Final Report

BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT, RIVER OPERABLE UNIT

Bradford Island
Cascade Locks, Oregon

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ACRONYMS & ABBREVIATIONS

%	percent/percentile
ADAF	age-dependent adjustment factor
ADD	average daily dose
ATL	acceptable tissue level
AUF	area use factor
BAF	bioaccumulation factor
BaPeq	benzo(a)pyrene equivalent(s)
BCF	bioconcentration factor
BERA	baseline ecological risk assessment
BHC	benzene hexachloride
BHHRA	baseline human health risk assessment
BHHERA	baseline human health and ecological risk assessment
BMF	biomagnification factor
BSAF	biota-sediment accumulation factor
BW	body weight
CEC	contaminant of ecological concern
CEM	conceptual exposure model
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	conversion factor
C_{fish}	COPC concentration in fish (mg/kg)
COC	chemical of concern (human health)
COI	contaminant of interest
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPEC	contaminant of potential ecological concern
C/R	concentration divided by risk based concentration
CRITFC	Columbia River intertribal fish consumption
C_{soil}	concentration in soil
CTE	central tendency exposure
CTL	critical tissue level
DDD	dichloro-diphenyl-dichloroethane
DDE	dichloro-diphenyl-dichloroethylene
DDT	dichloro-diphenyl-trichloroethane
DDx	DDT, DDD, and DDE
DEHP	bis(2-ethyl hexyl) phthalate
DETM	Data Evaluation Technical Memorandum
Eco-SSL	Ecological Soil Screening Levels
ECSI	Environmental Cleanup Site Information
ED	exposure duration (years)
EF	exposure frequency (days per year)
ELCR	excess lifetime cancer risk
EMPC	estimated maximum possible concentration
EPC	exposure point concentration
ERA	ecological risk assessment
EU	exposure unit
foc	fraction of organic carbon

FS	feasibility study
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HPAH	high molecular weight polycyclic aromatic hydrocarbon
HQ	hazard quotient
IR	ingestion rate
IRAF	infant risk adjustment factor
IRIS	Integrated Risk Information System
kg	kilogram(s)
K_{oc}	partitioning coefficient for organic chemicals
L	liter(s)
LOAEC	lowest-observed-adverse-effect concentration
LOAEL	lowest-observed-adverse-effect level
LPAH	low molecular weight polycyclic aromatic hydrocarbon
µg	microgram(s)
MCL	maximum contaminant level
MDL	method detection limit
mg	milligram(s)
mg/m^3	milligram(s) per cubic meter
MP	Management Plan
MRL	method reporting limit
NAPL	non-aqueous phase liquids
NOAEC	no-observed-adverse-effect concentration
NOAEL	no-observed-adverse-effect level
OCDD	octachlorodibenzo-p-dioxin
OCPs	organochlorine pesticides
ODEQ	Oregon Department of Environmental Quality
ORNL	Oak Ridge National Laboratory
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCB-Aro	total PCBs as Aroclors
PCB-Cong	total PCBs as congeners
PCB-TEQ	dioxin-like PCBs toxicity equivalence
PCB-TEQ-Mam	dioxin-like PCBs using the mammal TEQ
PEC	probable effects concentration
PM	project manager
PPRTV	provisional peer-reviewed toxicity value
PRG	preliminary remediation goals
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RBC	risk-based concentration
Rf_c	reference concentration
RfD_o	reference dose (oral)

RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RM	river mile
RME	reasonable maximum exposure
RSL	Regional Screening Level
SFo	slope factor (oral)
SLERA	screening level ecological risk assessment
SLV	screening level value
SVOC	semivolatile organic compound
TBD	to be determined
TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalence factor
TEQ	toxicity equivalence
TRV	toxicity reference value
UCL	upper confidence limit
UPL	upper prediction limit
URS	URS Corporation
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VCP	Voluntary Cleanup Program

EXECUTIVE SUMMARY

This report presents the River Operable Unit (OU) baseline human health risk assessment (BHHRA) and the baseline ecological risk assessment (BERA) for the Bradford Island, Bonneville Dam Complex. The Portland District of the United States Army Corps of Engineers (USACE) has characterized and evaluated the contamination arising from historical practices at Bradford Island in Oregon. Bradford Island is part of the Bonneville Dam Complex, which is located on the Columbia River at river mile (RM) 146.1, approximately 40 miles east of Portland, Oregon (Figure 1-1). The site is a multipurpose facility that consists of the First and Second Powerhouses, the old and new navigation locks, and a spillway with a capacity of 1.6 million cubic feet per second (Figure 1-2). For this document, the River OU is defined as the portion of the Bonneville Dam Forebay that is bounded by the Bonneville Dam and Spillway, the two powerhouses, and the Washington and Oregon side riverbanks of the Columbia River to a point upstream formed by the northern end of Goose Island. Historic sampling supported by hydrologic modeling has demonstrated that sediment from the Forebay is not transported upstream beyond Goose Island at RM 146.8.

Numerous investigations have been performed by the USACE and their contractors since 1997, focusing on two OUs: the Upland OU and the River OU (Figure 1-3). Historically, electrical equipment debris was disposed of directly in the river on the north side of the island (Figure 3-5 of the Final Remedial Investigation [RI] Report, URS Corporation [URS] 2012). The electrical equipment debris included light ballasts, electrical insulators, lightning arresters, electrical switches, rocker switches, a breaker box, and electrical capacitors. The electrical debris contaminated the surrounding sediment with polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and metals. The electrical equipment debris were removed in 2000 and 2002 (Appendix E of URS 2002a,b) and a PCB-contaminated sediment removal action was conducted in 2007 (Huang and Associates, Inc. 2007). Residual contaminated sediment, contaminated biota (e.g., fish and shellfish), and potential PCB-containing oil in rock crevices may currently be sources of contamination. Additional contaminants of interest (COIs) include semivolatile organic compounds (SVOCs), butyltins, and a few organochlorine pesticides (OCPs) and herbicides.

The Final RI report (URS 2012) documented the investigation, identified source areas at Bradford Island, defined the nature and extent of the environmental contamination, and identified the contaminants of potential concern (COPCs) for human health and contaminants of potential ecological concern (CPECs) in the media from the two OUs. Based on the screening level risk assessments (RAs) for the River OU that were completed as part of the RI, recommendations were made to either conduct a BHHRA and BERA or proceed directly into an Feasibility Study (FS). Subsequently, additional “pre-FS” sediment, clam, and smallmouth bass data were collected from the River OU and smallmouth bass from the Reference Area in 2011 (Figure 1-4). One of the main purposes for collecting these additional data was to better characterize the link between the Upland OU and River OU by analyzing sediment and tissue of the river for Upland OU COPCs and CPECs, i.e., OCPs. Based on the results of the “pre-FS” sediment and smallmouth bass results, USACE was requested to proceed into baseline human health and ecological risk assessment (BHHERA) evaluations.

The River OU BHHRA and BERA build upon on the data and findings of the Final RI and Data Evaluation Technical Memorandum (DETM) (URS 2014) and will serve as an appendix to the

River OU FS. Due to the anticipated outcome of the baseline RAs that will document the need for further evaluation of PCBs in an FS, this RA document goes beyond the traditional assessment of the presence/absence and magnitude of baseline risk. This premise is also the reason that multiple rounds of site-specific sediment and tissue data have been collected in support of a robust baseline RA. To maximize use of these site datasets and develop an RA that is most beneficial to the FS, site-specific risk-based concentrations (RBCs) were calculated for the chemicals recommended for further evaluation in the River OU FS (primarily PCBs). Exceedances of these RBCs were illustrated for purposes of risk interpretation and to allow for general observations of the spatial distribution of potentially impacted areas and to assist with development of future site management strategy.

Only aquatic-related exposure pathways were addressed in these baseline RAs. The Upland OU to River OU pathways (i.e., potential mass wasting, soil erosion) that were evaluated at a screening level in the Final RI report (URS 2012) were not addressed, as these possible pathways will be considered in the Upland FS or the River FS.

The site-specific tissue data collected from the River OU as part of the RI (2006 and 2008) and during the pre-FS sampling (2011) are a key component influencing the findings of both the BHHRA and BERA. The risk assessments used post-sediment removal clam tissue (2008 and 2011–BERA only), crayfish tissue (2008), and sculpin tissue (2008–BERA only), as well as smallmouth bass tissue data that were collected both prior to the 2007 sediment removal (collected in 2006) and after the removal during the pre-FS sampling in 2011. The crayfish tissue was collected after the sediment removal but may also represent exposure periods that date back to pre-removal conditions given the life span for crayfish. Crayfish, smallmouth bass, and other receptors that may have been exposed to both pre-removal and post-removal conditions are likely to show a trend of declining tissue concentrations over time, based on a comparison between 2006 and 2011 bass tissue data. While there was a wider spread in PCB concentrations reported in the 2011 bass dataset, only a few fish from a localized group of sample locations were found to have elevated detections. Younger fish typically have a lower PCB body burden than older fish, but the highest PCB concentrations were detected in young 2011 fish (age of the 2006 fish was not recorded). Generally low levels of PCBs were noted in the remaining 2011 bass samples as compared to the 2006 PCB concentrations in bass, which had a larger number of elevated PCB detections.

Baseline Human Health Risk Assessment

The BHHRA was conducted in accordance with current United States Environmental Protection Agency (USEPA) guidance (USEPA 2014) and supplemented with Oregon Department of Environmental Quality (ODEQ) guidance (ODEQ 2010, 2007), as appropriate. Exposure media included smallmouth bass tissue, crayfish tissue, sediment, and surface water. Receptors and exposure pathways that were evaluated included:

- tribal subsistence fishers consuming smallmouth bass from the entire River OU,
- non-tribal recreational fishers consuming smallmouth bass and crayfish from the entire River OU,
- recreational waders in direct contact with sediments in wadeable portions of the River OU,
- hypothetical swimmers in surface water in the entire River OU, and

- hypothetical downstream users of river water for potable use.

The COPCs for each medium and pathway were selected using a comprehensive process that considered all the data collected from the River OU from 2000 to 2011 and included PCBs, OCPs, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and non-carcinogenic PAHs and selected metals. Risks for fish and shellfish consumption were evaluated using tissue data with the exception of one COPC (dibenzofuran) that was not analyzed for in tissue.

Both reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios were assessed, using current USEPA and ODEQ guidance. Exposure factor values were selected to represent the mean or the upper bounds of the range of exposures. For example, for both subsistence and recreational fishers, it was assumed that 100% of smallmouth bass consumption was from bass collected only from the River OU for 26 years. Similarly, swimmers and waders were assumed to spend every weekend of the year in the River OU for 26 years. Adults and children were evaluated for all pathways. In addition, exposure of nursing infants who might be exposed to COPCs through ingestion of maternal milk was considered for selected COPCs using ODEQ's screening-level risk methodology.

Toxicity values for all COPCs were selected using USEPA's hierarchy of sources (USEPA 2015a, b). PCBs were evaluated using three separate forms of analysis and measurement, expressed as Total PCBs as Aroclors (PCB-Aro), Total PCBs as Congeners (PCB-Cong) and dioxin-like PCBs toxicity equivalence (PCB-TEQ). Excess lifetime cancer risk (ELCR), noncancer hazard quotient (HQ), and summed hazard index (HI) were reported for all chemicals without PCBs and for all COPCs including each type of PCB measurement. ELCR and HI for each receptor-pathway combination were characterized with regard to whether they were less than:

1) the USEPA risk level of 1 x 10^{-6} (also expressed as one in a million) or a HI of 1, whereby risk at or below this threshold has an insignificant contribution to risk (i.e., *de minimis*);
2) within the USEPA acceptable risk range of 1 x 10^{-6} to 1 x 10^{-4} (greater than one in one million to one in a hundred thousand) or
3) exceeding the USEPA acceptable risk range, i.e., greater than 1 x 10^{-4} (greater than one in a hundred thousand).

ODEQ's acceptable risk levels of 1 x 10^{-6} for individual chemicals and 1 x 10^{-5} for multiple chemicals with similar modes of action (e.g., cPAHs, PCBs) were also considered.

Risks for smallmouth bass consumption for both subsistence and recreational consumers exceeded the USEPA acceptable risk range for adults, children, and nursing infants. Crayfish consumption risks, risks to waders in direct contact with sediments, and risks for potable water users were generally within the USEPA acceptable risk range. Risks were *de minimis* for swimmers and potable water users of surface water, when taking into consideration that arsenic levels are lower than federal maximum contaminant levels (MCLs) and the state water quality criterion.

RBCs were calculated for the subset of chemicals of concern (COCs) associated with risks that were greater than 1 x 10^{-6} (based on ODEQ's *de minimis* threshold for individual chemicals) or noncancer HQ greater than 1, for any receptor-pathway combination. Bioaccumulation-based

RBCs were also calculated for sediment using site-specific biota-sediment accumulation factors. Individual locations of smallmouth bass, crayfish, and sediment samples that exceeded their RBCs are illustrated in Figures 2-4 to 2-6.

Based on a visual review of RBC exceedances, PCBs were the COCs that contributed to the greatest number of locations exceeding their RBCs and the greatest magnitude of exceedance above the RBCs for smallmouth bass, crayfish tissue, and bioaccumulation in sediment. Although all three types of PCB measurements were in general agreement on risk levels, the highest level of confidence is placed in the PCB-TEQ results.

OCPs (primarily gamma chlordane and dieldrin) also contributed to exceedances at a limited subset of locations that were co-located with PCB exceedances. A few other COCs (mercury, endrin, DDE, cPAHs) had relatively minor exceedances at a few locations in smallmouth bass. Overall, the spatial distribution of high magnitude exceedances of PCB and selected OCPs for smallmouth bass and sediment is primarily along the north shore and eastern tip of Bradford Island, and at one location in Goose Island Slough with particularly high PCBs (location 78).

Other relatively minor exceedances in crayfish tissue and sediment (direct contact) were noted for arsenic and cPAHs.

After review of the overall risk results and spatial distribution and magnitude of RBC exceedances, the COCs that were identified for further evaluation in the River OU FS were:

- Smallmouth bass tissue (tribal subsistence and non-tribal recreational consumption) – PCBs, gamma chlordane, dieldrin
- Crayfish tissue (non-tribal recreational consumption) – PCBs
- Sediment (bioaccumulation to fish) – PCBs
- Sediment (direct contact) – None
- Surface water (swimming, hypothetical potable use) – None

The estimated risks for the fish consumption scenario are based on exposures that are intended to be highly conservative in order to evaluate whether additional evaluation or action is warranted.. Use of the fish tissue data comes with several uncertainties as noted below. Many of the recreational (e.g., swimming in the River OU) and potable use exposures and assumptions are hypothetical in nature and do not actually occur under current conditions. ELCRs are only expressions of likelihood of cancer incidence, and HIs are estimated ratios to safe doses. Therefore, exceedance of the USEPA acceptable risk range or designation of a particular chemical as a COC does not automatically mean that adverse effects may have occurred or will occur in the future.

Baseline Ecological Risk Assessment

The entire River OU, including the Forebay and targeted samples near Eagle Creek and Goose Island, was retained for evaluation in the BERA. Sediment and the various tissue types that have been collected (clams, crayfish, sculpin, and smallmouth bass) were identified as media of concern for ecological receptors in the riverine environment.

The following list of receptors and exposure pathways identified in the RI/Management Plan (MP) were included in the River OU BERA:

- Benthic invertebrates exposed through direct contact with surface sediment.
- Fish exposed through direct contact and prey ingestion.
- Bald eagle (*Haliaeetus leucocephalus*) exposed through ingestion of surface water and prey (100% predatory fish).
- Osprey (*Pandion haliaetus*) exposed through ingestion of surface water and prey (100% predatory fish).
- American mink (*Neovison vison*) exposed through incidental ingestion of surface sediment and ingestion of surface water and prey (33% benthic invertebrates, 33% invertivorous fish, and 33% predatory fish).

The final list of CPECs that was carried into the BERA includes PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs), metals, PAHs, butyltins (direct toxicity only), OCPs, and SVOCs. This list is further subdivided into CPECs specific to each receptor group (benthic community [e.g., shellfish], fish, birds, and mammals) and medium (i.e., sediment and/or tissue). The sediment CPECs for the benthic community were evaluated for direct toxicity to this receptor group, the tissue CPECs for fish, birds, and mammals were evaluated for toxicity via dietary exposure, and fish were evaluated for both direct contact and dietary exposure.

Given the low mobility of benthic organisms, each sample location was considered an individual exposure unit (EU) for clams and crayfish. The invertivorous fish (sculpin) is more mobile but is highly territorial with a relatively small foraging range. Therefore, the exposure units were estimated as 0.1-mile increments of River OU shoreline, which resulted in eight individual EUs for the sculpin. For the predatory fish (smallmouth bass), the size of their foraging range is similar to the size of the River OU, and so the entire River OU from the Bonneville Dam to the northern tip of Goose Island was considered one EU for the bass. For the osprey, eagle, and mink, receptor-specific area use factors were calculated as the River OU site size divided by the size of the home range, resulting in site use estimates of 71%, 86%, and 65%, respectively.

Two types of toxicity benchmarks and toxicity reference values (TRVs) from the literature were used to develop an upper- and lower-bound risk estimate for each target receptor: 1) no-observed-adverse-effects concentration or level (NOAEC or NOAEL), and 2) lowest-observed-adverse-effects concentration or level (LOAEC or LOAEL). To help facilitate the risk interpretation process, receptor-specific RBCs were calculated for sediment and tissue for the identified CECs (i.e., CPECs with elevated exposure level/toxicity level ratios), so that exceedances of these RBCs could be illustrated on the River OU map. The RBCs are also meant to be applied in the FS during the selection of the final preliminary remediation goals (PRGs) for the River OU. To protect local populations of osprey, eagle, and mink, LOAEL-based RBCs were calculated. LOAEC-based RBCs were calculated to protect the benthic community, and NOAEC-based RBCs were calculated to protect fish at the individual level due to the potential presence of listed fish species in the River OU.

The following CECs identified through the BERA are recommended for further evaluation in the River OU FS:

- Benthic community – PCBs (PCB-Aro and PCB-Cong) and high molecular weight PAHs (HPAHs)

- Fish community – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for fish) and OCPs (gamma-chlordane, dieldrin, endrin, and endosulfan I)
- Piscivorous birds – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for birds) and OCPs (dieldrin)
- Mink – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for mammals)

Through visual observations of RBC exceedances, it is evident that the area of concern in the River OU that should comprise the focus of further evaluation in the FS is primarily confined to the former source areas on the north shore of Bradford Island, including the eastern tip of the island.

Similar to the BHHRA findings, PCBs were the CECs that contributed to the highest risk levels and greatest number of exceedances in all media evaluated in the BERA, with the exception of clam and crayfish tissue for which no CECs were identified. Maximum concentrations of OCPs were co-located with PCBs on the north shore of Bradford Island, adjacent to former underwater debris piles that were removed in 2000 and 2002, and also in one isolated detection on the northeastern tip of Goose Island. OCP compounds are not infrequently confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. However, co-location with elevated PCBs in tissue, lack of uniform levels of OCPs throughout the River OU, and lack of OCP detections above the sediment RBCs creates an uncertainty as to whether OCPs are site-related.

1.0 INTRODUCTION

This report presents the River Operable Unit (OU) baseline human health risk assessment (BHHRA) and baseline ecological risk assessment (BERA) for the Bradford Island, Bonneville Dam Complex. The Portland District of the United States Army Corps of Engineers (USACE) has characterized and evaluated the contamination arising from historical practices at Bradford Island in Oregon. Bradford Island is part of the Bonneville Dam Complex, which is located on the Columbia River at river mile (RM) 146.1, approximately 40 miles east of Portland, Oregon (Figure 1-1). The site is a multipurpose facility that consists of the First and Second Powerhouses, the old and new navigation locks, and a spillway with a capacity of 1.6 million cubic feet per second (USACE 2000). Figure 1-2 shows features of the Bonneville Dam Complex.

Site investigations on Bradford Island began with the Landfill. The Landfill was used from the early 1940s until the early 1980s. The USACE informed the United States Environmental Protection Agency (USEPA) and the Oregon Department of Environmental Quality (ODEQ) of the presence of the Landfill in 1996. The Landfill was added to the ODEQ Environmental Cleanup Site Information (ECSI) database in April 1997, and the Bonneville Dam Project Manager (PM) signed a ODEQ Voluntary Cleanup Agreement letter for the Landfill in February 18, 1998, under the ODEQ Voluntary Cleanup Program (VCP). In 2005, USACE continued the investigation of Bradford Island under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The USACE is currently working with the ODEQ to address the state’s concerns regarding this investigation and any associated cleanup.

Numerous investigations have been performed by the USACE and their contractors since 1997, focusing on two OUs: the Upland OU and the River OU (Figure 1-3). Historically, electrical equipment debris was disposed of directly in the river on the north side of the island (Figure 3-5 of the Final Remedial Investigation [RI] Report, URS Corporation [URS] 2012). The electrical equipment debris included light ballasts, electrical insulators, lightning arresters, electrical switches, rocker switches, a breaker box, and electrical capacitors. The electrical debris contaminated the surrounding sediment with polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and metals. The electrical equipment debris was removed in 2000 and 2002 (Appendix E of URS 2002a,b) and a PCB-contaminated sediment removal action was conducted in 2007 (Huang and Associates, Inc. 2007). Residual contaminated sediment, contaminated biota (e.g., fish and shellfish), and potential oil in rock crevices may currently be sources of contamination. Additional contaminants of interest (COIs) include semivolatile organic compounds (SVOCs), butyltins, and a few pesticides and herbicides. Based on site investigations, the River OU is defined as the portion of the Bonneville Dam Forebay that is bounded by the Bonneville Dam and Spillway, the two powerhouses, and the Washington and Oregon side riverbanks of the Columbia River to a point upstream formed by the northern end of Goose Island. Historic sampling supported by hydrologic modeling has demonstrated that sediment from the Forebay is not transported upstream beyond Goose Island at RM 146.8.

The Final RI report (URS 2012) documented the investigation, identified source areas at Bradford Island, defined the nature and extent of the environmental contamination, and identified the contaminants of potential concern (COPCs) for human health and contaminants of potential ecological concern (CPECs) in the media from the two OUs. Based on the screening level risk assessments (RAs) for the River OU that were completed as part of the RI, recommendations were made to either conduct a BHHRA and BERA or proceed directly into a Feasibility Study (FS). Subsequently, additional “pre-FS” sediment, clam, and smallmouth bass data were collected from the River OU and smallmouth bass from the Reference Area in 2011 (Figure 1-4). One of the main purposes for collecting these additional data was to better characterize the link between the Upland OU and River OU by analyzing sediment and tissue of the river for Upland OU COPCs and CPECs, i.e., organochlorine pesticides (OCPs). Based on the results of the “pre-FS” sediment and smallmouth bass sampling, USACE was requested to proceed into baseline human health ecological risk assessment (BHHERA) evaluations.

Tables 1-1 through 1-3 present the summary statistics for the COPCs/CPECs in sediment for the entire River OU, the Reference Area, and River OU human health wader exposure unit (EU), respectively. Tables 1-4 and 1-5 present the summary statistics for the COPCs/CPECs in surface water for the River OU and Reference Area, respectively. Tables 1-6 through 1-8 present the summary statistics for the COPCs/CPECs in tissue for the entire River OU, Reference Area, and ecological sculpin EUs. Sediment and tissue sampling locations are shown in Figure 1-5a for the entire River OU (including the Forebay and targeted Eagle Creek and Goose Island). Figure 1-5b shows a focused view of the Bradford Island north shore area.

The River OU BHHRA and BERA presented herein build upon on the data and findings of the Final RI (URS 2012) and Data Evaluation Technical Memorandum (DETM) (URS 2014) and will serve as an appendix to the River OU FS. Due to the anticipated outcome of the baseline RAs that will document the need for further evaluation of PCBs in an FS, this RA document goes beyond the traditional assessment of the presence/absence of risk. This premise is also the reason multiple rounds of site-specific sediment and tissue data have been collected in support of a robust baseline RA. To maximize use of these site datasets and develop a RA that is most beneficial to the FS, site-specific risk-based concentrations (RBCs) were calculated for the chemicals recommended for further evaluation in the River OU FS (primarily PCBs). Exceedances of these RBCs were illustrated for purposes of risk interpretation and to allow for general observations of potentially impacted areas.

The following topics were presented in the Final RI and DETM reports and are not repeated herein unless an approach has been modified or updated:

- Site Description (RI Section 3)
- Conceptual Site Model (RI Section 4)
- Pre-RI and RI Investigations (RI Section 5 and 6)
- RI Data Quality (RI Section 7)
- RI Screening HHRA Discussion (RI Section 11)
- RI Screening HHRA Tables (RI Appendix M)
- RI Screening ERA Discussion (RI Section 12)
- RI Screening ERA Tables (RI Appendix N)
- RI Data Sensitivity (RI Appendix K)
- RI Uncertainty Section (RI Appendix O)
- DETM Data Management and Processing (DETM Sections 2.1 and 2.2)

- DETM Updated Screening HHRA and ERA for Sediment (DETM Section 2.3)

The methodology for the BHHRA and BERA was originally presented in the Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP) (URS 2007) and recently refined by discussions with ODEQ during meetings in June 2014 and May 2015 and additional telephone calls in July and August 2015.

Only aquatic-related exposure pathways are addressed in this report. The Upland OU to River OU pathways (i.e., potential mass wasting, soil erosion) that were evaluated at a screening level in the Final RI report (URS 2012) were not addressed in the Upland OU baseline RAs. These possible pathways will be considered in the Upland FS or the River FS.

1.1 Report Objectives

The objectives of this report are as follows:

- Conduct a BHHRA and BERA to evaluate whether risks to human and ecological receptors are acceptable at the River OU.
- Identify which chemicals of concern (COCs) for human health/contaminants of ecological concern (CECs) in the River OU need to be addressed in the subsequent FS.
- Identify which COPCs/CPECs require no additional risk assessment and will not be carried forward to the FS.

This report will provide the basis for the River OU FS studies to be reported under a separate cover, the objectives of which will include the following:

- Evaluate potential cleanup alternatives.
- Establish Remedial Action Objectives (RAOs).
- Recommend proposed cleanup remedies.

1.2 Summary of Data Use and Management

In response to ODEQ's 1) concerns about historical sediment data from the north shore of the island being excluded from the RI, and 2) request that additional "pre-FS" sediment, clam, and smallmouth bass samples collected subsequent to the RI be evaluated in the BHHERA, representative historical sediment data from the River OU, RI data, and the 2011 "pre-FS" data were compiled and considered for the BHHERA.

As agreed upon with the ODEQ, URS treated all "estimated maximum possible concentration" (EMPC) PCB data as detect for the BHHERA. Accordingly, as a first step in compiling this BHHERA data set, URS re-processed the PCB congener RI data, changing the EMPC treatment from non-detect to detect, and treated all the "pre-FS" PCB congener EMPC data as detect.

In order to discern what historical sediment samples were representative, URS developed data management rules to apply to the historical "pre-RI" data, in conjunction with the "pre-FS" and RI data, to identify which historical data were representative and qualified for inclusion in the BHHERA. In developing data management rules, URS considered data recency, quality, method of collection (composite versus discrete), and location. Data collected along the north shore of

Bradford Island, which was subject to removal actions, were also evaluated. These data management rules are detailed in Section 2.1 of the DETM (URS 2014).

As described in Section 2.2 of the DETM (URS 2014), URS then processed the representative historical sediment data and the 2011 “pre-FS” data according to the RI Report data management rules (see Section 5.1 of the RI Report [URS 2012]), (i.e., primary and field duplicate averaging and calculated summation rules).

To summarize, this expanded BHHERA data set includes:

- Representative historical “pre-RI” River OU Forebay sediment samples (2003-2007)
- RI surface water, sediment, and tissue samples:
    - River OU Forebay surface water (2008)
    - River OU Forebay random sediment, clam, crayfish, sculpin (2008)
    - River OU Goose Island sediment, clam, crayfish, sculpin (2009)
    - River OU Eagle Creek sediment (2008)
    - River OU smallmouth bass (2006)
    - Reference Area sediment, clam, crayfish, sculpin (2008)
- “Pre-FS” sediment and tissue samples:
    - River OU sediment, clam, and smallmouth bass (2011)
    - Reference Area smallmouth bass (2011)

1.3 Organization

This report is organized as follows:

Executive Summary

Section 1 – Introduction

Section 2 – BHHRA

Section 3 – BERA

Section 4 – Summary

Section 5 – References

2.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The purpose of this BHHRA is to further evaluate the receptors, media, and COPCs identified for the River OU. The findings of this BHHRA were used to estimate cancer risk and noncancer hazards to the selected receptors, and identified, in combination with the BERA, COCs and pathways that should be retained for further evaluation in the River OU FS.

The BHHRA follows the methods described in the RI/FS MP (URS 2007) and the specific and general updates noted in the DETM (URS 2014). The BHHRA approach primarily follows USEPA guidance (1989, 1991, 1992a, 1993a, 2002a, 2002b, 2004, 2014, 2015a). ODEQ (2010) guidance documents were used during the RI HHRA screening process and are also considered in the BHHRA.

Overall, the BHHRA represents the last step in the risk assessment process whereby chemicals detected in site media are first designated as COIs at the start of the RI process. COIs are compared to various background-based and risk-based screening levels to develop a shorter list of COPCs that are quantitatively assessed in this BHHRA for their associated health risks. At the end of the BHHRA, COPCs whose risks or hazards exceed target risk levels are identified as COCs. These COCs are considered further in the context of the risk levels, spatial distribution, and other site information to develop a short list of COCs that are recommended for further evaluation in the River OU FS.

In addition to the methodology and data management updates listed in Section 1.2, the following updates were implemented in this BHHRA:

- For the recreational wader's exposure to sediment, a subset of the dataset based on wadeable locations in the River OU was created and used for this pathway.
- Exposure factors were updated based on changes in the USEPA 2015 Regional Screening Levels (RSL).
- Fish and shellfish consumption risks were estimated based only on tissue concentrations, although COPCs for this pathway were identified on the basis of both sediment and tissue data.

2.1 Exposure Media and COPCs

The biotic and abiotic contaminated media covered in this report include finfish, which are represented by smallmouth bass tissue; shellfish, which are represented by crayfish tissue; sediment; and surface water. The COPC selection process for the BHHRA was exhaustive and comprehensive and includes consideration of COPCs identified in the RI (URS 2012), the sediment DETM (URS 2014), and fish tissue data collected in 2011 (URS 2011). No COIs defined in the RI were eliminated solely on the basis of detection frequency, and all COIs detected in tissue and sediment were retained for consideration as COPCs.

The COPC selections were initially conducted in the RI using a more limited dataset. Table 11-3 of the RI identified the exposure media (soil, groundwater, and soil gas) and the recommended COPCs based on the screening level HHRA. The COPC list was augmented as needed based on updates to the dataset and in response to comments from ODEQ. There were no updates for surface water data collected in 2008.

Tables 2-1 and 2-2 present the supplemental COPC selection for sediment and tissue, respectively, as described in the DETM (URS 2014) and included the following steps:

- Chemicals present in the expanded sediment data set whose maximum concentrations exceeded sediment screening values for fish consumption and whose associated concentrations in tissue also exceeded tissue screening levels for fish consumption (using ODEQ's multi-pathway COPC selection process) were retained as COPCs for the BHHRA.
- Chemicals without fish consumption screening levels that were present in sediment and tissue were retained as COPCs.
- Inorganic chemicals in River OU sediment whose maximum concentrations did not exceed Upper Prediction Limits (UPLs) for the reference area were not retained as COPCs.

Table 2-3 summarizes the additional COPCs added by receptor and media and the final list of COPCs included in this BHHRA, as discussed below. Like the COI selection in the RI, frequency of detection was not a criterion for COPC selection for any River OU media.

Smallmouth Bass Tissue. COIs detected in smallmouth bass tissue were all selected as COPCs with the exception of bis(2-ethylhexyl) phthalate, which is included as a COPC for Tribal Subsistence Fisher but was screened out and is not a COPC for the Non-Tribal Recreational Fisher. The COPCs are as follows:

- <u>Metals:</u> aluminum, antimony, barium, chromium, copper, mercury, zinc
- <u>PCBs:</u> evaluated as Total PCBs as Aroclors (PCB-Aro), Total PCBs as Congeners (PCB-Cong), and dioxin-like PCBs using the mammal toxicity equivalence (PCB-TEQ-Mam)
- <u>Pesticides:</u> 4,4'-dichloro-diphenyl-dichloroethane (DDD), 4,4'-dichloro-diphenyl-dichloroethene (DDE), 4,4'-dichloro-diphenyl-trichloroethane (DDT), BHC (beta), BHC (gamma) Lindane, chlordane (alpha), chlordane (gamma), dieldrin, endosulfan I, endrin, endrin aldehyde, and methoxychlor
- <u>SVOCs:</u> bis(2-ethyhexl) phthalate (Tribal Subsistence Fisher only), dibenzofuran, p-cresol (4-methylphenol)
- <u>Carcinogenic PAHs (cPAHs)</u>

Crayfish Tissue. The COPCs are as follows:

- <u>Metals:</u> arsenic
- <u>SVOCs:</u> dibenzofuran
- <u>PCBs:</u> evaluated as PCB-Cong and PCB-TEQ-Mam

Dibenzofuran was retained as a tissue COPC because it was identified as a bioaccumulative sediment COPC that was not analyzed for in tissue. Because of the lack of toxicity values for this chemical and the uncertainties inherent in sediment-tissue relationships, this COPC is discussed in the uncertainty section.

Sediment. Sediment is evaluated for direct contact exposure (i.e., incidental ingestion and dermal contact) in the BHHRA and for contribution to exposure through bioaccumulative pathways. For direct contact only, all the COIs detected within the wadeable locations in the River OU (See Figure 2-1) were retained in the final COPC list for sediment; therefore, if a previously identified COPC was not detected in the subset of the dataset for wadeable locations, the COPC was not considered for this pathway. The wadeable locations were based on a surface water pool depth of 10 feet or less below the normal pool elevation (74 feet) of the Columbia River for the Bradford Island area (USGS 1994) to allow for seasonal variation and dam operations. Table 1-3 contains the dataset for the recreational wader. The COPCs are as follows:

- Metals: antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, silver, thallium, vanadium, and zinc
- PCBs: evaluated as PCB-Aro, PCB-Cong, and PCBs as mammal TEQ
- Butyltins: dibutyltin dichloride and tributyltin chloride
- Pesticides: 4,4'-DDE, 4,4'-DDT, benzene hexachloride (BHC) (gamma) Lindane, chlordane (gamma), endrin, endrin aldehyde, and endrin
- TPH: diesel range organics
- SVOCs: bis(2-ethyhexyl) phthalate, butyl benzyl phthalate, carbazole, di-n-butyl phthalate, p-cresol (4-methylphenol), and phenol
- PAHs: cPAHs, anthracene, fluoranthene, fluorene, phenanthrene, pyrene, acenaphthene, and fluorene

As described above, the COPCs identified for sediment based on the bioaccumulation pathway were used primarily to identify tissue COPCs (see Table 2-1 to 2-3). With the exception of bioaccumulative sediment COPCs that were not analyzed for in tissue (i.e., dibenzofuran), sediment data were not used to directly evaluate risks by the bioaccumulation pathway due to the availability of tissue data.

Surface Water. The COPCs are as follows:

- Metals: arsenic
- PCBs: evaluated as PCB-Cong and PCB-TEQ-Mam

2.2 Receptors and Exposure Pathways

The human health conceptual exposure model (CEM) depicted in Figure 2-2 presents potential exposures of human receptors to various media (i.e., finfish and shellfish tissue, sediment, and surface water). For all receptors, the entire River OU (including Forebay, Goose Island, and the mouth of Eagle Creek) was generally considered the EU. Those receptors and pathways that were recommended for further evaluation at the end of the RI (URS 2012) are described in this section.

The receptors, exposure pathways, and noteworthy exposure factors are discussed below.

Tribal Subsistence Fisher

Treaty rights allow members of the four treaty tribes to fish at usual and accustomed locations on the Columbia River. The tribes include the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Warm Springs Reservation, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation, and are referred to herein as the four treaty tribes. Bradford Island is a historic customary fishing location. The Tribal Subsistence

Fisher may have exposure though consumption of anadromous and resident fish. Subsistence activity is expected to occur year-round.

Non-Tribal Recreational Fisher

Recreational users may include non-tribal sport fishers in the area. Both tribal and non-tribal members of the public may also engage in water-based sporting activities.

A stakeholder survey was conducted for the Bonneville Dam area (Jones and Stokes 2006). The most popular recreational activities in the area are boating and fishing. Jet-skiing, kayaking, and canoeing were also mentioned as preferred activities by respondents in the survey. Therefore, in addition to consumption of sport fish such as smallmouth bass and occasional consumption of shellfish such as crayfish, exposure by direct contact to COPCs in wadeable sediments and in surface water of the River OU may occur. Please note: for exposure scenarios involving consumption of shellfish, which is the terminology used in ODEQ's 2007 sediment guidance, the BHHRA used the crayfish data as a surrogate for all "shellfish." Therefore, these shellfish and crayfish are used interchangeably herein.

Recreational Wader

Wading and swimming were not identified as popular activities within the River OU, but cannot be ruled out. Wadeable areas along the north shore of Bradford Island are limited due to the steep slopes. Anglers are known to wade while fishing near the mouth of Eagle Creek, which is within the backwater area of the dam, and so could have received sediments by current transport. It is also possible that anglers may boat across to Goose Island and fish from the shoreline of the island.

Hypothetical Recreational Swimmer

The swimmer scenario was selected to represent the hypothetical worst-case recreational exposure to surface water. The activity is prohibited in the River OU under current and future conditions due to the proximity to dam and spillway operations. Fishermen may occasionally go into the water for short periods to pull up nets.

Hypothetical Downstream Potable Water User

Surface water data were evaluated for a hypothetical resident downriver who may use unfiltered river water for potable water use. Residential uses include ingestion and dermal contact. There were no volatile COPCs and, therefore, the inhalation pathway was not complete.

Nursing Infant

The nursing infant was added as a new receptor to the BHHRA, following the publication of ODEQ’s HHRA guidance (ODEQ 2010). This receptor may be exposed to selected bioaccumulative COPCs in maternal milk during the first year of life.

2.3 Exposure Assessment

Quantifying exposure involves estimating chemical intake rates based on the evaluation of chemical releases from the site and estimation of exposure point concentrations (EPCs) for specific pathways. Two exposure scenarios were considered: a reasonable maximum exposure (RME) and a central tendency exposure (CTE). RME represents people who fall within the high (but still realistic) end of the exposure distribution (approximately the 95th percentile). The CTE represents individuals who have average exposure to environmental media.

The methods for calculating potential chemical intakes from fish tissue, sediment, and surface water for the populations and exposure pathways selected for quantitative evaluation primarily followed USEPA guidance and also considered ODEQ guidance, as appropriate. The risk-based screening values from ODEQ and USEPA that were used in the risk screening performed in the RI were based on intentionally conservative exposure assumptions. For this BHHRA, the selected values for the various exposure factors represent a combination of site-specific values (e.g., fish ingestion rates, exposure frequencies, and durations) and agency-suggested defaults (e.g., adult and child body weights). This is appropriate for baseline risk assessments, which are meant to provide a more site-specific and realistic evaluation of risks. Exposure factor values are drawn from the Risk Assessment Guidance for Superfund (RAGS) Part A (USEPA 1989) and all succeeding guidance documents including USEPA's most current updates to exposure factors (USEPA 2014). ODEQ's HHRA guidance and current tables for Calculating Risk-Based Concentrations for Individual Chemicals were also consulted (ODEQ 2010, 2012).

There is generally close agreement between the USEPA and ODEQ for the exposure factor values. Where exposure factor values are not available from the USEPA, ODEQ's recommended values were used. The ODEQ (2010) CTE exposure factors were the primary source of CTE values for this BHHRA.

2.3.1 Exposure Factors

For all receptors, both child and adult were evaluated. For media with COPCs that are recognized by ODEQ (2010) to be present in breast milk, the Nursing Infant cancer risk and noncancer hazard were also evaluated for those chemicals.

