water depth).

Surface water samples will be collected using the standard operating procedure, *Surface Water Sampling* (Appendix B). Water samples collected from depths of two feet and shallower will be obtained by lowering decontaminated bottles to the desired depth and allowing them to fill. Water from these bottles will be used either as samples or to fill other bottles. The mouth of the bottle will be orientated upstream to minimize the potential for contamination. If water depths are less than 0.5' (perhaps due to low water flow conditions at locations in June), samples will be collected with a decontaminated wide mouth sampling jar. A number of small samples may need to be collected in this manner and combined. Where depth permits (> 2' depth), decontaminated Niskin or Kemmerer water sample devices will be used to collect surface water samples. In all cases, the performance criteria for sampling are to collect water samples in a manner that prevents contamination from the sediments, minimizes the potential for contamination by the sampling system, and provides a representative sample of the water column. Potential contamination of surface water samples by sediments will also be minimized by either conducting all surface water sampling prior to the sediment sampling event or by performing surface water sampling prior to any sediment sampling at a location (if the sampling events are combined.) In either case, sampling will begin at the most downstream location (SD-13) and proceed upstream.

Water samples will be collected from the deep sections of the HBHA pond. These samples will be collected using a decontaminated Niskin or Kemmerer sampling device lowered to the specified depth (within 2 feet of the bottom). This is to evaluate exposure that may occur in these deeper waters and to examine the possible discharge/diffusion contributions of arsenic. Vertical variations of temperature, dissolved oxygen, and conductivity have been observed in HBHA pond indicating that this pond becomes stratified. Thus, contaminant concentrations may also vary with water depth. Arsenic speciation (as As III and As V) will be performed on the water samples collected from HBHA Pond. For comparison to a reference location, a shallow water and deep water sample will also be collected in Phillips Pond for the same analyses. This will assist in evaluating the origins of arsenic relative to surface water and future groundwater analysis, as well as specific arsenic levels for each species. Based upon previous

sampling results, USEPA expects higher arsenic concentrations to be present at depth (1-2 feet from the bottom) due to groundwater discharge, and/or desorption from sediment.

4.3.2 Water Sample Analytes, Containers, and Shipment Requirements

All surface water samples will be analyzed for VOCs, SVOCs, Pesticides, PCBs, total metals (unfiltered samples), dissolved (filtered samples), hardness, TOC, and TSS. Table 1-1 presents the chemical analytical parameters for surface water samples. Volatile organic samples will be drawn first and analyzed for VOCs. Two aliquots for all surface water samples at each location will be collected for metals so that the laboratory can filter one aliquot (through 0.45 μ m pore-size filtration unit) for analysis of dissolved metals and the other aliquot will be digested for total metals. Table 4-2 lists sample container types, preservation, and holding times for all analyses. All samples will be stored on ice, maintained at 4°C and delivered to the laboratory via courier on the same day of collection or via FedX for next day delivery.

Information on sample containers, preservation techniques, and holding times is provided in Table 4-2. Field duplicates, field blanks and MS/MSD/MD samples for QC will be collected at frequencies as described in Section 3 of this document.

4.3.3 Supporting Measurements for Surface Water Quality

At each location, the following water quality parameters will be measured in the field: dissolved oxygen, specific conductivity, temperature, pH, and turbidity. At locations with depths of less than 2', measurements will be made at mid-depth. At locations with depths of greater than 2', measurements will be made at the surface and at the bottom of the water column. At the deep sampling locations in Phillips Pond and HBHA Pond, measurements will be made at the surface, bottom, above the pycnocline/thermocline, within the pycnocline/thermocline, and below the pycnocline/thermocline. Water quality measurements will be made using a YSI 600XL meter for dissolved oxygen, specific conductivity, temperature, and pH and a Hariba turbidometer for qualitative turbidity measurements (as an indication of light penetration). Calibration of field equipment will be performed as described in Section 6 of this QAPP and U.S.EPA Region I's Draft Calibration of Field Instruments, as appropriate (Appendix A).

Table 4-2. Surface Water Samples: Number, Preservation, Container Specification, and Holding Time Requirements in Support of the Environmental Assessment.

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Semivolatile Organics	16	(2) 1-L Amber Glass Bottles	Cool, 4°C, protected from light	Extraction: within 7 days of collection Analysis: within 40 days of extraction
Metals (other than Arsenic)	16	(2) 500-ml Polyethylene Bottle's	(1) Nitric Acid, pH < 2, for total metals; Cool, 4°C (2) Unpreserved for lab-filtering/ dissolved metals	6 months 28d mercury 180 d all other metals
Arsenic -- total and species	16	(1) 500-mL Ultra-clean, polyethylene or glass bottle; bottles for collection of speciation samples will be wrapped in aluminum foil	Cool, 4°C, protected from light	48 hours
Volatile Organics	16	(3) 40-mL glass vials with Teflon-lined septum	Cool, 4°C, protected from light, HCl to pH<2	14 days
Pesticides	16	(2) 1-L Amber Glass Bottles	Cool, 4°C, protected from light	Extraction: within 7 days of collection Analysis: within 40 days of extraction
PCB Aroclors	16	(2) 1-L Amber Glass Bottles	Cool, 4°C, protected from light	Extraction: within 7 days of collection Analysis: within 40 days of extraction
Total Organic Carbon	16	(1) 500-mL or 1-L Amber Glass Bottles	Cool, 4°C, pH ≤2, sulfuric acid	28 days
Total Suspended Solids	16	(1) 500 mL or 1-L amber - glass bottle	Cool 4°C	7 days

There will be 13 surface and mid-depth samples and three deep samples for a total of 16.

4.4 Sediment Sampling

4.4.1 Sediment Sample Collection

Sediment samples will be collected at each of the 13 sediment locations listed in Table 4-1 using the Tall Eckman grab sampler. The Petite Ponar Grab sampler with sliding screens will be used as a back-up sampling device. These grab devices can be deployed safely either from small boats or by wading and were successful in sediment collection during the Reconnaissance Survey. The standard operating procedures for sediment sampling are described in the SOP, *Sampling Soft and Fine-Grained Sediments* (Appendix B). Prior to sampling at a location, the grabs and all other sampling devices such as spoons are decontaminated in accordance with the SOP, *Decontamination of Field Equipment* (Appendix B).

