SECTION 2

Field and Analytical Program Overview

This section summarizes the Phase I fish tissue sampling program conducted in the fall of 2005. It summarizes the DQOs for the sampling program, describes the types of samples collected and their locations, lists the analyses conducted on each sample, presents a review of the data validation and data usability, and describes the sample and data management programs. The proposed approach and methods are described in detail in the Fish Tissue A&R Document (CH2M HILL, 2005a) and, the Fish Tissue QAPP (CH2M HILL, 2005b). Details of the field program, including deviations in approach and methods from the QAPP, can be found in the Fish Tissue Field Report (CH2M HILL, 2006a).

2.1 Phase I Fish Tissue Study Design

The Phase I fish tissue sampling program was designed to provide information to support an assessment of potential risks to human and ecological receptors in the UCR. During project planning, USEPA's DQO process (USEPA, 2000b) was used to identify specific Phase I data needs for the human and ecological risk assessments and to establish decision rules for the collection and evaluation of fish tissue data. The Phase I fish tissue sampling program was then designed in consideration of the specific data needs identified in the DQO process, the unique site characteristics, and comments received from affected landowners, land managers, and regulators, including CCT, the Spokane Tribe of Indians (STI), U.S. Department of the Interior (DOI) agencies, Washington State Department of Ecology (Ecology), and WDOH. The Phase I fish tissue sampling program planning process, including the DQO process, and a detailed rationale for the sampling design are described in the Fish Tissue A&R document (CH2M HILL, 2005a) and the Fish Tissue QAPP (CH2M HILL, 2005b). The DQOs are summarized in Table 2-1.

The sampling design was as follows:

- The site was divided into three reaches (upper, middle, and lower) based on physical characteristics and historical contaminant distribution.
- Fish were collected from two distinct fish sample collection areas (FSCAs) located in each reach (a total of six FSCAs were sampled).
- Five of six FSCAs were co-located with the sediment sampling focus areas to allow for comparison of contaminant concentrations in fish to those in sediments.
- Targeted fish species were collected at each of the six selected FSCAs.
- Five composite samples (each composed of five individuals) were targeted for collection and analysis for each species from each FSCA.

- Whole body samples were analyzed for all species from all FSCAs. At one FSCA within each reach, for a total of three FSCAs, fillet and offal were analyzed separately for selected target species.
- Analytes included PCB aroclors, PCB congeners, dioxins and furans, Target Analyte List (TAL) metals, organic arsenic species, percent lipids, and percent moisture.

The following sections provide a brief summary of the target species, sample types, and target sample locations.

2.1.1 Target Species and Tissue Types

The following fish species and tissue types were targeted for collection during the Phase I fish tissue sampling program:

- Walleye *(Sander vitreus)* – Fillet and offal at three FSCAs and whole body at three FSCAs
- Rainbow trout *(Oncorhynchus mykiss)* – Fillet and offal at three FSCAs and whole body at three FSCAs
- Lake whitefish (*Coregonus clupeaformis*) – Whole body only
- Largescale sucker *(Catostomas macrocheilus)* – Whole body only
- Burbot (*Lota lota)* – Whole body only

Rainbow trout were identified in the field by experienced biologists as either wild fish or hatchery fish, based on morphological characteristics (i.e., fin erosion and/or dorsal fin ray deformation), and assigned to composite samples separately.

Alternative species were considered if sufficient numbers of individuals in the target size range (TSR) could not be collected. Potential alternate species and TSRs are detailed in the Fish Tissue QAPP. Mountain whitefish (*Prosopium williamsoni*) were collected at the most upstream FSCA because lake whitefish were not available due to habitat conditions.

During the sampling, the presence of sediment and slag was noted in the guts of largescale suckers collected from upstream sites. Slag was not observed in the guts of this species from sites downstream; however, a microscopic examination was not performed. Slag was not observed in the guts of other species. However, these observations were based on the unaided eye and not microscopic analysis. It was recognized that the potential for the presence of copious deposits of slag in the guts of large-scale suckers could add to the uncertainties in the tissue measurements and the future use of those data. The decision was made to conduct a pilot study to assess the relative impact of slag and/or sediment in the guts of largescale suckers on their overall whole body measurements. To assess the contribution of sediment/slag to the whole body tissue measurements of largescale suckers, measurements were made of the metal concentrations in the gutless whole body and in gut tissue and contents (hereafter referred to as "gut/gut contents"), and of the ash-free dry weight (AFDW) of the gut/gut contents. A Fish Tissue QAPP Addendum (CH2M HILL, 2006c) was prepared outlining procedures and analysis.

2.1.2 Sample Types

Individual species and tissue-specific samples were designed to consist of a composite of five individual fish of a similar size. At a minimum, three fish were to be used only if availability warranted adjusting the sample size. The objective of selecting a compositing approach was to collect samples that are representative of the average tissue concentration over the sample area. A compositing approach allowed for more individual fish to be analyzed, while controlling analytical costs. Increasing the number of individuals per composite sample within each sample area increases the representativeness of the estimate of the average tissue concentration for that sample area, and provides an estimate of long–term consumption exposures.

Compositing was done using the following approach, which is consistent with the statistical assumptions used to design the study presented in the Fish Tissue A&R Document (CH2M HILL, 2005a). More details on the compositing approach are presented in Section 3.2.2 of the Fish Tissue Field Report. Individuals of a given species collected from a given FSCA were randomly assigned to one of the five composites planned for collection at each FSCA. Fish were collected from three or more locations within the FSCA depending on habitat availability and optimal collection conditions. The individual fish collected within each FSCA were pooled by species. A random number generator was used to assign individuals of a given species to a sample composite at a given FSCA.

Of the fish captured, only the individuals within a size range that satisfied the following quality assurance (QA) requirements were kept. Composite sample acceptability requirements stipulate that individual fish for a composite sample be of similar size, and that the smallest individual in a composite be no less than 75 percent of the total length (size) of the largest individual in the same composite. Further, USEPA guidance (USEPA, 2000c) suggests that the relative difference between the average length of individuals within any composite sample and the average length of all individuals in all composite samples should not exceed 10 percent.