Table 2-4.1 presents the RME and CTE exposure factors for the Tribal Subsistence Fisher. Table 2-4.2 presents exposure factors for the Non-Tribal Recreational Fisher. Table 2-4.3 presents exposure factors for the Non-Tribal Recreational Wader exposure to sediment. Table 2-4.4 presents exposure factors for the Non-Tribal Recreational Swimmer to surface water. Table 2-4.5 presents exposure factors for the Hypothetical Downstream Potable Water User.

Tribal Subsistence Fisher

Fish consumption is the pathway of greatest interest for the River OU. Bioaccumulation and biomagnification are of primary interest because of the potential for chemical transfer through the food web (i.e., people may consume food that may have higher tissue residues of bioaccumulative chemicals). Thus, even though the people may not be directly exposed to chemicals in sediment or water, they may still be adversely affected because of their indirect exposure to these chemicals through consumption of fish, shellfish, or other food items.

The RI/FS MP (URS 2007) provides a detailed explanation of the literature research and local studies that supported how the fish and shellfish ingestion pathways were evaluated. Key objectives were the selection of representative species that are consumed, site-specific ingestion rates (intake), and the local habits that influence exposure, especially for the Tribal Subsistence Fishers.

Although salmon is the most popular finfish for the Tribal Subsistence Fisher, its migratory nature makes it a poor candidate for a site-specific risk assessment. Among the species considered, the smallmouth bass is a resident species that is known to occur in the River OU. It has a small home range and high fidelity to its range and, therefore, has the potential to spend its entire lifetime in the River OU. It is a trophic level 3/4 species feeding on smaller fish such as sculpin, peamouth, and juvenile fish, as well as crayfish and insect larvae. All these characteristics make it likely that the smallmouth bass is a fish species that may represent reasonable maximum exposure to COPCs. It is also extremely popular with sport fishers, non-tribal high consumption anglers, and also, to some extent, tribal fishermen. For these reasons, the smallmouth bass was selected as the finfish species used to estimate exposure doses for the fish consumption scenario for all receptors.

Although shellfish consumption appears to be relatively minor or minimal relative to finfish consumption, crayfish were selected as the shellfish species to represent this dietary item. Crayfish are known to occur in the River OU. They have a large home range and may be exposed to COPCs from sources other than the River OU. However, they are included in this evaluation to provide a comprehensive estimate of the potential exposure pathways for non-tribal recreational users.

For the tribal subsistence fisher, the Columbia River Intertribal Fish Commission (CRITFC) consumption study (CRITFC 1994) provided information on the fish species that are popular with tribal fishermen and their consumption rates. A recent survey of 43 stakeholders for the Bonneville area was also useful (Jones and Stokes 2006). Respondents generally fished from a minimum of two to three locations. None of the tribal respondents referred to consumption of shellfish or crayfish from the area. Therefore, shellfish ingestion was not considered for the Tribal Subsistence Fisher.

Exposure duration (ED) may range from as low as 3 years to a maximum of 26 years, consistent with typical residential EDs (ODEQ 2010, USEPA 2014). As described in the Human Health Risk Assessment work plan presented in Appendix B of the approved RI/FS MP (URS 2007), data collected from the CRITFC survey (1994) as well as other sources were used to derive CTE and RME daily ingestion rates for resident finfish (as represented by the smallmouth bass) which ranged from 4.9 to 18.3 grams per day for the child and from 15.8 to 43.8 grams per day for the adult.

Non-Tribal Recreational Fisher

The Non-Tribal Recreation Fisher may be exposed through ingestion of smallmouth bass and crayfish tissue. Local surveys were used to derive daily ingestion rates for finfish which ranged from 2.6 to 13.1 grams per day for the child and 4.2 to 23.3 grams per day for the adult. For shellfish, the ingestion rates ranged from 1.14 to 5.7 grams per day (child) and 3.3 to 17.9 grams per day (adult). This is an annualized ingestion rate applied 365 days per year.

Wader and Swimmer

Waders and swimmers may be tribal and non-tribal members of the public. The selected Wader and Swimmer CTE and RME EDs range from 5 to 150 days a year over a period of 3 to 26 years. Each activity was assumed to occur once a day for 30 minutes to 1 hour. The noted activities for the recreational users were functionally evaluated in this BHHRA as follows:

- **Wader** may be exposed by direct contact with sediment (i.e., incidental ingestion and dermal contact in wadeable areas [See Figure 2-1]).

- **Swimmer** may have direct contact with surface water (i.e., incidental ingestion and dermal contact) in the entire River OU.

Hypothetical Downstream Potable Water User

Typical residential exposure frequencies of 350 days a year were used with EDs between 3 to 26 years. Selected water ingestion rates ranged from 0.78 liters per day (child) to 2.5 liters per day (adult), per USEPA (2014) and ODEQ (2010) guidance. Typical showering values were used.

Nursing Infant

This receptor was evaluated only for selected relevant bioaccumulative COPCs (PCBs and DDTs) using default exposure assumptions and risk adjustment factors that are contingent upon the mother's exposures and risks. The Nursing Infant was assumed to be exposed to COPCs in maternal milk for a default period of 12 months (ODEQ 2010).

2.3.2 Exposure Point Concentrations

The EPC is a chemical-specific and media-specific value that represents the RME or CTE of the concentration to which a receptor is exposed.

As described in Appendix A of the RI/FS MP (URS 2007) and in accordance with the most recent USEPA guidance regarding statistical methodology to be used in EPC estimation (USEPA 2002a, 2013), the 95th percentile (%) upper confidence limit (UCL) on the mean in a given medium (95% UCL) was used as the EPC representing the RME. Where sample sizes are less than eight, the maximum or single location data may be used, as appropriate. As previously agreed, the 95% UCL is also acceptable to ODEQ and is more conservative than ODEQ's suggested 90% UCL. The EPC representing the CTE scenario also used the 95% UCL (USEPA 1992b). The EPCs were estimated using statistical methods and values recommended by USEPA's ProUCL software (USEPA 2013), as represented in the RI (URS 2012):

> **Tissue:** The lower of the maximum and 95% UCL for the entire River OU was used as the EPC for both smallmouth bass tissue and crayfish.
>
> **Sediment:** The lower of the maximum and 95% UCL from the wadeable areas was used as the EPC.
>
> **Surface Water:** There were only five surface water samples and therefore the maximum detected concentration was used for the EPC.

Please note: when calculating the 95% UCL using the ProUCL software, the software may recommend a method and value for the 95% UCL that is a higher percentile (e.g., recommending a 99% UCL). The UCL recommended by the proUCL software was selected, regardless, following USEPA's statistical methodology guidance (2013). For simplicity and clarity, the term used throughout the text is "95% UCL"; however, the specific UCLs recommended by ProUCL are shown in Tables 1-1 through 1-8.

2.3.3 Dose Estimation

The overall dose for each receptor and exposure pathway depends on receptor-specific exposure factors (Tables 2-4.1 through 2-4.5) and the concentration of the chemical in the exposure medium. Once the dose is calculated, it can be applied to chemical-specific toxicity data to estimate either cancer risk or noncancer health hazard. The following equations are examples of the cancer risk and noncancer health hazard equations that include the intake dose. This example is from the BHHRA for the adult fish ingestion pathway. The equations and variables vary for the different receptors, media, and exposure pathways and are presented and defined in their respective tables in Appendix B.

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Where,

SF_o	=	Slope Factor (oral): (milligram/kilogram [mg/kg]-day)$^{-1}$
C_{fish}	=	COPC Concentration in fish: mg/kg
IRF_a	=	Fish Ingestion Rate (adult): mg/day
EF	=	Exposure Frequency: day/year
ED_a	=	Exposure Duration (adult): years
CF_o	=	Conversion Factor (oral): units dependent
BW_a	=	Body Weight (adult): kg
AT_c	=	Average Time (cancer): days
RfD_o	=	Reference Dose (oral): mg/kg-day
$AT_{nc,a}$	=	Average Time noncancer (adult): days

The Nursing Infant evaluation does not calculate dose for the infant; rather, to calculate the infant's cancer risk and noncancer hazard, the mother's cancer risk and noncancer hazard index (HI) is modified by an Infant Risk Adjustment Factor (IRAF) that is both chemical- and pathway-specific. The Nursing Infant cancer risk and noncancer hazard are calculated using the following equation from ODEQ (2010):

Infant Cancer Risk = Mother's Risk x $IRAF_c$

Infant Noncancer Hazard = Mother's Hazard Quotient (HQ) x $IRAF_{nc}$

It should be noted that for certain scenarios where only the child noncancer HQ is available, the child HQ is modified using the ODEQ Residential Soil (Direct Contact) IRAFs. See Section 2.4 for further discussion on IRAFs.

2.4 Toxicity Values

Toxicity values for carcinogenic chemicals are known as cancer slope factors. For this BHHRA, oral cancer slope factors (SF_o) were used for the ingestion routes. Oral slope factors were also extrapolated for the dermal contact route of exposure, in the absence of dermal-specific values. Oral toxicity values for non-cancer effects, known as RfD_o were used to evaluate the non-cancer effects of both carcinogenic and non-carcinogenic chemicals.

The selection of toxicity values followed the hierarchy of sources that is recommended by USEPA (2003), and represented in the listing provided in USEPA (2015a), as follows:

- Integrated Risk Information System (IRIS) (USEPA)
- Provisional Peer-Reviewed Toxicity Values (PPRTVs) (USEPA)
- Minimal Risk Levels (Agency for Toxic Substances Disease Registry)
- Chronic Reference Exposure Levels (California Environmental Protection Agency)
- Appendices to PPRTVs (USEPA)
- Health Effects Assessment Summary Tables (HEAST)

Toxicity values for most of the COPCs were available from IRIS or as PPRTVs. A few selected COPCs are discussed in more detail below. The toxicity values used in the BHHRA are presented in Table 2-5 and within receptor- and exposure pathway-specific tables of the risk calculations tables in Appendix B.

2.4.1 Nursing Infant Risk

The Nursing Infant risk was evaluated using the ODEQ (2010) approach of applying IRAF for DDx (i.e., DDT, DDD, and DDE) and PCBs to calculate maternal cancer risk and noncancer hazard. ODEQ 2010 assumes that the concentration of a chemical in milk can be calculated from the long-term body burden in the mother and provides IRAFs for conversion of the mother's risk and hazard estimates to Nursing Infant risks and hazards.

The mother's cancer risks for the scenarios included in this BHHRA assume time-integrated exposure during childhood and adulthood. The IRAFs used in this risk assessment are as follows:

(Nursing) Infant Risk Adjustment Factors

Chemical	Fish Ingestion IRAF	Direct Contact IRAF	Source
Carcinogenic IRAFc			
DDT/DDE/DDD	0.007	0.004	ODEQ 2010
Total PCB	1	0.6	ODEQ 2010
PCB-TEQ	1	0.7	ODEQ 2010
Noncancer IRAFnc			
DDT/DDE/DDD	2	0.3	ODEQ 2010
Total PCB	25	4	ODEQ 2010
PCB-TEQ	2	0.3	ODEQ 2010

In general, the IRAF is less than or equal to 1 for carcinogens; therefore, the Nursing Infant risk would be similar to or lower than the mother's cancer risk. However, the noncancer HQ for the Nursing Infant would be greater than the mother's hazards for dietary pathways.

2.4.2 PCBs

Toxicity values for PCB-Aro and PCB-Cong were based on the toxicity values for Aroclor 1254 for the reasons described below. Toxicity values for PCB-TEQ-Mam were based on the dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), since PCB-TEQ-Mam represents the summation of the 12 PCB congeners that exhibit dioxin-like properties and mode of action.

Aroclor 1254 was the most abundant Aroclor mixture among the three Aroclors detected in sediment (Aroclors 1242, 1254, and 1260; Table 1-1) and the two Aroclors detected in tissue (Aroclors 1242 and 1254; Table 1-6). Therefore, the toxicity values for Aroclor 1254 were selected to represent the toxicity of the PCB-Aro.

There are no unique toxicity values available for non-dioxin-like PCB congeners. Because the sum of 209 congeners would be expected to be similar to the general congener composition as the dominant Aroclor (Aroclor 1254) within the sum Aroclor data, the same toxicity values were used for both PCB-Aro and PCB-Cong in this BHHRA. The IRIS (USEPA 2015b) "high risk and persistence; upper-bound slope factor" of 2.0 per mg/kg-day was used for PCB-Aro and PCB-Cong because this is also the representative value for Aroclor 1254. The uncertainty associated with this assumption is discussed further in Section 2.6.9.

IRIS does not list a noncancer reference dose for PCBs and therefore the RfD_o for Aroclor 1254 was used for PCB-Aro and PCB-Cong, which is consistent with USEPA (2015a).

2.4.3 Carcinogenic PAHs

cPAHs were evaluated by the use of Toxicity Equivalence Factors (TEFs) relative to benzo(a)pyrene, as listed below from USEPA (2015a) and ODEQ (2010).

Compound	TEF
Benzo(a)pyrene	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Benzo(ghi)perylene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-c,d)pyrene	0.1

The application of the TEFs derives a single cPAH concentration that is equivalent to benzo(a)pyrene equivalents (BaPeq). The cancer toxicity values (i.e., slope factor) for benzo(a)pyrene were then used to calculate cancer risk for cPAHs.

2.4.4 Mutagenic Mode of Action

Certain cPAHs are considered to be mutagenic in activity and may be more potent during early-life-stage exposures. The USEPA guidance (USEPA 2005) and ODEQ's RBCs include mutagenic considerations. Mutagenic toxicity was assumed for the risk estimation process for cPAHs consistent with USEPA (2015a) methods.

The following equation was used for mutagenic risk. See Section 2.3.3 for general definitions of terms and Tables 2-4.1–2-4.5 for receptor specific values.

$$Risk = SF_O \times \Bigg[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRF_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRFc \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRF_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRF_a \times ED_{16-26} \times ADAF_{16-26}}{BW_a \times AT_c \times 365\ days/year}\right)\Bigg]$$

The following age-dependent adjustment factors (ADAFs) and EDs were used:

Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	dimensionless
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	dimensionless
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	dimensionless
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-26}$	1	dimensionless
Exposure Duration, child 0-2	ED_{0-2}	2	years
Exposure Duration, child 2-6	ED_{2-6}	4	years
Exposure Duration, child 6-16	ED_{6-16}	10	years
Exposure Duration, adult 16-26	ED_{16-26}	10	years

2.5 Risk Characterization

The BHHRA evaluated the receptors over the entire River OU EU and the Wadeable Areas EU. The estimated lifetime cancer risk (ELCR) is an estimated probability of developing cancer based on conservative exposure factors. The noncancer HQ and its multi-chemical sum, the HI, are simple ratios of acceptable dose levels to estimated doses for each site-specific pathway. Both ELCR and, if appropriate, noncancer hazards were estimated for carcinogenic COPCs. For noncarcinogenic COPCs, only noncancer hazards were estimated.

CTE estimates are presented to provide a range and represent the average exposure, whereas RME represents more conservative, upper-bound reasonable maximum estimates. RME and CTE risk and hazards were estimated for each receptor and their exposure pathways as presented in the CEM (Figure 2-1). For this BHHRA, the numerical values use notation (i.e., cancer risk or very small values) in the format convention 1×10^{-6}. Per USEPA (1991), an ELCR of 1×10^{-6} or less is considered *de minimis* risk (i.e., the probability of an individual developing cancer due to this exposure is one in a million). A noncancer HI of less than 1 is also acceptable since the concentrations are cumulatively below harmful levels. USEPA (1990, 1991) uses the cancer risk range of 1×10^{-6} to 1×10^{-4} as an acceptable risk range and an ELCR greater than 1×10^{-4} as risk warranting some type of action. For cases where the receptor cancer risk falls within the USEPA acceptable risk range, the risks for chemical groups with a common mode of action (e.g., cPAHs and PCBs) may also be considered in the context of ODEQ's acceptable cumulative risk level of 1×10^{-5} (ODEQ 2010).

In the text, ELCRs and HQs are discussed to one significant figure (e.g., 1×10^{-6} and 2) following USEPA (1989) convention; however, the HQs are reported to two significant figures (e.g., 1.5) in the risk tables following ODEQ (2010) convention. In addition, ELCRs are reported to two significant figures in the tables to facilitate discussion of variations among the three types of PCB measurements used in the BHHRA.

It is important to remember that the estimated risks and hazards are only estimates and are based on intentionally conservative exposure and toxicity assumptions. Exceedance of any particular risk or hazard level does not imply that adverse health effects have already occurred or will occur. The estimates are merely an indication that additional evaluation or action may be warranted. The "*de minimis*" risk level corresponding to the "*point of departure*", as defined by USEPA is equivalent to ODEQ's acceptable risk level for individual carcinogens of 1 x 10^{-6}. USEPA notes that any potential actions to reduce risks at or below *de minimis* levels are generally not warranted because the associated risks to public health are very low. In practice, this is meant to indicate a likelihood that is so low that it cannot be distinguished from background rates. For example, the current background risk of all types of cancer in the U.S. population is 1 in 2 (0.5) for men and 1 in 3 (0.3) for women (American Cancer Society 2015).

Cancer risk is integrated over a person's lifetime and, therefore, for non-occupational exposures such as the scenarios considered in this BHHRA, the estimated exposure for a child is added to the adult exposure and reported as a single value that represents time-integrated exposure for the adult. For noncancer hazard, the estimated HI is greatly influenced by the body weight of the receptor during the time of exposure since that affects the magnitude of the dose. Therefore, in keeping with the comprehensive and site-specific nature of a baseline risk assessment, noncancer hazards were estimated separately for both child and adult exposures in this BHHRA.

For the select COPCs known to be found in breast milk, cancer risk and noncancer hazard were also estimated for the Nursing Infant for the infant milk ingestion pathway consistent with ODEQ (2010) methodology.

The screening level risk assessment in the RI Report (URS 2012) identified PCBs as the primary COPCs for the River OU. Due to different strengths and weaknesses between analytical methods for PCBs, multiple types of PCB data were collected for each medium to support analysis and characterization as well as to provide options for future applications of the data. Cancer risk and noncancer hazard from PCBs are presented as:

- PCB-Aro (estimated risks for data represented as sum of Aroclors)
- PCB-Cong (estimated risks for data represented as sum of 209 PCB congeners)
- PCB-TEQ-Mam (estimated risks for sum of dioxin-like PCB congeners)

To avoid "double-counting" of risks related to the different types of PCB measurements and summations, total risks for each pathway are presented as:

- all COPCs excluding PCBs
- all COPCs including PCB-Aro
- all COPCs including PCB-Cong
- all COPCs including PCB-TEQ-Mam

Thus, risks for all three types of PCB measurements were not summed together but are always presented separately, with and without non-PCB COPCs. Presentation of the results in this manner allows for an understanding of risk contributions for each type of PCB measurement and the contribution from PCBs to total risks for a pathway.

As discussed in Section 2.4.2, the toxicity values used for PCB-Aro and PCB-Cong are the same; variance in risk results is due to differing measured concentrations and/or statistical differences in methodology (e.g., UCL calculation for the EPC). The risk results for PCB-TEQ represent the subset of dioxin-like congeners and their associated toxicity. As discussed further in Section 2.6, the highest level of confidence is placed in the TEQ estimates of PCBs for cancer risk. However, all three types of estimates are presented in the BHHRA to include consideration of all three types of measurement.

Results are presented by receptor type for cancer (RME and CTE) and then noncancer (RME and CTE). Where the receptor cancer risk exceeds 1 x 10^{-6} risk and/or the noncancer HI exceeds 1, the corresponding chemicals with individual risk levels exceeding 1 x 10^{-6} risk or HQ greater than 1 are described further and may be considered as preliminary COCs.

Risk summaries are presented in Tables 2-6.1 through Tables 2-11.4. Tables are grouped by receptor activity, with a set of four tables per receptor group. The first table presents RME child and adult risk, the second presents the RME Nursing Infant risk, the third presents CTE child and adult risk, and the fourth table presents the CTE Nursing Infant risk. A summary of the cancer risk and noncancer hazards for all receptors is presented in Table 2-12. In the tables, ELCRs are shown using scientific notation, as in 1E-06. This is functionally equivalent to the arithmetic notation used in the text, as in 1 x 10^{-6}.

The estimated cancer risks shown in Tables 2-6.1 to 2-11.4 are based on time-integrated exposures to adults and children combined. The noncancer HQs and HIs shown in these tables are based on exposure to children and adults, separately.

Cancer risks (time-integrated) and non-cancer hazards (calculated separately for adulthood exposure only and childhood exposure only) are included in the detailed calculations in Appendix B where the results are shown by individual exposure route and as a cumulative summation.

2.5.1 Tribal Subsistence Fisher

The Tribal Subsistence Fisher, both child and adult, may be exposed through ingestion of finfish, as represented by smallmouth bass data for the River OU EU. Nursing Infant risk from PCBs and DDx are also evaluated. ELCRs are calculated probabilities, and noncancer hazard quotients are calculated ratios of the estimated dose to a reference dose, based on conservative exposure factors, which do not take into account the fish consumption advisories posted for the Bonneville area.

Tables 2-6.1 through Table 2-6.4 present the summary cancer risk and noncancer hazards for the Tribal Subsistence Fisher.

2.5.1.1 Cancer Risk: Tribal Subsistence Smallmouth Bass Fisher

As presented in Table 2-6.1, the RME ELCR for the child and adult, excluding PCBs, was 3E-03, exceeding the USEPA acceptable risk range. COPCs with cancer risk greater than 1 x 10^{-6} were pesticides (4,4'-DDE, chlordane [gamma], dieldrin) and cPAHs. Including PCB-Aro, the risk was 2 x 10^{-2}. Including PCB-Cong, the risk was 3 x 10^{-2}. Including PCB-TEQ-Mam, the risk was 2 x 10^{-2}. All the variants of PCB risks were within the same order of magnitude and in relatively close agreement. PCB-Cong contributed the highest risk of the three. The Tribal Subsistence Fisher child and adult RME cancer risk exceeded the USEPA acceptable risk range (1 x 10^{-4} to 1 x 10^{-6}).

As presented in Table 2-6.2, the Tribal Subsistence Fisher Nursing Infant RME cancer risk, based on the maternal risk, for DDx was 2 x 10^{-8} and is considered an insignificant contributor to risk. Including PCB-Aro, the risk was 8 x 10^{-3}. Including PCB-Cong, the risk was 1 x 10^{-2}.

Including PCB-TEQ-Mam, the risk was 9 x 10^{-3}. The Nursing Infant RME risk was lower than the child and adult, but still exceeded the USEPA acceptable risk range.

As presented in Table 2-6.3, the CTE ELCR for the child and adult, excluding PCBs, was 4 x 10^{-4}, within the USEPA acceptable risk range. COPCs exceeding the ODEQ cancer risk threshold of 1 x 10^{-6} were pesticides (chlordane [gamma] and dieldrin) and cPAHs. Including PCB-Aro, the risk was 2 x 10^{-3}. Including PCB-Cong, the risk was 4 x 10^{-3}. Including PCB-TEQ-Mam, the risk was 3 x 10^{-3}. All the variants of PCB risks were within the same order of magnitude and therefore in general agreement. PCB-Cong contributed the highest risk among the three types of PCB measurements. The Tribal Subsistence Fisher child and adult CTE cancer risk exceeded the USEPA acceptable risk range.

As presented in Table 2-6.4, the Tribal Subsistence Fisher Nursing Infant CTE cancer risk for DDx was 1 x 10^{-9} and an insignificant contributor to risk. Including PCB-Aro, the risk was 4 x 10^{-4}. Including PCB-Cong, the risk was 8 x 10^{-4}. Including PCB-TEQ-Mam, the risk was 5 x 10^{-4}. The Nursing Infant CTE cancer risk was lower than the child and adult risk, but still exceeded the USEPA acceptable risk range.

2.5.1.2 Noncancer: Tribal Subsistence Fisher

As presented in Table 2-6.1, the RME noncancer HI for adult exposures, excluding PCBs, was 12. COPCs exceeding the noncancer HQ of 1 were mercury and pesticides (chlordane[gamma], dieldrin, and endrin). The HQs associated with mercury and endrin were essentially at acceptable levels that would round down to 1 (HQ of 1.3 and 1.5 respectively), based on USEPA's one significant figure convention. Including PCB-Aro, the HI was 692. Including PCB-Cong, the HI was 1,303. Including PCB-TEQ-Mam, the HI was 375. Overall, the Tribal Subsistence Fisher Adult noncancer HI exceeded 1, with the primary contribution from PCBs and minor contributions from chlordane and dieldrin.

As presented in Table 2-6.1, the RME noncancer HI for child, excluding PCBs, was 28. COPCs exceeding the noncancer HQ of 1 were mercury and pesticides (chlordane [gamma], dieldrin, and endrin). Mercury was detected in River OU sediment below the Reference UPLs, and therefore mercury in fish tissue may not be site related. Including PCB-Aro, the HI was 1,542. Including PCB-Cong, the HI was 2,904. Including PCB-TEQ-Mam, HI was 835. All the variants of PCB HIs were within the same order of magnitude and therefore in general agreement. Similar to the cancer risks, PCB-Cong contributed the highest noncancer hazard among the three types of PCB measurements. Overall, the Tribal Subsistence Fisher child noncancer HI exceeded 1.

As presented in Table 2-6.2, the Tribal Subsistence Fisher Nursing Infant RME HI for DDx was 0.01 and an insignificant contributor to risk. The HI for PCB-Aro was 16,985. The HI for PCB-Cong was 32,268. The HI for PCB-TEQ-Mam was 724. The Nursing Infant noncancer HI was much higher than child risk due to the 25-fold IRAF.

As presented in Table 2-6.3, the CTE noncancer HI for adult exposures, excluding PCBs, was 4. COPCs exceeding the noncancer HQ of 1 were the pesticides chlordane (gamma) and dieldrin, with HQs at or slightly above the ODEQ risk threshold (HQs of 1 and 2, respectively). Including PCB-Aro, the HI was 250. Including PCB-Cong, the HI was 470. Including PCB-TEQ-Mam, the HI was 135. Overall, the Tribal Subsistence Fisher Adult noncancer HI exceeded 1, with the primary contribution from PCBs, and minor contribution from dieldrin.

As presented in Table 2-6.3, the CTE noncancer HI for child, excluding PCBs, was 7. COPCs exceeding the noncancer HQ of 1 were pesticides (chlordane [gamma] and dieldrin). Including PCB-Aro, the HI was 413. Including PCB-Cong, the HI was 778. Including PCB-TEQ-Mam, HI was 223. All the variants of PCB HIs were within the same order of magnitude (based on a single significant digit) and therefore in general agreement. PCB-Cong contributed the highest noncancer hazard of the three. The Tribal Subsistence Fisher child noncancer HI exceeded 1.

As presented in Table 2-6.4, the Tribal Subsistence Fisher Nursing Infant CTE HI for DDx was 0.004 and an insignificant contributor to risk. The HI for PCB-Aro was 6,127. The HI for PCB-Cong was 11,640. The HI for PCB-TEQ-Mam was 261. The Nursing Infant noncancer HI was much higher than the child due to the 25-fold IRAF.

2.5.2 Non-Tribal Recreational Fisher

The Non-Tribal Recreational Fisher, both child and adult, are exposed to contaminants through the ingestion of finfish (as represented by smallmouth bass tissue data) and shellfish (as represented by crayfish tissue data) for the River OU EU. Nursing Infant risk from PCBs and DDx are also evaluated. Separate bass and crayfish consumption risks and hazards were calculated for each recreational fisher receptor.

ELCRs are calculated probabilities, and noncancer hazard quotients are calculated ratios of the estimated dose to a reference dose, based on conservative exposure factors, which do not take into account the fish consumption advisories posted for the Bonneville area. The following sections discuss Non-Tribal Recreational Fisher exposed to smallmouth bass tissue and then exposure to crayfish tissue, and finally, exposure to both bass and crayfish.

2.5.2.1 Recreational Smallmouth Bass Fisher

Tables 2-7.1 through Table 2-7.4 present the summary cancer risk and noncancer hazards for the Non-Tribal Recreational Smallmouth Bass Fisher.

2.5.2.1.1 Cancer Risk: Non-Tribal Recreational Smallmouth Bass Fisher

As presented in Table 2-7.1, the RME ELCR for child and adult, excluding PCBs, was 1×10^{-3}, exceeding the USEPA acceptable risk range. COPCs with cancer risk greater than ODEQ’s risk threshold of 1×10^{-6} included pesticides (4,4’-DDE, chlordane [gamma], and dieldrin) and cPAHs. Including PCB-Aro, the risk was 7×10^{-3}. Including PCB-Cong, the risk was 1×10^{-2}. Including PCB-TEQ-Mam, the risk was 8×10^{-3}. All the variants of PCB risks were within one order of magnitude and therefore in general agreement. PCB-Cong contributed the highest risk of the three types of PCB measurements. The Non-Tribal Recreational Fisher child and adult RME cancer risk exceeded the USEPA acceptable risk range.

As presented in Table 2-7.2, Non-Tribal Recreational Fisher Nursing Infant RME cancer risk, based on the maternal risk, was 4×10^{-3} for PCB-Aro, 8×10^{-3} for PCB-Cong, and 5×10^{-3} for PCB-TEQ-Mam; the risk to nursing infants for all variants of PCBs was lower than the child and adult risk, but still exceeded the USEPA acceptable risk range.

As presented in Table 2-7.3, the CTE ELCR for the child and adult, excluding PCBs, was 1×10^{-4}, within the USEPA acceptable risk range. COPCs exceeding the ODEQ cancer risk threshold of 1×10^{-6} included pesticides (chlordane [gamma], and dieldrin) and cPAHs. Including PCB-Aro, the risk was 6×10^{-4}. Including PCB-Cong, the risk was 1×10^{-3}. Including PCB-TEQ-Mam, the risk was 7×10^{-4}. All the variants of PCB risks were within one order of magnitude and therefore in general agreement. The Non-Tribal Recreational Fisher child and adult CTE cancer risk exceeded the USEPA acceptable risk range.

As presented in Table 2-7.4, Non-Tribal Recreational Fisher Nursing Infant CTE cancer risk was 1 x 10^{-4} for PCB-Aro, 2 x 10^{-4} for PCB-Cong, and 1 x 10^{-4} for PCB-TEQ-Mam; risk to nursing infants from all variants of PCBs was lower than risk to the child and adult. PCB-Aro and PCB-TEQ-Mam risks were within the USEPA acceptable risk range, but PCB-Cong exceeded it.

2.5.2.1.2 Noncancer: Non-Tribal Recreational Smallmouth Bass Fisher

As presented in Table 2-7.1, the RME noncancer HI for adult exposures, excluding PCBs, was 6. COPCs exceeding the noncancer HQ of 1 were the pesticides chlordane(gamma) and dieldrin. The HQs associated with these pesticides were low, with HQs of 2 and 3, respectively. Including PCB-Aro, the HI was 353. Including PCB-Cong, the HI was 665. Including PCB-TEQ-Mam, the HI was 191. Overall, the Non-Tribal Recreational Fisher Adult noncancer HI exceeded 1, with the primary contribution from PCBs, and minor contributions from chlordane(gamma) and dieldrin.

As presented in Table 2-7.1, RME noncancer HI for child, excluding PCBs, was 11. Pesticides (chlordane [gamma] and dieldrin) exceeded the noncancer HQ of 1. Including PCB-Aro, the HI was 598. Including PCB-Cong, the HI was 1126. Including PCB-TEQ-Mam, HI was 324. All the variants of PCB HIs were within one order of magnitude and therefore in general agreement. The Non-Tribal Recreational Fisher child HI exceeded 1.

As presented in Table 2-7.2, the Non-Tribal Recreational Fisher Nursing Infant RME HI for PCB-Aro was 8,664. The HI for PCB-Cong was 16,465. The HI for PCB-TEQ-Mam was 369. The Nursing Infant noncancer HI was much higher than the child HI due to the 25-fold IRAF applied to the mother's HQ. Risks and hazards related to DDx were *de minimis* (i.e., HI < 1).

As presented in Table 2-7.3, the CTE noncancer HI for adult exposures, excluding PCBs, was 1; no individual COPCs exceeded the noncancer HQ of 1. Including PCB-Aro, the HI was 64. Including PCB-Cong, the HI was 120. Including PCB-TEQ-Mam, the HI was 34. Overall, the Non-Tribal Recreational Fisher Adult noncancer HI exceeded 1, with the primary contribution from PCBs.

As presented in Table 2-7.3, CTE noncancer HI for child, excluding PCBs, was 2. No individual COPCs exceeded the noncancer HQ of 1. Including PCB-Aro, the HI was 118. Including PCB-Cong, the HI was 222. Including PCB-TEQ-Mam, the HI was 64. All the variants of PCB HIs were within one order of magnitude and therefore in general agreement. The Non-Tribal Recreational Fisher child noncancer HI exceeded 1.

As presented in Table 2-7.4, Non-Tribal Recreational Fisher Nursing Infant CTE HI for DDx was 0.001 and an insignificant contributor to risk. The Nursing Infant CTE HI for PCB-Aro was 1,562. The HI for PCB-Cong was 2,967 and the HI for PCB-TEQ-Mam was 67. Risk from all PCB variants exceeded the noncancer HI of 1 for the nursing infant receptor group. Risks related to DDx were *de minimis*.

2.5.2.2 Non-Tribal Recreational Crayfish Fisher

Table 2-8.1 through Table 2-8.4 presents the summary cancer risk and noncancer hazards for the Non-Tribal Recreational Crayfish Fisher. It should be noted that PCB-Aro data was not available for crayfish tissue.

2.5.2.2.1 Cancer Risk: Non-Tribal Recreational Crayfish Fisher

As presented in Table 2-8.1, RME ELCR for the child and adult, excluding PCBs, was 7 x 10^{-5}, within the USEPA acceptable risk range. Arsenic exceeded the ODEQ cancer risk threshold of 1 x 10^{-6}. Including PCB-Cong, the risk was 8E-05. Including PCB-TEQ-Mam, the risk was 9 x 10^{-5}. Risks calculated from both variants of PCBs were within the same order of magnitude and therefore in general agreement. PCB-TEQ-Mam contributed the higher risk among two types of PCB measurements. The Non-Tribal Recreational Crayfish Fisher child and adult RME cancer risk fell within the USEPA acceptable risk range.

As presented in Table 2-8.2, Non-Tribal Recreational Fisher Nursing Infant RME cancer risk was 2 x 10^{-6} for PCB-Cong and 9 x 10^{-6} for PCB-TEQ-Mam; both were lower than the child and adult risks because arsenic is not considered for the Nursing Infant and only the PCB exposure is presented.

As presented in Table 2-8.3, CTE ELCR for the child and adult, excluding PCBs, was 6 x 10^{-6}, within the USEPA acceptable risk range. No individual COPCs exceeded the ODEQ cancer risk threshold of 1 x 10^{-6}. Including PCB-Cong, the risk was the same at 6 x 10^{-6}. Including PCB-TEQ-Mam, the risk was 7 x 10^{-6}. Both variants of PCB risks were within the same order of magnitude and therefore in general agreement. The Non-Tribal Recreational Crayfish Fisher child and adult CTE cancer risk fell within the USEPA acceptable risk range.

As presented in Table 2-8.4, Non-Tribal Recreational Fisher Nursing Infant CTE cancer risk was 6 x 10^{-8} for PCB-Cong and 2 x 10^{-7} for PCB-TEQ-Mam; both show lower risk to infants than the child and adult receptors. Levels were *de minimis*.

2.5.2.2.2 Noncancer: Non-Tribal Recreational Crayfish Fisher

As presented in Table 2-8.1, the RME noncancer HI for adult exposures, excluding PCBs was 0.4, less than the ODEQ risk threshold. Including PCB-Cong, the HI was 0.6. Including PCB-TEQ-Mam, the HI was 0.7. All variants of PCB HIs were in general agreement. Since the Non-Tribal Recreational Fisher adult noncancer HI was less than 1, hazard levels were *de minimis*.

As presented in Table 2-8.1, the RME noncancer HI for the child, excluding PCBs, was 0.6. Including PCB-Cong, the HI was 1. Including PCB-TEQ-Mam, HI was still 1. All the variants of PCB HIs were in general agreement. Since the Non-Tribal Recreational Fisher child HI was 1, it does not exceed unacceptable risk.

As presented in Table 2-8.2, the Non-Tribal Recreational Fisher Nursing Infant RME HI for PCB-Cong was 5 and for PCB-TEQ-Mam the HI was 0. 7. Only the PCB-Cong noncancer HQ exceeded 1. The Nursing Infant PCB-Cong noncancer HI was much higher than the child HI due to the 25-fold IRAF applied to the mother's HQ.

As presented in Table 2-8.3, the CTE noncancer HI for adult exposures, excluding PCBs, was 0.07, less than the ODEQ risk threshold. Including PCB-Cong, the HI was 0.1. Including PCB-TEQ-Mam, the HI was also 0.1. All variants of PCB HIs were in general agreement. Since the Non-Tribal Regreational Fisher adult noncancer HI was less than 1, hazard levels were *de minimis*.

As presented in Table 2-8.3, the CTE noncancer HI for the child, excluding PCBs, was 0.1. Including PCB-Cong, the HI was 0.2. Including PCB-TEQ-Mam, HI was also 0.2. The Non-Tribal Recreational Crayfish Fisher child noncancer risk is *de minimis*.

As presented in Table 2-8.4, the Non-Tribal Recreational Fisher Nursing Infant CTE HI for PCB-Cong was 0.9 and for PCB-TEQ-Mam the HI was 0.1. Both were insignificant contributors to risk.

2.5.2.3 Non-Tribal Recreational Fisher–Combined Smallmouth Bass and Crayfish Consumption

Since recreational exposure may consist of consuming both bass and crayfish, the combined cancer risk (summing the ELCR for smallmouth bass and the ELCR for crayfish) and noncancer hazard (summing the HI for smallmouth bass and the HI for crayfish) were considered and presented in Table 2-12. In all cases, the risks from only bass tissue were much higher (by nearly two orders of magnitude) than from only crayfish, and the mild increase typically would not vary from the bass tissue-only exposure based on one significant figure. PCB-Aro data was not available for crayfish tissue and therefore only bass tissue results are presented for this analyte.

2.5.3 Wader

The Recreational Wader (both child and adult) generally has direct contact with sediment within the wadeable shorelines of the River OU EU. Nursing Infant risk from PCBs and DDx are also evaluated.

Tables 2-9.1 through Table 2-9.4 present the summary cancer risk and noncancer hazards for the Non-Tribal Recreational Wader

2.5.3.1 Cancer - Wader

As presented in Table 2-9.1, the RME ELCR for this receptor, excluding PCBs, was 2×10^{-5}, which was due to arsenic and cPAHs. Including any of the variants of PCBs did not increase the risk appreciably. The risk falls within the USEPA acceptable risk range. Risk to the Nursing Infant was at or below *de minimis* risk; i.e., at or below ODEQ's threshold of 1×10^{-6} (Table 2.9-2).

As presented in Table 2-9.3, the CTE ELCRs for this receptor all fell below ODEQ's threshold of 1×10^{-6}, with the highest risk including PCB-Cong being 3×10^{-7}. CTE risks to the Nursing Infant were *de minimis*, even with PCBs included (Table 2-9.4).

2.5.3.2 Noncancer - Wader

As presented in Table 2-9.1, the RME HI for the adult wader, excluding PCBs, was 0.1. Including PCB-Aro or PCB-TEQ-Mam did not noticably increase the hazard (HI was still 0.1). Including PCB-Cong resulted in a HI of 0.2. All noncancer adult wader RME HIs were *de minimis*.

As presented in Table 2-9.1, the RME HI for the child wader, excluding PCBs, was 1, primarily due to arsenic. Including PCB-Aro or PCB-TEQ-Mam did not increase the hazard appreciably. Including PCB-Cong resulted in a HI of 2, exceeding the noncancer HI of 1 (Table 2.9-2). The Nursing Infant was similar, with the HI including PCB-Cong resulting in a HI of 2.