The goal of the sampling program is to collect representative sediment from the upper 2 inches (5-cm). This depth interval was selected as the zone most relevant to exposures of ecological receptors. Depositional sediments, characterized by clay/silt to fine sand grain sizes as identified in the Reconnaissance Survey results, will be sampled so that chemical analytical results can be compared from location to location. The sediments will be collected and analyzed for the chemicals and sediment parameters presented in the tables in Section 1 of this QAPP. It is estimated that 6 grabs will need to be collected at a location to provide sufficient sample volume for all the chemical analyses and for the toxicity tests. Samples for VOCs and SEM/AVS will be obtained from the first grab. All other samples will be drawn from a composite made up of the upper 2 inches of sediment from the six grabs.

Collection of VOC Samples

VOC samples for sediments will be collected directly from the sampling device for the first grab taken at a location. The sample will be collected using a syringe and placed in the "low-level" prepared VOC sample container (see Table 4-3). Both the Eckman and Petite Ponar Grabs with sliding screens permit direct access of surface sediment. This makes it possible to collect a VOC sample from the upper 2 inches prior to removing sediment from the grab.

Collection of SEM/AVS Samples

Samples for SEM/AVS will also be collected directly from the sampling device for the first grab taken at a location. This sample will be obtained using a stainless steel spoon or scoop. The SEM/AVS sample bottles provided by the laboratory will be filled completely.

Table 4-3. Sediment Samples: Number, Preservation, Container Specification, and Holding Time Requirements in Support of the Environmental Assessment

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Semivolatile Organics	13	(1) 4-ounce glass jar	Cool, 4°C, protected from light	Extraction: within 14 days of collection Analysis: within 40 days of extraction
Metals	13	(1) 4-ounce glass jar	Cool, 4°C	28d mercury, 180 d all other metals
Volatile Organics – Low Level Analysis	13	(3) 40-mL glass vials	5mL Organic-free water, teflon-coated stir bar, Cool, 4°C, protected from light	7 days
Volatile Organics – High Level Analysis	13	(1) 120-mL wide mouth glass jar	30-mL purge-and-trap grade Methanol, Cool, 4°C, protected from light	14 days
Pesticides	13	(1) 4-ounce glass jar	Cool, 4°C, protected from light	Extraction: within 14 days of collection Analysis: within 40 days of extraction
PCB Aroclors	13	(1) 4-ounce glass jar	Cool, 4°C, protected from light	Extraction: within 14 days of collection Analysis: within 40 days of extraction
AVS/SEM	13	(1) 4-ounce glass jar	Cool, 4°C, protected from light	21 days
Total Organic Carbon (TOC)	13	(1) 4-ounce glass jar	Cool, 4°C	28 days
Grain Size	13	Shelby Tubes or zip-lock bag	Cool, 4°C	NA

NA = Not Applicable

Collection of Other Physical and Chemical Samples

For all other parameters, the upper 2 inches of sediment will be removed from the grab and homogenized in a stainless steel bowl using a stainless steel spoon or scoop. Sufficient sediment will be collected (estimated to require 6 grabs) and mixed in the bowl so that subsamples can be taken for chemical analysis, physical analysis, and sediment toxicity testing. Each of these subsamples will be taken using either a stainless steel spoon or syringe. Each bottle will be labeled to identify sample location, analysis required, date, and the initials of the collector. All of these samples will be kept on ice within coolers and delivered to the appropriate laboratory within 24 hrs.

4.4.2 Sediment Sample Analytes, Containers, and Shipment Requirements

Required sample sizes are listed in Table 4-3 along with sample container types, preservation, and holding times. Sediment samples will be analyzed for VOCs, SVOCs, PCBs, pesticides, metals, AVS/SEM, arsenic speciation (for SD-3, SD-5, and SD-6), total organic carbon, and grain size using methods listed in Section 7 of this QAPP. Field QC samples, including field duplicates, field rinsate blanks and trip blanks, and matrix QC, described in Section 3 of this QAPP.

4.5 Benthic Invertebrate Sample Collection

Benthic invertebrates will be collected for tissue analyses of chemicals and to evaluate the composition and abundance of the benthic community. Information on tissue analyses will be used to evaluate potential effects on benthic invertebrate communities and to support food-chain modeling. Information on the composition and abundance of benthic invertebrates will be used to evaluate potential effects on the benthic invertebrate community.

4.5.1 Benthic Invertebrate Collection for Tissue Analysis

The goal of the sampling effort will be to obtain sufficient benthic invertebrate biomass for tissue analyses of chemicals at each of the 13 sampling locations listed in Table 4-1. It is recognized that this goal may be difficult to achieve and an approach has been developed to guide these sampling efforts. Part of this approach involves setting priorities for analysis with respect to analytes and with regard to the types of invertebrates.

USEPA and the ISRT have prioritized the analyses as follows: 1) all invertebrate samples will be analyzed for metals; 2) if sufficient additional sample is obtained, analysis will also be conducted for PAH compounds; 3) if sufficient extract is obtained for organic chemical analysis, the extract will be stored for possible future analysis of pesticides/PCBs.

During the Reconnaissance Survey in April 1999, amphipods were the most common benthic invertebrates observed and easily recognizable at most stations in the Aberjona River system. This group of organisms is important in the diet of many fish and wildlife species and is, therefore, a good candidate for collection and analysis of tissues if

sufficient sample amounts can be obtained. In softer sediments, chironomid insect larvae are likely to predominate.

During a conference call on May 21, 1999 with Joe LeMay and Patti Tyler of USEPA, a preference was expressed for collection of benthic invertebrate species at all locations and that amphipods and/or chironomid insect larvae should be favored as the benthic invertebrates of choice for collection. A key sampling issue is the level of effort required to achieve adequate sample sizes for tissue analysis. A subsequent call on June 2, 1999 helped finalize this aspect of the sampling design.