2.1.3 Target Sample Locations

Five composite samples for each target species and tissue type were planned for collection within each of the six fish sampling areas (Figure 2-1). At FSCAs 1, 3, and 6, both fillet and offal were targeted for analysis for walleye and rainbow trout and whole body samples were analyzed for all other species. At FSCAs 2, 4, and 5, whole body samples were analyzed for all species. Thus, a total of 180 composite samples were planned for collection (see Table 2-2). The inclusion of laboratory duplicates resulted in a total of 198 targeted composite samples.

To address the potential for overestimating the contribution of metals to largescale sucker whole body measurements, the gut (i.e., esophagus, stomach, and intestines) and gut contents were removed, producing both a “gut/gut contents” sample and a “gutless whole body” sample, from each individual in two randomly selected composite largescale sucker samples (five individuals) from FSCA 1 and from one each randomly selected composite from FSCAs 3 and 6. A total of 20 individual largescale suckers were processed. The “gut/gut contents” samples were analyzed for TAL metals, lipids, moisture and AFDW. The “gutless whole body” samples were analyzed for metals, lipids, and moisture.

2.2 Field Methods

2.2.1 Fish Collection and Handling

Because the target species selected for tissue analysis are found in different habitats within the UCR sampling areas, three different collection methods were necessary. Detailed methods are presented in the Fish Tissue QAPP and the Fish Tissue Field Report.

Target fish species were collected using the following equipment:

- Gill nets
- Boat electrofishing
- Burbot traps

Gill nets were constructed of monofilament mesh, with floats on the top horizontal line and weights on the bottom line, and were 200 feet long and 10 feet high, with 3- and 4-inch (stretch) mesh. The ends of the gill nets were weighted with one or more concrete or lead anchors attached by a short line (about 1 m) to keep the net near but above the bottom. An inflated buoy was attached to each end to mark the locations of the net at the water surface. Nets were generally deployed in the late afternoon or evening and retrieved the following morning. In some cases, the nets were re-deployed in the morning and picked up in the afternoon on the same day or the morning of the following day. A global positioning system (GPS) unit on board each vessel was used to document the location of each end of each gill net set upon deployment.

Electrofishing boats and operators were provided by the U. S. Fish and Wildlife Service (USFWS), STI, and CCT. Electrofishing was conducted in littoral or shoreline areas using generator settings that produced approximately 5 amperes. Settings were adjusted by the boat operator as necessary to fish effectively while limiting fish mortality. Electrofishing was conducted from dusk until approximately midnight. Long-handled nets were used that allowed the netters to reach stunned fish about 10 to 12 feet from the boat or under the water. Electrofishing was the primary method used to collect all species except lake whitefish and burbot, although both of these species were occasionally collected using electrofishing. At downstream locations, where burbot were found in shallow coves, electrofishing was very effective for this species. All stunned fish of the target species were netted. If they were clearly outside the TSR, they were returned to the water; otherwise, they were held in the live well until the electrofishing transect was completed.

Because burbot are predaceous fish found at or near the bottom in deep water, electrofishing and gill netting are not generally effective fishing methods in most locations. The burbot traps were constructed of a conical steel frame wrapped in nylon netting, with an opening that allowed fish to enter but not escape. Traps were baited with fresh fish cut into pieces and placed in a mesh bag inside the trap, and lowered to the bottom with a line attached to a surface buoy. Traps were deployed in a variety of locations at depths that ranged from approximately 20 to 100 feet. Burbot were caught across that depth range.

After collection using electrofishing and gill netting gear, fish were transferred to the live well on board the vessel. When all fish from a gillnet or electrofishing transect were collected, the sampling crews counted and sorted the fish by species and measured each

individual for comparison to the TSR. Because burbot traps usually held only one or two fish, burbot were not placed in the live well but were transferred immediately to a cooler filled with wet ice. For all collection methods, fish that were within the TSR were euthanized by a blow to the head using a heavy plastic stick. Each fish was identified using pre-labeled plastic tags attached to the fish with a nylon cable tie passed through the fish's mouth and out the gill opening under the operculum. After the tags were secured, each fish was placed into a cooler with ice and held onboard the vessel for the remainder of the morning or nighttime sampling activity.

At the end of each daily collection event, the tagged fish in coolers with ice were transported from the collection area to the onshore processing facility at the Kettle Falls Marina. The labeled fish coolers were filled with ice, sealed with signed custody seals, and locked in the processing station until the onshore processing was completed. Signed and dated copies of all field forms and notebooks were left with the coolers.

A detailed description of sample handling and processing is presented in the Fish Tissue QAPP. The tagged fish were processed for shipment to the laboratory at the onshore processing facility using the following procedures:

1. The fish tag numbers and species identification were checked against the collection forms.
2. Each fish was rinsed with a spray of site water, which was collected from the FSCA at the time of fish collection, to remove any ice, blood, or dirt from the body surface, then placed on heavy-duty aluminum foil, shiny side out.
3. The total length (i.e., anterior-most part of the fish to the tip of the compressed lobes of the caudal fin) of each fish was measured to the nearest millimeter.
4. Each fish was weighed to the nearest 2 grams using a laboratory balance that was calibrated daily and had been tared to the weight of the foil.
5. An external examination was performed to check for signs of disease, deformities, and/or abnormalities. The results were recorded on the external exam forms that are provided as an appendix to the Fish Tissue Field Report (CH2M HILL, 2006a).
6. Sex was determined by internal examination of the gonads. The results are provided in the Fish Tissue Field Report (CH2M HILL, 2006a).
7. Walleye and rainbow trout from FSCAs 1, 3, and 6 were filleted using a disposable scalpel. Scales were removed before filleting. Fillets from both species were removed and wrapped in aluminum foil separately from the offal.
8. Otoliths were removed from all species except the largescale suckers. The otoliths were removed by cutting into the skull of the fish with a disposable scalpel blade. Both otoliths were removed and placed into a small plastic vial with the fish identification information. For determining the age of rainbow trout, several scales were taken in addition to otoliths. For the largescale suckers, the opercula were removed to be used for age determination instead of otoliths. The results are provided in the Fish Tissue Field Report (CH2M HILL, 2006a).