As presented in Table 2-9.3, the CTE HI for the adult and child waders were below 1. CTE risks to the Nursing Infant were *de minimis*, even with PCBs included (Table 2-9.4).

Lead was a COPC for sediment and due to its unique toxicological properties, lead in sediment was not evaluated using standard risk assessment dose equations. The EPC for lead in sediment was 21 mg/kg, which is well below the USEPA (2015a) RSL value of 400 mg/kg for residential exposure and, therefore, lead concentrations at the site are unlikely to pose a risk to receptors.

2.5.4 Swimmer

The hypothetical Recreational Swimmer (child and adult) was assumed to have direct contact with surface water throughout the River OU EU. Nursing Infant risk from PCBs were also evaluated.

Tables 2-10.1 through Table 2-10.4 present the summary cancer risk and noncancer hazards for the Non-Tribal Recreational Swimmer.

The RME ELCR for adults, children and Nursing Infants were all below ODEQ's threshold of 1 x 10^{-6}, with risk no higher than 6 x 10^{-7} (Tables 2-10.1 and 2-10.2) and, therefore, acceptable.

The RME noncancer HIs were all below 1 for adult swimmer, child swimmers, and Nursing Infants, with no HI greater than 0.5 (Tables 2-10.1 and 2-10.2) and, therefore, acceptable. As presented in Table 2-10.3, the CTE noncancer values for adult and child swimmers and Nursing Infants (Tables 2-10.3 and 2-10.4) were likewise low and acceptable.

2.5.5 Hypothetical Downstream Potable Water User

The Hypothetical Downstream Potable Water User may be potentially exposed to the contaminant in the surface water through daily domestic uses, including ingestion. Child, adult, child plus adult, and Nursing Infant cancer risks and noncancer hazards were calculated.

Tables 2-11.1 through Table 2-11.4 present the summary cancer risk and noncancer hazards for the Hypothetical Downstream Potable Water User.

The RME ELCR for this receptor was 2 x 10^{-5}, primarily due to arsenic; this falls within the USEPA acceptable risk range (Table 2-11.1). PCBs were an insignificant contributor to risk. The CTE ELCR for this receptor was 8 x 10^{-6}, which also falls within the USEPA acceptable risk range (Table 2.11-3). The RME and CTE noncancer hazard were *de minimis* and, therefore, acceptable for both adults and children (Table 2.11-1 and Table 2.11-3). RME and CTE risks and noncancer hazards to the Nursing Infant were *de minimis* (Table 2.11-2 and 2.11-4).

The arsenic EPC for surface water was based on the maximum detected (out of 5 samples) value of 1.01 microgram/liter (ug/L) (total). This concentration is well below the federally regulated USEPA (2015a) maximum contaminant level (MCL) for arsenic of 10 ug/L. ODEQ (2014) uses the Human Health Water Quality Criteria for Toxic Pollutants which presents an inorganic arsenic criteria of 2.1 ug/L. The surface water EPC for arsenic meets both USEPA MCL and ODEQ water quality criteria.

2.5.6 Summary of Risk Estimates

Table 2-12 provides a summary of risk and hazard estimates for all the receptors and pathways included in the BHHRA. Chemicals that fall within or exceed the USEPA acceptable risk range (ELCR greater than 1 x 10^{-6}) and hazards (HQ greater than 1) are also noted for each scenario.

2.6 Uncertainty Assessment

Uncertainties are inherent in any risk-based approach to evaluation and decision making for potentially contaminated sites. The uncertainties may be general and systemic as well as specific to the site. The objective of the uncertainty assessment is to identify the sources of uncertainty in the RA process, understand their potential to contribute to either underestimation or overestimation of risk for the selected receptors and pathways, and describe how the uncertainty is addressed. By describing the nature and magnitude of the uncertainties, the findings and conclusions of the RA can be better understood and used as a tool for decision making.

The following discussion supplements the extensive uncertainty analysis performed in the RI. The sources of uncertainties discussed in this section will involve those related to the risk characterization presented in the BHHRA.

2.6.1 COPC Selection

The COPC selection process was intentionally conservative and exhaustive to reduce the potential for underestimation of risk. COPCs for tissues utilized the multi-pathway selection process recommended by ODEQ, included consideration of chemicals detected in sediments, and detected chemicals without screening level values.

2.6.2 COPCs without Screening Levels

Only three chemicals detected in sediments without bioaccumulation screening level values (SLVs) (dibenzofuran, endrin ketone, and heptachlor epoxide) were excluded as tissue COPCs based on their lack of detection in tissues. However, related chemicals that were detected in tissues were included in the quantitative risk estimation. Dibenzofuran is a chemical associated with PAHs but does not have any readily available toxicity values and is not classified regarding its carcinogenic potential (USEPA 2015b). Since cPAHs are well characterized in both sediments and tissues and are included in the quantitative risk assessment, the exclusion of dibenzofuran is not likely to underestimate risk. Similarly, the inclusion of endrin and methoxychlor in the quantitative risk assessment also minimizes the potential for underestimation of risk related to endrin ketone and heptachlor epoxide.

Arsenic, which was initially identified as a sediment COPC for bioaccumulation, was also excluded since smallmouth bass tissue arsenic levels were lower than the reference area UPLs. With the exception of inorganic COIs that were lower than reference area UPLs, all detected COIs in sediment were retained as COPCs for the wader receptor. The single detection of octachlorodibenzo-p-dioxin (OCDD) noted in sediments was lower than the lowest SLV for dioxins/furans and was also sufficient to exclude this is a COPC (see Section 3.5.2.3 for further discussion of OCDD). Manganese is listed as a BHHRA COPC in sediment. Risk to manganese in sediment was deemed acceptable to all receptors. Although manganese data were not available for the Reference Area sediments, it should be noted that manganese detections were below regional background (ODEQ 2013).

2.6.3 Non-Aqueous Phase Liquids (NAPL) Sources

Post-removal field data logs indicate that debris (e.g., glass, bulbs, wire, etc.) is still located along the north shore. The potential for NAPL sources of PCBs that may be present in rocky crevices in the river bottom cannot be ruled out. If present, these sources are likely limited to the north shore and eastern tip of Bradford Island. Therefore, the impact of these potential releases would be expected to be localized in distribution. Remaining debris and suspected NAPL will be further addressed in the River OU FS

2.6.4 Fish Tissue Data

Table 1-6 shows 38 smallmouth bass samples with PCBs having a 100% detection rate and a range of 13 ug/kg to 183,148 ug/kg (PCB-Cong). A review of the concentrations on Figure 2-3 shows five fish with 10,000 ug/kg or greater and the remaining 33 fish with significantly lower concentrations. Four of the fish were collected from along the north shore of Bradford Island and one fish from Goose Island Slough. Due to the dynamic nature of fish tissue collecting, there is uncertainty as to the representativeness of the caught fish, more so than typical stationary media. With such with such large differences in fish tissue concentrations, the UCL could be overestimated or underestimated. However, other parameters related to fish consumption are conservatively selected and would tend to overestimate exposure and risk. Apparent trends of PCB concentrations in fish tissue are discussed further in Section 3.5.2.4.

Due to the data gaps in the RI sampling (no pesticide or butyltin analysis and limited SVOC analysis), the 2011 Pre-FS tissue and sediment sampling was conducted to address these data gaps. The 2011 Pre-FS sampling was statistically robust for risk evaluation (not limited) and served its purpose by targeting the analytical data gaps in the former source areas, including the analytes with potential Upland contributions to the River. The maximum concentrations of OCPs occur in the former source area in the 2011 Pre-FS samples with the highest concentrations of PCBs, collected within the former source areas. OCP compounds can be confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. Their presence in localized areas of the Upland OU Landfill AOPC has been documented. Co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU creates an uncertainty as to whether OCPs are site-related from in-water disposal activities. The potential for the OCPs to be related to the upland-to-river pathway will be further evaluated in the FS.

2.6.5 EPC for RME and CTE

The 95% UCL values for tissue were used as the EPC for both RME and CTE scenarios. This is consistent with USEPA recommendations (USEPA 1992b), but is more conservative than required by ODEQ guidance (2010), which recommends the arithmetic mean to represent the CTE. The potential for overestimation of risk is increased by using the 95% UCL to represent the CTE.

2.6.6 Toxicity Values for Thallium and Vanadium

Thallium was selected as a COPC for direct contact with sediment. There were no peer-reviewed toxicity values available from within the USEPA preferred hierarchy of sources for thallium. The PPRTV RfD_o for thallium is 1 x 10^{-5} mg/kg-day (USEPA 2015a). However, in the PPRTV source document, due to various critical limitations in the study, USEPA presents this RfD_o as a provisional screening value in Appendix A of the PPRTV document, with even more uncertainty than a PPRTV (USEPA 2012) and does not endorse this value as part of the recommended hierarchy of values. Therefore, this screening value should be used and interpreted with great caution. In the absence of reliable human toxicity data, the provisional screening value is based on a 1988 rat study with hair follicle atrophy as the critical effect. An uncertainty factor of 3,000 was applied. Even with the high degree of uncertainty and poor quality of the toxicity value, the noncancer hazard represented by thallium for the wader scenario was less than 1 and warranted no further consideration. Overall, the use of the PPRTV-screening value for thallium has a high potential to overestimate risk but is useful in eliminating thallium as a health concern at the site.

Vanadium was selected as a COPC for direct contact with sediment with an EPC of 55.4 mg/kg. Elemental vanadium does not occur in nature, but vanadium may occur in six oxidation states in 65 different mineral ores and in association with fossil fuels (ATSDR 2012). There were no peer-reviewed toxicity values available from within the USEPA preferred hierarchy of sources for vanadium compounds other than vanadium pentoxide. Values are provided in IRIS for vanadium pentoxide (V_2O_5) which is one of the more toxic forms of vanadium. The RfD_o for vanadium pentoxide is 9 x 10^{-3} mg/kg-day (USEPA 2015b) and the reference concentration (Rf_c) is 7 x 10^{-6} milligrams per cubic meter (mg/m^3) (ORNL 2015). However, exposure to vanadium pentoxide for humans mostly occurs as ingestion through dietary pathways and inhalation of dust in occupational settings (ATSDR 2012). Vanadium in soils and sediments is typically not present as vanadium pentoxide. Therefore, it is unlikely to be the form in which vanadium occurs in site sediments or the pathway by which exposure might occur. To evaluate vanadium without using the vanadium pentoxide values, the HHRA adopted the approach used in the USEPA RSLs (2015a). The RfD_o for vanadium pentoxide was adjusted by the molecular weight of vanadium only (56% of total molecular weight) and applied to the RfD_o resulting in a vanadium-specific RfD_o of 5.04 x 10^{-3} mg/kg-day. The inhalation Rf_c for vanadium was selected as 1 x 10^{-4} mg/m^3 based on ATSDR (2012), which is based on chronic exposure to pentoxide. Overall, the use of the modified oral toxicity values and pentoxide-based inhalation values for vanadium has the potential to overestimate risk but is useful in eliminating vanadium as a health concern at the site.

2.6.7 Fish Tissue Consumption and Risks

A high degree of variability and uncertainty is likely in quantifying site-related contributions to COPC concentrations in fish tissue as well as in characterizing the fish consumption patterns of humans. Native American fish harvesters have high consumption rates but favor anadromous fish species such as salmon or large home range species such as sturgeon (CRITFC 1994), which would be likely to have limited exposure to site-related COIs and are considered safe to consume in the vicinity of Bonneville Dam (Oregon Health Authority 2013). Recreational sport fishers appear to favor resident species as well as anadromous species, but have lower consumption rates (ATSDR 2006). The fish species themselves also vary widely with regard to home range, abundance, and residence status in the River OU; trophic level and guild; lipid content; and other factors. The fish tissue concentrations measured for the BHHRA are whole-body values and do not reflect losses due to removal of fatty tissue, discarding of non-fillet body parts, or losses of COPCs during cooking.

Given the poor quality of fish habitat and lack of fishing success in the River OU (Oregon Bass and Panfish Club 2006), the assumption that 100% of subsistence and recreational consumption of resident smallmouth bass is from the River OU is an extremely conservative and unlikely assumption and would have a significant impact on overestimation of risk. Further discussion regarding the uncertainties are discussed in Section 3-5.2.4.

The primary goal of the evaluation of the fish consumption pathway in the baseline RA was to characterize the potential for reasonable maximum exposure to site-related COPCs; therefore, the effects of these uncertainties results in an intentional overestimation of exposure and risk.

2.6.8 Nursing Infant Risks

The risks for Nursing Infants should be considered as screening-level estimates. They are not site-specific baseline risks since no attempt was made to estimate Nursing Infant doses of COPCs. The screening-level, worst-case IRAFs presented in ODEQ's guidance (ODEQ 2010) were used to convert the mother's risk and hazard estimates to Nursing Infant estimates. This is likely to add an additional level of conservatism to the already conservative estimates of maternal risks and does not mean that the benefits of nursing are outweighed by the risks. The potential transfer of other OCPs (e.g., chlordane, dieldrin) to Nursing Infants could not be quantified due to the lack of chemical-specific IRAFs. Risks to Nursing Infants from these chemicals may be underestimated.

2.6.9 PCB Analysis, Summation, and Risks

For most of the media evaluated in this BHHRA, two separate analytical methods were used to quantify PCB concentrations, as Aroclors and as congeners. The data were then expressed in three ways, as PCB-Aro, PCB-Cong, and PCB-TEQ-Mam. For all receptors and media, the risk from all three variants of PCB summation were within one order of magnitude or less, showing a high level of concordance. The risks are shown separately for each PCB expression by intention, in order to avoid spurious "double-counting" or "triple-counting" of risks associated with the same chemical class.

PCB-Cong risk and noncancer hazard were always highest. This may be due to the assumption that the sum of 209 congeners may be assigned toxicity values corresponding to Aroclor 1254, which has similar cancer toxicity values to other Aroclors but also has an oral reference dose. In reality, such high toxicity values would likely not be representative of all the congeners. Similarly, toxicity values for Aroclor 1254 were assigned to the PCB-Aro measurement and would overestimate the noncancer hazard for the Aroclors in the mixture that are not Aroclor 1254. The potential for overestimation of Aroclor risk is expected to be low since Aroclor 1254 was the dominant Aroclor reported in site data.

Congener-level analysis provides the greatest degree of sensitivity and accuracy in measuring PCB concentrations in tissue. The toxicity values used for dioxin-like congeners are also considered to be more precise and reliable since they are based on TEFs relating to the mode of action of these congeners, while Aroclors and total congeners use generalized mixture-based toxicity values. Based upon analytical sensitivity and precision in toxicity values, the highest level of confidence is placed in the TEQ estimates of PCBs (PCB-TEQ-Mam) for cancer risk. Risks and hazards based on TEQ are typically similar to or up to an order of magnitude lower than PCB-Aro and PCB-Cong based estimates.

Another aspect of the congener data summation approach with inherent uncertainty is the treatment of EMPC data reported by the laboratory. Data for particular congeners in a sample flagged as EMPC are similar to J-flagged data for non-PCB congener analytes, as both indicate a positive detection, but the detection is not quantifiable in the sample and represents an estimated concentration. Like J-flagged data, EMPC data were included as detections in the PCB-Cong summations. Inclusion of the EMPC data as detections could either under- or overestimate exposure and is not expected influence the overall magnitude of risks.

2.6.10 cPAH Summation and Risks

cPAHs were identified and summed using the TEF methodology presented in ODEQ (2010). The mutagenic mode of action was assumed for the childhood exposure period and age-adjusted factors were incorporated to account for the increased vulnerability during that period. This is consistent with current USEPA and ODEQ guidance, but may represent some potential for overestimation of risk since infants are not expected to directly consume fish or be exposed to sediments. These estimated risks to infants are based on ingestion of maternal milk from adult females being exposed to sediments and consuming fish.

2.6.11 Noncancer Estimates and Target Organs

Noncancer hazards for chemicals are based on ratios of an estimated exposure dose to a “safe” or acceptable reference dose. However, not all non-cancer effects of chemicals affect the same organ system or produce the same adverse health effects. The acceptable dose, represented by the RfDo, is derived from toxicological studies that evaluate a range of noncancer effects and then select an RfD_o based on protection of one or more critical effects and target organs for that chemical. Summing the HQs associated with individual COPCs to arrive at an aggregate HI value is likely to overestimate the potential for noncancer effects since the RfD_o values would vary for each effect and target organ even within one individual.

The table below summarizes the critical effects and target organs associated with the five COCs for which HQs exceeded 1.

Target Organs Review Table

COCs with HQ > 1	Target Organ (s)	Critical Effect (RfD_o-based)
Mercury	Extremities, Central Nervous System	Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction
PCBs	Eyes, Extremities, Immune System	Ocular exudate, inflamed and prominent Meibomian glands, distorted growth of finger and toe nails; decreased antibody (IgG and IgM) response to sheep erythrocytes
Chlordane (gamma)	Liver	Hepatic necrosis
Dieldrin	Liver	Liver lesions
Endrin	Liver	Mild histological lesions in liver, occasional convulsions

Source: USEPA 2015b

2.6.12 Surface Water Data and Risks

Although there were five surface water samples used in this report, the sample collection method was a high volume sampler with a high sensitivity (method detection limit [MDL]) and the samples were collected in 2008. The uncertainty with using a limited number of samples from 2008 may overestimate or underestimate risk. However, since most of the COPCs identified in this BHHRA (PCBs, chlorinated pesticides, and cPAHs) have characteristics of low solubility, the impact of this uncertainty on water-related risk estimates is considered insignificant. Since the arsenic levels in surface water are well below the federal MCL and state water quality criterion, arsenic is not recommended as a COC for surface water. Additionally, since swimming is prohibited in the entire River OU, and potable use of untreated river water is also not known to occur, the level of uncertainty related to characterization of these hypothetical surface water exposure pathways is high.

2.6.13 Sediment-Tissue Relationships

Although sediment data were not used to estimate fish and shellfish consumption risks for the BHHRA, site-specific biota-sediment accumulation factors (BSAFs) were used to back-calculate risk-based concentrations in sediment that would be protective of the fish consumption exposure pathway. The uncertainties associated with the BSAFs are discussed further in Section 3.5.2 and are expected to result in RBCs that may be more stringent than necessary.

2.6.14 Dioxins/Furans

As discussed in detail in Section 3.5.2.3, OCDD is the only dioxin/furan isomer detected in site sediment (in Debris Pile #2 sample). During the Final RI/FS MP (URS 2007), the results of the dioxin and furan sampling were evaluated and it was concluded that dioxins and furans would not be investigated as part of the RI (i.e., dioxins and furans were not site COIs). The OCDD estimated detected concentration (0.014 ug/kg) is 200 times lower than the lowest human health ODEQ SLV (2.8 ug/kg). In addition, the one detection of OCDD was located in one of the three former debris piles (Debris Pile #2) and was co-located with high PCBs in the former removal areas that are recommended for further evaluation in the River OU FS. Therefore, the exclusion of dioxins and furans (i.e., OCDD) from evaluation in the BHHERA neither represents an oversight nor underestimates risk.

2.6.15 Overall Risk Estimates

The risks and hazards for the various exposure scenarios are discussed in the context of falling within, exceeding, or being less than the USEPA acceptable risk range for cancer risks and non-cancer HI. ELCRs on the order of 1 x 10^{-3} or 1 x 10^{-2} and HIs that are greater than 1,000 or 10,000 may appear to be highly elevated. However, these calculated values are the result of a combination of conservative exposure assumptions and the concentrations in exposure media. Accordingly, these estimated risk values are in part due to the multiple layers of conservatism that are intentionally built into the risk assessment methodology, from the selection of RME/CTE exposure factor values and toxicity values to assumptions such as whole-body, uncooked fish consumption without any cooking losses and the assumption that the consumer's entire resident finfish consumption is derived only from fish caught in the River OU. For chemicals such as PCBs, similarly elevated risks related to fish consumption for adults, children, and Nursing

Infants are often noted at other sites (e.g., Portland Harbor BHHRA [LWG 2013a]) and do not automatically mean that adverse effects have occurred or will occur.

2.7 Calculation of Site-Specific Risk-Based Concentrations

For each receptor and media, RBCs were calculated for COPCs with ELCRs that exceeded 1 x 10^{-6} and/or noncancer hazard HQ greater than 1. The RBCs are used in conjunction with site data to assist in illustrating the spatial distribution of site concentrations. The RBCs are also meant to be applied in the FS during the selection of the final preliminary remediation goals (PRGs) for the River OU and as a tool to evaluate the effectiveness of various site management strategies.

Likewise, the target cancer risk was 1 x 10^{-6} and target noncancer HQ was 1, utilizing the following equations:

Cancer-based RBC = EPC x Target Risk / Calculated ELCR

Noncancer-based RBC = EPC x Target HQ / Calculated HQ

For smallmouth bass tissue, RBCs were calculated for child, adult, child plus adult, and Nursing Infant for both Tribal Subsistence Fisher and Non-Tribal Recreational Fisher. Table 2-13 presents all the RBCs and the lowest RBC for each potential COC as well their respective upstream Reference UPLs. In all cases, except endrin and gamma-chlordane, the RBCs calculated for the COCs were lower than their respective Reference UPLs. For PCBs, the calculated RBCs were two orders of magnitude lower than their Reference UPLs. Figure 2-3 presents the locations throughout the River OU EU where detected concentrations in caught fish exceeded the RBC for smallmouth bass. For each location, the COCs and their concentrations are listed as well as the magnitude of the exceedance.

For crayfish tissue, RBCs were calculated for child, adult, child plus adult, and Nursing Infant for the Non-Tribal Recreational Fisher. Table 2-14 presents all the RBCs and the lowest RBC for each potential COC as well their respective upstream reference UPLs. The calculated RBC for arsenic was lower than the Reference UPL, while PCBs were slightly greater than Reference UPL. Figure 2-4 presents the locations throughout the River OU EU where detected concentrations in crayfish exceeded the RBC for crayfish.

For sediment, RBCs were calculated for child, adult, child plus adult, and Nursing Infant for the Non-Tribal Recreational Wader. Table 2-15 presents the lowest RBC for each potential COC. The calculated arsenic RBC was over six times lower than the Reference UPL, and both PCBs and cPAHs Reference UPLs were greater than the RBCs. Figures 2-5A and 2-5B present the wadeable locations throughout the River OU EU where detected concentrations in sediment exceeded the RBC for direct contact.

Additionally, the RBCs for the bioaccumulative pathway for sediment were calculated for the tissue COCs (also presented in Table 2-15) and represent a different exposure area. The following equation relates the tissue concentration based on chemical and tissue characteristics to a corresponding sediment concentration (See Appendix D for BSAF derivation):

Diet Risk-Based Sediment Concentration $= f_{oc} \times (RBC_{tissue} \div [BSAF \times f_{lipid}])$

Where:

f_{oc} = fraction of organic carbon (site-specific) = 0.0084 (median of all River OU data)

f_{lipid} = fraction of lipid (bass) = 0.03 (median of all River OU bass data)

f_{lipid} = fraction of lipid (crayfish) = 0.0073 (median of all River OU crayfish data)

BASF = Biota-Sediment accumulation factors (See Appendix D)

Note that due to high uncertainty for metals in tissue, a BSAF could not be derived for arsenic and mercury and, therefore, the Reference UPL was used as the RBC for plotting in the figures. The calculated RBCs for PCBs were lower than the Reference UPLs, and the RBC for cPAHs was higher. A reference UPL was not available for 4,4'-DDE. Figures 2-6A and 2-6B present the locations throughout the River OU EU where detected concentrations in sediment exceeded the sediment RBCs for the bioaccumulation pathway.

Figure 2-7 presents locations for all exceedances of RBCs for bass and crayfish tissue and sediment together and includes the magnitude of exceedance over the RBCs.

Table 2-16 presents all the potential COCs and RBCs for all tissue and sediment. This table provides the most conservative calculated RBC for each COC in each media (i.e., the selected RBC is the lowest of the cancer and non-cancer RBCs). For TEQ-Mam, the lowest RBC is cancer-based (adult+child) and for PCB-Cong, the lowest RBC is noncancer-based (nursing infant). Reference UPLs are also listed, as applicable.

2.8 Risk Interpretation

In this section, the calculated cancer risks and noncancer hazards are weighed with their associated uncertainties and other relevant information to better understand the nature and magnitude of the estimated risks in a site-specific manner. Additionally, the figures are used to identify any spatial trends and correlations among the preliminary COCs, magnitude of exceedance, and site features. Finally, the COCs whose risks and hazards exceed *de minimis* risk levels are evaluated further to develop a shorter list of relevant, risk-driving COCs that are recommended for further evaluation in the River OU FS.

As noted throughout the BHHRA and discussed in Section 2.6, the fish ingestion pathway is evaluated with multiple layers of conservatism to estimate the reasonable maximum hypothetical risk. The Nursing Infant pathway further increases the magnitude of the dose to the infant, relative to the mother's dose, by 25-fold. The infant exposure was used to derive the PCB RBCs, which resulted in the RBC being over two orders of magnitude below the Reference UPL for PCBs.

Smallmouth Bass Tissue

Figure 2-3 shows bass tissue exceedance at almost all the locations where these fish were sampled.

Risks related to **PCBs** and **OCPs** (gamma-chlordane and dieldrin) dominate the contributions to risk and hazards related to consumption of smallmouth bass. The RBCs for PCBs are a hundred or more times lower than the Reference UPLs (Table 2-13). However, due to risk levels that are greater than the USEPA acceptable risk range, the numerous bass locations of exceedance, and the magnitude of exceedance of the RBCs and the reference UPLs, PCBs are retained as the dominant COC for the smallmouth bass.

In addition, **gamma-chlordane** and **dieldrin** are retained as COCs since risk levels for these chemicals exceed the USEPA acceptable risk range, and four bass locations with a high magnitude of exceedance are noted (Figure 2-3). The exceedance locations are co-located with large exceedances for PCBs, and consist of three locations along the north shore of Bradford Island (locations 62, 63, 68), and one location in eastern tip of Goose Island (location 78).

DDE is associated with relatively low overall risk (4 x 10^{-6}; Table 2-6.1) and poses a low hazard to Nursing Infants (Table 2-6.2). Locations with exceedances of DDEs are distributed as follows: the south shore of Cascade Island (locations 64, 65, 67, 69, 70), around Boat Rock (locations 71, 72, 73, 74, 76), and the northern shore of Goose Island (locations 79, 81, 82, 83, 84). They do not appear to be associated with Bradford Island. Among the sediment samples, there is only one location with a minor exceedance of the DDE RBC for sediments (S1-35; Figure 2-6B), located along the north shore. The exceedance is less than twice the RBC. Since risks associated with DDE are well within the USEPA acceptable risk range and appear to be diffusely distributed with no site-related trends, DDE is not retained as a COC for smallmouth bass tissue.

Endrin is associated with a relatively low HQ of 3 (Table 2-6.1) for the RME scenario. There are only three bass locations where endrin exceeds the RBC (locations 63, 68, and 78), apparently co-located with PCBs, chlordane, and dieldrin. There were no exceedances of the endrin RBC in sediment (Figure 2-6A, B). Due to the relatively low risk associated with endrin, the limited number of low magnitude exceedances in tissue, and lack of exceedances in sediment, endrin is not retained as a COC for smallmouth bass tissue.

The overall HQ for **mercury** is relatively low (HQ of 3; Table 2-6.1). The lowest estimated RBC for mercury (0.082 mg/kg) is significantly lower than the Reference UPL for mercury in smallmouth bass tissue (0.36 mg/kg; Table 2-13). The range of mercury concentrations in the River OU smallmouth bass tissue (0.06–0.51 mg/kg) is similar to the reference range (0.045–0.64 mg/kg). The high exceedance rate for mercury (34 exceedances out of 38 detected) with a low and consistent magnitude throughout the River OU shows it to be similar to background with only three locations where the individual fish concentrations are slightly higher than the background UPL (0.51 mg/kg, 0.50 mg/kg, and 0.45 mg/kg at locations 13, 18 and 62, respectively; Figure 2-3). In addition, exceedances of bioaccumulation-based RBCs for mercury in sediment are very minor in number and magnitude (Figure 2-6A, B) and show no particular relationship to the tissue exceedances. Therefore, mercury is not retained as a COC for smallmouth bass tissue.

The RME risks related to **cPAHs** (2E-05; Table 2-6.1) are close to ODEQ's acceptable cumulative risk levels for chemical groups with similar mode of action. The lowest RBC for cPAHs (0.16 ug/kg; Table 2-13) is about 10 times lower than the Reference UPL (1.2 ug/kg; Table 1-7). Eight locations with low-level exceedances of the lowest RBC are noted on Figure 2-3, of which five are near the shoreline of Bradford Island, one along Cascade Island, and two near Goose Island Slough. All exceedances are within the USEPA acceptable risk range. Given the well-documented propensity for breakdown of PAHs in fish tissue and the low-level, diffuse distribution of PAHs and the low level of risks, cPAHs are not retained as COC for smallmouth bass tissue.

In summary, **PCBs, gamma chlordane,** and **dieldrin** are retained as COCs for the smallmouth bass tissue. Further discussion of these contaminants in bass tissue as related to ecological concerns are presented in Section 3.5.3.2. As expected, the north shore of the Bradford Island shows the grouping of the highest exceedance for PCBs and pesticides. The other grouping of high exceedances is around Goose Island. The high magnitude exceedances for pesticides are far fewer than for PCBs and are typically co-located with high magnitude exceedances for PCBs. The lowest RBCs for PCBs are often more than two orders of magnitude lower than the Reference UPL, regardless of whether Aroclors, congeners, or TEQ methods are used.

Crayfish Tissue

The crayfish tissue exceedance (Figure 2-4) differs from the smallmouth bass trends and no exceedances of high magnitude are seen. The crayfish data indicate numerous exceedances for **arsenic** (18 exceedances out of 18 detected) but low concentrations relative to the Reference UPL and of uniform magnitude throughout the River OU. The majority of the arsenic values in crayfish (0.30–0.68 mg/kg) at the site are lower than or only slightly higher than the Reference UPL of 0.54 mg/kg (range of 0.28 to 0.64 mg/kg) (Table 1-7). Therefore, arsenic in crayfish tissue is unlikely to pose a risk greater than local background conditions and is not retained as a COC.

PCBs in crayfish tissue exceed the lowest RBCs at five locations. The cancer PCB-TEQ RBC is exceeded at two locations along the Bradford Island shoreline (P05-CF and P06-CF) and one location along the south shore of Cascade Island (P01-CF), while the noncancer PCB-Cong RBC is exceeded at two locations along the Bradford Island shoreline (P04-CF and P07-CF). Two of the PCB-TEQ exceedances are generally in the low end of the USEPA acceptable risk range (1×10^{-5} to 1×10^{-6}) and do not exceed ODEQ's acceptable cumulative risk level of 1×10^{-5} for chemical groups with similar mode of action; only one location exceeds the USEPA acceptable risk range and ODEQ's acceptable cumulative risk level (P06-CF). Both noncancer PCB-Cong exceedances are generally low (less than a noncancer HQ of 5).

In summary, **PCBs**, based on cancer risk falling within the USEPA acceptable risk range and noncancer risk above an HQ above 1, are retained as COCs for crayfish tissue.

Sediment – Direct Contact

The wader exposure to sediment in Figure 2-5A shows low magnitude exceedances around the Upland with a high density grouping at the north shore.

The majority of **arsenic** exceedances are lower than the background UPL of 5.9 mg/kg (Table 1-2). Arsenic exceeded background at only one of 45 sediment locations (S-1-43; Figure 2-5B); therefore, risks related to arsenic are considered insignificant, and arsenic is not recommended for retention as a COC.

Of the remaining COCs, looking at the inset Figure 2-5B, there is one low magnitude exceedance for **PCBs** near the eastern tip of Bradford Island and a grouping of low magnitude cPAHs exceedances along the north shore, primarily at location S-1-43. The cumulative risks associated with cPAHs for RME waders is estimated at 7×10^{-6}, which is less than the acceptable cumulative risk level of 1×10^{-5} that is allowed by ODEQ for chemicals with a common mode of action. Given the low level of cPAH risks and the very minor exceedance of the RBC at a single location, these are not retained as COCs for the wader. Similarly, PCBs are not retained as COCs for the Nursing Infant of a mother exposed by wading, based on the low CTE to RME range of HQs (0.04 to 2; Tables 2-9.2 and 2-9.4) and the conservatism built into the screening-level evaluation of the Nursing Infant pathway.

Therefore, no COCs are retained for sediment for the direct contact pathway.

Sediment – Bioaccumulation

Risks were not calculated for bioaccumulation and fish consumption pathways using sediment data. However, sediment RBCs were developed for COPCs whose risks exceeded target risk or hazard levels in smallmouth bass tissue or crayfish tissue consumption scenarios.

Based on the discussion of COCs in tissue, **PCBs** are retained as the primary COC in sediments. Numerous exceedances are noted (Figure 2-6A, B), although the calculated RBCs are from 10 to more than 100 times lower than the Reference UPLs (Table 2-15).

No bioaccumulation-based RBC was calculated for **arsenic** or **mercury** due to modeling uncertainties. There are only two exceedances of the arsenic UPL value, at P-114 and S1-43. Arsenic was not selected as a COC for smallmouth bass or for crayfish tissue due to its low risk potential. Due to the low number of exceedances, measured concentrations in tissue, and low potential for site-related risk based on similarity of site sediment concentrations to the Reference UPL, arsenic was also not selected as a COC for sediments for the bioaccumulation pathway. Mercury was not selected as a COC for sediment, based on its low potential for risk in smallmouth bass tissues and the very few locations in sediment where mercury slightly exceeded the Reference UPL (Figures 2-6A, B).

None of the **OCPs** were retained as COCs for sediment. Among the OCPs which were identified as COCs in tissues, dieldrin and endosulfan 1 were not detected in sediments and are not retained as COCs. There were no exceedances of the RBC in sediment for chlordane and endrin. 4,4-DDE was not selected as a tissue RBC based on low risk potential and its detection at one sediment location (SI-43) at a concentration slightly exceeding the RBC. This location also contained PCBs. Therefore, 4,4-DDE was not retained as a COC for sediment.

cPAHs in sediment exceeded their bioaccumulation-based RBC at one location to the northeast of Bradford Island (Figure 26-A) and five locations along the north shore of Bradford Island (Figure 2-6B). The magnitude of exceedances is low (ELCR of 1×10^{-5} or less) and the locations along the north shore of Bradford Island are co-located with higher exceedances of PCBs. Given the low potential for fish consumption risk for cPAHs and since PAHs were not selected as tissue COCs, they are not retained as COCs for sediment.

In summary, **PCBs** are the only COC selected for sediments.

Figure 2-7 shows that, based on exposure to PCBs in bass tissue, the Tribal Subsistence Fishers are the primary receptors at risk. Exceedances of RBCs for all media are clustered primarily along the north shore of Bradford Island, with a smaller cluster of exceedances in Goose Island Slough. The reference UPLs are higher than RBCs for many COCs. If the RBCs were replaced by UPLs, there would be fewer exceedances and the exceedances would be of lower magnitude.

2.9 Conclusion and Recommendations

The BHHRA evaluated risks to subsistence consumers of smallmouth bass, recreational consumers of smallmouth bass and crayfish, recreational waders in wadeable sediments, and swimmers and potable water users of surface water from the River OU. The risk results are summarized in Table 2-12.

Cancer risks and non-cancer hazards that were greater than the USEPA acceptable risk range were identified for subsistence and recreational smallmouth bass consumption scenarios. Risks and hazards were within the USEPA acceptable risk range for recreational crayfish consumption and recreational waders in wadeable sediments. Risks were *de minimis* for hypothetical swimmers and potable water users of surface water, when the fact that **arsenic** levels are lower than federal and state MCLs was taken into consideration.

PCBs were the COCs that contributed to the highest risk levels and greatest number of exceedances in all media. A smaller number of exceedances of lower magnitude were noted for a few additional COCs including selected **OCPs** (DDE, chlordane, dieldrin, endrin), **cPAHs**, **arsenic**, and **mercury**.

Table 2-16 presents the most relevant and significant COCs recommended for further evaluation in the River OU FS and RBCs for all tissue and sediment. This table provides the most conservative calculated RBC for each COC in each media. Reference UPLs are also listed as applicable.

3.0 BASELINE ECOLOGICAL RISK ASSESSMENT

This section presents the findings of the BERA that was conducted for the River OU. The methodology followed for the BERA process is described in the RI/FS MP (URS 2007) and recently refined during discussions with ODEQ (meetings with ODEQ in June 2014 and May 2015), which determined that ODEQ would be used as a primary source of toxicity reference values (TRVs) and that the BERA would use representative historical sediment data as well as more recent data (see Section 1.2).

The purpose of this BERA is to further evaluate the CPECs identified for the River OU during the Screening Level Ecological Risk Assessment (SLERA) performed as part of the RI (URS 2012). The findings of this BERA will be used to identify CECs, receptors of concern, and pathways that should be retained for the River OU FS.

3.1 Exposure Media and CPECs

The entire River OU, including Forebay samples and targeted samples near Eagle Creek and Goose Island, was retained for evaluation in the BERA. Sediment and the various tissue types that have been collected (clams, crayfish, sculpin, and smallmouth bass) were identified as media of concern for ecological receptors in the riverine environment. Since surface water was not identified as an ecological medium of concern in the RI, this medium was only included in the ingestion pathway for wildlife receptors.

CPECs were identified for sediment and benthic invertebrate and fish tissue in Table 12-2 of the RI: PCBs, cadmium, lead, and mercury. In response to ODEQ's concerns about historical sediment data from the north shore of the island being excluded from the RI, the RI sediment data, additional sediment samples collected subsequent to the RI, and representative historical sediment data from the River OU were compiled and considered for the BHHERA. The approach used to compile the combined sediment dataset is detailed in the DETM and summarized in Section 1.2. This new combined sediment dataset was rescreened in the DETM (URS 2014) to update the list of sediment CPECs warranting consideration in the BERA (Table 2-3 of the DETM). Although collection of additional clam and bass tissue data also occurred subsequent to the RI, the updated tissue data screening was reserved for the BERA and is presented in Tables 3-1 and 3-2 and described below.

For the newly identified sediment CPECs in the DETM that have the potential to bioaccumulate (as defined in Table J-2 of the RI) and were not already on the list from the RI/SLERA, an updated tissue data screening was conducted (Table 3-1). In addition, since the additional 2011 tissue (bass and clam) were collected subsequent to the RI/SLERA and had never been screened, these data were screened for all detected COIs (Table 3-2).

- Clam – If either of the following criteria were met, the analyte was retained as a bioaccumulative CPEC in the BERA:
  - A sediment CPEC from the DETM was detected in the RI clam tissue above critical tissue levels (CTLs) (Table 3-1), or
  - Any analyte was detected in the 2011 clam tissue above CTLs (Table 3-2).

- Crayfish – If a sediment CPEC from the DETM was detected in crayfish tissue above CTLs or mammal acceptable tissue levels (ATLs), it was retained as a bioaccumulative CPEC in the BERA (Table 3-1).
- Sculpin – If a sediment CPEC from the DETM was detected in sculpin tissue above CTLs or mammal ATLs, it was retained as a bioaccumulative CPEC in the BERA (Table 3-1).
- Bass – If either of the following occurred, the analyte was retained as a bioaccumulative CPEC in the BERA:
  - A sediment CPEC from the DETM was detected in the RI bass tissue above CTLs, mammal ATLs, or bird ATLs (Table 3-1), or
  - Any analyte was detected in the 2011 bass tissue above CTLs, mammal ATLs, or bird ATLs (Table 3-2).
- Any sediment CPECs from the DETM or any analytes detected in 2011 tissue that lacked CTLs/ATLs were retained as CPECs in the BERA (Tables 3-1 and 3-2).

Sediment CPECs that are potentially bioaccumulative but already on the list of CPECs identified in the RI (Table 12-2 of the RI) were retained as bioaccumulative CPECs and evaluated in the BERA. In addition, all sediment CPECs from the DETM were retained for direct toxicity evaluation to fish and shellfish (e.g., benthic community) in the BERA.