Based on the Reconnaissance Survey and discussions with Joe LeMay and Patti Tyler, the following approach was defined for collection of benthic invertebrates for tissue analysis.

The sample team dedicated to this effort will consist of at three to four people per sample location. At all stream sediment locations and in the shallow station of HBHA Pond amphipods and chironomids will be collected. These taxa will be kept separate. All amphipods will be placed in one jar and all chironomids in another. The goal will be to collect sufficient amounts of amphipods and/or chironomids at all stations. Once the samples have been collected, the results of the collections will be discussed with USEPA and decisions made concerning how to proceed with the analysis. If adequate sample is obtained for a particular taxon (e.g., chironomid larvae) at all or most stations, then analysis will focus on that taxon. If sample sizes are small (e.g., less than 1 g for individual taxa), then the option of combining taxa will be considered. Stream samples will be collected for tissue analysis using a combination of kick nets and sediment grabs. A special sediment-sieving device with an extra large screen and running water has been built to support this sampling effort. The laboratory requires a minimum of 1 g per sample for metals and an additional 1 to 2 g for PAHs, pesticides, and PCBs. Additional sample would be needed to perform project-defined matrix QC including matrix spike and duplicate analyses (see Section 3 of this QAPP). On this basis, a minimum of 1 g wet weight of invertebrates (sufficient to support metals analysis, identified by USEPA and ISRT as the priority for this effort), will be collected per location for metals analysis and up to 5 g to support other analyses, if adequate tissue can be obtained. The number of organisms required to achieve sufficient sample size will depend on the size of the organism. Sample size requirements have been calculated for a range of body lengths that may be encountered and two sets of length to width ratios considered representative of the species expected (Table 4-4). These estimates will be used by the field collection team to estimate sample size requirements. This method will be simpler to implement than in-field weighing because a considerable amount of water as well as debris adheres to the animals when they are picked and sorted from the sample.

Table 4-4. Estimating Sample Size Requirements for Obtaining Sufficient Biomass for Tissue Analysis.

Body Length (cm)	Length:Width Ratio	Sample Requirements (# of organisms) to Achieve Specified Biomass Levels ^a		
		1 g	2 g	5 g
0.5	10	863	1725	4313
1	10	108	216	539
2	10	13	27	67
3	10	4	8	20
0.5	5	216	431	1078
1	5	27	54	135
2	5	3	7	17
3	5	1	2	5

a. The estimates assume a cylindrical body shape and a specific gravity of 1.1 g/cm³

Many of the amphipods and chironomids observed during the Field Reconnaissance Survey were small (~ 1 cm) and had length:width ratios between 5 to 1 and 10 to 1. It is estimated that up to 200 benthic invertebrate organisms may be needed to achieve approximately 2-g wet weight of tissue. Actual collection needs will be judged in the field using the information provided in Table 4-4 and by making length and width measurements representative of the organisms being collected. This information will provide the basis for estimating the number of animals that need to be obtained to achieve between 2 and 5g of organisms (preferably amphipods) per location.

At all pond locations, grab samplers will be used to collect the amphipods and/or chironomid insect larvae. As with the stream samples, both amphipods and chironomids will be collected and kept separately. A field decision will be made in consultation with the USEPA representative concerning which group of organisms to use for tissue analysis. This judgment will also be documented in the Field Log.

The following scheme will be used to achieve benthic invertebrate sample size requirements within a "reasonable period of time" during the Main Sampling Program.

- Judgments concerning the abundance of invertebrates at a location will initially be made using grab samples and/or kick net samples. A minimum of five grabs and/or kick net samples will be collected at each location and an effort of 45 minutes to an hour will be expended. This allocation of time is for sampling and sorting and does not include travel and set up time.
- If this initial sampling effort yields less than 0.25 g (based on sizes and numbers of animals), sampling for benthic invertebrates will cease because

the location would be unlikely to yield the sample-size requirement of at least 1-g of organisms within a "reasonable period of time." For these locations, the invertebrate sampling effort will be reallocated to epiphytic invertebrates.

- If this initial sampling effort yields 0.25 g or more organisms, then the collection will continue for an additional two hours and/or until an estimated 5 g of organisms are collected, whichever occurs first.
- The decision to reallocate sampling effort or to consider a sampling location complete will be made in the field after consultation with and concurrence from the USEPA representative.
- After the collection is complete at a location, the samples will be washed and rinsed with site surface water to help remove debris. The sample will be stored on ice in surface water and washed again at the end of the day's sampling effort.
- Invertebrates (amphipods or chironomids) will be analyzed for metals and, if adequate additional sample size is available, for PAHs. Additional material will be stored frozen.
- Because of expected low abundance of invertebrates at some stations, sample sizes after 3 hours of collection effort may range between 1 and 2 g wet weight. The chain-of-custody will include specific directions to the laboratory in such cases of limited sample sizes. These directions will be: 1) analyzed for metals; and 2) batch the preparation of limited sample size benthic invertebrates with samples of adequate mass so that appropriate project-specific matrix QC can be performed on another benthic sample in the same batch.
- At locations where the collection of adequate sample sizes of benthic invertebrates is judged to take longer than three hours, the sampling effort will be reallocated to provide information on collection of epiphytic invertebrates. These invertebrates include chironomid insect larvae and amphipods that live on plants as well as on the surface of sediments and other substrates. These animals are typically exposed to the water column as well as re-suspended surface sediments. Importantly, these invertebrates include those that are eaten by the mallard, a wildlife species that will be evaluated in the ERA.
- Based on field observations during the Reconnaissance Survey, it is possible that few benthic invertebrates will be found at the HBHA Pond Deep sampling locations such as SD-6 and possibly at Phillips and North Pond locations as well. These may be locations where benthic invertebrate sampling could be reallocated to sampling epiphytic invertebrates.
- Field decisions concerning whether or how to reallocate sampling effort will be made based on discussions with the USEPA representative will require

concurrence of the USEPA representative and will be documented in the Field Sampling Log.