9. Each fish (whole body or fillet and offal) was wrapped in aluminum foil, and a second identification label was placed on the aluminum foil. The fish was then placed inside a transparent low-density polyethylene (LDPE) bag and held in a –20 degree Celsius (ºC) freezer onsite until being shipped to the laboratory for homogenization.

The following are deviations from the original plan:

- The QAPP specified that filleting and otolith removal be done at an offsite laboratory. However, trials with store-bought rainbow trout showed that freezing and thawing of the samples made offsite processing difficult, thus compromising the integrity of the sample homogenization process. Based on this trial, the filleting and otolith removal procedure was moved to the onsite processing facility.
- The onsite processing followed the procedure specified in Section 3.4.1.2 of the QAPP, with the following exceptions:
  - All processing surfaces were covered with aluminum foil that was disposed of between each fish.
  - Otolith removal and filleting was done using disposable stainless steel scalpels and disposable forceps.

2.2.2 Collection Summary

Fish sampling was conducted in two separate events because of differences in habitat requirements for different species and differences in sampling gear/boat requirements. The first sampling event occurred between September 6 and September 16, 2005, and used gillnets that were set in deep water to fish primarily for lake whitefish. This time period preceded the fall spawning period for lake whitefish. Because of the riverine nature of FSCA 1, gill netting was impractical, so boat electrofishing was used. Although the sampling event was designed to collect lake whitefish, an opportunistic approach was taken such that, if sufficient numbers of other target species were collected, they were kept. The sampling was done by two boat crews provided by the Spokane Tribal Natural Resources Department.

The second sampling event was designed to collect all target species and used a combination of gill nets, electrofishing, and burbot traps. Sampling took place between October 12 and October 21, 2005. Sampling was done by crews from the USFWS, USEPA, and the CCT Natural Resources Department. Gill netting and electrofishing were conducted by the USFWS and CCT crews, and burbot trapping was conducted by the USEPA crew.

Tables 2-3 and 2-4 summarize the locations where fish sampling was done, by FSCA and by date and gear types. The tables also indicate whether any of the target species of the TSR were caught and kept at a particular sample location. Figures 2-1 to 2-7 show the distribution of sample locations with each FSCA. During the September sampling event, 316 fish were collected and kept (Table 2-3), and, during the October event, 495 fish were collected and kept (see Table 2-4). Composite samples were constructed only from individual fish captured in a single sampling event.

The number of individual fish of a given species collected at a FSCA in some instances exceeded the minimum target number of 25 needed to prepare the five composite samples.

In an effort to optimize the number of samples within the study design, in some cases more than 25 individuals were retained for further processing at an FSCA. In all cases, individual fish were randomly selected from those collected, and delivered to the onshore processing facility. In some cases, all the individuals in excess of 25 were retained for further processing; in others, up to 35 individuals were retained and the remainder discarded.

Deviations in collection from the Fish Tissue QAPP are detailed in the Fish Tissue Field Report. The deviations in collection are summarized as follows:

- The TSR for rainbow trout, largescale suckers, and lake whitefish was increased to account for the average size individual for each species that was being collected.
- Mountain whitefish were collected as an alternative species to lake whitefish at FSCA 1 due to habitat limitations.

2.2.3 Post-Collection Methods

Processed samples were shipped to the Applied Sciences Laboratory (ASL) for post-collection processing prior to shipment to the analytical laboratories. Individual samples were homogenized and composites were prepared in accordance with the study design. In addition, selected samples of largescale sucker were dissected to remove the gut and gut contents prior to homogenization. Detailed methods are presented in the Fish Tissue QAPP, the Supplemental Fish Tissue QAPP, and the Fish Tissue Field Report.

Laboratory processing and compositing used the following process:

1. Samples (i.e., whole body fish, fillets, or offal) were allowed to thaw for about 10 minutes for ease of cutting.
2. Fish were placed on a plastic cutting board and cut into 4-inch-wide pieces using a heavy, pivoting stainless steel blade.
3. Fish were homogenized using a Robot Coupe Blixer 7.
4. The homogenized sample was placed into pre-cleaned glass jars, labeled, and placed in the freezer.
5. The laboratory equipment was decontaminated using the following procedures as specified in the Fish Tissue QAPP. All pieces of the S-blade unit, the 7-quart stainless steel bowl, cutting board, spatulas, and cutting utensils were washed in the following order:
    - Scrub with warm water and phosphate-free detergent
    - Rinse with copious amounts of cold water
    - Rinse with copious amounts of deionized (DI) water
    - Rinse three times with pesticide-grade MeOH
    - Rinse three times with 1+3 nitric acid
    - Rinse three times with Type II Millipore water
    - Allow to drip dry

The largescale sucker samples randomly selected for dissection to produce "gut/gut contents" and "gutless whole body" samples were processed using the following procedure:

1. To remove the gut from each fish, the selected individuals were taken out of the freezer in groups of about five and individually placed inside two plastic garbage bags in a cooler of warm water to slightly thaw the tissue.
2. The frozen gastrointestinal tract and its contents, hereafter referred to as the gut/gut contents, was broken off at each end and cleanly pulled out of the body cavity. (The gastrointestinal tract consisted of the stomach, pyloric caeca, and intestine. In some cases the sample contained portions of the liver; however, every effort was made to minimize this situation.)
3. The gut/gut contents were removed from the fish body cavity and placed on a clean piece of aluminum foil and weighed and recorded.
4. The gut/gut contents were placed in a clean, decontaminated stainless steel cup and homogenized. (The gutless body samples were processed using the general homogenization procedure described above for all whole body fish, fillet, or offal samples.)
5. Following homogenization, the gut/gut contents sample was poured into two 4-ounce jars, one to be archived and another to be submitted for metals analysis. The jar for archiving was immediately frozen. The jar for metals analysis was sampled for AFDW determination prior to being frozen.
6. AFDW was measured for each homogenized gut/gut contents sample.