The final list of CPECs carried into the BERA is presented in the final column in Table 3-3 and includes PCBs (as PCB-Aro, PCB-Cong, and PCB-TEQs), metals, PAHs, butyltins (direct toxicity only), OCPs, and SVOCs. Table 3-3 presents the CPECs specific to each receptor group (benthic community [e.g., shellfish], fish, birds, and mammals) and medium (i.e., sediment and/or tissue). The sediment CPECs for the benthic community were evaluated for direct toxicity to this receptor group, the tissue CPECs for fish, birds, and mammals were evaluated for toxicity via dietary exposure, and fish were evaluated for both direct contact and dietary exposure.

3.2 Receptors and Exposure Pathways

Identification of receptors and exposure pathways are key components of the CEM. A schematic representation of the links between sources, release and transport mechanisms, potentially affected media, exposure routes, and potentially exposed human receptors are part of the ecological CEM for the River OU, which is provided as Figure 3-1 (originally Figure 12-19 of RI). It was concluded in the RI that exposure to River OU surface water by aquatic organisms living in the water column is not a significant exposure pathway. The following list of receptors and exposure pathways were included in the River OU BERA:

- Benthic invertebrates exposed through direct contact with surface sediment.
- Fish exposed through direct contact and prey ingestion.
- Bald eagle (*Haliaeetus leucocephalus*) exposed through ingestion of surface water and prey (100% predatory fish [i.e., smallmouth bass]).
- Osprey (*Pandion haliaetus*) exposed through ingestion of surface water and prey (100% predatory fish [i.e., smallmouth bass]).

- American mink (*Neovison vison*) exposed through incidental ingestion of surface sediment, and ingestion of surface water and prey (33% benthic invertebrates, 33% invertivorous fish, and 33% predatory fish).

These receptors and pathways are depicted in the food web model for the River OU, provided on Figure 3-2 (originally Figure 12-18 of RI). The assessment and measurement endpoints were originally presented in Table C-1 of the RI/FS MP (URS 2007) and the portion of this table relating to the River OU is attached in Appendix C. This table was updated so that the endpoints reflect both the approach used in the RI risk assessment as well as methods used in the BERA (e.g., evaluation of bird egg tissue).

3.3 Exposure Assessment

The ecological CEM for the River OU (Figure 3-1), in conjunction with the food web model (Figure 3-2), illustrates the most current understanding of potentially complete and significant ecological exposure pathways for the River OU. The most significant exposure pathway at the site originates from PCBs in benthic invertebrate and fish tissue that are consumed by birds, mammals, and predatory fish. Toxicity via direct contact with sediment, especially by epibenthic and infaunal organisms, is another potentially significant exposure pathway at the site. Although typically a minor exposure pathway, ingestion of river surface water (as drinking water) was considered potentially complete and significant in the BERA and included in the dose estimates for the osprey, eagle, and mink.

In addition to direct exposure to contaminants in sediment, benthic organisms may also be exposed to PCB-laden NAPL that potentially remain in the cracks and crevices of rocks in the former disposal areas. The source of the NAPL could originate from the historic disposal of electrical capacitors containing mineral oil into the river tht were removed in 2000 and 2002. Oil-phase transport of PCBs to biota residing on the river bottom may be the primary pathway of exposure at the site, given the multiple sediment removal actions that have resulted in much lower sediment PCB concentrations, but residual concentrations of PCBs in some fish samples remain high (including younger fish specimens: 2011 bass primarily 2 to 4 years old). River OU fish consuming benthic organisms in the former disposal area would be expected to have higher concentrations of PCBs than the concentrations in benthic prey given the capacity for PCBs to biomagnify in the aquatic food web. This concentration pattern is evident in the site data; PCB concentrations in clams and crayfish are much lower than concentrations in sculpin and smallmouth bass. Also see the NAPL discussion presented in Section 2.6.3.

3.3.1 Exposure Factors and Exposure Units

Tables 3-4 through 3-6 present the life history parameters for the osprey, eagle, and mink that were input into the dose equation (see Section 3.3.3), which were originally presented in the RI/FS MP (URS 2007).

For the less mobile receptors with small home ranges (i.e., benthic invertebrates such as clams and crayfish), it is feasible for an individual to forage solely within one specific area of the River OU. For this reason, each sample location was considered an individual EU for these benthic receptors. The invertivorous fish (sculpin) is more mobile, but is highly territorial with a relatively small foraging range. Similar to the Portland Harbor BERA (LWG 2013b), the EUs were estimated as 0.1-mile increments of River OU shoreline, which results in 13 segments, of which there are eight individual EUs total for the sculpin (Figure 1-5a). For the predatory fish (smallmouth bass), the size of the foraging range (approximately 1.4 km–0.87 mile; URS 2007) is similar to the size of the River OU (1.2 km). Therefore, the entire River OU from the Bonneville Dam to the northern tip of Goose Island was considered one EU for the bass. For the wider-ranging receptors (i.e., osprey, eagle, and mink), receptor-specific area use factors were calculated as the River OU site size divided by the size of the home range.

3.3.2 Exposure Point Concentrations

Sediment. The maximum detected concentrations for sediment were initially used as the EPCs for the benthic community exposed via direct contact. For CPECs selected based on this initial screening, the concentration for each location was used as the EPC for purposes of direct contact risk interpretation for the benthic community. The lower of the maximum and 95% UCL was used as the EPC for the mink exposed via incidental sediment ingestion (e.g., the maximum detected concentration may be the lowest EPC for reasons such as small sample size or a highly censored dataset with many non-detects).

Surface Water. The maximum detected concentrations for surface water of the River OU were used as the EPCs for the osprey, eagle, and mink exposed via water ingestion. Surface water data collected from the river during the RI were available for most dietary CPECs (i.e., those evaluated for the bioaccumulation pathway for wildlife). A simple sediment to water equilibrium partitioning method was used for dietary CPECs lacking river surface water data (Table 3-7), such as OCPs.

Partitioning coefficients (K_{oc}) were applied to sediment EPCs, the lower of the maximum detected concentration and 95% UCL, in the following equation. The fraction of organic carbon (foc) is a relevant parameter for the estimation of surface water concentrations of organic compounds, and the site-specific median foc of 0.0084 kg organic carbon per kg sediment dry weight (0.84%) was used:

<u>Organics</u>

$$C_{surface\ water}\ (mg/L) = \frac{C_{sediment}\ (mg/kg\ dry\ weight)}{K_{oc}\ (L/kg) \times foc}$$

The K_{oc} values are presented in Table 3-7 along with the estimated and measured surface water concentrations.

Benthic Invertebrate Tissue. The maximum detected concentrations were initially used for clam and crayfish tissue as the EPCs for the benthic community exposed via the dietary and direct contact pathways. For CPECs selected based on this screening, the concentration for each location was used as the EPC for the purposes of risk interpretation. The lower of the maximum and 95% UCL for crayfish was used as the EPC for the mink ingesting benthics as prey via the dietary pathway. Due to a lack of clam and crayfish tissue data for dibenzofuran, which was detected in sediment and lacks a bioaccumulation SLV (URS 2014), the concentration of this CPEC in benthic invertebrate tissue was estimated using the following equation:

$$C_{benthic\ tissue} = \frac{C_{sediment} \times BSAF \times f_{lipid}}{f_{oc}}$$

where:

$C_{benthic\ tissue}$ = Estimated concentration of a CPEC in benthic organisms (mg chemical per kg tissue dry weight)

$C_{sediment}$ = 95% UCL or maximum concentration of a CPEC measured in sediment (mg chemical per kg sediment dry weight)

BSAF = Biota-sediment accumulation factor for freshwater benthic organisms (kg organic carbon per kg lipid)

f_{lipid} = Site-specific lipid content of benthic invertebrates (kg lipid per kg organism dry weight)

f_{OC} = Site-specific fraction of organic carbon (OC) in sediment (0.0084 kg organic carbon per kg sediment dry weight)

Table 3-8 presents the BSAF and other parameters used to predict dibenzofuran concentrations in benthic organism tissue. The median site-specific clam and crayfish lipid contents (0.026 or 2.6%, and 0.0073 or 0.73%, respectively) were used in the equation above to estimate dibenzofuran concentrations in clams and crayfish.

Fish Tissue. The lower of the maximum and 95% UCL for sculpin and smallmouth bass tissue were used as the EPCs for predatory fish, osprey, eagle, and mink exposed via the dietary pathway. Due to a lack of fish tissue data for dibenzofuran, which was detected in sediment and lacks a bioaccumulation SLV (URS 2014), the concentration of this CPEC in fish tissue was estimated using the same BSAF-based equation and approach provided above for benthic tissue. Table 3-8 presents the BSAF and other parameters used to predict concentrations in sculpin and bass tissue. The median site-specific sculpin and bass lipid contents (0.041, or 4.1%, and 0.03, or 3%, respectively) were used in the equation to estimate dibenzofuran concentrations in sculpin and bass.

Bird Egg Tissue. The lower of the maximum and 95% UCL for bass tissue was used as the EPC to predict bird egg exposures originating from fish consumption by the parent bird. Egg tissue EPCs were developed for the subset of CPECs for which bird egg TRVs are available (mercury, PCB-Aro, PCB-Cong, PCB-TEQs, and total DDx; ODEQ 2007). Separate bird egg concentrations were estimated for the eagle and osprey through the following equation:

$$C_{bird\ egg\ tissue} = C_{fish\ concentration} \text{ x BMF}$$

where:

$C_{bird\ egg\ tissue}$ = Estimated concentration of a CPEC in piscivorous bird eggs (mg chemical per kg tissue dry weight)

C_{fish} = 95% UCL or maximum concentration of a CPEC measured in smallmouth bass tissue (mg chemical per kg tissue dry weight)

BMF = Biomagnification factor for fish tissue to bird eggs (kg fish tissue per kg bird egg tissue).

Table 3-8 presents the BMFs used to predict concentrations in osprey and eagle egg tissue, which were drawn from ODEQ's sediment bioaccumulation guidance (2007).

3.3.3 Dose Estimation

For the birds and mammals, site-specific daily dose estimates were developed to predict chemical intake from food resources (i.e., benthic invertebrates and fish), incidental sediment ingestion, and/or water ingestion. Site-specific daily dose estimates were calculated using the following general equation:

$$ADD = [(IR_{food} * C_{food}) + (IR_{water} * C_{water}) + (IR_{sed} * C_{sed})] * AUF/BW$$

where:

ADD	=	Average Daily Dose (mg/kg-day)
IR_{food}	=	Ingestion rate of food (kg/day dry weight [dw])
IR_{water}	=	Ingestion rate of water (L/day)
IR_{sed}	=	Ingestion rate sediment (mink only) (kg/day dw)
C_{food}	=	Concentration of chemical in food (mg/kg dw)
		$C_{food} = [(\text{diet fraction}_{food1} * C_{food1}) + (\text{diet fraction}_{food2} * C_{food2})$ .... $(\text{diet fraction}_{foodn} * C_{foodn})]$
C_{water}	=	EPC of chemical in water (mg/L)
C_{sed}	=	EPC of chemical in sediment (mg/kg dw)
AUF	=	Area use factor (decimal fraction)
BW	=	Body weight (kg)

Exposure parameters for the bird and mammal receptors listed above were discussed in Section 3.3.1 and are presented in Tables 3-4 through 3-6. The resulting ADD estimates for each receptor are presented in Tables 3-9 through 3-11. Site-specific benthic invertebrate and fish tissue data were used to calculate concentrations in food items as described in Section 3.3.2.

For bird eggs, the "estimated dose" is the predicted egg tissue concentrations described in Section 3.3.2, which are compared directly to ODEQ's bird egg ATLs (Table 3-12).

3.4 Toxicity Values

For most toxicological data, a distinction is made between a concentration (or dose) below which adverse effects have not been observed and the concentration (or dose) above which adverse effects are noted. These are referred to as the no-observed-adverse-effects concentration (NOAEC) for direct exposure or the no-observed-adverse-effects level (NOAEL) for ingestion exposure and the lowest-observed-adverse-effects concentration (LOAEC) for direct exposure and the lowest-observed-adverse-effects level (LOAEL) for ingestion exposure. In theory, the NOAEC or NOAEL represent the highest concentration at which no statistically significant differences were observed compared with controls, and the LOAEC or LOAEL is the lowest concentration at which effects were statistically different from controls.

Both the no-effect and lowest-effect concentrations are used for comparison because a continuum of concentrations is not tested and the exact concentration at which an adverse effect is first elicited is not known. However, if a concentration or dose is less than the no-effects TRV, confidence is high that there is little potential for risk. Conversely, a concentration or dose that is greater than the no-effects-based TRV does not necessarily indicate that a risk is probable.

There are exceptions to this approach. For example, in sediments, there generally are no NOAEC or LOAEC values *per se*, but there are other endpoints that provide bounding concentrations representing low likelihood of effects and concentrations at which effects are likely to occur. For simplicity, the NOAEC/LOAEC terminology is also used for sediment benchmarks, with the understanding that these are equivalent to lower-bound and upper-bound toxicity benchmarks. Both concentration-based benchmarks and dose-based TRVs are discussed in the following subsections.

3.4.1 Direct Toxicity Sediment Benchmarks

Direct toxicity sediment benchmarks protective of the freshwater benthic community were primarily selected from ODEQ's Level II SLVs (ODEQ 2001), as shown in Table 3-13. ODEQ's SLVs represent the NOAEC-based sediment benchmark. Consensus-based probable effects concentrations (PEC) for freshwater ecosystems (MacDonald et al. 2000) represent the LOAEC-based benchmark. In the absence of a consensus-based PEC, a LOAEC-based sediment benchmark was estimated by multiplying ODEQ's SLV by a factor of five (ODEQ 2001).

Due to the anticipated outcome of the baseline RAs that will document the need for further evaluation of PCBs in a FS, the BERA goes beyond the traditional assessment of the presence/absence and magnitude of baseline risk. To assist with development of the future site management strategy, in the cases where SLVs are lower than UPLs, the UPLs were used in the risk evaluation in place of the lower SLVs for metals only.

3.4.2 Benthic Invertebrate and Fish Tissue Benchmarks

Benthic invertebrate and fish tissue benchmarks protective of freshwater organisms exposed through their diet were primarily selected from ODEQ's CTLs (ODEQ 2007), as shown in Table 3-13. ODEQ's CTLs represent the NOAEC-based tissue benchmark protective of benthic invertebrates and fish (same value used for both organism types), and a LOAEC-based tissue benchmark was estimated by multiplying ODEQ's CTL by a factor of five (ODEQ 2001).

For CPECs in tissue lacking a ODEQ CTL, surrogate chemicals with CTLs were selected if an appropriate surrogate was available. In addition, ODEQ's approach for developing CTLs in which the chronic water quality criterion was multiplied by a water-fish bioconcentration factor (BCF) was used to estimate NOAEL-based tissue benchmarks. ODEQ's Level II SLVs were the selected water quality criteria used in the CTL equation, and BCFs were extracted from the Oak Ridge National Laboratory Risk Assessment (ORNL) Information System Database (Table 3-13).

3.4.3 Toxicity Reference Values for Birds and Mammals

Dose-based TRVs protective of birds and mammals were selected from the following resources in order of preference:

1) ODEQ's TRVs used in the development of acceptable tissue levels (ATLs) and bioaccumulation-based sediment SLVs (ODEQ 2007)
2) Portland Harbor TRVs used in the Final BERA (LWG 2013b)
3) TRVs used to calculate USEPA's Ecological Soil Screening Levels (Eco-SSLs) (USEPA 2005-2008); receptor-specific TRVs, such as mink studies or studies on aquatic birds, in the Eco-SSL selected when available
4) TRVs presented by the ORNL (Sample et al. 1996) with preferential selection for those based on mink or aquatic bird studies
5) Other reputable sources of the literature

Both NOAEL-based and LOAEL-based TRVs were selected for each receptor group and CPEC (Table 3-14). In cases where only a chronic LOAEL study was available, an uncertainty factor of 10 was applied to derive a chronic NOAEL. In cases where only a chronic NOAEL was available, a LOAEL was estimated by applying an uncertainty factor of 5.

ODEQ provides bird egg TRVs for a subset of CPECs (mercury, PCB-Aro, PCB-Cong, PCB-TEQs, and total DDx), and these concentration-based TRVs were used to predict risk to sensitive life stages of the osprey and eagle (Table 3-12). The bird egg TRVs were compared to the bird egg EPCs calculated from smallmouth tissue, as described in Section 3.3.2. ODEQ presents bird egg TRVs representing both NOAEC-based and LOAEC-based tissue benchmark (ODEQ 2007).

3.5 Risk Characterization

Risk characterization is the process of integrating the previous elements of the RA into quantitative or semi-quantitative estimates of risk. Risk characterization consists of risk estimation and uncertainty assessment. Risk estimation or the quantification of risk is then used as an integral component in remedial decision making and selection of potential remedies or actions. Uncertainty assessment describes the level of confidence in the risk estimation.

The two types of benchmarks and TRVs listed in Section 3.4 were incorporated into the analysis: one based on a NOAEC/NOAEL and a second based on an observed adverse effect in a test species (LOAEC/LOAEL). For HQs based on a NOAEC/NOAEL that are less than 1, adverse effects are unlikely because of the inherent conservatism (protectiveness) built into the exposure and effects assessments. HQs based on LOAEC/LOAEL (upper-bound risk estimates) that are greater than 1 indicate that exposure exceeds a known effect concentration for a test organism. In this case, potential risk management measures may be warranted for these receptors and exposure pathways.

For estimated exposures that exceeded the NOAECs/NOAELs (i.e., the NOAEC/NOAEL-based HQ is >1) but were less than the LOAEC/LOAEL (i.e., the LOAEC/ LOAEL based HQ is <1), the associated complete exposure pathways were considered in greater detail to develop conclusions about the likelihood that a risk or hazard is present. For non-listed (common) species (e.g., benthics, birds, and mammals) known to be present in the River OU, more emphasis was placed on CPECs with LOAEC/LOAEL-based HQs above 1. Given the potential presence of listed fish species in the vicinity of Bradford Island, more emphasis was placed on CPECs with NOAEC-based HQs above 1 for fish. However, the range of HQs developed for each receptor and CPEC was presented in the risk characterization.

It is most appropriate to calculate HIs (i.e., a summation of HQs) for CPEC groups when multiple chemicals demonstrate similar modes of toxicity or affect the same target organ. The implications of HQs greater than or less than 1 discussed above were also applied to HIs. Due to a lack of data regarding additive effects associated with exposure to multiple chemicals for nonhuman receptors, professional judgment was used in the development of HIs. For the BERA, HIs were calculated for metals and inorganics, total DDx, and total OCP (which includes the individual DDx isomers).

3.5.1 Summary of Hazard Quotients and Hazard Indices

The HQs and HIs calculated for birds and mammals are presented in Tables 3-9 through 3-12, and the HQs and HIs calculated for benthic invertebrates and fish are presented in Tables 3-15 through 3-19. These HQs and HIs are summarized below.

Osprey. NOAEL-based HQs for the osprey were greater than 1 for mercury, PCB-Aro, PCB-TEQ, PCB-Cong, chlordane (gamma), dieldrin, endrin, and endrin aldehyde (Table 3-9). The NOAEL-based HI for total metals and total pesticides were also greater than 1. LOAEL-based HQs or HIs were greater than 1 for mercury, PCB-Aro, PCB-TEQ, PCB-Cong, dieldrin, endrin, total metals, and total pesticides.

Based on a comparison of estimated osprey egg concentrations to ODEQ's bird egg ATLs, NOAEL-based HQs are greater than 1 for all five CPECs: mercury, PCB-Aro, PCB-Cong, PCB-TEQ, and sum DDx (Table 3-12). LOAEL-based HQs are greater than 1 for all but mercury, and the LOAEL-based HI for sum DDx is equal to 1.

Bald Eagle. The same CECs identified above for the osprey were identified for the eagle (Table 3-10) based on the dietary ingestion pathway. NOAEL-based HQs or HIs were greater than 1 for mercury, PCB-Aro, PCB-TEQ, PCB-Cong, chlordane (gamma), dieldrin, endrin, endrin aldehyde, total metals, and total pesticides. LOAEL-based HQs or HIs were greater than 1 for mercury, PCB-Aro, PCB-TEQ, PCB-Cong, dieldrin, endrin, total metals, and total pesticides.

NOAEL-based HQs for bald eagle eggs are greater than 1 for all five CPECs: mercury, PCB-Aro, PCB-Cong, PCB-TEQ, and sum DDx (Table 3-12). LOAEL-based HQs are greater than 1 for PCB-Aro, PCB-Cong, and the PCB-TEQ.

Mink. NOAEL-based HQs or HIs for the mink were greater than 1 for aluminum, mercury, PCB-Aro, PCB-TEQ, PCB-Cong, dieldrin, total metals, and total pesticides (Table 3-11). The NOAEL-based HI for total metals and total pesticides were also greater than 1. These same chemicals had LOAEL-based HQs greater than 1 with the exception of mercury.

Benthic Community. The potential for risk was estimated in two ways for the benthic community: toxicity from direct exposure to sediment and dietary toxicity. Direct toxicity was evaluated through a comparison of sediment EPCs to sediment SLVs protective of the freshwater benthic community. Dietary toxicity was evaluated by comparing ODEQ's CTLs to site-specific clam and crayfish tissue concentrations. Through the comparison to CTLs, the potential for risk was estimated for predatory benthic organisms as well as for fish that may prey on benthic organisms.

Table 3-15 presents the findings of the direct toxicity evaluation for sediment. NOAEC-based HQs were greater than 1 for nine metals, PCB-Aro, PCB-Cong, four pesticides, ten high molecular weight PAHs (HPAHs), two low molecular weight PAHs (LPAHs), and two SVOCs.

NOAEC-based HIs were greater than 1 for total metals, total pesticides, total HPAHs, total LPAHs, and total PAHs. LOAEC-based HQs were greater than 1 for four metals, PCB-Aro, PCB-Cong, two pesticides, and five HPAHs. The LOAEC-based HQ for bis(2-ethylhexyl)phthalate (DEHP) was equal to 1. LOAEC-based HIs were greater than 1 for total metals, total pesticides, total HPAHs, and total LPAHs.

Table 3-16 presents the findings of the dietary toxicity evaluation through a comparison of CTLs to clam tissue. NOAEC-based HQs were greater than 1 for four metals, PCB-Aro, PCB-Cong, and 4,4'-DDT. NOAEC-based HIs were greater than 1 for total metals, total DDx, and total pesticides (which includes total DDx). The only LOAEC-based HQ greater than 1 was for aluminum, and only the LOAEC-based HI for total metals was greater than 1.

Table 3-17 presents the findings of the dietary toxicity evaluation through a comparison of CTLs to crayfish tissue. Only the NOAEC-based HQ for lead was greater than 1, and the NOAEC-based HI for total metals was also greater than 1. The LOAEC-based HQs and HI were less than 1 for crayfish tissue.

Fish Community. Dietary toxicity for the fish community was evaluated by comparing ODEQ's CTLs to site-specific sculpin and smallmouth bass tissue concentrations. Through the comparison to CTLs, the potential for risk was estimated for predatory fish and benthic scavengers that may consume dead fish.

Table 3-18 presents the findings of the dietary toxicity evaluation for sculpin tissue. The following CECs were identified for each sculpin-specific EU:

- EU-02, EU-05, EU-06, EU-10, EU-11, and EU-12 – Only the NOAEC-based HQ for mercury and HI for total metals were greater than 1. All LOAEC-based HQs and the HI were less than 1.
- EU-04 – The NOAEC-based HQs for lead and mercury and the HI for total metals were greater than 1. All LOAEC-based HQs were less than 1 and the HI for total metals was slightly greater than 1.
- EU-07 – Only the NOAEC-based HI for total metals was greater than 1. All other NOAEC-based HQs and LOAEC-based HQs and HI were less than 1.

Table 3-19 presents the findings of the dietary toxicity evaluation for smallmouth bass tissue. NOAEC-based HQs were greater than 1 for PCB-Aro, PCB-TEQ, PCB-Cong, chlordane (gamma), dieldrin, endosulfan I, and endrin. NOAEC-based HIs were greater than 1 for total metals and total pesticides. LOAEC-based HQs were greater than 1 for PCB-Aro, PCB-TEQ, PCB-Cong, chlordane (gamma), and endosulfan I, and only the LOAEC-based HI for total pesticides was greater than 1.

3.5.2 Uncertainty Assessment

Uncertainties are inherent in any risk-based approach to evaluation and decision making for potentially contaminated sites. The uncertainties may be general and systemic as well as specific to the site. The objective of the uncertainty assessment is to identify the sources of uncertainty in the RA process, understand their potential to contribute to either underestimation or overestimation of risk for the selected receptors and pathways, and describe how the uncertainty is addressed. By describing the nature and magnitude of the uncertainties, the findings and conclusions of the RA can be better understood and used as a tool for decision making.

The following text presents a discussion of uncertainties that apply to the BERA. Uncertainties related to the calculation of RBCs are presented in Appendix D.

3.5.2.1 Data Quality Evaluation

Appendix A presents the methodology and findings of the data quality evaluation that was conducted for data that were not subjected to the sensitivity evaluation in the Final RI report (URS 2012). The approach for evaluating data quality in the RI was carried into Appendix A, where maximum MDLs (or RDLs in the case of PCB congeners) for pre-RI (2003 to 2007) and pre-FS (2011) sediment samples compiled in the DETM were compared to the SLVs used in the RI. In addition, the pre-FS (2011) clam and bass tissue MDLs/RDLs were compared to ODEQ's ATLs/CTLs used in the RI.

The goal of the data sensitivity analysis was to evaluate the level of confidence in the low end of the reported range of concentrations with respect to its usability in the BHHERA. As discussed in Section 7.4 of the Final RI (URS 2012), there are three categories in which individual data points may fall within a data set as they range from high to low concentrations: unqualified detections, detections at estimated concentrations ("J-flagged") and EMPC-flagged detections, or non-detects ("U-flagged"). Less uncertainty is associated with the upper end of the range of reported concentrations that are well above the MDL or RDL, i.e., well above the lowest initial calibration standard of the laboratory instrument. Refer to Section 2.6.9 for a description of the treatment of EMPC-flagged data and the potential influence on the risk assessment.

As shown in Table A-5, the outcome of the data sensitivity analysis indicated that elevated MDLs were present for many of the same COIs with elevated MDLs discussed in the RI (i.e., all PCB Aroclors, except Aroclors 1262 and 1268, in sediment and DEHP in smallmouth bass). Table A-5 also summarizes the newly identified COIs with elevated MDLs:

- Sediment – Cadmium; thallium; Aroclors 1262 and 1268; PCB Congeners 77, 81, 126, and 169; most butyltins; 2,3,4,7,8-PeCDF; 2,3,7,8-TCDD; and all pesticides with screening levels except aldrin
- Clam – p-Cresol
- Smallmouth Bass – PCB Congeners 81, 126, and 169; 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT; chlordane (alpha); and p-cresol

The elimination of the 100% non-detect analytes with elevated MDLs/RDLs as CPECs is subject to an unavoidable potential for underestimation of risk since they cannot be conclusively shown to be absent at concentrations of concern. However, there is less potential for underestimation of risk related to the analytes that were sometimes detected because the estimation of the EPC for these analytes by Pro-UCL and the Kaplan-Meyer method takes the absolute value of the MDL/RDL into consideration by including these detection limits in the concentration ranking for that analyte when the UCL uses the MDL/RDL as the censoring limit.

Table A-6 summarizes the COIs for which sediment or tissue screening levels were not available. This represents a different type of uncertainty that is not related to analytical data quality but is relevant to the risk assessment process. The lack of SLVs indicates an absence of reliable or suitable toxicological information for the evaluation of the chemicals. COIs that were never detected, including those with no SLVs available, may result in a potential for underestimation of risk. However, this uncertainty is unlikely to impact risk management decisions in the FS because the most studied chemicals with refined data quality procedures in the laboratory are often the most toxic. Also, if these COIs are site-related, it is presumed that they would be co-located with risk-driving CECs that will be further evaluated in the River OU FS.

3.5.2.2 Sediment Bioaccumulative CPECs below ATLs in Tissue

As shown in Table 3-1, four metals, butyltins, pesticides, and six SVOCs were retained as potential bioaccumulative CPECs in the DETM (URS 2014) because the EPC in sediment was above ODEQ's 2007 bioaccumulation SLVs. In Tables 3-2 and 3-3, tissue data for these potentially bioaccumulative CPECs in sediment were compared to ODEQ's ATLs and CTLs for a better understanding of their capacity to accumulate in site benthic invertebrate and fish tissues above screening levels. All sediment CPECs in Table 3-1 with the exception of arsenic, bis(2-ethylhexyl) phthalate, carbazole, and di-n-butyl phthalate were retained as bioaccumulative CPECs in tissue based on the comparison of maximum detected concentrations in tissue to ATLs/CTLs. Given the lack of tissue detections and/or low detected concentrations relative to ATLs/CTLs, it is unlikely that risk from dietary exposure is underestimated for arsenic, bis(2-ethylhexyl) phthalate, carbazole, and di-n-butyl phthalate.

3.5.2.3 Dioxins and Furans

In April 2006, prior to the 2007 in-water sediment removal action, two sediment samples (Debris Pile #1 and Debris Pile #2) were collected in north shore contaminated areas and analyzed for dioxins and furans (URS 2006). The sampling was conducted to primarily inform sediment characterization for disposal due to the concern that dioxins and furans might be present in sediment due to the in-river equipment disposal. OCDD is the only dioxin/furan isomer detected in site sediment (in the Debris Pile #2 sample). The OCDD detected concentration (0.014 ug/kg) was J-flagged. There is less confidence in J-flagged detections because, although the analyte has been positively identified, the reported value is estimated at the MRL, and the true concentration may actually be as low as the MDL.

During the Final RI/FS MP (URS 2007), the results of the dioxin and furan sampling were re-evaluated and it was concluded that dioxins and furans would not be investigated as part of the RI (i.e., dioxins and furans were not site COIs). Based on the RI/FS MP decision to not include dioxin/furans as COIs for the RI, the lack of dioxin/furan analysis (e.g., the OCDD estimated detection and/or dioxin/furan TEQs) in the BHHERA does not represent a data gap.

Additionally, the OCDD estimated detected concentration (0.014 ug/kg) is lower than the lowest human health or ecological ODEQ SLVs:

- OCDD is nearly 9,300 times lower than the lowest ecological ODEQ SLV for OCDD (130 ug/kg).
- OCDD is 200 times lower than the lowest human health ODEQ SLV (2.8 ug/kg).

USEPA guidance does not support development of TEQs in the absence of detections of 2,3,7,8-TCDD or multiple dioxin/furan isomers (USEPA 2008, USEPA 1987).

Based on the discussions presented above, the exclusion of dioxins and furans (i.e., OCDD) from evaluation in the BHHERA neither represents an oversight nor underestimates risk. In addition, the one detection of OCDD was located in one of the three former debris piles (Debris Pile #2) and was co-located with high PCBs in the former removal areas that are recommended for further evaluation in the River OU FS.

3.5.2.4 Age of Tissue Data

A major source of uncertainty for the River OU is whether the tissue and sediment data utilized in the BERA represent current conditions in the River OU. The risk characterization is based upon post-sediment removal clam tissue (2008 and 2011), crayfish tissue (2008), and sculpin tissue (2008), as well as smallmouth bass tissue data that were collected both prior to the 2007 sediment removal (collected in 2006) and after the removal during the pre-FS sampling in 2011. The crayfish tissue was collected after the sediment removal but may also represent exposure periods that date back to pre-removal conditions given the life span for crayfish. These factors may overestimate the number of COPCs and the magnitudes of the related HQs. Crayfish, smallmouth bass, and other receptors that may have been exposed to both pre-removal and post-removal conditions are likely to show a trend of declining tissue concentrations over time, as evidenced based on a comparison between 2006 and 2011 bass tissue data.

Figure 1-5 shows the bass samples collected in 2006 and 2011, and as described in the following risk interpretation section, some of the highest concentrations of PCBs in bass were detected in 2011. While there was a wider spread in PCB concentrations reported in the 2011 bass dataset, only a few fish were found to have elevated detections. Generally low levels of PCBs were noted in the remaining 2011 bass samples as compared to the 2006 PCB concentrations in bass, which had a larger number of elevated PCB detections. Although the 2006 and 2011 bass data may appear to be decreasing, these two datasets are not necessarily comparable and more data would be needed to make any strong inferences about data trends. Younger fish are often found to have a lower PCB body burden than older fish. However, the elevated concentrations were detected in young 2011 fish that were unlikely to have been exposed to pre-removal conditions. Therefore, there remains uncertainty as to whether the smallmouth bass data used in the BERA may over- or underestimate River OU exposure by fish consumers.

3.5.2.5 Selection of Toxicity Data

Most toxicological endpoints used for higher trophic-level receptors are individual-level effects: a reduction in progeny number for a female exposed during gestation, for example. Effects are likely to increase with increased exposure. Population-level effects are not necessarily a given outcome of organism-level responses, even when endpoints are those most commonly associated with population size (Moe 2008). Fewer pups per litter may mean more resources per pup, faster growth rates, and higher rate of survival to reproduction. Relying heavily on assessing risks on an individual-level may overestimate effects to the assessment endpoint: the population. Conservative assumptions used in exposure models are compounded by using toxicological endpoints that have minor repercussions on populations. Therefore, error in selecting toxicity endpoints is likely to result in an overestimate of risk.

TRVs were from toxicity studies conducted on laboratory-raised test species, and test conditions do not reflect those of the site. The relative sensitivities of the receptor species and test species are usually unknown, as is the influence of site conditions on bioavailability and toxicity of the contaminant. Many of the TRVs applied to the CPECs in the BERA were extrapolated from studies on bald eagles and mink (i.e., site-specific target receptors), which alleviates some of this uncertainty.

3.5.2.6 Lack of Toxicity Data

Toxicity data were not available for a limited number of CPECs. Those CPECs for which direct toxicity sediment benchmarks protective of the benthic community were not available are shown in Table 3-13: cobalt, thallium, vanadium, benzoic acid, and benzyl alcohol. Table 3-13 also shows that vanadium was the only CPEC lacking a tissue-based toxicity benchmark protective of freshwater organisms exposed through direct toxicity and their diet (i.e., benthic invertebrates and fish). As shown in Table 3-14, antimony is the only CPECs lacking avian TRVs, and mammalian TRVs were available for all CPECs. Unavailable toxicity data could cause underestimation of risk, but given the very few CPECs lacking toxicity data, this uncertainty is not expected to impact risk management decisions in the FS.

3.5.2.7 Use of Input Exposure Parameters

A detailed explanation of the selection of the input exposure parameters selected for the BERA can be found in the RI/FS MP (URS 2007). Resources used to determine input exposure parameter values included USEPA's Wildlife Exposure Factors Handbook (USEPA 1993b), Food Requirements of Wild Animals: Predictive Equations for Free-living Mammals, Reptiles, and Birds (Nagy 2001), and Estimates of Soil Ingestion by Wildlife (Beyer, Connor, and Gerould 1994).

There can be variability in input rates among individuals within a species, between species, between habitat types, and with the type and quantity of food items available. The direction and magnitude of the uncertainty associated with these variables is not measurable. For most receptors, a lower-end average body weight was paired with an upper-end average ingestion rate, resulting in conservative exposure assumptions. These assumptions may overestimate or underestimate actual "real world" intake since lower-end body weights would be protective of small adult receptors, but may underestimate risk for young individuals and overestimate risk for larger adult individuals.

3.5.2.8 Dietary Item Assumptions

For the BERA, the riverine avian receptors that typically consume more than one type of food item (i.e., the eagle and osprey) were conservatively assumed to consume only the food item (i.e., invertivorous/piscivorous fish [smallmouth bass]) that comprises a large portion of their diet and has the highest detected concentrations of CPECs. However, this assumption of exclusive intake of the a single prey item to estimate risk to a category of receptor (piscivorous birds) that prey on multiple categories of prey, e.g., carnivorous, herbivorous/insectivorous, and invertivorous/piscivorous fish (Figure 3-1), may over- or underestimate risk. For those species that consume more than one type of dietary item, risks are likely overestimated since certain types of food (e.g., plants) tend to uptake contaminants at a lower concentration.

Mink were selected to represent large carnivorous mammals for both the River OU and Upland OU. Mink are present in the area and could feasibly access the island and forage there on rodents, in addition to river foraging. Several sources of information on the mink's diet were consulted while developing the response to ODEQ's Specific Comment #22 to the Final RI (URS 2012), and the consensus is that mink's diet primarily consists of crayfish, fish, and other aquatic-related prey. Typically, 10% or less of their diet is comprised of terrestrial prey (e.g., birds and small mammals) (USEPA 1993b, 1995). Although the Upland OU BERA assumed 15% small mammals for the upland RA, mink were conservatively assumed to have a dietary composition of 100% prey from the River OU for this River OU BERA. This was done because it is likely that mink preferentially use the River OU (i.e., permanent water source, riverine habitat) rather than the Upland OU to forage. Therefore, the uncertainty that risk may have been underestimated in the River OU BERA is minimal and unlikely to impact risk management decisions in the FS.

In addition, although the mink was assumed to consume more the one type of riverine food item (i.e., crayfish, sculpin, and bass), the mink's diet was assumed to be comprised of each equally (i.e., 33.3% each). In actuality, mink dietary composition is likely to fluctuate with availability, season, and, potentially, animal preference. Additionally, in instances when an CPEC was not analyzed in all three tissues, the dietary composition was adjusted for that particular analyte based on available tissue analysis (e.g., 50% each if only analyzed in two tissues, or 100% if analyzed in a single tissue type). Both of these uncertainties may over- or underestimate risk to the mink; the direction and magnitude of this uncertainty is difficult to quantify.

3.5.2.9 Estimated Concentrations

In this BERA, estimated concentrations were calculated for:

- Organic CPECs lacking surface water analytical data for use in the wildlife (osprey, eagle, and mink) uptake modeling (i.e., drinking water ingestion); see Table 3-7b.
- Dibenzofuran tissue concentrations for clam, crayfish, sculpin, and smallmouth bass for direct and/or dietary toxicity for benthic invertebrates and fish, as well as prey for wildlife dietary exposure; see Table 3-8a.
- Bird egg estimated concentrations for mercury, PCBs, and DDx for evaluation of avian sensitive life stage (e.g., embryo); see Table 3-8b.

There is a level of uncertainty inherent whenever a concentration is estimated because assumptions are made and typically involve default values that may or may not be reflective of site conditions. For the organic CPECs lacking surface water analytical data (i.e., PCBs-Aro, pesticides, dibenzofuran, and p-cresol), surface water concentrations were calculated using default chemical-specific K_{oc} and site-specific sediment data (see Section 3.2.2). Since the resulting concentration represents the surface water concentration for the sediment pore water and immediately proximate water, it is probable that these estimated surface water concentrations overestimate concentrations near-surface, from which wildlife receptors drink. However, this drinking water pathway is minor exposure pathway and even these overestimated surface water concentrations are unlikely to have resulted in overestimation of dietary risk exposure, which is driven by prey items.

As described in Section 3.2.2, the estimated benthic and fish tissue dibenzofuran concentrations used the site-specific median lipid fractions for each of the prey. The use of site-specific lipid fractions, rather than default lipid values, helps to decrease the uncertainty inherent in the estimated concentrations. Since the fish BSAF used to estimate the dibenzofuran concentrations for all tissues was based on the median BSAF of whole-body fish (smallmouth bass, white sucker, and American eel), the BSAF may over- or underestimate risk for clam and crayfish, which lacked benthic BSAFs, and to a lesser degree, sculpin, since they were not represented in the available whole-body fish BSAF database.