- If epiphytic samples are collected, it appears reasonable that benthic invertebrates may be found along the root system and roots system/surface water interface. Therefore, epiphytic vegetation will be collected in its entirety. Benthic organisms will be removed from the epiphytic roots and included for analysis.

Invertebrates living on plants will be collected for tissue analysis of chemicals for locations at which sufficient biomass of invertebrates living within sediments can not be obtained. The reallocation of sampling and analytical effort from sediment invertebrates to epiphytic invertebrates will be decided in the field and will be based on discussions between Project Field Manager for Menzie-Cura and the USEPA representative. Epiphytic samples will be collected by cutting submerged aquatic vegetation above the root system and washing the organisms off the plants and onto sieves. These will be processed as described above for benthic invertebrates.

Samples of benthic or epiphytic invertebrates for tissue analysis will be placed in ziplock bags or glass jars and stored on ice for overnight courier shipment to the analytical laboratory. Information recorded in field logs and/or the chain-of-custody for benthic invertebrates samples will include: the client, site name, Sample Identification Number, sampling location, physical characteristics of the sampling station, estimated weight of the sample, date and time, and names of field personnel. Subsequent processing of the sample will be completed at the laboratory.

Information on sample containers, preservation, and holding times are provided in Table 4-5. Analytical methods and detection limits for tissue analyses are presented in Section 7 of this QAPP. Collection locations are listed in Table 4-1.

Table 4-5. Benthic Tissue Analysis Samples: Number, Sample Preservation, Container Specification, and Holding Time Requirements In Support of the Environmental Assessment

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time*
Metals	13 benthic or epiphytic	1-L Amber Glass Bottles or Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	28 d mercury, 180 d all other metals
Semivolatile Organics (PAHs)	13 benthic or epiphytic (if sufficient biomass is collected)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen <10°C	Extraction: 1 year frozen, within 14 days of thawing Analysis: within 40 days of extraction
Pesticides	13 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C, protected from light; store frozen <10°C	Extraction: 1 year frozen, within 14 days of thawing Analysis: within 40 days of extraction
PCB Aroclors	13 benthic or epiphytic (held for possible future analysis)	Same as above for delivery to the lab	Cool, 4°C shipment, stored at < -10°C, protected from light	Extraction: 1 year frozen, within 14 days of thawing Analysis: within 40 days of extraction

*Note: Holding times start from when sample is thawed.

4.5.2 Benthic Invertebrate Collection for Community Evaluation

The analysis of benthic community structure (e.g. diversity and abundance of benthic invertebrates) will be used to support the assessment of possible effects on benthic invertebrates. The data will be analyzed for taxa richness, abundance, percent dominant taxon/taxa, and community composition (see Section 7 of QAPP).

At each of the 13 locations described in Table 4-1, benthic invertebrates will be collected with an Eckman or petite ponar grab using techniques described in the standard operating procedure, *Collection of Benthic Invertebrates with a Grab Sampler* (Appendix B). Three samples will be collected from each location and analyzed separately to provide a measure of within-station variability. This will yield 13 locations x 3 grabs/location = 39 samples.

Each invertebrate benthic sample will be washed in the field through a 0.5-mm mesh sieve, placed into 1-liter plastic jars, and preserved with isopropyl alcohol (Table 4-6). A sample-washing device has been constructed for the project. The device is designed to provide running water to help wash the samples.

Table 4-6. Samples for Analysis of Benthic Invertebrate Composition and Abundance: Number, Sample Preservation, Container Specification, and Holding Time Requirements In Support of the Environmental Assessment.

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Benthic invertebrates	39 (13 stations x 3 samples)	1 liter plastic jars	Isopropyl alcohol	NA

4.5.3 Assessment of Habitat Conditions at Benthic Sampling Locations

Habitat conditions at each of the 13 sample locations will be evaluated in the field and by several of the analytical measurements made in the laboratory. At each station the following will be determined: physical characteristics of sediments (field observations and grain size analysis), organic content of sediments (field observations on the nature of the sediments and laboratory measurements of total organic carbon), water depth, stream flow velocity (estimated in the field), width of water body, characteristics of shoreline, bordering vegetation, extent of overhanging vegetation. Observations for the Habitat Assessment will be guided by the *Habitat Assessment Field Data Sheet-Low gradient Streams, USEPA Rapid Bioassessment Protocols, 1989*.

4.6 Sediment Toxicity Tests

Samples for the sediment toxicity tests will be taken from the same homogenized composite sediment sample that is collected at each of the 13 sediment locations (Table 4-1) for chemical and physical analyses. This homogenized sample will consist of the upper 2 inches of sediment from 6 grabs. A clean scoop will be used to transfer the sediment sample from the mixing bowl to the sample container. Unrepresentative material (e.g., stones, wood chips) will be removed from the sample at the discretion of the field sampler and will be documented in the field log. Approximately 3.5 liters of sediment per location will be collected and placed into clean wide mouth glass jars, labeled, and placed on ice in a cooler. Samples will be provided to the laboratory within 24 hrs. At the laboratory, sediment samples for toxicity testing will be refrigerated to 4°C and protected from light prior to use in testing to maintain the integrity of the original sediment.

The sediment toxicity tests will be used to evaluate whether chemicals in sediments within HBHA pond and HBHA wetland are toxic to benthic invertebrates. Acute toxicity tests will be conducted at all 13 sampling locations with the amphipod *Hyallela* and the insect larvae *Chironomus* in accordance with analytical methods presented in Section 7 of this QAPP and Appendix B. Tests of reference sediments will be initiated first. It is anticipated that these sediments will not be acutely toxic and will proceed to chronic testing. A Reference Location will not proceed to a chronic test only if toxicity is substantial (> 75%) and significantly greater less than the control sediment. For stations in HBHA and downstream locations, acute toxicity results will be compared to both the Reference Locations and the control sediments. If acute toxicity for HBHA and downstream locations is significantly greater than that in the Reference Locations and the control sediments, then it will be concluded that the sediments are toxic to benthic invertebrates and chronic tests are not needed to confirm the finding. At no time will the integrity of the testing program be put in jeopardy. Therefore, if there is a question concerning the need for a chronic test, that test will be performed. The sequential testing (acute followed by chronic) will eliminate the need to set up and run long-term tests for sediments in which the organisms can not survive. The chronic test methods are described in Section 7 and Appendix B. Numbers, preservation, and containers are summarized in Table 4-7.