The method that was used to randomly assign individual samples (i.e., whole body, fillet, or offal) from a FSCA into composite samples by species is as follows. The method was designed to avoid or minimize inclusion of fish outside the TSR where possible, randomly distribute 25 fish into 5 composites of 5 individuals, and meet the QA requirements specified in the Fish Tissue QAPP. In this methodology, each composite sample was checked to ensure that the smallest individual was not less than 75 percent of the length of the largest, and that the mean length of fish in each composite sample was not more than 10 percent larger or 10 percent smaller than the mean length of all composite samples for that species. Occasional but small deviations from the former rule were unavoidable because the size distributions in some locations exceeded the TSR. Composites that had minor deviations were identified in the Fish Tissue Field Report (CH2M HILL, 2006a).

A randomizer application (www.randomizer.net) was used to select a randomly organized list of 25 individuals from the total number (25 or more) available, and the list was then sequentially grouped into 5 composites of 5 individuals. The following procedure was used to randomly assign individual samples to composites:

1. List individuals from an FSCA by field tag number and length in millimeters.
2. Sort by size.
3. Identify any individuals outside the TSR.
4. If at least 25 individuals are within the TSR, proceed to step 5; if not, proceed to step 8.

5. Sequentially number individuals within the TSR (e.g., 1 through >/= 25).
6. Use the randomizer application (www.randomizer.net) to select a randomly organized list of 25 numbers from the total number available (e.g., 25 randomly drawn from 30 individuals within the TSR).
7. Sequentially group the randomly organized list into five composites. Proceed to step 14.
8. If 25 individuals within the TSR are not available, the most extreme individuals are eliminated, retaining only enough outside the TSR to total 25 individuals. If individuals larger and smaller than the TSR are present in the sample, it may be necessary to balance the number of individuals above and below the TSR used in the composite to minimize deviation from the mean length of all species collected from all FSCAs.
9. Use randomizer to produce a randomly organized set of numbers from 1 to 25.
10. Sequentially group the randomly organized list into five composites.
11. Calculate the mean length of fish and the ratio of the smallest fish to the largest for each composite sample.
12. If the smallest is less than 75 percent of the largest, repeat (up to three times) steps 9 through 11.
13. If repeating steps 9 through 11 consistently fails to produce acceptable composite groupings, consult USEPA Task Order Project Officer (TOPO), Quality Assurance Officer (QAO), and/or risk assessors.
14. Calculate mean size of individuals in each composite, and compare largest and smallest mean across all composites, within and among FSCAs.
15. If mean length of any composite varies by more than +/-10 percent of the grand mean, consult USEPA TOPO, QAO, and/or risk assessors.

Details of the actual assignment of individual fish to composites are presented in the Fish Tissue Field Report.

2.2.4 Fish Tissue Composites Submitted for Analysis

Table 2-5 presents a summary of the Phase I fish tissue composites that were submitted for chemical analysis. A total of 165 fish tissue composites and 15 QA replicates were prepared and submitted for chemical analysis. In addition, two randomly selected composites of largescale suckers from FSCA 1 and one each from FSCAs 3 and 6 were selected for further processing into gutless and gut/gut contents samples. A total of 20 individual fish were submitted as gutless and as gut/gut contents for chemical analysis. The total composites prepared following sampling represented 85 percent of the targeted number. The QA replicates represented 83 percent of the target.

The following are deviations from the original plan:

- Three whole body composites of walleye were prepared from FSCA 5.

- Two whole body walleye composites were added to FSCA 6 to give a total of 10 for the lower reach. This was done in accordance with the study design in the A&R Document and the Fish Tissue QAPP.
- Four five-fish whole body composites and one three-fish whole body composite of wild rainbow trout were prepared at FSCA 2.
- One four-fish fillet composite and one four-fish offal composite of wild rainbow trout were prepared at FSCA 6.
- An additional whole body wild rainbow trout composite was prepared from FSCA 5, giving a total of six (i.e., one wild and five hatchery).
- A three-fish whole body composite of lake whitefish from each collection period (September and October) was prepared at FSCA 6.
- Five mountain whitefish composites were prepared as an alternative to lake whitefish at FSCA 1.
- Five largescale sucker composite samples were available from FSCA 1; however, two were randomly selected, and the fish were submitted individually as gutless and as gut/gut contents for analysis.
- Only four largescale sucker composites were prepared from FSCA 4.
- Five largescale sucker composite samples were available from FSCAs 3 and 6; however, one was randomly selected, and the fish were submitted individually as gutless and as gut/gut contents for analysis.
- No whole body burbot composites were prepared from FSCA 1.
- Three three-fish whole body burbot composites were prepared at FSCA 2.
- Four whole body burbot composites were prepared at FSCA 4.

2.3 Analytical Program

Following collection, onshore processing, and processing at the ASL, the samples were packaged and sent under chain of custody via FedEx overnight delivery to the USEPA Region 10 Manchester Laboratory for analysis and further distribution. The following analyses were performed:

- **TAL Metals:** Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, uranium, vanadium, and zinc.
- **PCB Aroclors:** 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.
- **Dioxins and Furans:** Tetra- through octa-chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans.
- **PCB Congeners:** 209 congeners.

- **Arsenic Speciation:** Inorganic arsenic (As+3 and AS+5), ASB + Cation, dimethylarsonic acid (DMA), monomethylarsonic acid (MMA), and unknown (assumed to be arsenal sugars).
- **Percent lipids.**
- **Percent moisture.**

The analytical suite conducted on each sample type is listed in Table 2-6. Chemical analyses were conducted by Contract Laboratory Program (CLP) laboratories and the USEPA Region 10 Manchester Laboratory.

PCB congeners were analyzed initially on a subset of samples using high-resolution methods. Depending on the results and the risk analysis, other archived samples, as well as future samples, may be analyzed for only the most common and key congeners (e.g., PCBs 126 and 169).

2.3.1 Phase I Fish Tissue Chemical Data QA/QC Program

The objective of the Phase I fish tissue data collection and analyses was to generate data of known quality appropriate for project needs in terms of end decisions. This objective was accomplished through the following cycle:

- The DQO process identified project data needs and decision rules and was documented as an appendix to the Fish Tissue QAPP.
- The QAPP defined organization, functional activities, procedures, and policy that were implemented to obtain project-specific data of known and appropriate quality.
- Detailed laboratory analytical procedures and quality assurance/quality control (QA/QC) procedures were followed, including documentation (Table 2-7).
- Laboratory and field QA/QC was performed through audits by the USEPA QA Officer.
- Data quality and usability review outside the laboratory were documented in data validation reports.
- Individual data points were qualified by applying data validation report flags to the project database.
- An overall assessment of data quality was performed to evaluate the usability of the data within the context of the project objectives.