As described by ODEQ (2007), for some chemicals, such as mercury, PCBs, and DDx, the most important and most sensitive effects on birds are to the developing embryos. Since bird eggs were not collected and analyzed, bird egg concentrations were estimated by multiplying ODEQ's default BMFs (ODEQ 2007) by the smallmouth bass tissue concentrations (see Section 3.2.2). The study for which the default eagle BMFs are from (Buck 2004) noted that the PCB BMFs varied "quite markedly" among the Columbia River segments evaluated (i.e., ranged from 90 to 155) and used prey fish tissue from a wider range of prey items than the assumed dietary assumptions for this BERA (i.e., 100% bass). It also notes that "the actual BMFs for DDE and total PCBs may be somewhere between the values reported for our study and the Bi-State Study [lower for PCBs and mercury, but higher for DDE]" and that some of the difference between the eagle BMFs vs osprey BMFs from the Willamette River (Henny et al. 2003) may be due to the difference in reporting since "total PCBS were reported based on summation of congeners for the osprey and reported as Aroclor PCBs for eagles." The use of the default BMFs, which showed variations among the study river segments from studies on which they are based, introduces a level of uncertainty that is hard to quantify and may over- or underestimate risk. However, combined with the dietary assumption of 100% bass (with highest detected CPEC concentrations), this likely conservatively skews the uncertainty toward overestimation.

3.5.2.10 River OU Evaluation Strategy

Two types of data representing different sampling strategies were incorporated into the BERA:

- Strategy 1 – random grid samples collected from the Forebay during the RI
- Strategy 2 – targeted samples collected on the basis of identified source areas (i.e., former removal areas on the north shore of the island) or specific targeted areas (i.e., Goose Island and mouth of Eagle Creek)

Whether the sampled areas are representative habitat depends on the receptor species. These two types of data were combined to calculate EPCs for wide-ranging receptors: osprey, eagle, mink, and smallmouth bass. Smaller-ranging or immobile receptors were evaluated either on a point by point basis (clams and crayfish) or smaller EU-sections throughout the River OU (0.1-mile increments for sculpin). Individuals of these small-ranging receptor groups could feasibly be exposed to CPEC concentrations in the former source areas on the north shore of the island throughout their life span, assuming appropriate habitat is available.

Unlike benthic invertebrates and small fish, it is unrealistic to assume piscivorous birds and mammals would solely be exposed to media from the north shore of the island, given this small area relative to the size of their home ranges, which are equivalent to or larger than the entire River OU. In addition, the primary risk-driving pathway for these receptors is the fish ingestion pathway, and highest PCB concentrations were detected in smallmouth bass from the north shore as well as Goose Island Slough. Bass would forage along the shorelines throughout the River OU, where habitat is most suitable and food is abundant. The assumption that a mink or piscivorous bird would forage solely along the north shore of the island and only on bass from the north shore of the island would result in an overestimation of exposure and risk to these wildlife receptors. Therefore, the River OU evaluation strategy was maintained for the wider-ranging receptors due to the fewer uncertainties with this approach.

Due to the data gaps in the RI sampling (no pesticide or butyltin analysis and limited SVOC analysis), the 2011 Pre-FS tissue and sediment sampling was conducted to address these data gaps. The 2011 Pre-FS sampling was statistically robust for risk evaluation (not limited) and served its purpose by targeting the analytical data gaps in the former source areas, including the analytes with potential Upland contributions to the River. The maximum concentrations of OCPs occur in the former source area in the 2011 Pre-FS samples, with the highest concentrations of PCBs collected within the former source areas. OCP compounds can be confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. Their presence in localized areas of the Upland OU Landfill AOPC has been documented. Co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU creates an uncertainty as to whether OCPs are site-related from in-water disposal activities. The potential for the OCPs to be related to the upland-to-river pathway will be further evaluated in the FS.

3.5.3 Risk Interpretation

In this final phase of the risk characterization process, the quantitative and qualitative components of the BERA are evaluated to gain a better understanding of the actual potential for ecological risk. The actual risk drivers in the River OU and the extent of impacts for these CECs are identified to develop supportable recommendations for risk managers to review. The CECs are defined as the subset of CPECs for which HQs were shown to be greater than 1 in this BERA. The outcome of the risk characterization will constitute the basis of remedial decisions for the protection of ecological receptors and risk driving receptors and exposure pathways.

To help facilitate the risk description discussion in Section 3.5.3.2, receptor-specific RBCs were calculated for sediment and tissue for the CECs identified in Section 3.5.2, with the exception of aluminum (see Sections 3.5.3.2.3 and 3.5.3.2.5 for explanation), so that exceedances of these RBCs could be illustrated on the River OU map. The RBCs are also meant to be applied in the FS during the selection of the final PRGs for the River OU as a tool to evaluate the effectiveness of various site management strategies. The approach used to calculate RBCs is discussed in the following section.

3.5.3.1 Calculation of Site-Specific Risk-Based Concentrations

Tissue RBCs. The general equation used to establish wildlife ATLs presented in ODEQ's 2007 guidance (Equation C-3) with the addition of the AUF was used to calculate site-specific RBCs in tissue protective of the osprey, eagle, and mink (Table 3-20):

$$\text{Site-Specific RBC}_{tissue} = \text{TRV}/(\text{IR}_{food}/\text{BW}) \times \text{AUF}$$

where:

Site-Specific RBC_{tissue}	=	RBC in tissue (mg/kg-wet weight)
TRV	=	Toxicity reference value represented (mg/kg-bw/day)
IR_{food}	=	Ingestion rate of food (kg/day wet weight)
BW	=	Body weight (kg)
AUF	=	Area use factor (decimal fraction)

The receptor-specific input parameters described in Section 3.3.3 and presented in Tables 3-4 through 3-6, and the LOAEL-based TRVs described in Section 3.4.3 and presented in Table 3-14, were applied to protect populations of these three target receptors (ODEQ 2007).

To calculate fish tissue RBCs protective of eagle and osprey eggs (mg CEC/kg fish tissue -wet weight), the LOAEL-based TRVs for bird eggs in Table 3-14 were divided by the receptor-specific bird egg biomagnification factors provided in Table 3-8.

Tissue RBCs for benthic invertebrates were selected as the LOAEC-based tissue benchmarks in Table 3-13 to protect the benthic community, and the NOAEC-based tissue benchmarks were selected as the tissue RBCs for fish due to the potential presence of listed fish species in the River OU.

The site-specific tissue RBCs are presented in Table 3-20, which also presents the lowest RBC per CEC selected to create the RBC exceedance figures (Figures 3-3 and 3-4). The fish diet RBCs are the lowest of the diet (tissue) RBCs, which are based on NOAECs. The exception is for the CECs with bird egg RBCs (PCB-Aro, PCB-Cong, and PCB-TEQ), as the bird egg (tissue) RBCs are the lowest. Table 3-20 also provides the Upstream Reference UPLs for the four tissue types collected for general perspective. The lowest tissue RBC for lead is less than the UPL for crayfish and bass, and the lowest RBC for mercury is less than the UPL for bass and is equal to the sculpin UPL. The lowest tissue RBC for PCB-Cong, which is a bird egg RBC, is lower than the bass UPL and the next highest RBC (fish diet) is equivalent to the bass UPL.

Sediment RBCs. The general equation used to establish wildlife SLVs for organic CECs in ODEQ’s 2007 guidance (Equation D-1) was applied to back-calculate RBCs in sediment for the dietary CECs, i.e., the CECs for which RBCs in tissue were calculated in Table 3-20:

$$\text{Site-Specific } RBC_{sediment} = f_{oc} \text{ x } (RBC_{tissue} \div [BAF \text{ x } f_{lipid}])$$

where:

Site-Specific $RBC_{sediment}$	=	RBC in sediment (mg/kg-dry weight)
f_{oc}	=	Site-specific fraction of organic carbon (decimal fraction)
RBC_{tissue}	=	RBC in tissue (mg/kg-wet weight)
BAF	=	Site-specific bioaccumulation factor (kg organic carbon/ kg lipid)
f_{lipid}	=	Site-specific fraction of lipid (decimal fraction)

The RBCs in sediment calculated using the equation above for fish, osprey, eagle, bird egg, and mink, as well as the site-specific values for f_{oc} and $f_{lipid,}$ are shown in Table 3-21. Upstream Reference UPLs for sediment are also shown in the table. The lowest sediment RBC for PCB-Aro, which is a bird egg RBC, is lower than the sediment UPL.

The site-specific bioaccumulation factors were developed by first using sediment and clam paired datasets from the River OU to estimate BSAFs. The site-specific median sediment-clam BSAF was selected for each organic CEC (USEPA 2009). To account for biomagification in the food web that ultimately reflects accumulation in smallmouth bass tissue, River OU clam and bass median concentrations were used to estimate clam-bass biomagnification factors. To estimate final site-specific BAFs, the sediment-clam BSAFs were multiplied by the clam-bass BMFs. A more detailed description of the methodology used to estimate the BAFs as well as the numerical values selected for the BSAFs and BMFs are provided in Appendix D.

Given the high level of uncertainty associated with establishing BAFs (BSAFs) for inorganics and in accordance with ODEQ’s 2007 guidance, BAFs were not calculated for inorganic CECs.

The sediment RBCs for the fish, osprey, eagle, bird egg, and mink defaulted to the Upstream Reference UPLs for lead and mercury (Table 3-21).

Sediment RBCs for direct toxicity to the benthic community are represented in Table 3-21 by the LOAEC TRVs provided in Table 3-13.

The CECs with exceedances of the lowest RBC for any receptor group are plotted in Figures 3-3 through 3-6. The locations with exceedances of the lowest site-specific RBC for each CEC from Tables 3-20 and 3-21 are identified with a data posting box that provides the concentrations of the CECs that exceed the RBCs at that particular location. Sample locations without a data posting box indicate that CEC concentrations are below the RBCs at that particular location. Dietary sediment RBCs for several CECs are not depicted on the figures because the maximum concentration in sediment is below the dietary sediment RBC (i.e., the predicted risk was based on tissue and not sediment). Sample-specific RBC exceedances are color-coded on the figures to allow for better visualization of the extent of potentially impacted areas ("Conc. ÷ RBC" on figures, discussed as "sample-specific C/Rs"):

- sample-specific C/Rs between 1 and 5 = low risk (green)
- sample-specific C/Rs between 5 and 10 = moderate risk (blue)
- sample-specific C/Rs greater than 10 = moderate to high risk (orange)

The following subsection provides a description of the potential for risk to the target receptors in consideration of the HQs summarized in Section 3.5.1, the uncertainties described in Section 3.5.2, and the location-specific RBC exceedances as well as the spatial distribution of CEC concentrations relative to the RBCs.

3.5.3.2 Risk Description

This section relies heavily on Figures 3-3 through 3-6 to describe the extent of elevated CEC concentrations relative to the receptor-specific RBCs discussed above. Because exposure through fish tissue ingestion is the primary route of exposure for predatory fish, the osprey, eagle, and mink tissue RBC exceedances are discussed for each of these individual target receptors. The description of tissue RBC exceedances for each receptor is followed by a summary of the exceedances of the lowest sediment RBCs back-calculated from these tissue RBCs.

3.5.3.2.1 Fish Community

Site-specific sculpin and bass tissue data were used to evaluate the potential for risk to the fish community.

Sculpin

The following CECs were identified in sculpin tissue due to NOAEL-based HQs greater than 1: lead, mercury, PCB-Aro, PCB-TEQ, and PCB-Cong. Figure 3-3 presents the location-specific concentrations above the lowest tissue RBCs, i.e., the fish diet RBCs (Table 3-20).

One sculpin sample (SF-13, which borders EUs-4 and -5 on the mainland of the Oregon shoreline across from the eastern tip of Bradford Island) had a concentration above the fish tissue RBC for **lead** (2.6 times greater than the RBC). This sample is bound by samples with concentrations below the RBC. Based on the isolated low exceedance of the NOAEL-based RBC, the potential for risk from lead is low.

For **mercury**, eight sculpin samples collected throughout the River OU (from both sides of the river and along the Bradford Island shoreline) exceeded the fish diet RBC. The RBC for mercury is equivalent to the Upstream Reference UPL in sculpin tissue. Samples SF-15 and SF-16 are located in a small unnamed island in the middle of the river across from the southern tip of Goose Island. The maximum detection occurred in sample SF-03 from the eastern tip of Bradford Island, resulting in a sample-specific C/R of 2.3. The second highest sample-specific C/R of 2.2 is associated with SF-16, which is from the small island in the middle of the river upstream of Bradford Island. Sample-specific C/Rs for the six remaining locations with RBC exceedances range from 1.1 to 1.8. Concentrations of mercury in sculpin tissue are fairly homogeneous throughout the River OU. Based on the uniform concentrations of mercury in sculpin from the River OU and low exceedances of the NOAEL-based RBC (equal to the UPL), the potential for risk from mercury is low, and River OU concentrations appear to be at background levels.

For **PCBs**, the following sculpin samples were greater than the fish diet RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors – SF-03 (C/R=4) and SF-04 (C/R=1.1), both in EU-4 off the eastern tip of Bradford Island
- Congeners – SF-03 (C/R=11), SF-04 (C/R=2.1), and SF-05 (C/R=1.3), in EU-4 off the eastern tip of Bradford Island (SF-05 borders EU-4 and EU-13)
- TEQ for fish – SF-03 (C/R=1.3) in EU-4 off the eastern tip of Bradford Island

PCB concentrations appear to decrease with distance from SF-03, which is closest to the former removal area, moving south around the eastern tip of Bradford Island to SF-05. Given the elevated sample-specific C/Rs in EU-4, especially at SF-03, the sculpin's small home range, and because fish are protected at the individual level due to the potential transient presence of salmonids and other sensitive species, there is a localized unacceptable potential for risk to small predatory fish from PCBs in sculpin tissue.

Smallmouth Bass

The following CECs were identified in bass tissue due to NOAEL-based HQs greater than 1: PCB-Aro, PCB-TEQ, PCB-Cong, gamma-chlordane, dieldrin, endrin, and endosulfan I. Figure 3-4 presents the location-specific concentrations above the lowest tissue RBCs (not including bird egg RBCs), i.e., the fish diet RBCs. Bird egg RBCs for tissue are lower than the fish diet RBCs for tissue (Table 3-20) and were plotted on a separate figure (Figures 3-5a and 3-5b) from the "diet" related RBCs. For PCBs, the fish diet RBCs from Table 3-20 were compared to the sample-specific concentrations shown on Figure 3-4 to estimate sample-specific C/Rs in order to assess magnitude of exceedance.

For **OCPs**, concentrations of gamma-chlordane and dieldrin exceeded the fish diet RBCs in four bass samples: three from the north shore of Bradford Island (62, 63, and 68) and one from the eastern tip of Goose Island (78). Sample-specific C/Rs for gamma-chlordane in the three north shore samples ranged from 11 to 83, and the elevated C/R for Goose Island sample 78 was 20. Sample-specific C/Rs for dieldrin in the three north shore samples ranged from 1.4 to 11, and the C/R for Goose Island sample 78 was 2.8.

Concentrations of endrin and endosulfan I exceeded the fish diet RBCs in two bass samples from the north shore (63 and 68 for endrin, and 62 and 63 for endosulfan I) and also at Goose Island sample 78. Sample-specific C/Rs for endrin in the two north shore samples ranged from 2 to 4.4, and the C/R for Goose Island sample 78 was 1.4. Sample-specific C/Rs for endosulfan I in the two north shore samples ranged from 11 to 24, and the elevated C/R for Goose Island sample 78 was 22.

An evaluation of OCP occurrence relative to PCBs was performed because 1) there is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island since OCPs were not identified as sediment CPECs for fish diet (see sediment discussion below and footnote “d” in Table 3-21 for more detail), and 2) identification of OCP compounds may be confounded by the presence of elevated PCB congeners during laboratory analyses (due to similarity of structure and overlapping mass ratios). With the exception of endosulfan I, sample 68 has the maximum concentrations of OCPs and PCBs, followed by sample 63, both of which are adjacent to former underwater debris piles that were removed in 2000 and 2002. Co-location with elevated PCBs was noted in the bass data distribution. Nonetheless, given the elevated sample-specific C/Rs for OCPs along the north shore of Bradford Island and the one isolated detection on the northeastern tip of Goose Island, and because fish are protected at the individual level due to the potential transient presence of salmonids and other sensitive species, OCPs were considered to have the potential to pose an unacceptable risk to large predatory fish ingesting bass as prey.

For **PCBs**, the following bass samples were greater than the fish diet RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors – 16, 17, 18, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 1.4 to 151); and 2, 8, 11, and 78 from Goose Island (C/Rs ranging from 3.1 to 63)
- Congeners – 3, 16, 17, 18, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 2 to 426); and 2, 8, 11, 13, and 78 from Goose Island (C/Rs ranging from 3.0 to 161)
- TEQ for fish – 17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 5.8 to 31); and 11 and 78 from Goose Island (C/Rs ranging from 3.8 to 13)

As stated above, sample 68 has the maximum concentrations of OCPs and PCBs, followed by sample 63, both of which were collected in 2011 adjacent to former underwater debris piles that were removed in 2000 and 2002. Given the elevated sample-specific C/Rs for PCBs along the north shore of Bradford Island and around Goose Island, and because fish are protected at the individual level due to the potential transient presence of salmonids and other sensitive species, PCBs were considered to have the potential to pose an unacceptable risk to large predatory fish ingesting bass as prey.

3.5.3.2.2 Piscivorous Birds

Site-specific smallmouth bass tissue data were used to evaluate the potential for risk to the osprey and eagle. These data were entered into the dose equation for a comparison to dose-based TRVs (mg/kg-bw/day) and were also used to estimate bird egg tissue concentrations through the application of fish-bird egg BMFs (see Section 3.5.2) for a comparison to bird egg TRVs.

Tissue and sediment RBCs were back-calculated for both types of exposure scenarios for birds: bird diet RBCs and bird egg RBCs.

Osprey

The following CECs were identified in bass tissue due to LOAEL-based HQs greater than 1: mercury, PCB-Aro, PCB-TEQ, PCB-Cong, dieldrin, and endrin. LOAEL-based HQs for osprey eggs were also greater than 1 for the three types of PCBs evaluated. The osprey egg HQs are higher than the dose-based osprey HQs.

Figure 3-4 presents the location-specific concentrations above the lowest tissue RBCs (not including bird egg RBCs), i.e., the fish diet RBCs. Bird egg RBCs for tissue were plotted on a separate figure from the "diet" related RBCs (Figure 3-5). Osprey diet RBCs from Table 3-20 were compared to the sample-specific concentrations shown on Figure 3-4 to estimate sample-specific C/Rs in order to assess magnitude of exceedance.

For **mercury**, sample-specific bass tissue samples exceeded the osprey diet RBC at 16 locations throughout the River OU. Sample-specific C/Rs are provided in parentheses.

- Three samples from north shore of Bradford Island – 16 (C/R=1.6), 62 (C/R=2.4), 18 (C/R=2.6)
- One sample from small unnamed island in middle of River OU – 74 (C/R=1.2)
- Twelve samples around Goose Island – 2, 6, 7, 8, 9, 10, 11, 13, 14, 15, 81, and 82 (C/Rs range from 1.1 to 2.7)

Smallmouth bass tissue samples 1 through 20 were collected in 2006 prior to the sediment removal in 2007, and bass tissue samples 62 through 84 were collected post-sediment removal as part of the pre-FS sampling that occurred in 2011 (see Section 3.5.2 for a discussion of the uncertainties associated with the age of the tissue data). The osprey diet RBC for mercury is approximately two times lower than the Upstream Reference UPL in bass tissue.

The maximum concentration of mercury in bass tissue was detected in Goose Island sample 13 (C/R=2.7). Concentrations of mercury in bass tissue are fairly homogeneous throughout the River OU. Based on the uniform concentrations of mercury in bass from the River OU and low exceedances of the osprey diet RBC, which is lower than the UPL, the potential for risk from mercury is low, and River OU concentrations appear to be at background levels.

For **OCPs**, concentrations of dieldrin exceeded the osprey diet RBCs in four bass samples, three from the north shore of Bradford Island (62, 63, and 68) and one from the eastern tip of Goose Island (78). Sample-specific C/Rs for dieldrin in the three north shore samples ranged from 1.3 to 10, and the C/R for Goose Island sample 78 was 2.6. Only one bass tissue concentration of endrin exceeded the osprey diet RBC (sample 68), resulting in a sample-specific C/R of 1.7.

Sample 68, which is adjacent to former underwater debris piles that were removed in 2000 and 2002, had the maximum concentrations of OCPs and PCBs. OCP compounds are not infrequently confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. However, co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU create an uncertainty as to whether OCPs are site-related. Given the elevated sample-specific C/Rs for

OCPs along the north shore of Bradford Island and, to a lesser extent, the one isolated detection on the northeastern tip of Goose Island, there is an unacceptable potential for risk to osprey populations from OCPs in bass tissue.

For **PCBs**, the following bass samples were greater than the osprey diet RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors –17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 3.0 to 15); and 11 and 78 from Goose Island (C/Rs ranging from 3.3 to 6.3)
- Congeners –17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 6.2 to 43); and 11 and 78 from Goose Island (C/Rs ranging from 4.4 to 16)
- TEQ for birds – 17, 18, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 1.3 to 69); and 11 and 78 from Goose Island (C/Rs ranging from 9 to 26)

As stated above, sample 68 had the maximum concentrations of OCPs and PCBs, followed by sample 63, both of which were collected in 2011 adjacent to former underwater debris piles that were removed in 2000 and 2002. Given the elevated sample-specific C/Rs for PCBs along the north shore of Bradford Island and around Goose Island, there is an unacceptable potential for risk to osprey populations from PCBs in bass tissue.

Bald Eagle

The same bass tissue CECs identified above for the osprey were identified for the eagle due to LOAEL-based HQs greater than 1: mercury, PCB-Aro, PCB-TEQ, PCB-Cong, dieldrin, and endrin. LOAEL-based HQs for osprey eggs were also greater than 1 for the three types of PCBs evaluated. The eagle egg HQs are higher than the dose-based eagle HQs.

As described for the osprey, eagle diet RBCs from Table 3-20 were compared to the sample-specific concentrations shown on Figure 3-4 to estimate sample-specific C/Rs in order to assess magnitude of exceedance. Bird egg RBCs for tissue were plotted on a separate figure from the "diet" related RBCs (Figure 3-5).

For **mercury**, sample-specific bass tissue samples exceeded the osprey diet RBC at 16 locations throughout the River OU. Sample-specific C/Rs are provided in parentheses.

- Three samples from the north shore of Bradford Island – 16 (C/R=1.5), 62 (C/R=2.3), 18 (C/R=2.5)
- One sample from a small unnamed island in middle of River OU – 74 (C/R=1.2)
- Eleven samples from around Goose Island – 2, 6, 7, 8, 9, 10, 11, 13, 14, 81, and 82 (C/Rs range from 1.1 to 2.6)

Smallmouth bass tissue samples 1 through 20 were collected in 2006 prior to the sediment removal in 2007, and bass tissue samples 62 through 84 were collected post-sediment removal as part of the pre-FS sampling that occurred in 2011 (see Section 3.5.2 for a discussion of the uncertainties associated with the age of the tissue data). The eagle diet RBC for mercury is approximately two times lower than the Upstream Reference UPL in bass tissue.

The maximum concentration of mercury in bass tissue was detected in Goose Island sample 13 (C/R=2.6). Concentrations of mercury in bass tissue are fairly homogeneous throughout the River OU. Based on the uniform concentrations of mercury in bass from the River OU and low exceedances of the eagle diet RBC, which is lower than the UPL, the potential for risk from mercury is low, and River OU concentrations appear to be at background levels.

For **OCPs**, concentrations of dieldrin exceeded the eagle diet RBCs in three bass samples: two from the north shore of Bradford Island (63 and 68) and one from the eastern tip of Goose Island (78). Sample-specific C/Rs for dieldrin in the three north shore samples ranged from 2.6 to 7.8, and the C/R for Goose Island sample 78 was 2.0. Only one bass tissue concentration of endrin exceeded the eagle diet RBC (sample 68), resulting in a sample-specific C/R of 1.3.

As described above, the maximum concentrations of OCPs and PCBs occur in the former source area. OCP compounds can be confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. However, co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU creates an uncertainty as to whether OCPs are site-related. Given the elevated sample-specific C/Rs for OCPs along the north shore of Bradford Island, and to a lesser extent, the one isolated detection on the northeastern tip of Goose Island, there is an unacceptable potential for risk to eagle populations from OCPs in bass tissue.

For **PCBs**, the following bass samples were greater than the osprey diet RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors –17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 2.3 to 12); and 11 and 78 from Goose Island (C/Rs ranging from 2.5 to 4.8)
- Congeners –17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 4.7 to 32); and 11 and 78 from Goose Island (C/Rs ranging from 3.4 to 12)
- TEQ for birds – 17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 7.8 to 53); and 11 and 78 from Goose Island (C/Rs ranging from 6.8 to 20)

As stated above, sample 68 has the maximum concentrations of OCPs and PCBs, followed by sample 63, both of which were collected in 2011 adjacent to former underwater debris piles that were removed in 2000 and 2002. Given the elevated sample-specific C/Rs for PCBs along the north shore of Bradford Island and around Goose Island, there is an unacceptable potential for risk to eagle populations from PCBs in bass tissue.

Osprey and Eagle Eggs

LOAEL-based HQs for osprey and eagle eggs were greater than 1 for the three types of PCBs evaluated. Figure 3-5 presents the location-specific concentrations above the lowest tissue RBCs for PCBs, i.e., the bird egg RBCs (Table 3-20). The bird egg RBC for PCB-Cong is approximately two times lower than the Upstream Reference UPL in bass tissue.

The following bass samples were greater than the bird egg RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors – all bass samples collected from the north shore of Bradford Island (C/Rs ranging from 3.3 to 361), five samples from Goose Island (C/Rs ranging from 1.1 to 150), and one from main Oregon shoreline
- Congeners – all bass samples from the north shore of Bradford Island (C/Rs ranging from 6.6 to 1,017), seven from Goose Island (C/Rs ranging from 1.5 to 385), and four

additional samples (three from south side of Bradford Island and one from main Oregon shoreline)

- TEQ for birds – all bass samples from the north shore of Bradford Island (C/Rs ranging from 1.0 to 138), five from Goose Island (C/Rs ranging from 1.0 to 52), and one from south side of Bradford Island

There is inherent uncertainty in the bird egg evaluation and RBCs established for this exposure scenario, primarily due to the applied default BMF (see Section 3.5.2). There are many more bird egg RBC exceedances than bird diet RBC exceedances, but the highest magnitude of these exceedances (i.e., orange color-coding), as shown on Figure 3-6, demonstrates the same areas of primary impact as the bird diet RBC exceedances. Given the elevated sample-specific C/Rs for PCBs along the north shore of Bradford Island and around Goose Island, there is an unacceptable potential for risk to bird embryos from PCBs in bass tissue. However, the magnitude of impact based on bird egg RBC exceedances is likely exaggerated given the uncertainty in the estimation of these RBCs.

3.5.3.2.3 Mink

Site-specific smallmouth bass tissue, sculpin tissue, and crayfish tissue data were used to evaluate the potential for risk to the mink. The following CECs were identified in one or more of these tissues due to LOAEL-based HQs greater than 1: aluminum, mercury, PCB-Aro, PCB-TEQ, PCB-Cong, and dieldrin. With the exception of aluminum, all of these CECs were detected at very low levels in crayfish, and concentrations detected in sculpin and smallmouth bass resulted in the elevated mink HQs (Table 3-11). The highest **aluminum** EPC was for crayfish (116 mg/kg), and the EPC for bass is much lower (5.4 mg/kg). No aluminum data are available for sculpin. Given the low mink HQs for aluminum (NOAEL-based HQ = 4.8 and LOAEL HQ = 2.2), and the fact that the crayfish and bass tissue EPCs are below Upstream Reference UPLs (204 mg/kg for crayfish and 9.0 for bass, as shown in Table I-7), the potential for risk to the mink from exposure to aluminum in crayfish and fish is low.

In addition, given the low concentrations of the remaining CECs in crayfish tissue, crayfish tissue was eliminated as a medium of concern for the mink, and mink diet RBCs were only compared to sculpin and bass tissue data for purposes of risk interpretation.

Figures 3-3 and 3-4 present the location-specific concentrations in sculpin and bass tissue, respectively, above the lowest tissue RBCs, i.e., the fish diet RBCs (Table 3-20). As described for the piscivorous birds, mink diet RBCs from Table 3-20 were compared to the sample-specific concentrations shown on Figures 3-3 and 3-4 to estimate sample-specific C/Rs in order to assess magnitude of exceedance.

Sculpin samples were not analyzed for OCPs and, therefore, dieldrin concentrations were only plotted on for bass (Figure 3-4). In addition, no sculpin samples exceeded the mink diet RBC for PCB-Aro. For **PCBs**, the following sculpin samples were greater than the mink diet RBCs for PCB-Cong and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Congeners – SF-03 (C/R=2.3) in EU-4 off the eastern tip of Bradford Island
- TEQ for mammals – SF-03 (C/R=3.8) in EU-4 off the eastern tip of Bradford Island (Figure 3-3)

Higher sample-specific C/Rs and more mink diet RBC exceedances were demonstrated for smallmouth bass tissue samples. For **PCBs**, the following bass samples were greater than the mink diet RBCs for PCB-Aro, PCB-Cong, and PCB-TEQ. Sample-specific C/Rs are provided in parentheses.

- Aroclors –17, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 6 to 31); and 11 and 78 from Goose Island (C/Rs ranging from 6.8 to 13)
- Congeners –17, 18, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 1.1 to 87); and 11 and 78 from Goose Island (C/Rs ranging from 9.2 to 33)
- TEQ for birds – 17, 18, 62, 63, and 68 from the north shore of Bradford Island (C/Rs ranging from 1.4 to 81); and 11 and 78 from Goose Island (C/Rs ranging from 12 to 33)

As stated above, sample 68 has the maximum concentrations of PCBs, followed by sample 63, both of which were collected in 2011 adjacent to former underwater debris piles that were removed in 2000 and 2002. Given the elevated sample-specific C/Rs for PCBs along the north shore of Bradford Island and around Goose Island, there is an unacceptable potential for risk to mink populations from PCBs in bass tissue, and in sculpin tissue to a less extent.

Concentrations of **dieldrin** exceeded the mink diet RBCs in two smallmouth bass samples, both from the north shore of Bradford Island (63 and 68). Sample-specific C/Rs for dieldrin in the these north shore samples ranged from 1.02 to 3.1. Given the low and infrequent exceedances of the mink diet RBC for tissue, the potential for risk from dieldrin is low.

3.5.3.2.4 Sediment Bioaccumulation

The tissue data discussed above for birds provides a more realistic estimate of exposure to bioaccumulative CECs. The back-calculated sediment RBCs were generated as a tool for identifying the general areas of the River OU that may be contributing to food web-related risks, but the uncertainty inherent in the sediment to tissue link reflected in the sediment RBCs (i.e., the BAFs) makes them less reliable than the tissue RBCs for predicting risk to fish and wildlife.

Figures 3-6a and 3-6b present location-specific concentrations above the lowest sediment RBCs (not including bird egg RBCs), i.e., the fish diet RBCs. Bird egg RBCs for sediment are lower than the fish diet RBCs for sediment (Table 3-21) and were plotted on a separate figure (Figures 3-5a and 3-5b) from the “diet” related RBCs.

As discussed in Section 3.5.3, the sediment RBCs for the fish and the wildlife receptors defaulted to the Upstream Reference UPLs for all inorganics (Table 3-21).

As shown on Figure 3-5a, exceedances of fish diet RBCs for sediment are highly localized to the north shore and eastern tip of Bradford Island. Some slight sediment RBC (i.e., UPL) exceedances for mercury and lead are found along the main Oregon shoreline and on the southern shore of Bradford Island. Only one low exceedance for PCBs is outside of the former source area along Bradford Island (P43).

The maximum concentration of **PCBs** in sediment was detected at P113, resulting in a sample-specific C/R of 980 for PCB-Cong and 45 for PCB-Aro. The majority of samples with PCB C/Rs greater than 10 are located in a cluster (11 samples) along the northeastern tip of Bradford Island, and then at four additional samples (P115 through TR-21) spread out along the shoreline between this main cluster and the western most sampling location near the dam. There is also an isolated RBC exceedance south of the main cluster on the northeastern tip of the island.

The highest sample-specific **lead** C/R of 8.1 is located on the northwestern shoreline and is bound by samples with only slight RBC exceedances and concentrations less than the RBC. The maximum concentration of **mercury** was detected at P116 on the northwestern shoreline with a sample-specific C/R of 2.6. Mercury was only detected in two additional samples above the sediment RBC with low C/Rs (A3 C/R = 1.1 and P04 C/R = 1.3).

The sediment data confirm that PCBs are the primary site-related CECs for fish exposed through their diet. OCP data are not plotted on Figures 3-6a and 3-6b because none of these CECs exceeded their respective sediment RBCs (see footnote "d" in Table 3-21 for more detail). Although one sediment sample had a sample-specific C/R for lead of 8.1 (sample S1-43), sculpin and bass tissue data do not indicate an unacceptable risk to fish from exposure to lead. Mercury concentrations in sediment are generally less than the UPL and likely reflect natural variations in background levels.

3.5.3.2.5 Benthic Community

The potential for risk was estimated in two ways for the benthic community: toxicity from direct exposure to sediment and dietary toxicity. Dietary toxicity was evaluated by comparing ODEQ's CTLs to site-specific clam and crayfish tissue concentrations. Use of these CTLs allows for an assessment of risk for predatory benthic organisms as well as fish that may prey on benthic organisms. Only the LOAEL-based HQ for aluminum in clam tissue was greater than 1 (Table 3-16) and all LOAEL-based HQs were less than 1 for crayfish tissue (Table 3-17). The maximum detected concentration of aluminum in clams (262 mg/kg) is similar to the LOAEL-based TRV (218 mg/kg). Given the low dietary HQs for aluminum in clam tissue (NOAEL-based HQ = 3.8 and LOAEL HQ = 1.2), and the lack of other CECs in clams and crayfish tissue, the potential for risk to the predatory benthic organisms and invertivorous fish is low.

Direct toxicity was evaluated through a comparison of sediment EPCs to sediment SLVs protective of the freshwater benthic community. The following CECs were identified in one or more of these tissues due to LOAEL-based HQs greater than one: three metals, PCB-Aro, PCB-Cong, two pesticides, and five HPAHs as well as total HPAHs (Table 3-15). Although the LOAEL-based HQs for individual LPAHs were less than 1, the LPAHs HI exceeded 1; therefore, LPAHs was also retained as a CEC given the well-documented additive effects of this chemical group.

Figures 3-7A and 3-7B present the location-specific concentrations above benthic invertebrate direct toxicity RBCs. With the exception of one sediment RBC exceedance for nickel at P14 on the main Oregon shoreline south of Bradford Island (Figure 3-7A), all sediment RBC exceedances occurred on the north shore of the island (former removal area) (Figure 3-7B).

For **metals**, two samples had chromium concentrations above the sediment RBCs: S1-43 (sample-specific C/R = 5.6) and adjacent sample S1-32 (sample-specific C/R = 1.1). Both samples were collected from the northwestern shoreline near the catch basin adjacent to the Sandblast Area in the Upland OU. The only concentration of nickel reported above the sediment RBC also occurred at S1-43 (sample-specific C/R = 5.8). S1-43 and S1-32 are bound by samples with concentrations less than the RBCs for chromium and nickel. The only concentration of copper above the sediment RBC was detected in sample "Debris Pile 02" resulting in a sample-specific C/R of 1.6. Given the low and infrequent RBC exceedances for metals and because the few locations with exceedances are bound by samples with concentrations less than the RBCs, the potential for risk from metals in sediment is low.

For **PCBs**, eleven samples had concentrations above the sediment RBC for PCB-Aro (sample-specific C/Rs range from 1.7 to 33), and two samples had concentrations above the RBC for PCB-Cong (C/Rs range from 1.2 to 6.4). The maximum concentration of PCB-Aro was detected a S1-43, and S2-56 also had a concentration greater than 10 times the RBC. The maximum concentration of PCB-Cong occurred at P113. The potential for risk to the benthic community from direct exposure to PCBs in sediment is low for the benthic community as a whole. Given the few areas with RBC exceedances shown on Figure 3-7b on the north shore of the Bradford Island, there is a potential for risk to some individuals of the benthic community in these localized areas of the island.

For **OCPs**, only one location had concentrations of gamma-chlordane and DDT above the sediment RBC (P113): sample-specific C/Rs of 2.0 and 2.2. Given the low and infrequent RBC exceedances for gamma-chlordane and DDT, the potential for risk from OCPs in sediment is low.

For **PAHs**, samples S1-43, Debris Pile 02, S1-50, and S1-36 have concentrations of total HPAHs above the sediment RBC, and S1-43 and S1-50 also have elevated concentrations of total LPAHs. The sample-specific C/Rs for HPAHs range from 1.1 to 8.5, with the highest concentrations detected at S1-50 and S1-43. The two elevated C/Rs for LPAHs ranged from 1.3 to 1.8, and are of low concern for benthic invertebrates. Similar to PCBs, the potential for risk from direct exposure to HPAHs in sediment is low for the benthic community as a whole. Given the few areas with RBC exceedances shown on Figure 3-7B on the north shore of the Bradford Island, there is a potential for risk to some individuals of the benthic community in these localized areas of the island.

3.6 Conclusions and Recommendations

The BERA evaluated risks to the benthic community through exposure to sediment and through an evaluation of bioaccumulative CPECs in site-specific clam and crayfish tissue. Risks to the fish community, including sensitive species that may be transiently present in the River OU (i.e., salmonids), were assessed through an evaluation of CPECs in site-specific sculpin and smallmouth bass tissue. Piscivorous wildlife receptors, represented by the osprey, bald eagle, and mink, were assessed through an evaluation of CPECs in their prey (smallmouth bass for the birds and bass, sculpin and crayfish for the mink), as well as through incidental ingestion of surface water, and incidental ingestion of sediment for the mink only.

The following CECs identified through the BERA are recommended for further evaluation in the River OU FS:

- Benthic community – PCBs (PCB-Aro and PCB-Cong) and HPAHs
- Fish community – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for fish) and OCPs (gamma-chlordane, dieldrin, endrin, and endosulfan I)
- Piscivorous birds – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for birds) and OCPs (dieldrin)

- Mink – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for mammals)

Table 3-22 summarizes these CECs per medium and receptor. Figure 3-8 presents a visual summary of the exceedances of the lowest RBC for each medium and CEC listed above. This figure emphasizes that the area of concern in the River OU that should comprise the focus of further evaluation in the FS is primarily confined to the former source areas on the north shore of Bradford Island, including the eastern tip of the island.

Similarly to the BHHRA findings, PCBs were the CECs that contributed to the highest risk levels and greatest number of exceedances in all media evaluated in the BERA, with the exception of clam and crayfish tissue for which no CECs were identified. Maximum concentrations of OCPs were co-located with PCBs on the north shore of Bradford Island, adjacent to former underwater debris piles that were removed in 2000 and 2002, and also in one isolated detection on the northeastern tip of Goose Island. OCP compounds are not infrequently confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. However, co-location with elevated PCBs in tissue, lack of uniform levels of OCPs throughout the River OU, and lack of OCP detections above the sediment RBCs creates an uncertainty as to whether OCPs are site-related.

4.0 SUMMARY

This report presents the River OU BHHRA and BERA for the Bradford Island Bonneville Dam Complex. The Portland District of the USACE has characterized and evaluated the contamination arising from historical practices at Bradford Island, a multipurpose facility located at RM 146.1 that consists of the First and Second Powerhouses, the old and new navigation locks, and a spillway with a capacity of 1.6 million cubic feet per second.

Numerous investigations have been performed by the USACE and their contractors since 1997, focusing on the Upland and River OUs. The Final RI report (URS 2012) documented the investigation, identified source areas at Bradford Island, defined the nature and extent of the environmental contamination, and identified the COPCs for human health and CPECs in the media from the two OUs. Based on the screening level RAs for the River OU that were completed as part of the RI, site-specific BHHRAs and BERAs were conducted.

The River OU BHHRA and BERA are addenda to and build upon on the data and findings of the Final RI. Only aquatic-related exposure pathways were addressed in these baseline RAs. The Upland OU to River OU pathways (i.e., potential mass wasting, soil erosion) that were evaluated at a screening level in the Final RI report (URS 2012) were not addressed in the River OU, as these possible pathways will be considered in the Upland FS or the River FS.