Table 4-7. Samples for Toxicity Tests: Number, Preservation, Container Specification, and Holding Time Requirements in Support of the Environmental Assessment.

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Chironomus acute test	13	(1) wide-mouth glass jar, pre-cleaned, capacity of 1.25 L of sediment	Cool, 4°C	14 day holding time
Chironomus chronic test	13	(1) wide-mouth glass jar, pre-cleaned, capacity of 1.25 L of sediment	Cool, 4°C	14 day holding time
Amphipod acute test	13	(1) wide-mouth glass jar, pre-cleaned, capacity of 1.25 L of sediment	Cool, 4°C	14 day holding time
Amphipod chronic test	13	(1) wide-mouth glass jar, pre-cleaned, capacity of 1.25 L of sediment	Cool, 4°C	14 day holding time

4.7 Vegetation Sample Collection

Plant species to be collected for chemical analysis include the cattail (*Typha latifolia*) as emergent vegetation and submergent vegetation such as pondweed (*Potamogeton* sp.) or coontail (*Ceratophyllum*). Each plant sample used for tissue analysis will consist of a single species. Plants can uptake chemicals in sediments to different degrees and a composite sample of more than one species could confound interpretation of the results. Submergent vegetation shall be evaluated in the field during fishing and sediment sampling activities. If no submergent vegetation is present at HBHA Pond, submergent vegetation will be collected either at Pond 1 (SD-09), or downgradient of HBHA Pond at SD-08.

4.7.1 Collection of Emergent Vegetation

During the Reconnaissance Survey, the emergent cattail species *Typha latifolia* was observed both in HBHA wetlands and in the Reference Ponds (Phillips and North). In follow-up discussions with Joe LeMay and Patti Tyler of USEPA, it was agreed that this species would be the target species for emergent vegetation because it is known to be favored as food by muskrat, the predominant aquatic mammal in HBHA wetlands. Samples will be obtained by digging up individual plants with a trowel. The roots below the plant/soil interface will be cut off, washed free of sediment and/or soil and kept to form the required sample. Lower stems (1-foot length) above the roots will also be cut off and kept as a sample. Samples will be placed in ziplock bags, labeled, and kept on ice for shipment to the laboratory. The collection strategy of sampling roots and lower stems separately is based on the feeding habits of muskrat that are known to eat the roots and/or lower stems of cattails. It also reflects the possibility that metals may differ in concentration between the roots and lower stems.

Each composite sample of cattail roots or lower stems will consist of five plants. Composite samples will be collected in each of the following locations if plants are available: HBHA Pond, HBHA Wetland Pond #1, and HBHA Pond #3. During the Reconnaissance Survey, cattails were observed in HBHA Wetland Ponds #1 and #3 but were not observed in HBHA Pond. If, during the Main Sampling Program, cattails are not observed in HBHA Pond, the next most downstream stand of cattails will be chosen for sampling (perhaps from the stream segment between HBHA Pond and Wetland Pond #1). This yields a total of 3 locations x 2 composites/location x 2 parts of plants (roots and lower stems) = 12 composite samples for HBHA Pond and wetlands.

Two composite samples of five plants each will also be collected from each of the two Reference Locations: Phillips Pond and North Pond for a total of 2 locations x 2 composites/location x 2 parts of plants (roots and lower stems) = 8 composite samples for emergent vegetation. The collections and analyses are summarized in Table 4-8.

4.7.2 Collection of Submergent Vegetation

Submerged aquatic plants are used as food by many species of aquatic birds and mammals. Some species favor eating roots while others feed on stems and leaves. Some species eat entire plants. In addition, submerged aquatic plants can take up chemicals either through the roots or through the leaves and stems. For these reasons, it is important to measure chemical concentrations in roots and leaves/stems.

During the Reconnaissance Survey a variety of submerged aquatic plants was observed. However, based on limited observations in April 1999, the species of plants differ among ponds. The plan for collection of plants is to first collect from the HBHA to determine the plant species to be sought in the Reference Ponds. Preference will be given to the most common species present in a particular pond. Ideally, this would be the same species for all ponds. However, field observations indicate that species may be restricted to particular locations. For example a monospecific stand of *Ceratophyllum* was observed in North Pond during the Reconnaissance Survey while it was not seen in HBHA. Decisions on which species to sample will be made in the field based on consultation between the Menzie-Cura Field Operations Manager and the representative from USEPA.

Samples will be obtained by digging up individual plants with a trowel. The roots below the plant/sediment interface will be cut off, washed free of sediment and kept to form the required sample. The entire plant above the roots will also be kept as a sample. Samples will be placed in ziplock bags, labeled, and kept on ice for shipment to the laboratory.

Each composite sample of roots or upper plant will consist of five plants. Composite samples will be collected in each of the following locations if plants are available: HBHA Pond, HBHA Wetland Pond #1, and HBHA Pond #3. If, during the Main Sampling Program, submerged aquatic plants are not observed in one of these locations, one of the HBHA stream locations (e.g., SD-8 or SD-10) will be used. During the Reconnaissance Survey submerged aquatic plants were observed at SD-8. This yields a total of 3 locations

x 2 composites/location x 2 parts of plants (roots and lower stems) = 12 composite samples for HBHA Pond and wetlands.

Two composite samples of five plants each will also be collected from each of the two Reference Locations: Phillips Pond and North Pond for a total of 2 locations x 2 composites/location x 2 parts of plants (roots and lower stems) = 8 composite samples for submerged aquatic vegetation. Samples will be placed in ziplock bags, labeled, and kept on ice for shipment to the laboratory. The collections and analyses are summarized in Table 4-8.

Table 4-8. Plant tissue analysis samples: Number, Sample Preservation, Container Specification, and Holding Time Requirements in Support of the Environmental Assessment.