The following subsections describe the analytical methodology, the data validation methodology, and the overall data quality evaluation findings. Information about QA/QC samples is provided in this report in Appendix B. Data quality evaluation reports for the individual method and sample results are provided as Appendix F.

2.3.2 Analytical Program/Methodology

A listing of analytes and associated methods is provided in Table 2-7. In addition, for each analytical parameter and method, the standard USEPA analytical method references are

provided in the Fish Tissue QAPP. These documents identify the following method-specific QC requirements:

- Method-specific QC procedure
- Level of effort (frequency of QC checks) for each QC procedure
- Quantitative acceptance limits for QC data
- Corrective action requirements for the laboratories for QC data that are outside the acceptance limits
- Documentation

These requirements, as detailed for each analytical method in the Fish Tissue QAPP, were followed by the laboratory as the project analytical requirements.

2.3.3 Data Quality Assessment and Quality Control Data

DQOs are prescribed in the Fish Tissue QAPP in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. The following is a description of the assessment for each parameter. PARCC objectives for the project are shown in Table 2-7. Associated data for the PARCC parameters are provided in the laboratory data package.

2.3.3.1 Accuracy

Accuracy measurement data include laboratory control sample and matrix spike recovery data for both organic and inorganic analytical parameters, as well as surrogate recovery data for organic parameters. The accuracy data were provided to the project team (data users) for consideration during data evaluation because these data need to be applied to whole sites. Over 90 percent of the data are within the criteria, thus meeting project goals.

2.3.3.2 Precision

Precision measurement data include laboratory and field duplicate data expressed as relative percent deviation. The validation reports also detail duplicates outside control limits, if any. The duplicate data were provided to the project team (data users) for consideration during data evaluation because these data need to be applied to whole sites. Over 90 percent of the data are within the criteria, thus meeting project goals.

2.3.3.3 Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the sampled media. Representativeness is assessed in both qualitative and quantitative terms. The project report discusses the qualitative aspects of representativeness in terms of design of the field sampling plan, sampling techniques, sample handling protocols, and associated documentation. Quantitative measures of representativeness include field and laboratory blank measurements to identify whether contamination was introduced through field or laboratory operations. Field duplicate measurements are used to establish variability.

Laboratory and trip blank measurements were detailed on a sample- and parameter-specific basis in the validation reports. All qualifications as a result of laboratory and trip blank effects were incorporated into the project sample/analyte-specific data. Field blank results are summarized in the database and were provided to data users on a sitewide basis.

Field duplicate results are listed in Appendix B.

2.3.3.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability of data has been established through use of the following:

- Standard analytical methods and QC procedures established in the Fish Tissue QAPP and USEPA CLP and Manchester Regional Laboratory protocols
- Consistent reporting units for a specified procedure

2.3.3.5 Completeness

This QA/QC analysis assesses completeness as a measure of the amount of valid data obtained from the analytical measurements. Field activity completeness was assessed within the context of the overall sampling design and meets project goals. Data completeness was found to be above 90 percent at large and meets project goals.

2.4 Sample Management and Recordkeeping

A sample is physical evidence collected from a hazardous waste site, from the immediate environment, or from another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence. Field notebooks, sampling records, chain-of-custody forms, and other field documents were used to record information about each sample collected during the Phase I sediment sampling event.

2.4.1 Field Notebooks

A bound field notebook was maintained by each sampling field team leader. The field notebook provides a daily record of significant events, observations, and measurements during the field investigation. All entries were signed and dated.

2.4.2 Field Documents

Field documents including sample custody seals, chain-of-custody records, and packing lists were obtained from the Regional Sample Control Coordinator (RSCC) in USEPA's Quality Assurance Office. Chain-of-custody procedures were used to maintain and document sample collection and possession. After sample packaging, one or more of the following chain-of-custody forms was completed, as necessary, for the appropriate samples:

- Organic traffic report and chain-of-custody record; Forms II Lite forms as applicable
- Inorganic traffic report and chain-of-custody record; Forms II Lite forms as applicable
- USEPA Region 10 Chain-of-Custody Record
- Overnight shipping courier air bill

Copies of the above forms were filled out and distributed in accordance with the instructions for sample shipping and documentation. Completed field QA/QC summary forms were sent to the RSCC at USEPA's Region 10 Quality Assurance Office at the conclusion of the sampling event. The sampling records and other data from the sampling event are provided in the Fish Tissue Field Report.

2.5 Data Management Program

Data obtained during the Phase I sampling program were managed according to the processes described in the project-specific data management plan prepared for the UCR site (CH2M HILL, 2004a) and according to the procedures described in the Fish Tissue QAPP.

Following receipt of validated data, the data and validation qualifiers were input into the site information management system (SIMS) database to facilitate queries and report preparation. The data are stored in SIMS with all laboratory and independent validator qualifiers included. Laboratory data from ASCII or equivalent files, provided by the USEPA Region 10 CLP Project Officer, were adapted to files compatible with the project database, as described in the project-specific data management plan. The SIMS database continues to be maintained in a manner that is compatible with, and provided to, USEPA or others at USEPA's request.