4.1 Baseline Human Health Risk Assessment

The baseline HHRA included evaluation of smallmouth bass tissue, crayfish tissue, sediment, and surface water. Receptors and exposure pathways that were evaluated included:

- tribal subsistence fishers consuming smallmouth bass from the entire River OU
- non-tribal recreational fishers consuming smallmouth bass and crayfish from the entire River OU
- recreational waders in direct contact with sediments in wadeable portions of the River OU
- hypothetical swimmers in surface water in the entire River OU
- hypothetical downstream users of river water for potable use.

The COPCs for each medium and pathway were selected using a comprehensive process that considered all the data collected from the River OU from 2000 to 2011 and included PCBs, OCPs, cPAHs, and non-carcinogenic PAHs and selected metals.

Both RME and CTE scenarios were assessed, using current USEPA and ODEQ guidance. Adults and children were considered for all pathways. In addition, exposure of nursing infants who might be exposed to COPCs through ingestion of maternal milk was considered for selected COPCs, using ODEQ’s screening-level risk methodology.

Toxicity values for all COPCs were selected using USEPA’s hierarchy of sources (USEPA 2015a, b). PCBs were evaluated using three separate forms of analysis and measurement, expressed as PCB-Aro, PCB-Cong, and PCB-TEQ. ELCR and noncancer HQHQ and summed HI were reported for all chemicals without PCBs and for all COPCs including each type of PCB measurement. ELCR and HI for each receptor-pathway combination were characterized with regard to whether they were:

- less than the USEPA risk level of 1 x 10^{-6} (also expressed as 1 x 10^{-6} or one-in-a-million) or HI of 1, whereby risk at or below this threshold has an insignificant contribution to risk (i.e., *de minimis*);
- within the USEPA acceptable risk range of 1 x 10^{-6} to 1 x 10^{-4}; or
- exceeding the USEPA acceptable risk range, i.e., greater than 1 x 10^{-4}.

ODEQ's acceptable risk level of 1 x 10^{-5} for chemicals with similar modes of action (e.g., cPAHs, PCBs) was also considered.

Risks for smallmouth bass consumption for both subsistence and recreational consumers exceeded the USEPA acceptable risk range for adults, children, and nursing infants. Crayfish consumption risks, risks to waders in direct contact with sediments, and risks for potable water users were generally within the USEPA acceptable risk range. Risks were *de minimis* for hypothetical swimmers and potable water users of surface water, when taking into consideration that arsenic levels that are lower than federal MCLs and the state water quality criterion.

RBCs were calculated for the subset of COCs associated with risks that were greater than 1 x 10^{-6} or noncancer HQ greater than 1.0, for any receptor-pathway combination. Bioaccumulation-based RBCs were also calculated for sediment using site-specific biota-sediment accumulation factors. Individual locations of smallmouth bass, crayfish, and sediment samples that exceeded their RBCs were illustrated in Figures 2-4 through 2-6.

Based on visual review of RBC exceedances, PCBs were the COCs that contributed to the greatest number of locations exceeding RBCs and the greatest magnitude of exceedance above the RBCs for smallmouth bass, crayfish tissue, and bioaccumulation in sediment. OCPs (primarily gamma chlordane and dieldrin) also contributed to exceedances at a limited subset of locations that were co-located with PCB exceedances. A few other COCs (mercury, endrin, DDE, cPAHs) had relatively minor exceedances at a few locations in smallmouth bass. Overall, the spatial distribution of high magnitude exceedances of PCB and selected OCPs for smallmouth bass and sediment is primarily along the north shore and eastern tip of Bradford Island and at one location in Goose Island Slough with particularly high PCBs (location 78).

Other relatively minor exceedances in crayfish tissue and sediment (direct contact) were noted for arsenic and cPAHs.

After review of the overall risk results and spatial distribution and magnitude of RBC exceedances, the most relevant and significant COCs that were identified for further evaluation in the River OU FS were:

- Smallmouth bass tissue (tribal subsistence and non-tribal recreational consumption) – PCBs, gamma chlordane, dieldrin
- Crayfish tissue (non-tribal recreational consumption) – PCBs
- Sediment (bioaccumulation to fish) – PCBs
- Sediment (direct contact) – None
- Surface water (hypothetical swimming, hypothetical potable use) - None

The estimated risks for the fish consumption scenario are based on assumptions that are intended to overestimate exposure in order to evaluate whether additional evaluation or action is warranted. ELCRs are only expressions of likelihood of cancer incidence, and HIs are estimated ratios to safe doses. Therefore, exceedance of the USEPA acceptable risk range does not automatically mean that adverse effects may have occurred or will occur.

4.2 Baseline Ecological Risk Assessment

The entire River OU, including the Forebay and targeted samples near Eagle Creek and Goose Island, was retained for evaluation in the BERA. Sediment and the various tissue types that have been collected (clams, crayfish, sculpin, and smallmouth bass) were identified as media of concern for ecological receptors in the riverine environment.

The following list of receptors and exposure pathways identified in the RI/MP were included in the River OU BERA:

- Benthic invertebrates exposed through direct contact with surface sediment
- Fish exposed through direct contact and prey ingestion
- Bald eagle exposed through ingestion of surface water and prey (100% predatory fish).
- Osprey exposed through ingestion of surface water and prey (100% predatory fish)
- American mink exposed through incidental ingestion of surface sediment, and ingestion of surface water and prey (33% benthic invertebrates, 33% invertivorous fish, and 33% predatory fish)

The final list of CPECs that was carried into the BERA includes PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs), metals, PAHs, butyltins (direct toxicity only), OCPs, and SVOCs. This list is further subdivided into CPECs specific to each receptor group (benthic community [e.g., shellfish], fish, birds, and mammals) and medium (i.e., sediment and/or tissue). The sediment CPECs for the benthic community were evaluated for direct toxicity to this receptor group, the tissue CPECs for fish, birds, and mammals were evaluated for toxicity via dietary exposure, and fish were evaluated for both direct contact and dietary exposure.

Given the low mobility of benthic organisms, each sample location was considered an individual EU for clams and crayfish. The invertivorous fish (sculpin) is more mobile, but is highly territorial with a relatively small foraging range. Therefore, the EUs were estimated as 0.1-mile increments of River OU shoreline, which resulted in eight individual EUs total for the sculpin. For the predatory fish (smallmouth bass), the size of their foraging range is similar to the size of the River OU, and so the entire River OU from the Bonneville Dam to the northern tip of Goose Island was considered one EU for the bass. For the osprey, eagle, and mink, receptor-specific area use factors were calculated as the River OU site size divided by the size of the home range, resulting in site use estimates of 71%, 86%, and 65%, respectively.

Two types of toxicity benchmarks and TRVs from the literature were used to develop an upper- and lower-bound risk estimate for each target receptor: 1) no-observed-adverse-effects concentration or level (NOAEC or NOAEL), and 2) lowest-observed-adverse-effects concentration or level (LOAEC or LOAEL). To help facilitate the risk interpretation process, receptor-specific RBCs were calculated for sediment and tissue for the identified CECs (i.e., CPECs with elevated exposure level/toxicity level ratios), so that exceedances of these RBCs could be illustrated on the River OU map. The RBCs are also meant to be applied in the FS during the selection of the final PRGs for the River OU. To protect local populations of osprey, eagle, and mink, LOAEL-based RBCs were calculated. LOAEC-based RBCs were calculated to protect the benthic community, and NOAEC-based RBCs were calculated to protect fish at the individual level due to the potential presence of listed fish species in the River OU.

The following CECs were identified through the BERA that are recommended for further evaluation in the River OU FS:

- Benthic community – PCBs (PCB-Aro and PCB-Cong) and HPAHs
- Fish community – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for fish) and OCPs (gamma-chlordane, dieldrin, endrin, and endosulfan I)
- Piscivorous birds – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for birds) and OCPs (dieldrin)
- Mink – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for mammals)

Through visual observations of RBC exceedances, it is evident that the area of concern in the River OU that should comprise the focus of further evaluation in the FS is primarily confined to the former source areas on the north shore of Bradford Island, including the eastern tip of the island.

Similar to the BHHRA findings, PCBs were the CECs that contributed to the highest risk levels and greatest number of exceedances in all media evaluated in the BERA, with the exception of clam and crayfish tissue for which no CECs were identified. Maximum concentrations of OCPs were co-located with PCBs on the north shore of Bradford Island, adjacent to former underwater debris piles that were removed in 2000 and 2002, and also in one isolated detection on the northeastern tip of Goose Island. OCP compounds are not infrequently confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. However, co-location with elevated PCBs in tissue, lack of uniform levels of OCPs throughout the River OU, and lack of OCP detections above the sediment RBCs creates an uncertainty as to whether OCPs are site-related.

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TABLES

Table 1-1
Statistical Summary for River OU Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
PCB Aroclors		Aroclor 1248	ug/kg	109	0.39	39	107	76	108	108	140	2	2%	2.4	15	5.8	95% KM (t) UCL
PCB Aroclors		Aroclor 1254	ug/kg	109	0.49	8.9	36	0.9	909	86	22000	73	67%	609	2595	2172	97.5% KM (Chebyshev) UCL
PCB Aroclors		Aroclor 1260	ug/kg	109	0.28	379	106	5.8	60.3	35	140	3	3%	2.0	14	4.7	95% KM (t) UCL
PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	109	0.62	12	34	1.35	895	86	22191	75	69%	616	2610	2188	97.5% KM (Chebyshev) UCL
PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	29	0.19	0.19	1	2.1E-04	0.031	0.0020	0.53	28	97%	0.030	0.099	0.22	99% KM (Chebyshev) UCL
PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	29	4.9E-05	0.14	21	1.0E-04	0.0045	1.7E-04	0.032	8	28%	0.0014	0.0059	0.013	99% KM (Chebyshev) UCL
PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	29	N/A	N/A	0	0.0013	5.65	0.025	98	29	100%	5.6	18.7	40	99% Chebyshev (Mean, Sd) UCL
PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	29	N/A	N/A	0	5.8E-05	0.31	0.0014	5.3	29	100%	0.31	1.01	2.2	99% Chebyshev (Mean, Sd) UCL
PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	28	N/A	N/A	0	0.0027	12	0.067	233	28	100%	12	44.7	96	99% Chebyshev (Mean, Sd) UCL
PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	29	1.6E-04	0.29	3	6.4E-05	0.19	0.0010	3.1	26	90%	0.17	0.59	1.3	99% KM (Chebyshev) UCL
PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	29	4.8E-05	0.21	16	1.2E-04	2.2E-04	2.1E-04	4.2E-04	13	45%	1.7E-04	9.8E-05	0.00021	95% KM (t) UCL
PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	29	9.4E-04	9.4E-04	1	4.0E-04	2.34	0.0096	47	28	97%	2.3	8.6	18	99% KM (Chebyshev) UCL
PCB Congeners	157	2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	1	N/A	N/A	0	7.4E-01	0.74	0.74	0.74	1	100%	N/A	N/A	0.74	Max Detected
PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	6.4E-04	7.1E-04	2	1.7E-04	0.66	0.0039	8.5	27	93%	0.61	1.8	4.0	99% KM (Chebyshev) UCL
PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	4.5E-05	0.036	28	1.6E-04	1.6E-04	1.6E-04	1.6E-04	1	3%	5.2E-05	2.6E-05	1.6E-04	Max Detected
PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	29	4.8E-05	8.1E-04	2	9.8E-05	0.0441	6.2E-04	0.74	27	93%	0.041	0.14	0.30	99% KM (Chebyshev) UCL
PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	29	N/A	N/A	0	0.065	220	1.1	4312	29	100%	220	807	1712	99% Chebyshev (Mean, Sd) UCL
PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	29	N/A	N/A	0	1.2E-05	0.0027	1.4E-04	0.050	29	100%	0.0027	0.0093	0.014	97.5% Chebyshev (Mean, Sd) UCL
PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	29	N/A	N/A	0	6.4E-08	1.2E-04	1.7E-06	0.0022	29	100%	1.2E-04	4.1E-04	0.00087	99% Chebyshev (Mean, Sd) UCL
PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	29	N/A	N/A	0	2.1E-07	7.5E-04	2.6E-05	0.013	29	100%	7.5E-04	0.0025	0.0054	99% Chebyshev (Mean, Sd) UCL
Metals		Aluminum	mg/kg	108	N/A	N/A	0	5360	15059	14550	25800	108	100%	15059	4433	15767	95% Student's-t UCL
Metals		Antimony	mg/kg	33	0.040	0.040	1	0.040	0.20	0.15	0.70	32	97%	0.19	0.16	0.32	95% KM (Chebyshev) UCL
Metals		Arsenic	mg/kg	46	N/A	N/A	0	0.68	4.4	3.2	32	46	100%	4.4	4.9	7.6	95% Chebyshev (Mean, Sd) UCL
Metals		Barium	mg/kg	108	N/A	N/A	0	26	131	130	283	108	100%	131	43	138	95% Student's-t UCL
Metals		Beryllium	mg/kg	108	0.10	0.70	15	0.10	0.33	0.30	0.60	93	86%	0.31	0.11	0.32	95% KM (BCA) UCL
Metals		Cadmium	mg/kg	108	0.075	1.0	44	0.17	0.63	0.52	4.1	64	59%	0.45	0.46	0.52	95% KM (t) UCL
Metals		Chromium	mg/kg	108	N/A	N/A	0	10	27	20	620	108	100%	27	59	37	95% Modified-t UCL
Metals		Cobalt	mg/kg	46	N/A	N/A	0	4.8	9.9	9.5	23	46	100%	9.91	3.2	11	95% Adjusted Gamma UCL
Metals		Copper	mg/kg	109	N/A	N/A	0	11	33	28	284	109	100%	33	28	38	95% Modified-t UCL
Metals		Lead	mg/kg	109	N/A	N/A	0	2.9	13	11	121	109	100%	13	12	19	95% Chebyshev (Mean, Sd) UCL
Metals		Manganese	mg/kg	24	N/A	N/A	0	202	441	444	773	24	100%	441	152	494	95% Student's-t UCL
Metals		Mercury	mg/kg	46	0.020	0.040	6	0.0070	0.12	0.086	0.54	40	87%	0.10	0.11	0.14	95% GROS Adjusted Gamma UCL
Metals		Nickel	mg/kg	108	N/A	N/A	0	6.4	23	18	520	108	100%	23	49	32	95% Modified-t UCL
Metals		Silver	mg/kg	24	0.40	1.0	23	2.0	2.0	2.0	2.0	1	4%	0.47	0.32	2.0	Max Detected
Metals		Thallium	mg/kg	108	0.056	0.40	34	0.091	0.26	0.21	0.60	74	69%	0.21	0.12	0.23	95% KM (BCA) UCL
Metals		Vanadium	mg/kg	46	N/A	N/A	0	19	48	46	90	46	100%	48	15	52	95% Student's-t UCL
Metals		Zinc	mg/kg	108	N/A	N/A	0	46	104	100	226	108	100%	104	34	110	95% Approximate Gamma UCL
NWTPH-Dx		Diesel Range Organics	mg/kg	46	1.8	2.8	7	2.3	16	11	54	39	85%	13	13	20	95% GROS Adjusted Gamma UCL
NWTPH-Dx		Residual Range Organics	mg/kg	46	5.0	180	12	5.9	85	54	480	34	74%	72	94	134	95% KM (Chebyshev) UCL
Butyltins		Dibutyltin dichloride	ug/kg	24	5.8	14	23	4.6	4.6	4.6	4.6	1	4%	4.6	0	4.6	Max Detected
Butyltins		Tributyltin chloride	ug/kg	24	5.8	14	23	13	13	13	13	1	4%	6.1	1.5	13	Max Detected
Pesticides		BHC (gamma) Lindane	ug/kg	21	0.04	20	19	0.080	0.15	0.15	0.22	2	10%	0.052	0.041	0.075	95% KM (t) UCL
Pesticides		Chlordane (gamma)	ug/kg	21	0.036	18	14	0.16	9.0	1.9	44	7	33%	3.1	9.5	6.9	95% KM (Percentile Bootstrap) UCL
Pesticides		Endrin Aldehyde	ug/kg	21	0.11	4000	17	0.67	3.6	2.7	8.2	4	19%	0.90	2.0	1.8	95% KM (t) UCL
Pesticides		Endrin Ketone	ug/kg	21	0.093	99	20	0.32	0.32	0.32	0.32	1	5%	0.11	0.055	0.32	Max Detected
Pesticides		Endrin	ug/kg	21	0.057	29	17	0.54	3.1	2.3	7.4	4	19%	0.71	1.7	1.49	95% KM (t) UCL
Pesticides		Heptachlor Epoxide	ug/kg	21	0.042	21	20	0.44	0.44	0.44	0.44	1	5%	0.065	0.094	0.44	Max Detected
Pesticides		4,4'-DDD	ug/kg	21	0.086	44	20	0.15	0.15	0.15	0.15	1	5%	0.090	0.015	0.15	Max Detected
Pesticides		4,4'-DDE	ug/kg	21	0.075	7100	18	0.29	0.62	0.36	1.2	3	14%	0.20	0.29	0.37	95% KM (t) UCL
Pesticides		4,4'-DDT	ug/kg	21	0.13	67	17	0.90	46	21	140	4	19%	9.0	31	22	95% KM (t) UCL
Pesticides		Total DDx (MDL-based)	ug/kg	21	0.13	7100	15	1.1	43	1.5	199	6	29%	13	44	121	99% KM (Chebyshev) UCL
SVOCs		Benzoic Acid	ug/kg	24	160	370	23	300	300	300	300	1	4%	166	29	300	Max Detected
SVOCs		Benzyl Alcohol	ug/kg	24	19	45	23	22	22	22	22	1	4%	19	0.61	22	Max Detected
SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	73	7.0	200	48	7.5	385	51	3800	25	34%	141	603	455	95% KM (Chebyshev) UCL
SVOCs		Butyl Benzyl Phthalate	ug/kg	46	1.5	10	45	10	10	10	10	1	2%	1.7	1.2	10	Max Detected
SVOCs		Dibenzofuran	ug/kg	100	1.8	11	99	11	11	11	11	1	1%	1.9	0.92	11	Max Detected
SVOCs		Di-n-butyl Phthalate	ug/kg	46	5.5	19	37	5.6	31	15	87	9	20%	11	16	15	95% KM (Percentile Bootstrap) UCL
SVOCs		p-cresol (4-Methylphenol)	ug/kg	46	1.5	6.7	37	4.8	31	11	180	9	20%	7.3	26	14	95% KM (BCA) UCL
SVOCs		Phenol	ug/kg	24	6.3	15	23	24	24	24	24	1	4%	7.0	3.5	24	Max Detected
LPAH		Acenaphthene	ug/kg	126	1.0	5.1	122	2.8	28	28	53	4	3%	1.9	5.8	2.8	95% KM (t) UCL
LPAH		Anthracene	ug/kg	126	0.90	14	114	1.5	26	3.5	140	12	10%	3.3	15	9.5	95% KM (Chebyshev) UCL
LPAH		Fluorene	ug/kg	126	1.1	6.7	124	14	22	22	29	2	2%	1.4	2.7	2.0	95% KM (t) UCL
LPAH		Phenanthrene	ug/kg	126	1.3	4.5	77	1.4	33	10	510	49	39%	14	54	23	95% KM (BCA) UCL
HPAH		Benzo(a)anthracene	ug/kg	126	1.4	5.1	77	1.6	52	13	890	49	39%	21	98	39	95% KM (BCA) UCL

Table 1-1
Statistical Summary for River OU Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
HPAH		Benzo(a)pyrene	ug/kg	126	1.6	16	79	1.7	59	19	1300	47	37%	23	121	42	95% KM (BCA) UCL
HPAH		Benzo(b)fluoranthene	ug/kg	126	2.1	15	78	4.0	49	21	750	48	38%	20	81	34	95% KM (BCA) UCL
HPAH		Benzo(g,h,i)perylene	ug/kg	126	1.6	5.3	87	2.6	41	13	870	39	31%	14	78	27	95% KM (BCA) UCL
HPAH		Benzo(k)fluoranthene	ug/kg	126	2.3	11	84	2.3	52	20	715	42	33%	19	75	32	95% KM (BCA) UCL
HPAH		Chrysene	ug/kg	126	1.4	6.1	67	1.4	56	15	1200	59	47%	27	126	49	95% KM (BCA) UCL
HPAH		Dibenz(a,h)anthracene	ug/kg	126	1.5	5.7	116	2.5	49	20	320	10	8%	5	29	11	95% KM (BCA) UCL
HPAH		Fluoranthene	ug/kg	126	1.8	5.9	72	2.5	83	17	1700	54	43%	36	173	63	95% KM (BCA) UCL
HPAH		Indeno(1,2,3-cd)pyrene	ug/kg	126	1.8	5.9	87	2.2	44	12	960	39	31%	15	86	29	95% KM (BCA) UCL
HPAH		Pyrene	ug/kg	126	1.3	10	68	1.8	79	16	2000	58	46%	37	196	75	95% KM (BCA) UCL
TLPAH		Total LPAHs (KM-capped, MDL-based)	ug/kg	126	5.4	36	77	5.5	55	21	688	49	39%	26	77	39	95% KM (BCA) UCL
THPAH		Total HPAHs (KM-capped, MDL-based)	ug/kg	126	19	67	62	15	416	89	8200	64	51%	220	982	604	95% KM (Chebyshev) UCL
TPAH		Total PAHs (KM-capped, MDL-based)	ug/kg	126	25	103	62	17	459	107	8694	64	51%	245	1056	658	95% KM (Chebyshev) UCL
BaPEQ		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	126	4.4	12	65	0.36	67	15	1873	61	48%	34	175	62	95% KM (BCA) UCL

Notes:
See Appendix A for data quality evolution of non-detects.

% = percent
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic PAH
EPC = exposure point concentration
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in dry weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SD = standard deviation
SVOC = semi-volatile organic compound
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in dry weight

Table 1-2
Statistical Summary for Reference Area Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
PCB Aroclors		Aroclor 1016	ug/kg	18	1.7	13	18	N/A	N/A	N/A	N/A	0	0%	13	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1221	ug/kg	18	1.7	11	18	N/A	N/A	N/A	N/A	0	0%	11	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1232	ug/kg	18	1.7	12	18	N/A	N/A	N/A	N/A	0	0%	12	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1242	ug/kg	18	1.7	16	18	N/A	N/A	N/A	N/A	0	0%	16	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1248	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1254	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1260	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1262	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
PCB Aroclors		Aroclor 1268	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	18	1.7	16	18	N/A	N/A	N/A	N/A	0	0%	16	Non-parametric (Max ND)
PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	18	N/A	N/A	0	4.3E-04	0.0010	9.9E-04	0.0020	18	100%	0.0017	Normal UPL
PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	18	5.6E-05	9.9E-05	12	4.9E-05	8.1E-05	6.8E-05	1.4E-04	6	33%	1.4E-04	Non-parametric UPL
PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0030	0.0090	0.0080	0.028	18	100%	0.018	WH Gamma UPL
PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	1.5E-04	4.8E-04	3.8E-04	0.0016	18	100%	9.9E-04	HW Gamma UPL
PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0083	0.026	0.022	0.071	18	100%	0.055	WH Gamma UPL
PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	18	3.1E-04	4.5E-04	7	1.7E-04	5.1E-04	3.7E-04	0.0012	11	61%	1.2E-03	Non-parametric UPL
PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	5.8E-05	1.4E-04	2	8.4E-05	1.6E-04	1.6E-04	3.4E-04	16	89%	3.4E-04	Non-parametric UPL
PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	9.3E-04	0.0029	0.0025	0.0085	18	100%	0.0058	WH Gamma UPL
PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	0.0010	0.0011	2	4.8E-04	0.0015	0.0012	0.0038	16	89%	0.0038	Non-parametric UPL
PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	5.4E-05	2.0E-04	17	8.6E-05	8.6E-05	8.6E-05	8.6E-05	1	6%	8.6E-05	Non-parametric UPL
PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	18	N/A	N/A	0	7.2E-05	2.5E-04	2.4E-04	5.7E-04	18	100%	4.6E-04	Normal UPL
PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	2.2E-05	6.9E-05	6.5E-05	1.5E-04	18	100%	1.2E-04	Normal UPL
PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	1.2E-07	1.0E-06	9.9E-07	2.5E-06	18	100%	2.0E-06	Normal UPL
PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	5.4E-07	1.6E-05	1.5E-05	3.7E-05	18	100%	3.1E-05	Normal UPL
PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	18	N/A	N/A	0	0.17	0.49	0.41	1.2	18	100%	0.94	WH Gamma UPL
Metals		Aluminum	mg/kg	18	N/A	N/A	0	7380	17328	13300	33500	18	100%	38000	Lognormal UPL
Metals		Antimony	mg/kg	18	N/A	N/A	0	0.15	0.26	0.26	0.52	18	100%	0.43	Normal UPL
Metals		Arsenic	mg/kg	18	N/A	N/A	0	3.0	4.2	3.8	6.0	18	100%	5.9	Lognormal UPL
Metals		Barium	mg/kg	18	N/A	N/A	0	86	167	135	312	18	100%	315	Lognormal UPL
Metals		Beryllium	mg/kg	18	N/A	N/A	0	0.19	0.44	0.35	0.75	18	100%	0.85	Lognormal UPL
Metals		Cadmium	mg/kg	18	N/A	N/A	0	0.26	0.48	0.47	0.75	18	100%	0.67	Normal UPL
Metals		Chromium	mg/kg	18	N/A	N/A	0	13	20	19	27	18	100%	28	Normal UPL
Metals		Cobalt	mg/kg	18	N/A	N/A	0	5.7	9.7	9.0	15	18	100%	15	Normal UPL
Metals		Copper	mg/kg	18	N/A	N/A	0	8.2	26	19	48	18	100%	56	Gamma UPL
Metals		Lead	mg/kg	18	N/A	N/A	0	8.7	12	11	15	18	100%	15	Normal UPL
Metals		Mercury	mg/kg	18	N/A	N/A	0	0.041	0.13	0.12	0.23	18	100%	0.21	Normal UPL
Metals		Nickel	mg/kg	18	N/A	N/A	0	9.9	15	14	26	18	100%	21	Gamma UPL
Metals		Thallium	mg/kg	18	N/A	N/A	0	0.15	0.24	0.23	0.36	18	100%	0.35	Normal UPL
Metals		Vanadium	mg/kg	18	N/A	N/A	0	26	45	42	77	18	100%	71	Normal UPL
Metals		Zinc	mg/kg	18	N/A	N/A	0	70	88	88	109	18	100%	106	Normal UPL
NWTPH-Dx		Diesel Range Organics	mg/kg	18	N/A	N/A	0	7	16	13	31	18	100%	32	Gamma UPL
NWTPH-Dx		Residual Range Organics	mg/kg	18	150	180	5	29	49	41	100	13	72%	100	Non-parametric UPL
SVOCs		Acenaphthene	ug/kg	18	1.0	1.1	18	N/A	N/A	N/A	N/A	0	0%	1.1	Non-parametric (Max ND)
SVOCs		Anthracene	ug/kg	18	1.4	1.5	16	1.4	1.9	1.9	2.3	2	11%	2.3	Non-parametric UPL
SVOCs		Benzo(a)anthracene	ug/kg	18	1.4	1.4	4	1.6	3.3	3.0	10	14	78%	10.0	Non-parametric UPL

Table 1-2
Statistical Summary for Reference Area Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
SVOCs		Benzo(a)pyrene	ug/kg	18	1.6	1.6	9	1.6	4.5	3.8	11	9	50%	11.0	Non-parametric UPL
SVOCs		Benzo(b)fluoranthene	ug/kg	18	2.5	2.5	5	2.7	5.8	4.8	17	13	72%	17	Non-parametric UPL
SVOCs		Benzo(g,h,i)perylene	ug/kg	18	2.3	2.3	8	2.3	4.3	3.6	7.9	10	56%	7.9	Non-parametric UPL
SVOCs		Benzo(k)fluoranthene	ug/kg	18	2.5	2.6	17	5.0	5	5.0	5	1	6%	5.0	Non-parametric UPL
SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	18	N/A	N/A	0	4.9	15	7.2	110	18	100%	110	Non-parametric UPL
SVOCs		Butyl Benzyl Phthalate	ug/kg	18	1.5	1.6	16	2.5	3.2	3.2	3.8	2	11%	3.8	Non-parametric UPL
SVOCs		Carbazole	ug/kg	18	1.3	1.4	18	N/A	N/A	N/A	N/A	0	0%	1.4	Non-parametric (Max ND)
SVOCs		Chrysene	ug/kg	18	1.4	1.4	3	1.9	4.4	3.7	9.8	15	83%	9.8	Non-parametric UPL
SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	18	4.4	4.4	2	0.33	4.1	3.4	15	16	89%	15	Non-parametric UPL
SVOCs		Dibenz(a,h)anthracene	ug/kg	18	2.2	2.3	18	N/A	N/A	N/A	N/A	0	0%	2.3	Non-parametric (Max ND)
SVOCs		Di-n-butyl Phthalate	ug/kg	18	2.6	2.6	3	3.5	5.84	5.2	11	15	83%	11.0	Non-parametric UPL
SVOCs		Di-n-octyl Phthalate	ug/kg	18	1.2	1.3	18	N/A	N/A	N/A	N/A	0	0%	1.3	Non-parametric (Max ND)
SVOCs		Fluoranthene	ug/kg	18	2.2	2.2	3	2.3	6.6	5.1	31	15	83%	31	Non-parametric UPL
SVOCs		Fluorene	ug/kg	18	1.7	1.8	18	N/A	N/A	N/A	N/A	0	0%	1.8	Non-parametric (Max ND)
SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	18	1.9	1.9	9	2.0	4.2	3.2	8.8	9	50%	9	Non-parametric UPL
SVOCs		p-cresol (4-Methylphenol)	ug/kg	18	2.9	2.9	7	4.5	62	7.9	210	11	61%	210	Non-parametric UPL
SVOCs		Phenanthrene	ug/kg	18	1.3	1.3	2	1.3	3.0	2.8	5.9	16	89%	5.9	Non-parametric UPL
SVOCs		Pyrene	ug/kg	18	N/A	N/A	0	1.5	5.0	4.1	23	18	100%	13	Gamma UPL
SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	18	N/A	N/A	0	16	35	29	125	18	100%	125	Non-parametric UPL
SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	18	5.4	5.4	2	5.4	7.1	7.2	10	16	89%	10.0	Non-parametric UPL
SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	18	N/A	N/A	0	17	39	34	133	18	100%	133	Non-parametric UPL

Notes:
For analytes with less than 100% detection rate, but at least one detection, the maximum detected value was assessed as the non-parametric UPL (USEPA 2009).
For analytes with no detections (0% detection rate), the maximum MDL is shown as the non-parametric UPL (USEPA 2009).

% = percent
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic PAH
EPC = exposure point concentration
EU = Exposure Unit
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in dry weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SD = standard deviation
SVOC = semi-volatile organic compound
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in dry weight

Source
USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. Office of Resource Conservation and Recovery, EPA 530-R-09-007.

Table 1-3
Statistical Summary for Human Health River OU-Wader EU Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
PCB Aroclors		Aroclor 1248	ug/kg	27	0.54	21	26	76	76	76	76	1	4%	3.3	14	76	Max Detected
PCB Aroclors		Aroclor 1254	ug/kg	27	0.53	8.9	10	1.5	81	25	670	17	63%	51	128	129	95% GROS Adjusted Gamma UCL
PCB Aroclors		Aroclor 1260	ug/kg	27	0.28	21	24	5.8	60	35	140	3	11%	7.0	27	18	95% KM (t) UCL
PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	27	0.63	12	8	1.9	87	50	670	19	70%	62	128	172	95% KM (Chebyshev) UCL
PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	6	N/A	N/A	0	4.1E-04	0.024	0.0024	0.13	6	100%	0.024	0.053	0.13	Max Detected
PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	6	6.6E-05	0.0059	3	1.4E-04	1.6E-04	1.5E-04	1.9E-04	3	50%	1.3E-04	4.6E-05	0.00019	Max Detected
PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	6	N/A	N/A	0	0.0040	4.0	0.038	24	6	100%	3.99	9.7	24	Max Detected
PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	6	N/A	N/A	0	2.7E-04	0.22	0.0021	1.3	6	100%	0.22	0.53	1.3	Max Detected
PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	6	N/A	N/A	0	0.013	8.9	0.10	53	6	100%	8.9	22	53	Max Detected
PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	6	2.0E-04	2.0E-04	1	9.6E-04	0.18	0.0019	0.87	5	83%	0.15	0.32	0.87	Max Detected
PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	6	6.4E-05	0.053	3	2.2E-04	3.0E-04	2.6E-04	4.2E-04	3	50%	2.0E-04	1.3E-04	0.00042	Max Detected
PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	6	N/A	N/A	0	0.0014	1.2	0.011	6.9	6	100%	1.2	2.8	6.9	Max Detected
PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	6	7.1E-04	7.1E-04	1	0.0038	0.38	0.0045	1.9	5	83%	0.32	0.70	1.9	Max Detected
PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	6	N/A	N/A	0	1.0E-04	0.026	7.0E-04	0.15	6	100%	0.026	0.063	0.15	Max Detected
PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	6	N/A	N/A	0	7.4E-07	5.1E-04	2.9E-05	0.0030	6	100%	5.1E-04	0.0012	0.0030	Max Detected
PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	6	N/A	N/A	0	0.21	136	1.5	808	6	100%	136	329	808	Max Detected
Metals		Aluminum	mg/kg	27	N/A	N/A	0	5360	15641	16300	25500	27	100%	15641	4933	17260	95% Student's-t UCL
Metals		Antimony	mg/kg	11	N/A	N/A	0	0.040	0.28	0.14	0.70	11	100%	0.28	0.25	0.42	95% Student's-t UCL
Metals		Arsenic	mg/kg	16	N/A	N/A	0	0.68	5.0	2.9	32	16	100%	5.0	7.4	7.7	95% H-UCL
Metals		Barium	mg/kg	27	N/A	N/A	0	40	130	128	230	27	100%	130	43	144	95% Student's-t UCL
Metals		Beryllium	mg/kg	27	0.10	0.30	3	0.20	0.36	0.33	0.60	24	89%	0.33	0.12	0.37	95% KM (t) UCL
Metals		Cadmium	mg/kg	27	0.075	0.50	12	0.17	0.65	0.69	1.2	15	56%	0.42	0.33	0.54	95% KM (t) UCL
Metals		Chromium	mg/kg	27	N/A	N/A	0	13	47	21	620	27	100%	47	116	145	95% Chebyshev (Mean, Sd) UCL
Metals		Cobalt	mg/kg	16	N/A	N/A	0	5.9	10	11	15	16	100%	10	2.3	11	95% Student's-t UCL
Metals		Copper	mg/kg	27	N/A	N/A	0	15	30	29	51	27	100%	30	10	33	95% Student's-t UCL
Metals		Lead	mg/kg	27	N/A	N/A	0	2.9	17	11	121	27	100%	17	22	21	95% H-UCL
Metals		Manganese	mg/kg	10	N/A	N/A	0	202	415	428	773	10	100%	415	166	511	95% Student's-t UCL
Metals		Mercury	mg/kg	16	0.020	0.030	3	0.0070	0.097	0.070	0.22	13	81%	0.082	0.069	0.11	95% KM (t) UCL
Metals		Nickel	mg/kg	27	N/A	N/A	0	9.9	38	19	520	27	100%	38	97	119	95% Chebyshev (Mean, Sd) UCL
Metals		Silver	mg/kg	10	0.40	1.0	9	2.0	2.0	2.0	2.0	1	10%	0.56	0.48	2.0	Max Detected
Metals		Thallium	mg/kg	27	0.056	0.30	9	0.091	0.25	0.25	0.50	18	67%	0.20	0.12	0.24	95% KM (Percentile Bootstrap) UCL
Metals		Vanadium	mg/kg	16	N/A	N/A	0	19	49	47	77	16	100%	49	16	55	95% Student's-t UCL
Metals		Zinc	mg/kg	27	N/A	N/A	0	46	110	92	191	27	100%	110	42	124	95% Student's-t UCL
NWTPH-Dx		Diesel Range Organics	mg/kg	16	1.8	2.4	2	2.3	21	16	53	14	88%	19	15	26	95% KM (t) UCL
NWTPH-Dx		Residual Range Organics	mg/kg	16	5.0	150	4	5.9	127	73	480	12	75%	106	134	260	95% KM (Chebyshev) UCL
Butyltins		Dibutyltin dichloride	ug/kg	10	5.8	5.9	9	4.6	4.6	4.6	4.6	1	10%	4.6	0	4.6	Max Detected
Butyltins		Tributyltin chloride	ug/kg	10	5.8	5.9	9	13	13	13	13	1	10%	6.5	2.2	13	Max Detected
Pesticides		4,4'-DDE	ug/kg	7	0.076	16	6	1.2	1.2	1.2	1.2	1	14%	0.30	0.45	1.2	Max Detected
Pesticides		4,4'-DDT	ug/kg	7	0.13	0.19	6	41	41	41	41	1	14%	6.0	14	41	Max Detected
Pesticides		BHC (gamma) Lindane	ug/kg	7	0.041	0.043	6	0.080	0.080	0.080	0.080	1	14%	0.047	0.014	0.080	Max Detected
Pesticides		Chlordane (gamma)	ug/kg	7	0.037	0.11	6	10	10	10	10	1	14%	1.5	3.5	10	Max Detected
Pesticides		Endrin Aldehyde	ug/kg	7	0.11	9.0	6	3.2	3.2	3.2	3.2	1	14%	0.63	1.2	3.2	Max Detected
Pesticides		Endrin	ug/kg	7	0.058	0.091	6	2.7	2.7	2.7	2.7	1	14%	0.44	0.93	2.7	Max Detected
Pesticides		Total DDx (MDL-based)	ug/kg	7	0.13	16	5	1.4	29	29	56	2	29%	8.4	20	56	Max Detected
SVOCs		Acenaphthene	ug/kg	30	1.0	5.1	28	20	28	28	36	2	7%	2.8	7.0	5.9	95% KM (t) UCL
SVOCs		Anthracene	ug/kg	30	1.4	4.7	25	2.6	40	25	140	5	17%	7.8	25	17	95% KM (Percentile Bootstrap) UCL
SVOCs		Benzo(a)anthracene	ug/kg	30	1.4	5.1	14	2.7	80	16	890	16	53%	43	159	342	99% KM (Chebyshev) UCL
SVOCs		Benzo(a)pyrene	ug/kg	30	1.6	3.9	15	4.5	54	22	420	15	50%	28	76	54	95% KM (BCA) UCL
SVOCs		Benzo(b)fluoranthene	ug/kg	30	2.4	14	15	4.2	60	25	510	15	50%	31	91	65	95% KM (BCA) UCL
SVOCs		Benzo(g,h,i)perylene	ug/kg	30	1.9	5.3	18	3.3	25	11	100	12	40%	11	22	25	95% GROS Adjusted Gamma UCL
SVOCs		Benzo(k)fluoranthene	ug/kg	30	2.5	11	18	3.2	72	27	420	12	40%	30	79	78	95% GROS Adjusted Gamma UCL
SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	22	7.0	200	14	9.9	993	43	3800	8	36%	368	1058	2766	99% KM (Chebyshev) UCL
SVOCs		Butyl Benzyl Phthalate	ug/kg	16	1.5	9.9	15	10	10	10	10	1	6%	2.0	2.1	10	Max Detected
SVOCs		Carbazole	ug/kg	19	1.3	4.7	15	2.2	36	10	120	4	21%	8.6	27	21	95% KM (t) UCL
SVOCs		Chrysene	ug/kg	30	2.6	6.1	11	1.4	90	13	1200	19	63%	57	214	457	99% KM (Chebyshev) UCL
SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	30	5.5	12	10	1.8	60	16	622	20	67%	41	113	173	97.5% KM (Chebyshev) UCL
SVOCs		Dibenz(a,h)anthracene	ug/kg	30	1.5	5.7	26	3.1	23	23	42	4	13%	4.4	8.7	7.5	95% KM (t) UCL
SVOCs		Di-n-butyl Phthalate	ug/kg	16	5.5	14	11	5.6	27	10	87	5	31%	12	20	22	95% KM (t) UCL
SVOCs		Fluoranthene	ug/kg	30	2.0	5.9	11	2.5	131	19	1700	19	63%	84	305	653	99% KM (Chebyshev) UCL
SVOCs		Fluorene	ug/kg	30	1.1	6.7	29	14	14	14	14	1	3%	1.5	2.3	14	Max Detected

Table 1-3
Statistical Summary for Human Health River OU-Wader EU Sediment Samples
Bradford Island - River Operable Unit

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	30	1.9	5.9	18	3.2	29	14	140	12	40%	13	28	29	95% GROS Adjusted Gamma UCL
SVOCs		p-cresol (4-Methylphenol)	ug/kg	16	1.5	6.7	12	4.8	53	13	180	4	25%	14	43	36	95% KM (t) UCL
SVOCs		Phenanthrene	ug/kg	30	1.8	4.5	14	1.7	55	7.8	510	16	53%	30	94	75	95% GROS Adjusted Gamma UCL
SVOCs		Phenol	ug/kg	10	6.4	6.5	9	24	24	24	24	1	10%	8.2	5.3	24	Max Detected
SVOCs		Pyrene	ug/kg	30	1.9	10	10	2.0	133	17	2000	20	67%	90	357	755	99% KM (Chebyshev) UCL

Notes:
See Appendix A for data quality evaluation of non-detects.