Parameter	Number of Samples	Sample Container(s)	Preservative	Holding Time
Metals	10 composite samples of cattail roots/tubers	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	28 d mercury 180 d all other metals
Metals	10 composite samples of cattail lower stems	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	28 d mercury 180 d all other metals
Metals	10 composite samples of roots of submerged aquatic plants	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	28 d mercury 180 d all other metals
Metals	10 composite samples of leaves and stems of submerged aquatic plants	Clean Ziplock Bags	Cool, 4°C, protected from light; store frozen < -10°C	28 d mercury 180 d all other metals

4.8 Fish Sample Collection

Fish sampling will focus on four ponds: HBHA Pond, HBHA Wetland Pond #3, Phillips Pond (reference), and North Pond (reference). The goals of the fish-sampling program are to:

1. identify the composition and general abundance of fish in the ponds to determine if HBHA ponds are depauperate in species composition and or relative abundance in comparison to the Reference Ponds;
2. examine the age structure and the weight and length relationships for species in the ponds; again, comparisons will be made between the HBHA ponds and the Reference Ponds;
3. evaluate the habitat quality of the ponds with respect to supporting different fish species;
4. determine the potential of the ponds for supporting recreational fishing;
5. measure body burdens of chemicals in fish tissues for use in ERA and HERA; and,

5. examine fish for gross histopathological anomalies and compare these between HBHA Ponds and Reference Ponds.

4.8.1 Collection of Fish and Fish Habitat Assessment

U.S. Fish and Wildlife Service (USFWS) will conduct the fish-sampling program. Sampling with an electroshocker boat will be the primary sampling method. A SOP for this sampling is provided in Appendix B. Other methods that may be used by USFWS if needed include gill nets, leaded lines, trout lines, rod and reel, and traps. Sampling will be conducted in the HBHA Ponds first (HBHA Pond and Wetland Pond #3) to determine the species of fish that are present. This is most important for selecting species for tissue analyses because the Reference Pond species will be the same as the species collected in the HBHA. USFWS and Menzie-Cura have discussed the implementation of the field program and will coordinate sampling efforts in the field. A biologist working for Menzie-Cura will participate in the effort and will discuss the observations with the USFWS biologists. Menzie-Cura and USFWS will select fish from the field collections for tissue analyses. The selected fish will be weighed and measured by USFWS and their scales taken (for largemouth bass). The animals will be placed in labeled ziplock bags, placed into a second bag, and placed in a cooler with dry ice. It is anticipated that more fish than will be needed will be selected for analysis in order to insure that there are comparable species among the various sampling ponds. In other words, if there are two bottom fish species collected in HBHA Wetland Pond #3, 5 individuals of each will be kept for possible tissue analysis. The decision concerning which fish to analyze will be made after all ponds have been sampled.

The USFWS sampling protocol involves maintaining the fish alive until decisions have been made on which fish to process. USFWS will be responsible for making all observations on fish (identification, age, length, weight, and presence of gross histopathological anomalies). USFWS will record these data on data sheets and in logs. Copies of these data entries will be made available to Menzie-Cura. USFWS will remove scales from largemouth bass and selected sunfish for analysis of fish age and they will make determinations of age at their laboratory. The age of selected brown bullheads will be determined by examining spines present in the pectoral fins. The analytical USFWS will also be responsible for assessing the habitat quality of the ponds for supporting fish as well as the potential of the ponds for recreational fishing. Menzie-Cura and USEPA will participate in a discussion of these habitat features. This assessment will be qualitative and based on a combination of experience in similar water bodies, a qualitative assessment of the physical and water quality conditions provided by the habitat, and the use of a method for assessing recreational fishing potential.

Menzie-Cura and the contract laboratory – Woods Hole Group - will be responsible for obtaining tissues from the selected fish. Fish will be kept frozen until just prior to analysis. All dissections and inspections of the fish will be made at the laboratory by Dr. George Hampson, a fishery biologist with the Woods Hole Oceanographic Institute. Dr. Menzie of Menzie-Cura will coordinate with Dr. Hampson.

During the sampling program, the habitat features of each of the four ponds will be documented. Information pertinent to fish populations include: water depth, physical sediment characteristics, type and extent of submerged and emergent vegetation, area, nature of contiguous aquatic environments, general water quality conditions (dissolved oxygen, conductivity, pH, and temperature), and characteristics of shoreline. These will be documented in the field and recorded in logbooks and by using photographs and video.

USFWS will evaluate the four ponds' ability to provide a sustainable fish population that supports recreational fishing. This evaluation will be based on the results of the fish collection. For example, successful collection of adult edible fish species such as largemouth bass and yellow perch would be an indication that the Site ponds contain fish that are sought for recreational fishing. The presence of large sunfish may also indicate this potential. The USFWS plans to use the number of fish caught, species composition, and proportional stock density (PSD) to assess fish stocks. PSD is a categorization and comparison of species-specific size classes that is used to evaluate fishing potential.

4.8.2 Fish Collection for Tissue Analysis

The selection of specific fish for analysis will be based on in-field discussions between Menzie-Cura, USEPA representative, and USFWS. The selection will be made in accordance with the general criteria presented later in this section that have been developed through discussions between Menzie-Cura, USFWS, and USEPA. Menzie-Cura and Woods Hole Group will be responsible for dissecting fish to obtain tissue samples for chemical analyses. This will be conducted at the Woods Hole Group Laboratory and will be performed in accordance with the SOP provided in Appendix B.

The workplan for collecting and analyzing fish tissues for chemicals is slightly different from that described in the USEPA letter of August 25, 1998. That initial scope called for the following:

- Small fish: analyze whole fish for metals
- Medium fish: analyze offal and fillet for metals
- Large fish: analyze target organs (liver and kidneys) and fillets for metals

Instead of the designations of small, medium, and large, it is more useful to obtain fish that represent different feeding strategies (trophic levels). To support the ERA and HERA, fish from three trophic levels (forager, bottom feeder, and piscivore) will be collected from HBHA and from the Reference Ponds for tissue analyses of chemicals. Forager species such as minnows, shiners, and small sunfish, which feed primarily on invertebrates, are eaten by wildlife species and, in the case of larger sunfish, may be eaten by people. Bottom fish such as bullheads, suckers, and eels are in the most intimate contact with sediments and are therefore useful species to examine for judging potential effects of sediments. People also sometimes eat these species. Piscivorous fish such as

adult largemouth bass, yellow perch, and chain pickerel are those most likely to be eaten by humans. They are also eaten by wildlife species.