TABLE 2-1
Phase I Remedial Investigation Data Quality Objectives for Fish Tissue Contaminants
Upper Columbia River RI/FS

Problem Statement	Identify the Decision	Inputs to Decisions	Study Boundaries	Decision Rule	Acceptable Limits on Decision Errors	Optimized Sampling Design
Human Health Risk Assessment						
Contaminants are likely present in edible fish at concentrations that pose unacceptable risk to some people who consume fish from the UCR.	Determine whether measures are needed to reduce fish contaminant concentrations, and/or reduce exposure to people consuming fish from the UCR depending on the levels of contamination and the intensity of consumption.	Demographic information. Fish consumption information (intake rates and body parts). USEPA IRIS and other toxicological databases and literature values. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-6). Length, weight, and age of each fish analyzed.	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the patterns of contaminant concentrations in fish tissue from the Columbia River between the U.S.-Canada Border and Grand Coulee Dam).	If calculated cancer risk or HI estimates are above regulatory risk targets and uncertainties are acceptable, a remedial action alternative may need to be developed; otherwise, no further evaluation is necessary for human health reasons.	Decision is to be made using quantitative and qualitative data.	Sample design described for Phase I Fish Tissue QAPP.
Aquatic Risk Assessment						
Determine whether measures are needed to prevent exposure of fish or bioaccumulation of site contaminants from the UCR to contaminant concentrations that pose unacceptable risk to fish.	If the lines of evidence indicate that fish are not potentially at risk, with low uncertainty, then no further action may be taken. If the lines of evidence indicate that fish are not potentially at risk, with moderate to high uncertainty, then additional data collection may be necessary. If the lines of evidence indicate that fish are potentially at risk, with moderate to high uncertainty, then additional data collection may be necessary. If the lines of evidence indicate that fish are potentially at risk, with low uncertainty, then remedial action alternatives will need to be developed.	Toxicological databases and literature. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-6).	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site (note that the Phase I study area is bounded by the U.S.-Canada Border and Grand Coulee Dam).	If representative PCOI concentrations are above protective concentrations, a remedial action alternative may need to be developed; otherwise, no further evaluation is necessary for aquatic risk reasons.	Decision is to be made using quantitative and qualitative data.	Sample design described for Phase I Fish Tissue QAPP.

TABLE 2-1
Phase I Remedial Investigation Data Quality Objectives for Fish Tissue Contaminants
Upper Columbia River RI/FS

Problem Statement	Identify the Decision	Inputs to Decisions	Study Boundaries	Decision Rule	Acceptable Limits on Decision Errors	Optimized Sampling Design
Wildlife Risk Assessment						
Contaminants may be present in fish and invertebrates at concentrations that pose unacceptable risk to wildlife (birds and mammals) in the UCR site.	If the lines of evidence indicate that wildlife communities are not potentially at risk, with low uncertainty about the result, then no further action may be taken. If the lines of evidence indicate that wildlife communities are not potentially at risk, with moderate to high uncertainty about the result, then additional data collection may be necessary. If the lines of evidence indicate that wildlife communities are potentially at risk, with moderate to high uncertainty about the result, then additional data collection may be necessary. If the lines of evidence indicate that wildlife communities are potentially at risk, with low uncertainty about the result, then remedial action alternatives will need to be developed.	Wildlife home ranges and migration patterns. Habitat maps. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-6). Benthic tissue analytical data (if available) or modeled data.	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site (note that the Phase I study area is bounded by the U.S.-Canada Border and Grand Coulee Dam.	If representative PCOI concentrations are above protective concentrations, a remedial action alternative will need to be developed; otherwise, no further evaluation is necessary.	Decision is to be made using quantitative and qualitative data.	Sample design described for Fish Tissue QAPP.

PCOI = potential contaminant of interest
IRIS = Integrated Risk Information System

TABLE 2-2
Targeted Fish Sampling Locations and Composite Number
Upper Columbia River RI/FS

		Number of Composite Samples									
		Walleye			Rainbow Trout			Lake Whitefish	Large-Scale Sucker	Burbot	
River Reach	**Sample Location (FSCA)**	**Whole Body**	**Fillet[b]**	**Offal[b]**	**Whole Body**	**Fillet[b]**	**Offal[b]**	**Whole Body**	**Whole Body**	**Whole Body**	**Total**
Upper	1[a]	0	5[d]	5[d]	0	5[d]	5[d]	5[d]	5[d, e]	5[d]	35
Upper	2[a]	5[d]	0	0	5[d]	0	0	5	5	5	25
Middle	3[a]	0	5	5	0	5	5	5	5[e]	5	35
Middle	4[a]	5	0	0	5	0	0	5	5	5	25
Lower	5	5	0	0	5	0	0	5	5	5	25
Lower	6[a]	0	5	5	0	5	5	5	5[e]	5	35
QA Replicates[d]		2	2	2	2	2	2	2	2	2	18
	Total	17	17	17	17	17	17	32	32	32	198

[a] FSCA falls within sediment sample focus area.

[b] Fillet and offal to be taken from the same five individuals for each composite.

[c] For rainbow trout, composites to be noted as composed of wild, hatchery, or mixed-origin individuals.

[d] Three QA replicate samples to be formed from one composite sample at the indicated FSCA.

[e] Two replicates from FSCA 1 to be randomly selected and individuals analyzed individually as gutless whole body and as gut/gut content samples. One replicate from FSCAs 3 and 6 to be randomly selected and individuals analyzed individually as gutless and as gut samples.

TABLE 2-3
Summary of September Phase I Fish Tissue Sampling Event
Upper Columbia River RI/FS

Date	Crew	FSCA	Gear	Individuals Collected by Species						
				Walleye	Rainbow (Wild)	Rainbow (Hatchery)	Lake Whitefish	Mountain Whitefish	Largescale Sucker	Burbot
9/6/2005	STI-1	1	E	14	4			8	5	
9/7/2005	STI -1	1	E	12	10			9	9	
9/7/2005	STI -2	2	N	3						
9/8/2005	STI -1	1	E		12			8	3	
9/8/2005	STI -2	2	N				1			
9/9/2005	STI -2	2	N	9			1			
9/10/2005	STI -1	3	N	14			15			
9/10/2005	STI -2	3	N	25			35			
9/12/2005	STI -2	4	N	23			12			
9/12/2005	STI -1	4	N				2			
9/13/2005	STI -1	5	N				28			
9/13/2005	STI -2	5	N	2						
9/14/2005	STI -2	4	N				1			
9/14/2005	STI -1	6	N	29			1			
9/15/2005	STI -1	4	N				20			
9/15/2005	STI -2	6	N				1			

STI-1 = Spokane Tribal Biologist Crew 1
STI-2 = Spokane Tribal Biologist Crew 2

E = electrofishing
N = gill netting

TABLE 2-4
Summary of October Phase I Fish Tissue Sampling Event
Upper Columbia River RI/FS