% = percent
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic PAH
EPC = exposure point concentration
EU = exposure unit
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in dry weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SD = standard deviation
SVOC = semi-volatile organic compound
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in dry weight

Table 1-4
Statistical Summary for River OU Surface Water Samples
Bradford Island - River Operable Unit

Analyte Group	Preparation Fraction	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	UCL	Selected UCL Type
PCB Congeners	Column	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	2.9E-08	3.3E-08	3	4.8E-08	6.3E-08	6.3E-08	7.7E-08	2	7.7E-08	Max Detected
PCB Congeners	Filter	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	3.1E-08	3.9E-08	2	4.6E-08	5.1E-08	5.1E-08	5.6E-08	3	5.6E-08	Max Detected
PCB Congeners	C+F	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	3.1E-08	3.1E-08	1	4.6E-08	7.0E-08	5.0E-08	1.3E-07	4	1.3E-07	Max Detected
PCB Congeners	Column	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	1.1E-07	1.3E-07	1.2E-07	1.6E-07	5	1.6E-07	Max Detected
PCB Congeners	Filter	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	2.2E-07	3.3E-07	3.4E-07	4.2E-07	5	4.2E-07	Max Detected
PCB Congeners	C+F	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	3.4E-07	4.6E-07	4.9E-07	5.4E-07	5	5.4E-07	Max Detected
PCB Congeners	Column	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	3.3E-07	4.0E-07	3.6E-07	5.0E-07	5	5.0E-07	Max Detected
PCB Congeners	Filter	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	5.2E-07	8.9E-07	9.5E-07	1.1E-06	5	1.1E-06	Max Detected
PCB Congeners	C+F	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	8.8E-07	1.3E-06	1.3E-06	1.6E-06	5	1.6E-06	Max Detected
PCB Congeners	Column	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/L	5	3.7E-09	7.0E-09	3	9.0E-09	9.5E-09	9.5E-09	1.0E-08	2	1.0E-08	Max Detected
PCB Congeners	C+F	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/L	5	3.7E-09	7.0E-09	3	9.0E-09	9.5E-09	9.5E-09	1.0E-08	2	1.0E-08	Max Detected
PCB Congeners	Column	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	2.3E-08	2.8E-08	4	3.6E-08	3.6E-08	3.6E-08	3.6E-08	1	3.6E-08	Max Detected
PCB Congeners	Filter	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	8.5E-08	1.9E-07	1.1E-07	3.6E-07	5	3.6E-07	Max Detected
PCB Congeners	C+F	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	8.5E-08	2.0E-07	1.1E-07	3.6E-07	5	3.6E-07	Max Detected
PCB Congeners	Column	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	1.4E-08	1.4E-08	1	1.0E-08	1.2E-08	1.2E-08	1.4E-08	4	1.4E-08	Max Detected
PCB Congeners	Filter	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	3.3E-08	8.3E-08	4.9E-08	1.5E-07	5	1.5E-07	Max Detected
PCB Congeners	C+F	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	4.7E-08	9.2E-08	5.5E-08	1.6E-07	5	1.6E-07	Max Detected
PCB Congeners	Filter	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/L	5	6.0E-09	8.0E-09	3	6.4E-08	7.7E-08	7.7E-08	9.0E-08	2	9.0E-08	Max Detected
PCB Congeners	C+F	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/L	5	1.8E-09	4.0E-09	3	6.4E-08	7.7E-08	7.7E-08	9.0E-08	2	9.0E-08	Max Detected
PCB Congeners	Column		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	2.1E-11	1.3E-09	2.2E-11	3.9E-09	5	3.9E-09	Max Detected
PCB Congeners	Filter		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	5.0E-11	1.6E-09	2.4E-09	2.9E-09	5	2.9E-09	Max Detected
PCB Congeners	C+F		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	7.2E-11	2.9E-09	2.5E-09	6.8E-09	5	6.8E-09	Max Detected
PCB Congeners	Column		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	3.2E-12	6.5E-12	3.6E-12	1.3E-11	5	1.3E-11	Max Detected
PCB Congeners	Filter		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	5.7E-12	1.3E-11	1.5E-11	1.8E-11	5	1.8E-11	Max Detected
PCB Congeners	C+F		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	8.3E-12	1.8E-11	1.8E-11	3.0E-11	5	3.0E-11	Max Detected
PCB Congeners	Column		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	1.7E-11	2.4E-11	1.9E-11	3.6E-11	5	3.6E-11	Max Detected
PCB Congeners	Filter		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	3.4E-11	6.2E-11	6.8E-11	8.0E-11	5	8.0E-11	Max Detected
PCB Congeners	C+F		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	5.1E-11	8.3E-11	8.5E-11	1.1E-10	5	1.1E-10	Max Detected
PCB Congeners	Column		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	9.6E-05	1.3E-04	1.4E-04	1.6E-04	5	1.6E-04	Max Detected
PCB Congeners	Filter		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	1.5E-05	3.6E-05	2.7E-05	6.2E-05	5	6.2E-05	Max Detected
PCB Congeners	C+F		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	1.1E-04	1.6E-04	1.6E-04	2.1E-04	5	2.1E-04	Max Detected
Metals	Dissolved		Arsenic	ug/L	5	N/A	N/A	0	0.72	0.852	0.89	0.94	5	0.94	Max Detected
Metals	Dissolved		Barium	ug/L	5	N/A	N/A	0	21	22.8	23	24	5	24	Max Detected
Metals	Dissolved		Beryllium	ug/L	5	0.020	0.020	3	0.003	0.0035	0.0035	0.004	2	0.0040	Max Detected
Metals	Dissolved		Cadmium	ug/L	5	0.0070	0.0080	3	0.008	0.009	0.009	0.01	2	0.010	Max Detected
Metals	Dissolved		Copper	ug/L	5	N/A	N/A	0	0.44	0.47	0.46	0.52	5	0.52	Max Detected
Metals	Dissolved		Lead	ug/L	5	0.0030	0.0090	2	0.014	0.024	0.022	0.036	3	0.036	Max Detected
Metals	Dissolved		Thallium	ug/L	5	N/A	N/A	0	0.023	0.0264	0.024	0.031	5	0.031	Max Detected
Metals	Dissolved		Zinc	ug/L	5	7.0	7.0	4	7.5	7.5	7.5	7.5	1	7.5	Max Detected
Metals	Total		Aluminum	ug/L	5	145	152	2	91	110.3	99	141	3	141	Max Detected
Metals	Total		Arsenic	ug/L	5	N/A	N/A	0	0.81	0.91	0.92	1.01	5	1.0	Max Detected
Metals	Total		Barium	ug/L	5	N/A	N/A	0	22	24.2	24	27	5	27	Max Detected
Metals	Total		Beryllium	ug/L	5	0.020	0.020	3	0.003	0.006	0.006	0.009	2	0.0090	Max Detected
Metals	Total		Cadmium	ug/L	5	N/A	N/A	0	0.009	0.0142	0.013	0.019	5	0.019	Max Detected
Metals	Total		Copper	ug/L	5	N/A	N/A	0	0.67	0.704	0.67	0.79	5	0.79	Max Detected
Metals	Total		Lead	ug/L	5	N/A	N/A	0	0.079	0.118	0.108	0.175	5	0.18	Max Detected
Metals	Total		Thallium	ug/L	5	N/A	N/A	0	0.026	0.0292	0.028	0.033	5	0.033	Max Detected
NWTPH-Dx	Dissolved		Diesel Range Organics	ug/L	5	N/A	N/A	0	14	24.2	18	46	5	46	Max Detected
NWTPH-Dx	Total		Diesel Range Organics	ug/L	5	11	11	3	15	15	15	15	2	15	Max Detected
SVOCs	Column		Acenaphthene	ug/L	5	N/A	N/A	0	7.1E-04	0.0010	0.0010	0.0013	5	0.0013	Max Detected

Table 1-4
Statistical Summary for River OU Surface Water Samples
Bradford Island - River Operable Unit

Analyte Group	Preparation Fraction	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	UCL	Selected UCL Type
SVOCs	C+F		Acenaphthene	ug/L	5	N/A	N/A	0	7.1E-04	0.0010	0.0010	0.0013	5	0.0013	Max Detected
SVOCs	Filter		Anthracene	ug/L	5	N/A	N/A	0	1.8E-05	2.7E-05	2.9E-05	3.2E-05	5	0.000032	Max Detected
SVOCs	C+F		Anthracene	ug/L	5	N/A	N/A	0	1.8E-05	2.7E-05	2.9E-05	3.2E-05	5	0.000032	Max Detected
SVOCs	Column		Benzo(a)anthracene	ug/L	5	1.2E-05	1.2E-05	1	8.3E-06	1.1E-05	1.0E-05	1.5E-05	4	0.000015	Max Detected
SVOCs	C+F		Benzo(a)anthracene	ug/L	5	5.2E-05	5.2E-05	1	8.3E-06	1.1E-05	1.0E-05	1.5E-05	4	0.000015	Max Detected
SVOCs	Column		Benzo(b)fluoranthene	ug/L	5	1.1E-05	1.8E-05	4	9.2E-06	9.2E-06	9.2E-06	9.2E-06	1	0.0000092	Max Detected
SVOCs	Filter		Benzo(b)fluoranthene	ug/L	5	3.3E-05	4.2E-05	2	7.1E-05	7.7E-05	7.7E-05	8.3E-05	3	0.000083	Max Detected
SVOCs	C+F		Benzo(b)fluoranthene	ug/L	5	3.3E-05	4.2E-05	2	7.1E-05	8.0E-05	7.7E-05	9.2E-05	3	0.000092	Max Detected
SVOCs	Column		Chrysene	ug/L	5	N/A	N/A	0	3.9E-05	4.7E-05	4.9E-05	5.1E-05	5	0.000051	Max Detected
SVOCs	Filter		Chrysene	ug/L	5	6.3E-05	8.4E-05	3	1.1E-04	1.2E-04	1.2E-04	1.3E-04	2	0.00013	Max Detected
SVOCs	C+F		Chrysene	ug/L	5	N/A	N/A	0	3.9E-05	9.5E-05	5.1E-05	1.7E-04	5	0.00017	Max Detected
SVOCs	Column		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	2.1E-06	1.2E-05	2.9E-06	5.0E-05	5	0.000050	Max Detected
SVOCs	Filter		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	5.6E-05	8.1E-05	2	1.1E-05	3.5E-05	1.2E-05	8.0E-05	3	0.000080	Max Detected
SVOCs	C+F		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	2.1E-06	9.0E-06	1.0E-05	1.6E-05	5	0.000016	Max Detected
SVOCs	Filter		Fluoranthene	ug/L	5	N/A	N/A	0	1.1E-04	1.6E-04	1.4E-04	2.1E-04	5	0.00021	Max Detected
SVOCs	C+F		Fluoranthene	ug/L	5	N/A	N/A	0	1.1E-04	1.6E-04	1.4E-04	2.1E-04	5	0.00021	Max Detected
SVOCs	Column		Phenanthrene	ug/L	5	N/A	N/A	0	0.0013	0.0014	0.0014	0.0015	5	0.0015	Max Detected
SVOCs	Filter		Phenanthrene	ug/L	5	6.6E-05	1.1E-04	4	1.9E-04	1.9E-04	1.9E-04	1.9E-04	1	0.00019	Max Detected
SVOCs	C+F		Phenanthrene	ug/L	5	N/A	N/A	0	0.0013	0.0014	0.0014	0.0016	5	0.0016	Max Detected
SVOCs	Column		Total HPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	1.1E-04	2.4E-04	1.3E-04	6.8E-04	5	0.00068	Max Detected
SVOCs	Filter		Total HPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	3.5E-04	4.6E-04	4.0E-04	6.0E-04	5	0.00060	Max Detected
SVOCs	C+F		Total HPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	2.2E-04	3.8E-04	4.0E-04	5.5E-04	5	0.00055	Max Detected
SVOCs	Column		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0022	0.0025	0.0025	0.0026	5	0.0026	Max Detected
SVOCs	Filter		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	1.0E-04	1.6E-04	1.6E-04	2.5E-04	5	0.00025	Max Detected
SVOCs	C+F		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0021	0.0024	0.0024	0.0026	5	0.0026	Max Detected
SVOCs	Column		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0023	0.0025	0.0025	0.0027	5	0.0027	Max Detected
SVOCs	Filter		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	3.1E-04	5.2E-04	4.8E-04	8.2E-04	5	0.00082	Max Detected
SVOCs	C+F		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0026	0.0028	0.0028	0.0032	5	0.0032	Max Detected

Notes:
See Appendix A for data quality evaluation of non-detects.

% = percent
BaPEQ = benzo(a)pyrene equivalents
C+F = Sum of column (dissolved phase) and filter (particulate phase)
cPAH = carcinogenic PAH
EPC = exposure point concentration
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SD = standard deviation
SVOC = semi-volatile organic compound
TEQ = toxicity equivalence
ug/L = micrograms per liter, in wet weight

Table 1-5
Statistical Summary for Reference Area Surface Water Samples
Bradford Island - River Operable Unit

Analyte Group	Preparation Fraction	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
PCB Congeners	Column	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	4.1E-08	4.3E-08	2	4.7E-08	7.3E-08	8.0E-08	9.2E-08	3	60%	9.2E-08	Max Detected
PCB Congeners	Filter	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	3.2E-08	3.9E-08	2	4.7E-08	5.8E-08	5.7E-08	7.1E-08	3	60%	7.1E-08	Max Detected
PCB Congeners	C+F	77	3,3',4,4'-Tetrachlorobiphenyl	ug/L	5	3.9E-08	3.9E-08	1	4.7E-08	9.9E-08	9.8E-08	1.5E-07	4	80%	1.5E-07	Max Detected
PCB Congeners	Column	81	3,4,4',5-Tetrachlorobiphenyl	ug/L	5	6.2E-09	7.3E-09	5	N/A	N/A	N/A	N/A	0	0%	7.3E-09	Max ND
PCB Congeners	Filter	81	3,4,4',5-Tetrachlorobiphenyl	ug/L	5	4.3E-09	5.7E-09	5	N/A	N/A	N/A	N/A	0	0%	5.7E-09	Max ND
PCB Congeners	C+F	81	3,4,4',5-Tetrachlorobiphenyl	ug/L	5	4.3E-09	5.7E-09	5	N/A	N/A	N/A	N/A	0	0%	5.7E-09	Max ND
PCB Congeners	Column	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	1.3E-07	1.5E-07	1.5E-07	1.8E-07	5	100%	1.8E-07	Max Detected
PCB Congeners	Filter	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	2.6E-07	3.1E-07	3.0E-07	4.0E-07	5	100%	4.0E-07	Max Detected
PCB Congeners	C+F	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	3.9E-07	4.7E-07	4.6E-07	5.6E-07	5	100%	5.6E-07	Max Detected
PCB Congeners	Column	114	2,3,4,4',5-Pentachlorobiphenyl	ug/L	5	9.0E-09	1.7E-08	5	N/A	N/A	N/A	N/A	0	0%	1.7E-08	Max ND
PCB Congeners	Filter	114	2,3,4,4',5-Pentachlorobiphenyl	ug/L	5	1.4E-08	2.2E-08	5	N/A	N/A	N/A	N/A	0	0%	2.2E-08	Max ND
PCB Congeners	C+F	114	2,3,4,4',5-Pentachlorobiphenyl	ug/L	5	9.0E-09	1.7E-08	5	N/A	N/A	N/A	N/A	0	0%	1.7E-08	Max ND
PCB Congeners	Column	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	3.8E-07	5.1E-07	5.5E-07	5.9E-07	5	100%	5.9E-07	Max Detected
PCB Congeners	Filter	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	7.4E-07	9.7E-07	9.3E-07	1.2E-06	5	100%	1.2E-06	Max Detected
PCB Congeners	C+F	118	2,3',4,4',5-Pentachlorobiphenyl	ug/L	5	N/A	N/A	0	1.1E-06	1.5E-06	1.5E-06	1.8E-06	5	100%	1.8E-06	Max Detected
PCB Congeners	Column	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/L	5	7.0E-09	1.4E-08	5	N/A	N/A	N/A	N/A	0	0%	1.4E-08	Max ND
PCB Congeners	Filter	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/L	5	1.7E-08	2.6E-08	5	N/A	N/A	N/A	N/A	0	0%	2.6E-08	Max ND
PCB Congeners	C+F	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/L	5	7.0E-09	1.4E-08	5	N/A	N/A	N/A	N/A	0	0%	1.4E-08	Max ND
PCB Congeners	Column	126	3,3',4,4',5-Pentachlorobiphenyl	ug/L	5	3.9E-09	7.0E-09	5	N/A	N/A	N/A	N/A	0	0%	7.0E-09	Max ND
PCB Congeners	Filter	126	3,3',4,4',5-Pentachlorobiphenyl	ug/L	5	5.5E-09	8.0E-09	5	N/A	N/A	N/A	N/A	0	0%	8.0E-09	Max ND
PCB Congeners	C+F	126	3,3',4,4',5-Pentachlorobiphenyl	ug/L	5	3.9E-09	7.0E-09	5	N/A	N/A	N/A	N/A	0	0%	7.0E-09	Max ND
PCB Congeners	Column	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	2.6E-08	3.6E-08	5	N/A	N/A	N/A	N/A	0	0%	3.6E-08	Max ND
PCB Congeners	Filter	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	8.5E-08	9.9E-08	9.9E-08	1.2E-07	5	100%	1.2E-07	Max Detected
PCB Congeners	C+F	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	8.5E-08	9.9E-08	9.9E-08	1.2E-07	5	100%	1.2E-07	Max Detected
PCB Congeners	Column	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	1.3E-08	1.8E-08	5	N/A	N/A	N/A	N/A	0	0%	1.8E-08	Max ND
PCB Congeners	Filter	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	4.1E-08	5.7E-08	5.7E-08	7.0E-08	5	100%	7.0E-08	Max Detected
PCB Congeners	C+F	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	N/A	N/A	0	4.1E-08	5.7E-08	5.7E-08	7.0E-08	5	100%	7.0E-08	Max Detected
PCB Congeners	Column	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	1.0E-09	3.0E-09	5	N/A	N/A	N/A	N/A	0	0%	3.0E-09	Max ND
PCB Congeners	Filter	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	1.7E-09	3.4E-09	5	N/A	N/A	N/A	N/A	0	0%	3.4E-09	Max ND
PCB Congeners	C+F	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/L	5	1.0E-09	2.4E-09	5	N/A	N/A	N/A	N/A	0	0%	2.4E-09	Max ND
PCB Congeners	Column	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/L	5	1.4E-09	3.6E-09	5	N/A	N/A	N/A	N/A	0	0%	3.6E-09	Max ND
PCB Congeners	Filter	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/L	5	4.0E-09	6.0E-09	5	N/A	N/A	N/A	N/A	0	0%	6.0E-09	Max ND
PCB Congeners	C+F	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/L	5	1.4E-09	3.6E-09	5	N/A	N/A	N/A	N/A	0	0%	3.6E-09	Max ND
PCB Congeners	Column		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	2.7E-11	2.2E-09	2.4E-09	4.6E-09	5	100%	4.6E-09	Max Detected
PCB Congeners	Filter		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	5.9E-11	1.8E-09	2.4E-09	3.6E-09	5	100%	3.6E-09	Max Detected
PCB Congeners	C+F		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	9.5E-11	4.0E-09	2.9E-09	7.7E-09	5	100%	7.7E-09	Max Detected
PCB Congeners	Column		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	4.5E-12	9.2E-12	8.4E-12	1.5E-11	5	100%	1.5E-11	Max Detected
PCB Congeners	Filter		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	7.0E-12	1.2E-11	1.3E-11	1.8E-11	5	100%	1.8E-11	Max Detected
PCB Congeners	C+F		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	1.2E-11	2.1E-11	1.9E-11	3.1E-11	5	100%	3.1E-11	Max Detected
PCB Congeners	Column		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	2.4E-11	3.0E-11	2.6E-11	4.0E-11	5	100%	4.0E-11	Max Detected
PCB Congeners	Filter		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	4.3E-11	5.8E-11	5.6E-11	7.5E-11	5	100%	7.5E-11	Max Detected
PCB Congeners	C+F		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/L	5	N/A	N/A	0	6.7E-11	8.4E-11	8.6E-11	1.0E-10	5	100%	1.0E-10	Max Detected
PCB Congeners	Column		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	1.1E-04	1.4E-04	1.5E-04	1.5E-04	5	100%	1.5E-04	Max Detected
PCB Congeners	Filter		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	2.1E-05	2.4E-05	2.5E-05	2.7E-05	5	100%	2.7E-05	Max Detected
PCB Congeners	C+F		Total PCBs as Congeners (KM-based, capped)	ug/L	5	N/A	N/A	0	1.3E-04	1.6E-04	1.7E-04	1.8E-04	5	100%	1.8E-04	Max Detected
Metals	Dissolved		Aluminum	ug/L	5	20	20	4	27	27	27	27	1	20%	27	Max Detected
Metals	Dissolved		Antimony	ug/L	5	7.0	7.0	5	N/A	N/A	N/A	N/A	0	0%	7.0	Max ND
Metals	Dissolved		Arsenic	ug/L	5	1.1	1.2	3	0.94	1.1	1.1	1.3	2	40%	1.3	Max Detected
Metals	Dissolved		Barium	ug/L	5	N/A	N/A	0	22	23	23	24	5	100%	24	Max Detected
Metals	Dissolved		Beryllium	ug/L	5	0.0080	0.020	5	N/A	N/A	N/A	N/A	0	0%	0.020	Max ND
Metals	Dissolved		Cadmium	ug/L	5	0.0050	0.0070	5	N/A	N/A	N/A	N/A	0	0%	0.0070	Max ND
Metals	Dissolved		Chromium	ug/L	5	2.0	2.0	5	N/A	N/A	N/A	N/A	0	0%	2.0	Max ND
Metals	Dissolved		Cobalt	ug/L	5	2.0	2.0	4	2.2	2.2	2.2	2.2	1	20%	2.2	Max Detected
Metals	Dissolved		Copper	ug/L	5	N/A	N/A	0	0.45	0.55	0.55	0.61	5	100%	0.61	Max Detected
Metals	Dissolved		Lead	ug/L	5	0.0090	0.0090	2	0.014	0.018	0.015	0.024	3	60%	0.024	Max Detected

Analyte Group	Preparation Fraction	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
Metals	Dissolved		Mercury	ug/L	5	0.030	0.030	5	N/A	N/A	N/A	N/A	0	0%	0.030	Max ND
Metals	Dissolved		Nickel	ug/L	5	2.0	2.0	5	N/A	N/A	N/A	N/A	0	0%	2.0	Max ND
Metals	Dissolved		Thallium	ug/L	5	0.020	0.024	3	0.019	0.019	0.019	0.020	2	40%	0.020	Max Detected
Metals	Dissolved		Vanadium	ug/L	5	5.0	5.0	5	N/A	N/A	N/A	N/A	0	0%	5.0	Max ND
Metals	Dissolved		Zinc	ug/L	5	7.0	7.0	5	N/A	N/A	N/A	N/A	0	0%	7.0	Max ND
Metals	Total		Aluminum	ug/L	5	N/A	N/A	0	91	109	115	123	5	100%	123	Max Detected
Metals	Total		Antimony	ug/L	5	7.0	7.0	4	9.3	9.3	9.3	9.3	1	20%	9.3	Max Detected
Metals	Total		Arsenic	ug/L	5	1.1	1.1	1	0.91	1.2	1.2	1.3	4	80%	1.3	Max Detected
Metals	Total		Barium	ug/L	5	N/A	N/A	0	21	24	25	26	5	100%	26	Max Detected
Metals	Total		Beryllium	ug/L	5	0.0080	0.020	2	0.0090	0.014	0.011	0.021	3	60%	0.021	Max Detected
Metals	Total		Cadmium	ug/L	5	0.020	0.020	3	0.010	0.016	0.016	0.021	2	40%	0.021	Max Detected
Metals	Total		Chromium	ug/L	5	2.0	2.0	4	2.0	2.0	2.0	2.0	1	20%	2.0	Max Detected
Metals	Total		Cobalt	ug/L	5	2.0	2.0	4	2.0	2.0	2.0	2.0	1	20%	2.0	Max Detected
Metals	Total		Copper	ug/L	5	N/A	N/A	0	0.61	0.74	0.76	0.83	5	100%	0.83	Max Detected
Metals	Total		Lead	ug/L	5	N/A	N/A	0	0.058	0.10	0.091	0.20	5	100%	0.20	Max Detected
Metals	Total		Mercury	ug/L	5	0.030	0.030	5	N/A	N/A	N/A	N/A	0	0%	0.030	Max ND
Metals	Total		Nickel	ug/L	5	2.0	2.0	5	N/A	N/A	N/A	N/A	0	0%	2.0	Max ND
Metals	Total		Thallium	ug/L	5	0.020	0.037	4	0.021	0.021	0.021	0.021	1	20%	0.021	Max Detected
Metals	Total		Vanadium	ug/L	5	5.0	5.0	5	N/A	N/A	N/A	N/A	0	0%	5.0	Max ND
Metals	Total		Zinc	ug/L	5	7.0	7.0	5	N/A	N/A	N/A	N/A	0	0%	7.0	Max ND
NWTPH-Dx	Dissolved		Diesel Range Organics	ug/L	5	11	12	4	13	13	13	13	1	20%	13	Max Detected
NWTPH-Dx	Dissolved		Residual Range Organics	ug/L	5	21	100	2	20	22	21	24	3	60%	24	Max Detected
NWTPH-Dx	Total		Diesel Range Organics	ug/L	5	11	12	2	13	15	14	19	3	60%	19	Max Detected
NWTPH-Dx	Total		Residual Range Organics	ug/L	5	20	100	2	22	39	24	71	3	60%	71	Max Detected
SVOCs	Column		Acenaphthene	ug/L	5	N/A	N/A	0	8.6E-04	0.0014	0.0013	0.0024	5	100%	0.0024	Max Detected
SVOCs	Filter		Acenaphthene	ug/L	5	1.4E-05	3.3E-05	5	N/A	N/A	N/A	N/A	0	0%	3.3E-05	Max ND
SVOCs	C+F		Acenaphthene	ug/L	5	N/A	N/A	0	8.6E-04	0.0014	0.0013	0.0024	5	100%	0.0024	Max Detected
SVOCs	Column		Anthracene	ug/L	5	5.9E-05	1.3E-04	5	N/A	N/A	N/A	N/A	0	0%	1.3E-04	Max ND
SVOCs	Filter		Anthracene	ug/L	5	N/A	N/A	0	1.1E-05	1.9E-05	1.9E-05	2.4E-05	5	100%	2.4E-05	Max Detected
SVOCs	C+F		Anthracene	ug/L	5	N/A	N/A	0	1.1E-05	1.9E-05	1.9E-05	2.4E-05	5	100%	2.4E-05	Max Detected
SVOCs	Column		Benzo(a)anthracene	ug/L	5	1.8E-05	1.8E-05	1	9.3E-06	1.3E-05	1.4E-05	1.6E-05	4	80%	1.6E-05	Max Detected
SVOCs	Filter		Benzo(a)anthracene	ug/L	5	2.1E-05	3.8E-05	5	N/A	N/A	N/A	N/A	0	0%	3.8E-05	Max ND
SVOCs	C+F		Benzo(a)anthracene	ug/L	5	2.1E-05	2.1E-05	1	9.3E-06	1.3E-05	1.4E-05	1.6E-05	4	80%	1.6E-05	Max Detected
SVOCs	Column		Benzo(a)pyrene	ug/L	5	1.3E-05	2.0E-05	5	N/A	N/A	N/A	N/A	0	0%	2.0E-05	Max ND
SVOCs	Filter		Benzo(a)pyrene	ug/L	5	2.0E-05	4.1E-05	5	N/A	N/A	N/A	N/A	0	0%	4.1E-05	Max ND
SVOCs	C+F		Benzo(a)pyrene	ug/L	5	2.0E-05	4.1E-05	5	N/A	N/A	N/A	N/A	0	0%	4.1E-05	Max ND
SVOCs	Column		Benzo(b)fluoranthene	ug/L	5	8.7E-06	1.5E-05	5	N/A	N/A	N/A	N/A	0	0%	1.5E-05	Max ND
SVOCs	Filter		Benzo(b)fluoranthene	ug/L	5	2.3E-05	3.3E-05	3	5.1E-05	5.3E-05	5.3E-05	5.6E-05	2	40%	5.6E-05	Max Detected
SVOCs	C+F		Benzo(b)fluoranthene	ug/L	5	2.3E-05	3.3E-05	3	5.1E-05	5.3E-05	5.3E-05	5.6E-05	2	40%	5.6E-05	Max Detected
SVOCs	Column		Benzo(g,h,i)perylene	ug/L	5	1.2E-05	2.0E-05	5	N/A	N/A	N/A	N/A	0	0%	2.0E-05	Max ND
SVOCs	Filter		Benzo(g,h,i)perylene	ug/L	5	1.7E-05	4.0E-05	5	N/A	N/A	N/A	N/A	0	0%	4.0E-05	Max ND
SVOCs	C+F		Benzo(g,h,i)perylene	ug/L	5	1.7E-05	4.0E-05	5	N/A	N/A	N/A	N/A	0	0%	4.0E-05	Max ND
SVOCs	Column		Benzo(j,k)flouranthenes	ug/L	5	9.3E-06	1.6E-05	5	N/A	N/A	N/A	N/A	0	0%	1.6E-05	Max ND
SVOCs	Filter		Benzo(j,k)flouranthenes	ug/L	5	2.1E-05	5.5E-05	5	N/A	N/A	N/A	N/A	0	0%	5.5E-05	Max ND
SVOCs	C+F		Benzo(j,k)flouranthenes	ug/L	5	2.1E-05	5.5E-05	5	N/A	N/A	N/A	N/A	0	0%	5.5E-05	Max ND
SVOCs	Column		Bis(2-ethylhexyl) Phthalate	ug/L	5	0.0058	0.017	5	N/A	N/A	N/A	N/A	0	0%	0.017	Max ND
SVOCs	Filter		Bis(2-ethylhexyl) Phthalate	ug/L	5	0.0028	0.013	5	N/A	N/A	N/A	N/A	0	0%	0.013	Max ND
SVOCs	C+F		Bis(2-ethylhexyl) Phthalate	ug/L	5	0.0084	0.017	5	N/A	N/A	N/A	N/A	0	0%	0.017	Max ND
SVOCs	Column		Butyl Benzyl Phthalate	ug/L	5	2.6E-04	5.0E-04	5	N/A	N/A	N/A	N/A	0	0%	5.0E-04	Max ND
SVOCs	Filter		Butyl Benzyl Phthalate	ug/L	5	1.6E-04	0.0055	5	N/A	N/A	N/A	N/A	0	0%	0.0055	Max ND
SVOCs	C+F		Butyl Benzyl Phthalate	ug/L	5	3.2E-04	0.0055	5	N/A	N/A	N/A	N/A	0	0%	0.0055	Max ND
SVOCs	Column		Chrysene	ug/L	5	N/A	N/A	0	3.9E-05	5.1E-05	4.8E-05	6.6E-05	5	100%	6.6E-05	Max Detected
SVOCs	Filter		Chrysene	ug/L	5	4.5E-05	9.3E-05	5	N/A	N/A	N/A	N/A	0	0%	9.3E-05	Max ND
SVOCs	C+F		Chrysene	ug/L	5	N/A	N/A	0	3.9E-05	5.1E-05	4.8E-05	6.6E-05	5	100%	6.6E-05	Max Detected
SVOCs	Column		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	2.3E-06	1.0E-05	3.1E-06	4.0E-05	5	100%	4.0E-05	Max Detected

Table 1-5
Statistical Summary for Reference Area Surface Water Samples
Bradford Island - River Operable Unit

Analyte Group	Preparation Fraction	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
SVOCs	Filter		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	4.9E-05	5.8E-05	3	7.5E-05	7.5E-05	7.5E-05	7.6E-05	2	40%	7.6E-05	Max Detected
SVOCs	C+F		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	2.4E-06	1.7E-05	9.5E-06	5.8E-05	5	100%	5.8E-05	Max Detected
SVOCs	Column		Dibenz(a,h)anthracene	ug/L	5	1.5E-05	2.2E-05	5	N/A	N/A	N/A	N/A	0	0%	2.2E-05	Max ND
SVOCs	Filter		Dibenz(a,h)anthracene	ug/L	5	1.8E-05	2.9E-05	5	N/A	N/A	N/A	N/A	0	0%	2.9E-05	Max ND
SVOCs	C+F		Dibenz(a,h)anthracene	ug/L	5	1.8E-05	2.9E-05	5	N/A	N/A	N/A	N/A	0	0%	2.9E-05	Max ND
SVOCs	Column		Di-n-butyl Phthalate	ug/L	5	5.2E-04	7.3E-04	5	N/A	N/A	N/A	N/A	0	0%	7.3E-04	Max ND
SVOCs	Filter		Di-n-butyl Phthalate	ug/L	5	2.4E-04	6.0E-04	5	N/A	N/A	N/A	N/A	0	0%	6.0E-04	Max ND
SVOCs	C+F		Di-n-butyl Phthalate	ug/L	5	5.2E-04	7.3E-04	5	N/A	N/A	N/A	N/A	0	0%	7.3E-04	Max ND
SVOCs	Column		Di-n-octyl Phthalate	ug/L	5	9.1E-05	2.0E-04	5	N/A	N/A	N/A	N/A	0	0%	2.0E-04	Max ND
SVOCs	Filter		Di-n-octyl Phthalate	ug/L	5	1.2E-04	0.0011	5	N/A	N/A	N/A	N/A	0	0%	0.0011	Max ND
SVOCs	C+F		Di-n-octyl Phthalate	ug/L	5	1.6E-04	0.0011	5	N/A	N/A	N/A	N/A	0	0%	0.0011	Max ND
SVOCs	Column		Fluoranthene	ug/L	5	4.9E-04	5.9E-04	2	6.2E-04	6.3E-04	6.3E-04	6.3E-04	3	60%	6.3E-04	Max Detected
SVOCs	Filter		Fluoranthene	ug/L	5	7.9E-05	7.9E-05	1	1.0E-04	1.3E-04	1.3E-04	1.6E-04	4	80%	1.6E-04	Max Detected
SVOCs	C+F		Fluoranthene	ug/L	5	4.9E-04	4.9E-04	1	1.0E-04	6.0E-04	7.6E-04	7.8E-04	4	80%	7.8E-04	Max Detected
SVOCs	Column		Indeno(1,2,3-cd)pyrene	ug/L	5	1.3E-05	2.2E-05	5	N/A	N/A	N/A	N/A	0	0%	2.2E-05	Max ND
SVOCs	Filter		Indeno(1,2,3-cd)pyrene	ug/L	5	1.5E-05	4.2E-05	5	N/A	N/A	N/A	N/A	0	0%	4.2E-05	Max ND
SVOCs	C+F		Indeno(1,2,3-cd)pyrene	ug/L	5	1.6E-05	4.2E-05	5	N/A	N/A	N/A	N/A	0	0%	4.2E-05	Max ND
SVOCs	Column		Phenanthrene	ug/L	5	N/A	N/A	0	0.0012	0.0013	0.0013	0.0015	5	100%	0.0015	Max Detected
SVOCs	Filter		Phenanthrene	ug/L	5	5.7E-05	1.1E-04	5	N/A	N/A	N/A	N/A	0	0%	1.1E-04	Max ND
SVOCs	C+F		Phenanthrene	ug/L	5	N/A	N/A	0	0.001	0.0013	0.0013	0.0015	5	100%	0.0015	Max Detected
SVOCs	Column		Total HPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	1.2E-04	6.3E-04	7.4E-04	7.8E-04	5	100%	7.8E-04	Max Detected
SVOCs	Filter		Total HPAHs (KM-capped, MDL-based)	ug/L	5	2.9E-04	2.9E-04	1	3.1E-04	3.6E-04	3.7E-04	3.8E-04	4	80%	3.8E-04	Max Detected
SVOCs	C+F		Total HPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	1.2E-04	6.5E-04	9.1E-04	9.9E-04	5	100%	9.9E-04	Max Detected
SVOCs	Column		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0021	0.0028	0.0026	0.0041	5	100%	0.0041	Max Detected
SVOCs	Filter		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	8.4E-05	1.3E-04	1.3E-04	1.6E-04	5	100%	1.6E-04	Max Detected
SVOCs	C+F		Total LPAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0021	0.0028	0.0026	0.0040	5	100%	0.0040	Max Detected
SVOCs	Column		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0022	0.0033	0.0030	0.0047	5	100%	0.0047	Max Detected
SVOCs	Filter		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	3.0E-04	3.6E-04	3.7E-04	4.2E-04	5	100%	4.2E-04	Max Detected
SVOCs	C+F		Total PAHs (KM-capped, MDL-based)	ug/L	5	N/A	N/A	0	0.0024	0.0034	0.0032	0.0049	5	100%	0.0049	Max Detected

Notes:

% = percent
BaPEQ = benzo(a)pyrene equivalents
C+F = Sum of column (dissolved phase) and filter (particulate phase)
cPAH = carcinogenic PAH
EPC = exposure point concentration
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SD = standard deviation
SVOC = semi-volatile organic compound
TEQ = toxicity equivalence
ug/L = micrograms per liter, in wet weight