The tissues that will be analyzed also differ somewhat from that identified in the USEPA August 25, 1998 letter. The following target tissues will be analyzed:

Forager Fish:	analyze whole fish
Bottom Fish:	analyze liver, remaining offal, and fillet
Piscivorous Fish:	analyze liver, remaining offal, and fillet

The USEPA and USFWS have concurred with these tissue categories. All fish for possible analysis will be stored frozen. Following the completion of the sampling program, Menzie-Cura and USEPA will determine the specific analyses that will be performed. The following reflects the general plan and is dependent upon the types and numbers of fish that are collected.

The goal of the sampling effort is to collect at least five fish from each trophic category from each of the four ponds for tissue analysis of metals. This would yield a total of 3 trophic categories x 5 fish/category x 4 ponds = 60 fish. It is recognized that this goal may be difficult to meet because some of the trophic categories may not be present or fewer than five fish may be collected. In this case, the effort will focus on those fish that are collected within each of the target categories. If no piscivorous fish are obtained in HBHA (i.e., no adult largemouth bass, yellow perch, crappies, or chain pickerel), large individuals of sunfish species (e.g., bluegills) will be substituted for this category. This substitution is made because some people do eat these larger sunfish. If bluegill or other larger sunfish is used as a substitute for largemouth bass, then a second forager species (e.g., golden shiners) will be used as the forager species. Fish selected for tissue analyses in the Reference Ponds will be defined by what is collected within the HBHA. More fish species than needed for chemical analyses will be collected in the HBHA to help insure that there are species matches between the HBHA and Reference Ponds. The final decision on which fish to analyze will be made after the collections are complete. This decision will involve a discussion with the USFWS biologists and will take into account the criteria identified above. The decision will also be discussed with the USEPA RPM or other USEPA representative designated by the RPM.

All fish samples will be placed in ziplock bags and stored on dry ice for shipment to the analytical laboratory. A summary of collections for tissue analyses is provided in Table 4-9.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated through field activities or by the laboratories, shall be reduced, reviewed, and evaluated prior to use in the Ecological and Human Health Risk Assessments using the following procedures. Reconciliation with risk assessment requirements is described in Section 12.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field measurements for quantitative analyses include pH, temperature, specific conductance, and dissolved oxygen. Qualitative measurement of turbidity will be taken to assess light penetration. In addition, field activities include observations and sample collection information. Raw data consist of instrument responses in the form of meter, recorder, or printer output. The technician/operator performing the analysis will enter the data in a field logbook or form for each parameter. All reductions of data must follow the procedures and equations provided in the respective testing protocols (see Table 7-1). The reduction of field data will consist of summarizing the raw field data, which may be presented in the form of tables, logs, illustrations, and graphs, as deemed appropriate.

9.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures will be performed according to the following general protocols and laboratory-specific protocols as described in the laboratory QAPP. All raw analytical data will be recorded and documented using laboratory standard procedures. Laboratory data will include, at a minimum, the unique sample identification number, analytical method used, name of analyst, the date of analysis, matrix sampled, reagent and standard concentrations, and instrument settings. Periodic review of laboratory notebooks (logbooks) and data reports shall be performed by the Lab QA Manager as described in the laboratory QAPP.

Analytical results for sediment samples will be reported on a dry-weight basis. Results for tissue (biota) analyses will be reported on a wet-weight basis. QC data (e.g., laboratory duplicates, surrogates, MS/MSDs) will be compared to the acceptance criteria defined in this QAPP in Sections 3 and 7. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis. After the laboratory submits the laboratory data package to the Ecological Project Manager, the data are considered approved by the laboratory and ready for third party data review or validation.

9.2 Data Validation

All data used in the ERA and HHRA will be evaluated for usability for project goals using the procedures described in this section and in the SOP included as Appendix D.

9.2.1 Procedures Used to Validate Field Data

The procedures to evaluate field information for the Environmental Risk Assessment include checking for transcription errors and review of field logbooks for completeness and field measurements based on the criteria in Section 6 and field SOPs. Historical data from previous Site assessments may be compared to the data generated during this assessment as part of the verification process. These reviews will be performed by the Ecological Project Manager and the Chemistry QA Team.

9.2.2 Procedures Used to Validate Laboratory Data

Procedures to evaluate laboratory data are detailed in the SOP included in Appendix D, and were derived from the USEPA *Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses; Part II. Volatile/Semivolatile Data Validation Functional Guidelines* (1996), USEPA *Region I Laboratory Data Validation Functional Guidelines for Inorganic Analyses* (1989), USEPA *Guidance for Data Useability in Risk Assessment* (9285.7-09A, April 1992), and USEPA quality assurance guidance document QA/G-9. The Chemistry QA Team, New Environmental Horizons, Inc., have modified the EPA protocols to include the criteria in this project QAPP as listed in Sections 3 and 8 (see Appendix D).

Data generated from the April 20, 1999 Preliminary Reconnaissance Survey (USEPA Region I), April 29-30, 1999 Reconnaissance Survey (Menzie-Cura), and June 4, 1999 Supplemental Reconnaissance Sediment Sampling (USEPA Region I) were reviewed to make decisions about sediment sample preparation procedures and Site locations. Also, the QC data were reviewed to ensure that the methods and laboratory's performing the work are meeting the data quality objectives of this QAPP. This is a pro-active approach to generation of valid data for this program. In this way, any issues that may affect the usability or validity of the data for use in risk assessment can be uncovered and corrective actions implemented prior to the start of the Main Sampling Program.