Date	Crew	FSCA	Gear	Individuals Collected by Species						
				Walleye	Rainbow (Wild)	Rainbow (Hatchery)	Lake Whitefish	Mountain Whitefish	Largescale Sucker	Burbot
10/12/2005	FWS	2	E	10	4				2	1
10/12/2005	CCT	2	E	22	4	2				1
10/13/2005	FWS	2	E		3		1		3	
10/13/2005	CCT	2	E		12	1			9	1
10/13/2005	CCT	2	N				9		1	1
10/13/2005	EPA	2	T							3
10/14/2005	EPA	2	T							4
10/14/2005	CCT	2	N				20		1	1
10/14/2005	CCT	3	E		2	6			3	2
10/14/2005	FWS	3	E		6	7			12	1
10/15/2005	FWS	3	E		2	4			12	1
10/15/2005	EPA	3	T							12
10/15/2005	CCT	4	E			1			1	7
10/15/2005	EPA	4	E			1				4
10/16/2005	EPA	3	T							9
10/16/2005	FWS	4	E		1	26				
10/16/2005	CCT	4	E		1				24	10
10/16/2005	CCT	5	E						2	
10/17/2005	EPA	4	T							1
10/17/2005	FWS	5	E	2		4			24	5

TABLE 2-4
Summary of October Phase I Fish Tissue Sampling Event
Upper Columbia River RI/FS

Date	Crew	FSCA	Gear	Individuals Collected by Species						
				Walleye	Rainbow (Wild)	Rainbow (Hatchery)	Lake Whitefish	Mountain Whitefish	Largescale Sucker	Burbot
10/17/2005	CCT	5	E	1	5	22			1	
10/17/2005	CCT	6	E			1			1	
10/18/2005	CCT	5	E	1						1
10/18/2005	EPA	5	T							12
10/18/2005	FWS	6	E		3	14			30	15
10/19/2005	FWS	1	E					7	11	
10/19/2005	FWS	2	E						4	
10/19/2005	CCT	5	N	8						
10/19/2005	CCT	5	E	3						
10/19/2005	EPA	5	T							9
10/19/2005	FWS	6	E			6				
10/20/2005	CCT	6	N	16	1	1	1			6
10/20/2005	EPA	6	T							4
10/21/2005	CCT	6	N				2			

STI-1 = Spokane Tribal Biologist Crew 1
STI-2 = Spokane Tribal Biologist Crew 2
CCT = Colville Confederated Tribal Biologist Crew
FWS = U.S. Fish and Wildlife Service Crew
EPA = U.S. Environmental Protection Agency Crew

E = electrofishing
N = gill netting
T = burbot trap

TABLE 2-5
Summary of Fish Tissue Composite Samples Submitted for Chemical Analysis
Upper Columbia River RI/FS

FSCA	Walleye		Rainbow Trout			Lake Whitefish		Mountain Whitefish		Largescale Sucker		Largescale Sucker Gut[e]		Burbot	
				Wild	Hatchery										
	Planned	Actual	Planned	Actual	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
FSCA1	5F/5O	5F/5O	5F/5O	5F/5O	0	5WB	0	0	5WB[d]	5WB	3WB	0	2	5WB	0
FSCA 2	5WB	5WB	5WB	5WB[a]	0	5WB	5WB	0	0	5WB	4WB	0	0	5WB	3WB[f]
FSCA 3	5F/5O	5F/5O	5F/5O	2F/2O	3F/3O	5WB	5WB	0	0	5WB	4WB	0	1	5WB	5WB
FSCA 4	5WB	5WB	5WB	0	5WB	5WB	5WB	0	0	5WB	5WB	0	0	5WB	4WB
FSCA 5	5WB	3WB	5WB	1WB	5WB	5WB	5WB	0	0	5WB	5WB	0	0	5WB	5WB
FSCA 6	5F/5O	5F/5O + 2WB	5F/5O	1F/1O[b]	4F/4O	5WB	2WB[c]	0	0	5WB	4WB	0	1	5WB	5WB
Total	45	45	45	22	24	30	22	0	5	30	25	0	4	30	22
QA Rep	2	2	2	3	3	2	2	0	1	2	3	0	1	2	2

[a] Four 5-fish composites and one 3-fish composite were formed.

[b] One 4-fish fillet composite and one 4-fish offal composite were formed.

[c] A 3-fish composite from each collection period (September and October) was formed.

[d] Mountain whitefish were used as a substitute for lake whitefish at this FSCA because of habitat limitations.

[e] Individual largescale suckers from a randomly selected composite were dissected to remove the gut and gut contents. The gutless whole body and gut/gut content samples were analyzed individually.

[f] Three 3-fish composites were formed.

TABLE 2-6
Summary of Analytical Program by Fish Species and Tissue Type
Upper Columbia River RI/FS

	Analyte						
Target Species	**TAL Metals**	**Inorganic Arsenic**	**PCB Aroclors**	**PCB Congeners**	**Dioxin/Furan Congeners**	**Percent Lipids**	**Percent Moisture**
Walleye							
Fillet	15	3	15	3	15	15	15
Offal	15	3	15	3	15	15	15
Whole Body	17	5	17	3	17	17	17
Wild Rainbow Trout							
Fillet	9	3	9	2	9	9	9
Offal	9	3	9	2	9	9	9
Whole Body	8	3	9	2	9	9	9
Hatchery Rainbow Trout							
Fillet	8	2	8	2	8	8	8
Offal	8	2	8	2	8	8	8
Whole Body	12	2	12	2	12	12	12
Lake Whitefish							
Whole Body	24	2	24	5	24	24	24
Mountain Whitefish							
Whole Body	7	3	7	1	7	7	7
Largescale Sucker							
Whole Body	29	4	29	6	29	29	29
Gutless[a]	22	6	NA	NA	NA	NA	NA
Gut/Contents[a]	22	6	NA	NA	NA	NA	NA
Burbot							
Whole Body	24	4	24	5	24	24	24
Total	229	51	185	38	185	185	185

[a] Individual largescale suckers were analyzed as gut/gut contents and as gutless whole body samples.

Note: The number of analyses listed for each sample type includes a duplicate QA sample.

NA = not analyzed

TABLE 2-7
Analytical Program Objectives, Procedures, and Criteria
Upper Columbia River RI/FS

Analytes[a]	Target Detection Limit[b]	Analytical Precision (Relative Percent Deviation)[c]	Analytical Accuracy (Percent Recovery[c]	Overall Complete-ness (%)	Method	Reference
TAL Metals and Uranium		±20%	75 – 125%	90	CLP/ ILM05.3/S W846-6000/7000	CLP/ MEL
PCBs (Aroclors)		±50%	50 – 150%	90	CLP/ OLM04.3/S W8082	CLP/ MEL
PCBs (congeners)		±20%	25 – 150%	90	Method 1668A	CLP/ MEL
Inorganic Arsenic		±20%	75 – 125%	90	MEL	MEL
Dioxins/ Furans (tetra through octa)		±20%	75 – 125%	90	Method 1613B	CLP/ MEL
% Lipids	0.1%	NA	NA	90	Bligh and Dyer[d] modified by MEL	CLP/ MEL
% Moisture	0.1%	NA	NA	90	PSEP[e]	CLP/ MEL

[a] Specific analytes are shown in Table 2-4 of the Fish Tissue QAPP, as well as data tables in this report.

[b] Detection limits are shown in the data tables in this report.

[c] Detection limits, precision, accuracy, and methods were fish-tissue- and laboratory-specific. The laboratories targeted the analytical concentration goals (ACGs) shown in Table 2-3 of the QAPP.

[d] Bligh and Dyer, 1959.

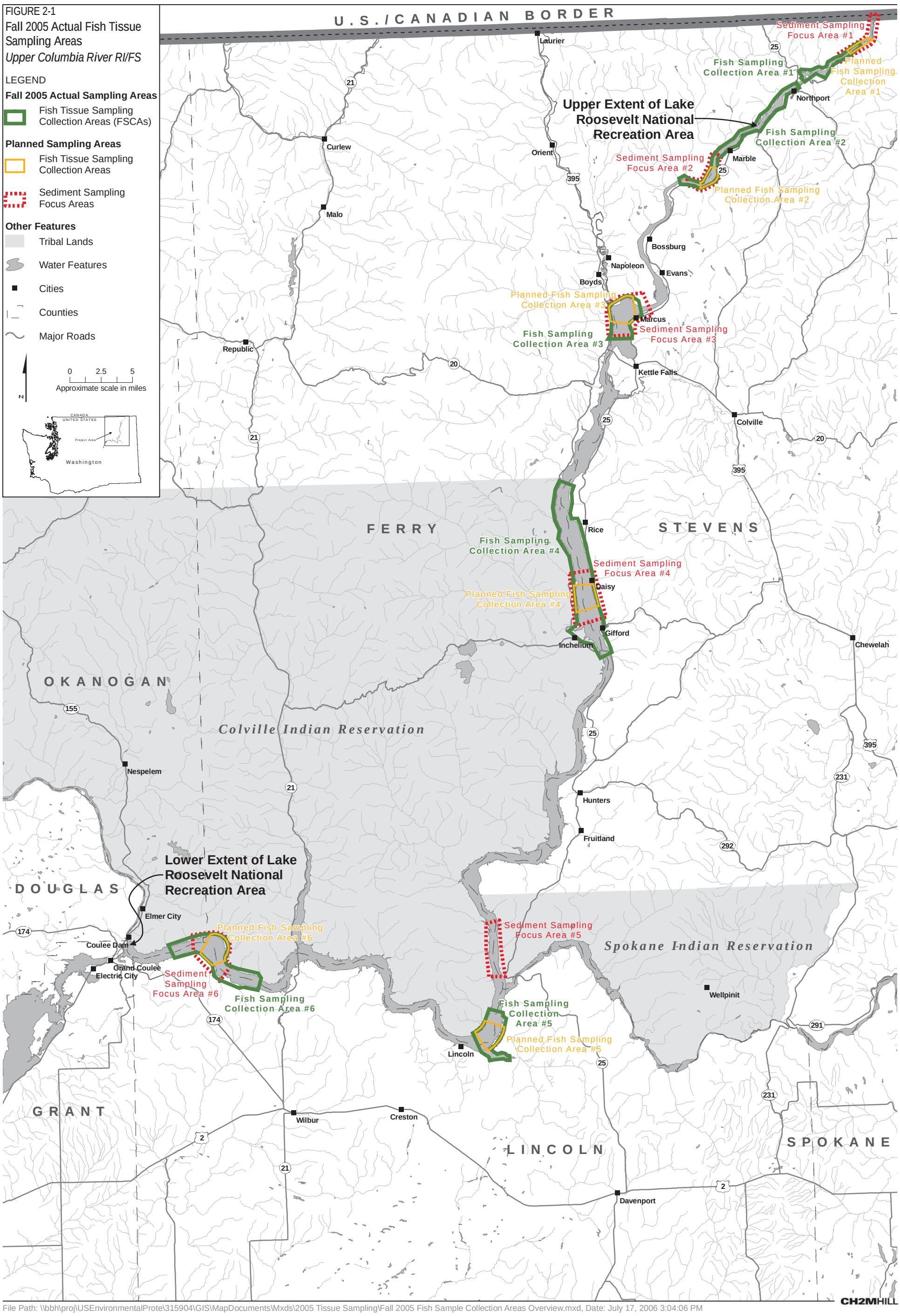
[e] Puget Sound Estuary Program (PSEP), 1997.

Notes: CLP indicates USEPA CLP methodology and QA/QC.
MEL indicates USEPA Region 10 Manchester Environmental Laboratory methodology and QA/QC.

FIGURE 2-1

Fall 2005 Actual Fish Tissue Sampling Areas

Upper Columbia River RI/FS



File Path: \\bbh\proj\USEnvironmentalProte\315904\GIS\MapDocuments\Mxds\2005 Tissue Sampling\Fall 2005 Fish Sample Collection Areas Overview.mxd, Date: July 17, 2006 3:04:06 PM