One hundred percent of the data generated during the Main Sampling Program will be assessed for usability, completeness, and adherence to key QA/QC objectives for this project. This data assessment review will follow guidance in USEPA's *Guidance for Data Useability in Risk Assessment*, (PB9285.7-09A, April 1992) and will include a review of all technical holding times, instrument performance check sample results, initial and continuing calibration results, and all batch and matrix QC including field blanks, field duplicates, MS/MSD, matrix duplicates, surrogate recoveries, method blanks, laboratory control samples, standard

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reference material results, and the identification and quantitation of specific compounds of interest.

Data Assessment in support of Industri-Plex requires the review and evaluation of chemical data based upon EPA Region I guidance for data assessment of inorganic and organic and site-specific requirements as defined in this QAPP. The purpose of the data usability assessment is to provide information to the data users (e.g., regulators, risk assessors) of the uncertainty and bias in the data for decision making.

For the Industri-plex project, approximately 10% of the data (one data package, or SDG, per chemical fraction) will undergo the Region I Tier III-type Data Usability Review. The remainder of the data will undergo the Region I Tier II-type Data Usability Review. Data usability assessment will be performed using the project-specific protocols detailed in Appendix D and briefly summarized below.

Data Usability Review Process

A two-stage process for assessment will be performed. The first stage is equivalent to a Region I Tier III validation in scope. The laboratory will submit one full deliverable (Tier III type), including raw data, results, and QC summaries, for each type of analysis they are performing (e.g., Semivolatile Organics Compounds by Method 8270C). This data package will undergo an in-depth evaluation of all of the quality control information provided, as well as a review of the raw data on instrument calibrations, extraction procedures, qualitative and quantitative determinations to ensure that the laboratory is producing data in a manner which is compliant with the methods and with the QAPP. NEH will use a project-specific checklist to conduct the Data Usability Reviews (an example is included in Attachment A of Appendix D) and a project-specific Data Usability Summary Report (included in Attachment B of Appendix D) to document this Tier III-type data usability review. Data summary spreadsheets, with standard data qualifiers applied to the results, will also be generated, as required by the data users. This process combines the functions of third-party validation with usability assessment for a comprehensive review and evaluation of the data for risk assessment. This Tier III-type data usability review will provide a measure of "insurance" of the comparability, accuracy, precision, and sensitivity of the results for the project.

Any deficiencies in performance of the work by the laboratory that are uncovered during the Data Usability Review will quickly be brought to the laboratory's attention for corrective action. If these deficiencies prove to be major, the reviewer may request that the laboratory submit another Tier III package of data after all corrective actions have been taken to ensure the integrity of the project.

Once the first stage has been successfully completed, the second stage of the assessment process involves an abbreviated, project-specific Data Usability Checklist Review (an example is provided in Attachment C of Appendix D) which is equivalent in scope to a Region I Tier II validation. The laboratory will provide a Tier II deliverable for assessment, which includes sample results and QC summary data (but no raw data). The checklist will be used to evaluate the key data quality indicators for the samples. The data users will be provided with these Data Usability Checklists and a Data Usability Summary Report (as included in Attachment B). Data summary spreadsheets, with standard data qualifiers applied to the results, will also be generated, as required by the data users.

In addition to the precision, accuracy, and sensitivity criteria as defined in Section 3 and 8 of this QAPP, the overall completeness of the data package will also be evaluated. Completeness checks will be administered on all laboratory data packages to determine whether deliverables specified in the QAPP Section 9.3, below, are present. The reviewer will determine whether all required items are present and request copies of missing deliverables using resubmittal request documentation *via* facsimile or email. Such documentation will be included in the Data Usability Summary reports (see Appendix D).

Additionally, method detection limit studies (MDL) for all chemicals of concern in the matrices of interest will be performed by the analytical laboratory. These MDLs must support the project reporting limit requirements and have been performed within one year of the analysis of samples collected for the Environmental Risk Assessment. The laboratory shall follow the MDL procedures as outlined in the Federal Register, Vol. 49, no. 209, October 26, 1984, pp.198-199 and associated laboratory QAPP SOPs.

9.3 Data Reporting

9.3.1 Field Data Reporting

Field data reporting for measurements are described in Sections 4.0, 5.0, 6.0, and Appendix B-7 of this QAPP.

9.3.2 Laboratory Data Reporting

The Laboratory will provide at least two hard-copies of each laboratory data report, an original and a copy for the Data Usability Review, to the Ecological Project Manager. Electronic deliverables may be required for the project database. Specific formats for electronic deliverables shall be determined by the Ecological Project Manager in discussions with the analytical laboratory prior to the start of the program.

The laboratory data reports for the environmental chemical results must include the following, at a minimum:

1. Case Narrative

- Date of issuance
- Laboratory analysis performed
- Any deviations from intended analytical strategy
- Numbers of samples and respective matrices
- QC procedures utilized and also references to the acceptance criteria
- Project name and number
- Condition of samples 'as-received'
- Discussion of whether or not sample holding times were met
- Discussion of technical problems or other observations which may have created analytical difficulties
- Discussion of any laboratory QC checks which failed to meet project criteria
- Signature of the Laboratory QA Manager and/or Laboratory Director or designee

2. Chemistry Data Package

- Summary page indicating dates of analyses for samples and laboratory QC checks
- Cross referencing of laboratory sample to project sample identification numbers
- Description of laboratory data qualifiers used
- Sample preparation and analyses summary or form with dates of preparation/extraction/analysis and methods used for samples
- Sample results on a dry-weight basis for sediments and on a wet-weight basis for biota, with units clearly labeled and dilutions clearly marked.
- Sample-specific reporting limits for all compounds
- QC summaries including: MS/MSD recoveries, laboratory control samples/standard reference material recoveries, surrogate recoveries, method blank results

In addition, the laboratory data package that will undergo the Region I Tier III-type Data Usability Review must also include the following:

- Raw data for sample results and laboratory QC samples
- Results of (dated) initial and continuing calibration checks, and GC/MS tuning results
- Calibration check compounds, system performance check results
- Chromatograms/spectra or other raw data of sample results and QC checks
- Example result calculations