Table 1-6
Statistical Summary for River OU Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
CF	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.0016	0.0057	0.0039	0.0207	16	100%	0.0057	0.0053	0.0088	95% H-UCL
CF	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	16	1.3E-04	3.6E-04	9	2.1E-04	5.1E-04	3.1E-04	0.0013	7	44%	3.1E-04	3.1E-04	0.00046	95% KM (Percentile Bootstrap) UCL
CF	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.0037	0.032	0.012	0.13	16	100%	0.032	0.040	0.075	95% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.0021	0.11	0.0059	0.80	16	100%	0.11	0.22	0.66	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.082	1.9	0.17	14	16	100%	1.9	3.7	11	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.0021	0.066	0.0049	0.46	16	100%	0.066	0.13	0.39	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	16	4.0E-04	0.0035	8	2.4E-04	0.0018	4.7E-04	0.0078	8	50%	0.0011	0.0019	0.0019	95% KM (BCA) UCL
CF	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.013	0.56	0.026	3.9	16	100%	0.56	1.1	3.3	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	16	N/A	N/A	0	0.0085	0.24	0.020	1.5	16	100%	0.24	0.47	1.4	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	16	N/A	N/A	0	6.6E-04	0.014	0.0016	0.082	16	100%	0.014	0.026	0.079	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	16	N/A	N/A	0	8.3E-05	5.0E-04	2.7E-04	0.0026	16	100%	5.0E-04	6.6E-04	0.0012	95% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	16	N/A	N/A	0	8.6E-07	2.0E-05	3.0E-06	1.5E-04	16	100%	2.0E-05	3.8E-05	0.00012	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	16	N/A	N/A	0	4.6E-06	1.8E-04	4.0E-05	0.0014	16	100%	1.8E-04	3.7E-04	0.0011	99% Chebyshev (Mean, Sd) UCL
CF	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	16	N/A	N/A	0	0.55	6.4	1.0	43	16	100%	6.4	11	19	95% Chebyshev (Mean, Sd) UCL
CF	Metals		Aluminum	mg/kg	18	N/A	N/A	0	71	108	102	157	18	100%	N/A	N/A	116	95% Approximate Gamma UCL
CF	Metals		Antimony	mg/kg	18	N/A	N/A	0	0.0080	0.028	0.017	0.13	18	100%	N/A	N/A	0.042	95% H-UCL
CF	Metals		Arsenic	mg/kg	18	N/A	N/A	0	0.30	0.47	0.45	0.68	18	100%	N/A	N/A	0.52	95% Approximate Gamma UCL
CF	Metals		Barium	mg/kg	18	N/A	N/A	0	52	65	63	84	18	100%	N/A	N/A	69	95% Student's-t UCL
CF	Metals		Beryllium	mg/kg	18	N/A	N/A	0	0.0017	0.0032	0.0033	0.0041	18	100%	N/A	N/A	0.0034	95% Student's-t UCL
CF	Metals		Cadmium	mg/kg	18	N/A	N/A	0	0.061	0.11	0.085	0.21	18	100%	N/A	N/A	0.13	95% Approximate Gamma UCL
CF	Metals		Chromium	mg/kg	18	N/A	N/A	0	0.19	0.63	0.70	1.2	18	100%	N/A	N/A	0.76	95% Student's-t UCL
CF	Metals		Cobalt	mg/kg	18	N/A	N/A	0	0.19	0.24	0.24	0.39	18	100%	N/A	N/A	0.241	95% Student's-t UCL
CF	Metals		Copper	mg/kg	18	N/A	N/A	0	11	19	19	36	18	100%	N/A	N/A	22	95% Student's-t UCL
CF	Metals		Lead	mg/kg	18	N/A	N/A	0	0.10	0.60	0.52	2.7	18	100%	N/A	N/A	0.93	95% Approximate Gamma UCL
CF	Metals		Mercury	mg/kg	18	N/A	N/A	0	0.016	0.023	0.022	0.036	18	100%	N/A	N/A	0.024	95% Student's-t UCL
CF	Metals-Methyl Mercury		Methyl Mercury	mg/kg	17	N/A	N/A	0	0.025	0.031	0.030	0.040	17	100%	N/A	N/A	0.033	95% Student's-t UCL
CF	Metals		Nickel	mg/kg	18	N/A	N/A	0	1.2	4.6	4.7	5.4	18	100%	N/A	N/A	4.9	95% Student's-t UCL
CF	Metals		Thallium	mg/kg	18	N/A	N/A	0	0.012	0.018	0.017	0.029	18	100%	N/A	N/A	0.020	95% Student's-t UCL
CF	Metals		Vanadium	mg/kg	18	N/A	N/A	0	0.30	0.45	0.40	0.73	18	100%	N/A	N/A	0.47	95% Student's-t UCL
CF	Metals		Zinc	mg/kg	18	N/A	N/A	0	17	20.5	20.6	23	18	100%	N/A	N/A	21	95% Student's-t UCL
CF	SVOCs		Acenaphthene	ug/kg	16	0.11	0.50	9	0.11	0.17	0.14	0.26	7	44%	0.14	0.046	0.16	95% KM (t) UCL
CF	SVOCs		Anthracene	ug/kg	16	0.065	0.065	11	0.069	0.18	0.13	0.43	5	31%	0.080	0.026	0.094	95% KM (t) UCL
CF	SVOCs		Benzo(a)anthracene	ug/kg	16	0.066	0.5	6	0.23	0.27	0.27	0.35	10	63%	0.26	0.032	0.27	95% KM (Percentile Bootstrap) UCL
CF	SVOCs		Benzo(a)pyrene	ug/kg	16	0.061	0.081	13	0.12	0.15	0.16	0.17	3	19%	0.13	0.015	0.14	95% KM (t) UCL
CF	SVOCs		Benzo(b)fluoranthene	ug/kg	16	0.070	0.070	8	0.096	0.14	0.13	0.24	8	50%	0.12	0.045	0.14	95% KM (t) UCL
CF	SVOCs		Benzo(g,h,i)perylene	ug/kg	16	0.073	0.073	11	0.098	0.19	0.16	0.39	5	31%	0.13	0.074	0.17	95% KM (t) UCL
CF	SVOCs		Benzo(k)fluoranthene	ug/kg	16	0.056	0.056	8	0.086	0.12	0.11	0.16	8	50%	0.10	0.023	0.11	95% KM (t) UCL
CF	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	16	66	66	12	67	83	78	110	4	25%	71	12	77	95% KM (t) UCL
CF	SVOCs		Chrysene	ug/kg	16	0.076	0.20	8	0.082	0.14	0.12	0.31	8	50%	0.12	0.061	0.14	95% KM (t) UCL
CF	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	16	0.16	0.16	3	0.031	0.10	0.054	0.26	13	81%	0.090	0.075	0.18	95% KM (Chebyshev) UCL
CF	SVOCs		Fluoranthene	ug/kg	16	0.50	0.50	1	0.17	0.35	0.30	0.75	15	94%	N/A	N/A	0.43	95% Approximate Gamma UCL
CF	SVOCs		Fluorene	ug/kg	16	0.15	0.15	10	0.15	0.23	0.17	0.51	6	38%	0.16	0.0162	0.17	95% KM (t) UCL
CF	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	16	0.064	0.064	12	0.15	0.17	0.17	0.18	4	25%	0.163	0.007	0.17	95% KM (t) UCL
CF	SVOCs		Phenanthrene	ug/kg	16	0.36	0.36	5	0.42	0.58	0.51	0.86	11	69%	0.51	0.14	0.58	95% KM (BCA) UCL
CF	SVOCs		Pyrene	ug/kg	16	0.50	0.50	1	0.16	0.36	0.29	1.2	15	94%	N/A	N/A	0.47	95% Approximate Gamma UCL
CF	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	16	N/A	N/A	0	0.88	1.5	1.3	3.8	16	100%	1.5	0.69	1.8	95% Student's-t UCL
CF	SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	16	0.69	0.69	3	0.69	1.0	0.83	2.3	13	81%	0.95	0.40	1.4	95% KM (Chebyshev) UCL
CF	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	16	N/A	N/A	0	1.1	2.2	2.1	5.2	16	100%	2.2	0.97	2.7	95% Student's-t UCL
SB	PCB Aroclors		Aroclor 1242	ug/kg	38	2.2	280	37	260	260	260	260	1	3%	9.8	44	260	Max Detected
SB	PCB Aroclors		Aroclor 1254	ug/kg	38	5.0	420	17	12	8134	190	65000	21	55%	4501	12269	24793	99% KM (Chebyshev) UCL
SB	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	38	5.0	424	17	12	8166	190	65000	21	55%	4519	12273	24818	99% KM (Chebyshev) UCL
SB	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.014	1.83	0.043	25	38	100%	1.8	5.1	7.0	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	38	0.0062	0.19	4	7.2E-04	0.11	0.0023	1.5	34	89%	0.094	0.32	0.62	99% KM (Chebyshev) UCL
SB	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.30	581	2.1	9040	38	100%	581	1778	2382	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.033	34	0.17	504	38	100%	34	100	136	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	1.2	1354	6.2	20000	38	100%	1354	3984	5390	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.025	21	0.086	298	38	100%	21	62	83	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	0.048	0.048	1	0.0031	0.54	0.0099	6.4	37	97%	0.53	1.4	2.8	99% KM (Chebyshev) UCL
SB	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.22	184	1.3	2640	38	100%	184	522	713	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.093	51	0.34	735	38	100%	51	146	199	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.013	4.1	0.046	58	38	100%	4.1	12	16	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	0.0012	0.25	0.0041	3.5	38	100%	0.25	0.70	0.96	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	2.6E-05	0.014	1.0E-04	0.20	38	100%	0.014	0.041	0.055	97.5% Chebyshev (Mean, Sd) UCL

Table 1-6
Statistical Summary for River OU Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
SB	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	3.6E-04	0.12	0.0014	1.7	38	100%	0.12	0.34	0.46	97.5% Chebyshev (Mean, Sd) UCL
SB	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	38	N/A	N/A	0	13	11608	64	183148	38	100%	11608	35083	47149	97.5% Chebyshev (Mean, Sd) UCL
SB	Metals		Aluminum	mg/kg	38	N/A	N/A	0	0.34	4.2	3.8	16	38	100%	4.2	3.4	5.4	95% Adjusted Gamma UCL
SB	Metals		Antimony	mg/kg	38	0.0050	0.0060	19	0.0029	0.0086	0.0080	0.026	19	50%	0.0060	0.0044	0.010	95% GROS Adjusted Gamma UCL
SB	Metals		Arsenic	mg/kg	38	N/A	N/A	0	0.17	0.38	0.36	0.70	38	100%	0.38	0.12	0.41	95% Student's-t UCL
SB	Metals		Barium	mg/kg	38	N/A	N/A	0	0.72	2.2	2.0	6.4	38	100%	2.2	1.4	2.6	95% Adjusted Gamma UCL
SB	Metals		Beryllium	mg/kg	38	5.0E-04	9.0E-04	34	5.0E-04	6.0E-04	6.0E-04	7.0E-04	4	11%	5.2E-04	4.6E-05	0.00054	95% KM (t) UCL
SB	Metals		Cadmium	mg/kg	38	N/A	N/A	0	0.0040	0.010	0.0084	0.028	38	100%	0.010	0.0059	0.012	95% Adjusted Gamma UCL
SB	Metals		Chromium	mg/kg	38	0.020	0.15	17	0.020	0.21	0.14	0.86	21	55%	0.14	0.19	0.19	95% KM (t) UCL
SB	Metals		Cobalt	mg/kg	38	N/A	N/A	0	0.0060	0.033	0.033	0.076	38	100%	0.033	0.023	0.049	95% Chebyshev (Mean, Sd) UCL
SB	Metals		Copper	mg/kg	38	N/A	N/A	0	0.30	0.81	0.66	2.0	38	100%	0.81	0.43	0.93	95% Adjusted Gamma UCL
SB	Metals		Lead	mg/kg	38	N/A	N/A	0	0.0040	0.011	0.0099	0.036	38	100%	0.011	0.0059	0.013	95% Adjusted Gamma UCL
SB	Metals		Mercury	mg/kg	38	N/A	N/A	0	0.060	0.21	0.16	0.51	38	100%	0.21	0.13	0.25	95% Adjusted Gamma UCL
SB	Metals		Nickel	mg/kg	38	N/A	N/A	0	0.038	0.19	0.21	0.40	38	100%	0.19	0.12	0.28	95% Chebyshev (Mean, Sd) UCL
SB	Metals		Thallium	mg/kg	38	N/A	N/A	0	0.0079	0.014	0.013	0.022	38	100%	0.014	0.0031	0.014	95% Student's-t UCL
SB	Metals		Vanadium	mg/kg	38	N/A	N/A	0	0.023	0.053	0.050	0.13	38	100%	0.053	0.021	0.059	95% Student's-t UCL
SB	Metals		Zinc	mg/kg	38	N/A	N/A	0	11	13.8	13.5	18	38	100%	14	1.5	14	95% Student's-t UCL
SB	Butyltins		Monobutyltin	ug/kg	13	0.18	0.18	12	0.22	0.22	0.22	0.22	1	8%	0.18	0.011	0.22	Max Detected
SB	Pesticides		4,4'-DDD	ug/kg	19	2.7	20	3	1.3	3.8	3.2	8.6	16	84%	3.6	2.1	4.5	95% KM (Percentile Bootstrap) UCL
SB	Pesticides		4,4'-DDE	ug/kg	19	23	200	4	13	33	23	76	15	79%	30	20	39	95% GROS Adjusted Gamma UCL
SB	Pesticides		4,4'-DDT	ug/kg	19	1.0	16000	13	2.8	5.9	3.8	17	6	32%	3.2	3.9	5.2	95% KM (t) UCL
SB	Pesticides		BHC (beta)	ug/kg	19	0.41	1.3	13	0.46	0.97	0.74	2.0	6	32%	0.62	0.39	0.79	95% KM (t) UCL
SB	Pesticides		BHC (gamma) Lindane	ug/kg	19	0.21	0.97	15	0.41	1.2	0.87	2.5	4	21%	0.42	0.53	0.67	95% KM (t) UCL
SB	Pesticides		Chlordane (alpha)	ug/kg	19	0.25	220	18	0.30	0.30	0.30	0.30	1	5%	0.25	0.012	0.3	Max Detected
SB	Pesticides		Chlordane (gamma)	ug/kg	19	0.26	0.55	4	0.40	565	1.1	5000	15	79%	446	1162	3192	99% KM (Chebyshev) UCL
SB	Pesticides		Dieldrin	ug/kg	19	0.20	2.4	11	0.27	620	186	2900	8	42%	261	677	549	95% KM (t) UCL
SB	Pesticides		Endosulfan I	ug/kg	19	0.22	5.5	14	0.39	99	95	210	5	26%	26	63	54	95% KM (t) UCL
SB	Pesticides		Endrin Aldehyde	ug/kg	19	0.62	0.62	13	1.0	409	325	1200	6	32%	130	301	261	95% KM (t) UCL
SB	Pesticides		Endrin	ug/kg	19	0.28	0.94	8	0.28	214	0.62	1200	11	58%	124	294	827	99% KM (Chebyshev) UCL
SB	Pesticides		Methoxychlor	ug/kg	19	0.48	17	17	0.80	0.85	0.85	0.90	2	11%	0.53	0.13	0.61	95% KM (t) UCL
SB	Pesticides		Total DDx (MDL-based)	ug/kg	19	2300	6800	3	16	1041	30	16040	16	84%	883	3573	9306	99% KM (Chebyshev) UCL
SB	SVOCs		Acenaphthene	ug/kg	38	0.11	0.94	17	0.086	0.66	0.35	1.6	21	55%	0.47	0.45	0.60	95% KM (t) UCL
SB	SVOCs		Anthracene	ug/kg	38	0.065	0.98	3	0.047	2.7	2.2	17	35	92%	2.5	3.2	7.6	99% KM (Chebyshev) UCL
SB	SVOCs		Benzo(a)anthracene	ug/kg	38	0.038	2.0	32	1.0	5.0	2.8	17	6	16%	0.83	2.9	1.7	95% KM (Percentile Bootstrap) UCL
SB	SVOCs		Benzo(a)pyrene	ug/kg	38	0.073	1.5	30	0.72	4.2	5.0	7.4	8	21%	1.0	2.1	1.6	95% KM (t) UCL
SB	SVOCs		Benzo(b)fluoranthene	ug/kg	38	0.066	1.4	32	0.11	3.2	4.1	4.4	6	16%	0.56	1.3	0.95	95% KM (t) UCL
SB	SVOCs		Benzo(g,h,i)perylene	ug/kg	38	0.073	1.9	32	0.42	2.3	2.7	3.3	6	16%	0.48	0.92	0.78	95% KM (Percentile Bootstrap) UCL
SB	SVOCs		Benzo(k)fluoranthene	ug/kg	38	0.056	1.2	29	0.11	4.2	3.8	7.7	9	24%	1.0	2.3	1.7	95% KM (t) UCL
SB	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	38	66	5000	31	89	338	130	1600	7	18%	129	248	210	95% KM (% Bootstrap) UCL
SB	SVOCs		Butyl Benzyl Phthalate	ug/kg	38	7.3	12	36	33	237	237	440	2	5%	19	69	119	97.5% KM (Chebyshev) UCL
SB	SVOCs		Chrysene	ug/kg	38	0.055	1.9	30	0.50	3.5	3.4	10	8	21%	0.83	2.0	1.4	95% KM (t) UCL
SB	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	38	0.16	8.4	28	0.017	6.2	5.3	13	10	26%	1.7	3.8	2.8	95% KM (t) UCL
SB	SVOCs		Dibenz(a,h)anthracene	ug/kg	38	0.059	6.5	32	0.41	2.8	3.4	4.1	6	16%	0.51	1.1	0.85	95% KM (t) UCL
SB	SVOCs		Di-n-butyl Phthalate	ug/kg	38	8.2	71	22	12	61	50	220	16	42%	32	41	43	95% KM (t) UCL
SB	SVOCs		Di-n-octyl Phthalate	ug/kg	38	5.4	11	23	5.9	13	10	23	15	39%	9.2	4.6	11	95% KM (t) UCL
SB	SVOCs		Fluoranthene	ug/kg	38	0.090	0.98	11	0.15	2.1	1.5	6.5	27	71%	1.5	1.8	2.0	95% KM (BCA) UCL
SB	SVOCs		Fluorene	ug/kg	38	0.15	0.15	2	0.30	2.3	2.3	5.2	36	95%	2.2	1.6	3.3	95% KM (Chebyshev) UCL
SB	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	38	0.064	2.0	31	0.70	3.9	5.3	6.1	7	18%	0.81	1.8	1.3	95% KM (t) UCL
SB	SVOCs		p-cresol (4-Methylphenol)	ug/kg	38	7.6	7.7	20	8.8	37	27	130	18	47%	21	24	37	95% GROS Adjusted Gamma UCL
SB	SVOCs		Phenanthrene	ug/kg	38	N/A	N/A	0	0.54	4.1	5.0	8.6	38	100%	4.1	2.7	6.0	95% Chebyshev (Mean, Sd) UCL
SB	SVOCs		Pyrene	ug/kg	38	0.098	1.0	28	0.060	2.5	0.70	7.2	10	26%	0.75	1.7	1.5	95% GROS Adjusted Gamma UCL
SB	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	38	0.73	15	9	0.54	17	14	70	29	76%	14	16	30	97.5% KM (Chebyshev) UCL
SB	SVOCs		Total LPAHs (KM, capped, MDL-based)	ug/kg	38	N/A	N/A	0	1.1	9.5	11	29	38	100%	9.5	7.0	14	95% Chebyshev (Mean, Sd) UCL
SB	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	38	N/A	N/A	0	1.7	21	20	99	38	100%	21	21	36	95% Chebyshev (Mean, Sd) UCL
SC	PCB Aroclors		Aroclor 1254	ug/kg	17	13	130	14	130	767	470	1700	3	18%	242.4	373	436	95% KM (t) UCL
SC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	17	13	130	14	130	767	470	1700	3	18%	242.4	373	436	95% KM (t) UCL
SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0043	0.047	0.015	0.44	18	100%	0.047	0.10	0.15	95% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	18	2.3E-04	0.30	11	3.8E-04	7.9E-04	8.1E-04	0.0015	7	39%	5.7E-04	3.4E-04	0.00075	95% KM (t) UCL
SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.30	19	0.70	269	18	100%	19	63	167	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.021	1.5	0.071	20	18	100%	1.5	4.7	13	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.87	57	3.4	757	18	100%	57	178	473	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.013	0.85	0.039	12	18	100%	0.85	2.8	7.3	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0024	0.032	0.0060	0.41	18	100%	0.032	0.094	0.13	95% Chebyshev (Mean, Sd) UCL

Table 1-6
Statistical Summary for River OU Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.11	9.7	0.42	118	18	100%	9.7	28.1	75	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.035	2.4	0.15	31	18	100%	2.4	7.2	19	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	0.0013	0.16	17	0.0037	0.0037	0.0037	0.0037	1	6%	0.0016	8.2E-04	0.0037	Max Detected
SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0038	0.21	0.018	2.5	18	100%	0.21	0.58	1.6	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	5.1E-04	0.0096	0.0017	0.12	18	100%	0.0096	0.028	0.038	95% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	1.9E-05	6.2E-04	5.9E-05	0.0082	18	100%	6.2E-04	0.0019	0.0051	99% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	2.9E-04	0.0060	7.8E-04	0.078	18	100%	0.0060	0.018	0.025	95% Chebyshev (Mean, Sd) UCL
SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	18	N/A	N/A	0	8.2	375	31	4776	18	100%	375	1124	3010	99% Chebyshev (Mean, Sd) UCL
SC	Metals		Arsenic	mg/kg	17	N/A	N/A	0	0.18	0.31	0.29	0.44	17	100%	N/A	N/A	0.34	95% Student's-t UCL
SC	Metals		Cadmium	mg/kg	17	N/A	N/A	0	0.0072	0.020	0.018	0.045	17	100%	N/A	N/A	0.024	95% Approximate Gamma UCL
SC	Metals		Lead	mg/kg	17	0.021	0.021	1	0.031	0.079	0.064	0.31	16	94%	0.076	0.064	0.10	95% KM (BCA) UCL
SC	Metals		Mercury	mg/kg	17	N/A	N/A	0	0.033	0.15	0.13	0.31	17	100%	N/A	N/A	0.19	95% Student's-t UCL
TC	PCB Aroclors		Aroclor 1254	ug/kg	28	14	74	11	21	247	120	1200	17	61%	158	278	496	97.5% KM (Chebyshev) UCL
TC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	28	14	74	11	21	247	120	1200	17	61%	158	278	496	97.5% KM (Chebyshev) UCL
TC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.027	0.070	0.038	0.29	24	100%	0.070	0.075	0.14	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	24	N/A	N/A	0	6.9E-04	0.0082	0.0021	0.067	24	100%	0.0082	0.016	0.023	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.35	8.1	0.48	57	24	100%	8.1	17	23	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.020	0.50	0.029	3.3	24	100%	0.50	1.0	1.4	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	24	N/A	N/A	0	1.6	36	3.5	237	24	100%	36	66	95	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.028	0.64	0.072	3.9	24	100%	0.64	1.14	1.7	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.0031	0.010	0.0051	0.057	24	100%	0.010	0.014	0.023	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.097	2.5	0.20	16	24	100%	2.5	4.6	6.6	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.093	1.6	0.26	9.1	24	100%	1.6	2.5	3.9	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	24	N/A	N/A	0	0.0015	0.013	0.0022	0.085	24	100%	0.013	0.025	0.035	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	24	N/A	N/A	0	0.0019	0.0068	0.0027	0.036	24	100%	0.0068	0.0096	0.015	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	24	N/A	N/A	0	3.1E-05	3.1E-04	5.0E-05	0.0019	24	100%	3.1E-04	5.4E-04	0.00079	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	24	N/A	N/A	0	3.8E-04	0.0026	6.5E-04	0.015	24	100%	0.0026	0.0042	0.0063	95% Chebyshev (Mean, Sd) UCL
TC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	24	N/A	N/A	0	21	287	33.7	2029	24	100%	287	563	788	95% Chebyshev (Mean, Sd) UCL
TC	Metals		Aluminum	mg/kg	29	N/A	N/A	0	9.4	80	49	262	29	100%	80	75	114	95% Adjusted Gamma UCL
TC	Metals		Antimony	mg/kg	29	0.0010	0.0050	19	0.0020	0.0042	0.0044	0.0070	10	34%	0.0024	0.0017	0.0033	95% KM (Percentile Bootstrap) UCL
TC	Metals		Arsenic	mg/kg	29	N/A	N/A	0	1.6	2.2	2.2	3.1	29	100%	2.2	0.36	2.3	95% Student's-t UCL
TC	Metals		Barium	mg/kg	29	N/A	N/A	0	1.2	2.1	2.1	3.2	29	100%	2.1	0.53	2.2	95% Student's-t UCL
TC	Metals		Beryllium	mg/kg	29	N/A	N/A	0	7.0E-04	0.0029	0.0023	0.0072	29	100%	0.0029	0.0017	0.0035	95% Adjusted Gamma UCL
TC	Metals		Cadmium	mg/kg	29	N/A	N/A	0	0.24	0.36	0.36	0.46	29	100%	0.36	0.057	0.38	95% Student's-t UCL
TC	Metals		Chromium	mg/kg	29	N/A	N/A	0	0.30	0.66	0.60	1.2	29	100%	0.66	0.23	0.74	95% Student's-t UCL
TC	Metals		Cobalt	mg/kg	29	N/A	N/A	0	0.067	0.11	0.12	0.17	29	100%	0.11	0.027	0.12	95% Student's-t UCL
TC	Metals		Copper	mg/kg	29	N/A	N/A	0	6.5	9.2	9.0	14	29	100%	9.2	1.6	9.7	95% Student's-t UCL
TC	Metals		Lead	mg/kg	29	N/A	N/A	0	0.021	0.067	0.058	0.18	29	100%	0.067	0.042	0.083	95% Adjusted Gamma UCL
TC	Metals		Mercury	mg/kg	28	N/A	N/A	0	0.0054	0.011	0.0095	0.034	28	100%	0.011	0.0056	0.012	95% Adjusted Gamma UCL
TC	Metals-Methyl Mercury		Methyl Mercury	mg/kg	24	N/A	N/A	0	0.0024	0.0043	0.0047	0.0065	24	100%	0.0043	0.0011	0.0047	95% Student's-t UCL
TC	Metals		Nickel	mg/kg	29	N/A	N/A	0	0.095	0.25	0.26	0.39	29	100%	0.25	0.083	0.28	95% Student's-t UCL
TC	Metals		Thallium	mg/kg	29	N/A	N/A	0	0.0045	0.0088	0.0072	0.019	29	100%	0.0088	0.004	0.010	or 95% Modified-t UCL
TC	Metals		Vanadium	mg/kg	29	N/A	N/A	0	0.078	0.27	0.21	0.61	29	100%	0.27	0.16	0.34	95% Adjusted Gamma UCL
TC	Metals		Zinc	mg/kg	29	N/A	N/A	0	16	22.2	22	28	29	100%	22	2.8	23	95% Student's-t UCL
TC	Pesticides		4,4'-DDD	ug/kg	4	N/A	N/A	0	1.2	2.0	2.1	2.7	4	100%	2.0	0.62	2.7	Max Detected
TC	Pesticides		4,4'-DDE	ug/kg	4	N/A	N/A	0	8.0	9.0	9.0	10	4	100%	9.0	0.93	10	Max Detected
TC	Pesticides		4,4'-DDT	ug/kg	4	N/A	N/A	0	24	83	100	110	4	100%	83	41	110	Max Detected
TC	Pesticides		BHC (alpha)	ug/kg	4	N/A	N/A	0	0.59	0.69	0.69	0.81	4	100%	0.69	0.11	0.81	Max Detected
TC	Pesticides		BHC (beta)	ug/kg	4	1.3	2.1	3	1.5	1.5	1.5	1.5	1	25%	1.4	0.094	1.5	Max Detected
TC	Pesticides		BHC (delta)	ug/kg	4	0.50	1.2	3	0.61	0.61	0.61	0.61	1	25%	0.56	0.055	0.61	Max Detected
TC	Pesticides		BHC (gamma) Lindane	ug/kg	4	0.21	0.26	3	0.36	0.36	0.36	0.36	1	25%	0.25	0.065	0.36	Max Detected
TC	Pesticides		Chlordane (gamma)	ug/kg	4	N/A	N/A	0	5.9	13	14	18	4	100%	13	5.3	18	Max Detected
TC	Pesticides		Endosulfan I	ug/kg	4	5.3	5.3	1	0.85	1.8	1.7	2.7	3	75%	1.8	0.76	2.7	Max Detected
TC	Pesticides		Endrin Aldehyde	ug/kg	4	N/A	N/A	0	1.0	2.1	2.3	2.9	4	100%	2.1	0.80	2.9	Max Detected
TC	Pesticides		Endrin	ug/kg	4	N/A	N/A	0	1.4	3.1	3.4	4.1	4	100%	3.1	1.2	4.1	Max Detected
TC	Pesticides		Total DDx (MDL-based)	ug/kg	4	N/A	N/A	0	35	94	111	121	4	100%	94	40	121	Max Detected
TC	SVOCs		Acenaphthene	ug/kg	24	0.11	0.11	1	0.23	0.93	0.91	4.1	23	96%	0.89	0.73	1.6	95% KM (Chebyshev) UCL
TC	SVOCs		Anthracene	ug/kg	24	0.065	0.33	4	0.28	1.1	0.99	2.7	20	83%	0.91	0.62	1.5	95% KM (Chebyshev) UCL
TC	SVOCs		Benzo(a)anthracene	ug/kg	24	0.066	22	11	0.48	1.4	0.99	3.5	13	54%	0.98	0.99	1.5	95% GROS Adjusted Gamma UCL
TC	SVOCs		Benzo(a)pyrene	ug/kg	24	0.081	0.86	19	0.38	0.97	0.58	2.7	5	21%	0.29	0.54	0.50	95% KM (t) UCL
TC	SVOCs		Benzo(b)fluoranthene	ug/kg	24	0.07	0.80	13	0.40	1.0	0.71	3.2	11	46%	0.53	0.73	0.80	95% KM (t) UCL
TC	SVOCs		Benzo(g,h,i)perylene	ug/kg	24	0.073	2.5	14	0.090	0.49	0.255	2.5	10	42%	0.27	0.49	0.48	95% KM (BCA) UCL
TC	SVOCs		Benzo(k)fluoranthene	ug/kg	24	0.056	0.58	20	0.16	1.1	0.775	2.5	4	17%	0.23	0.54	0.45	95% KM (t) UCL

Table 1-6
Statistical Summary for River OU Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
TC	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	24	66	390	5	67	393	150	890	19	79%	327	309	437	95% KM (BCA) UCL
TC	SVOCs		Butyl Benzyl Phthalate	ug/kg	24	7.3	12	21	13	14	14	15	3	13%	8.1	2.2	9.1	95% KM (t) UCL
TC	SVOCs		Chrysene	ug/kg	24	0.076	7.8	11	1.9	3.1	2.9	6.1	13	54%	2.2	1.6	2.8	95% KM (t) UCL
TC	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	24	0.23	3.0	9	0.076	0.90	0.24	7.9	15	63%	0.67	1.6	2.8	97.5% KM (Chebyshev) UCL
TC	SVOCs		Dibenz(a,h)anthracene	ug/kg	24	0.059	0.50	22	0.48	2.3	2.3	4.2	2	8%	0.25	0.83	1.7	97.5% KM (Chebyshev) UCL
TC	SVOCs		Di-n-butyl Phthalate	ug/kg	24	8.2	170	22	59	65	65	71	2	8%	13	16	21	95% KM (t) UCL
TC	SVOCs		Di-n-octyl Phthalate	ug/kg	24	5.4	16	23	38	38	38	38	1	4%	6.8	6.5	38	Max Detected
TC	SVOCs		Fluoranthene	ug/kg	24	8.6	16	5	6.3	12	12	18	19	79%	11	2.7	12	95% KM (t) UCL
TC	SVOCs		Fluorene	ug/kg	24	N/A	N/A	0	0.92	2.1	2.2	3.8	24	100%	2.1	0.66	2.3	95% Student's-t UCL
TC	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	24	0.064	0.50	16	0.080	0.87	0.36	2.6	8	33%	0.34	0.69	0.60	95% KM (Percentile Bootstrap) UCL
TC	SVOCs		p-cresol (4-Methylphenol)	ug/kg	24	7.6	11	13	8.6	17	14	31	11	46%	12	7.1	15	95% KM (t) UCL
TC	SVOCs		Phenanthrene	ug/kg	24	N/A	N/A	0	4.5	9.2	9.4	15	24	100%	9.2	2.5	10	95% Student's-t UCL
TC	SVOCs		Pyrene	ug/kg	24	0.098	7.2	12	1.6	3.4	2.8	6.5	12	50%	2.2	1.9	3.3	95% GROS Adjusted Gamma UCL
TC	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	24	12	17	3	5.6	25	19	54	21	88%	23	13	28	95% KM (Percentile Bootstrap) UCL
TC	SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	24	N/A	N/A	0	5.9	13	13	25	24	100%	13	4.0	15	95% Student's-t UCL
TC	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	24	N/A	N/A	0	7.1	30	28	61	24	100%	30	12	34	95% Student's-t UCL

Notes:
See Appendix A for data quality evaluation of non-detects.

% = percent
BaPEQ = benzo(a)pyrene equivalents
CF = Crayfish
cPAH = carcinogenic PAH
EPC = exposure point concentration
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SB = Smallmouth bass
SC = Sculpin
SD = standard deviation
SVOC = semi-volatile organic compound
TC = Clam
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in wet weight

Table 1-7
Statistical Summary for Reference Area Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
CF	Metals		Aluminum	mg/kg	19	N/A	N/A	0	71	134	131	221	19	100%	204	Normal UPL
CF	Metals		Antimony	mg/kg	19	N/A	N/A	0	0.0060	0.015	0.012	0.039	19	100%	0.033	Gamma UPL
CF	Metals		Arsenic	mg/kg	19	N/A	N/A	0	0.28	0.38	0.36	0.64	19	100%	0.54	Gamma UPL
CF	Metals		Barium	mg/kg	19	N/A	N/A	0	40	68	69	120	19	100%	104	Normal UPL
CF	Metals		Beryllium	mg/kg	19	N/A	N/A	0	0.0026	0.0035	0.0033	0.0061	19	100%	0.0049	Gamma UPL
CF	Metals		Cadmium	mg/kg	19	N/A	N/A	0	0.046	0.094	0.084	0.20	19	100%	0.16	Normal UPL
CF	Metals		Chromium	mg/kg	19	0.13	0.13	1	0.12	0.49	0.50	1.2	18	95%	1.2	Non-parametric UPL
CF	Metals		Cobalt	mg/kg	19	N/A	N/A	0	0.22	0.33	0.34	0.44	19	100%	0.43	Normal UPL
CF	Metals		Copper	mg/kg	19	N/A	N/A	0	12	18	18	33	19	100%	27	Lognormal UPL
CF	Metals		Lead	mg/kg	19	N/A	N/A	0	0.056	0.41	0.32	1.6	19	100%	1.1	Gamma UPL
CF	Metals		Mercury	mg/kg	19	N/A	N/A	0	0.011	0.018	0.018	0.025	19	100%	0.023	Normal UPL
CF	Metals-Methyl Mercury		Methyl Mercury	mg/kg	19	N/A	N/A	0	0.018	0.027	0.026	0.037	19	100%	0.037	Normal UPL
CF	Metals		Nickel	mg/kg	19	N/A	N/A	0	0.99	1.8	1.8	3.4	19	100%	2.9	Normal UPL
CF	Metals		Thallium	mg/kg	19	N/A	N/A	0	0.014	0.022	0.021	0.037	19	100%	0.032	Gamma UPL
CF	Metals		Vanadium	mg/kg	19	N/A	N/A	0	0.26	0.57	0.59	0.80	19	100%	0.86	Normal UPL
CF	Metals		Zinc	mg/kg	19	N/A	N/A	0	18	22	21	37	19	100%	37	Non-parametric UPL
CF	PCB Aroclors		Aroclor 1016	ug/kg	19	2.4	4.8	19	N/A	N/A	N/A	N/A	0	0%	4.8	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1221	ug/kg	19	2.6	5.2	19	N/A	N/A	N/A	N/A	0	0%	5.2	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1232	ug/kg	19	2.3	4.6	19	N/A	N/A	N/A	N/A	0	0%	4.6	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1242	ug/kg	19	2.2	4.4	19	N/A	N/A	N/A	N/A	0	0%	4.4	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1248	ug/kg	19	0.51	1.1	19	N/A	N/A	N/A	N/A	0	0%	1.1	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1254	ug/kg	19	1.8	3.6	19	N/A	N/A	N/A	N/A	0	0%	3.6	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1260	ug/kg	19	1.9	3.8	19	N/A	N/A	N/A	N/A	0	0%	3.8	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1262	ug/kg	19	2.5	5.0	19	N/A	N/A	N/A	N/A	0	0%	5.0	NonParametric (Max ND)
CF	PCB Aroclors		Aroclor 1268	ug/kg	19	2.0	4.0	19	N/A	N/A	N/A	N/A	0	0%	4.0	NonParametric (Max ND)
CF	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	19	2.6	5.2	19	N/A	N/A	N/A	N/A	0	0%	5.2	NonParametric (Max ND)
CF	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.0013	0.0028	0.0026	0.0047	17	100%	0.0043	Normal UPL
CF	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	17	1.0E-04	4.0E-04	11	1.5E-04	1.8E-04	1.7E-04	2.5E-04	6	35%	0.00025	Non-parametric UPL
CF	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.0020	0.0084	0.0076	0.025	17	100%	0.019	Normal UPL
CF	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.0024	0.0037	0.0035	0.0082	17	100%	0.0061	Normal UPL
CF	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.053	0.13	0.11	0.32	17	100%	0.26	Normal UPL
CF	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.0019	0.0034	0.0030	0.0074	17	100%	0.0061	WH Gamma UPL
CF	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	17	2.1E-04	0.0020	9	2.4E-04	4.0E-04	4.3E-04	5.3E-04	8	47%	0.00053	Non-parametric UPL
CF	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.012	0.019	0.017	0.039	17	100%	0.032	Normal UPL
CF	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	17	N/A	N/A	0	0.0082	0.014	0.011	0.030	17	100%	0.025	WH Gamma UPL
CF	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	17	9.1E-05	3.3E-04	17	N/A	N/A	N/A	N/A	0	0%	3.3E-04	NonParametric (Max ND)
CF	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	17	N/A	N/A	0	7.7E-04	0.0012	0.0012	0.0022	17	100%	0.0018	WH Gamma UPL
CF	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	17	N/A	N/A	0	6.8E-05	1.7E-04	1.7E-04	2.7E-04	17	100%	0.00028	Normal UPL
CF	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	17	N/A	N/A	0	6.3E-07	2.2E-06	2.3E-06	4.0E-06	17	100%	4.3E-06	Normal UPL
CF	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	17	N/A	N/A	0	3.3E-06	2.5E-05	1.5E-05	5.9E-05	17	100%	6.4E-05	Normal UPL
CF	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	17	N/A	N/A	0	0.37	0.80	0.72	1.9	17	100%	1.4	Normal UPL
CF	SVOCs		Acenaphthene	ug/kg	18	0.11	0.11	15	0.12	0.15	0.13	0.19	3	17%	0.19	Non-parametric UPL
CF	SVOCs		Anthracene	ug/kg	18	0.065	0.065	16	0.098	0.14	0.14	0.19	2	11%	0.19	Non-parametric UPL
CF	SVOCs		Benzo(a)anthracene	ug/kg	18	0.066	0.066	16	0.31	0.36	0.36	0.40	2	11%	0.40	Non-parametric UPL
CF	SVOCs		Benzo(a)pyrene	ug/kg	18	0.081	0.081	17	0.12	0.12	0.12	0.12	1	6%	0.12	Non-parametric UPL
CF	SVOCs		Benzo(b)fluoranthene	ug/kg	18	0.070	0.070	14	0.082	0.15	0.14	0.23	4	22%	0.23	Non-parametric UPL
CF	SVOCs		Benzo(g,h,i)perylene	ug/kg	18	0.073	0.50	18	N/A	N/A	N/A	N/A	0	0%	0.50	NonParametric (Max ND)
CF	SVOCs		Benzo(k)fluoranthene	ug/kg	18	0.056	0.056	14	0.072	0.14	0.14	0.20	4	22%	0.20	Non-parametric UPL
CF	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	18	66	66	14	69	76	73	87	4	22%	87	Non-parametric UPL
CF	SVOCs		Butyl Benzyl Phthalate	ug/kg	18	7.3	7.3	15	15	21	18	31	3	17%	31.0	Non-parametric UPL
CF	SVOCs		Carbazole	ug/kg	18	9.1	9.1	18	N/A	N/A	N/A	N/A	0	0%	9.1	NonParametric (Max ND)
CF	SVOCs		Chrysene	ug/kg	18	0.076	0.076	13	0.091	0.17	0.12	0.27	5	28%	0.27	Non-parametric UPL
CF	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	18	0.16	0.16	13	0.014	0.17	0.16	0.37	5	28%	0.37	Non-parametric UPL
CF	SVOCs		Dibenz(a,h)anthracene	ug/kg	18	0.059	0.059	15	0.072	0.12	0.12	0.16	3	17%	0.16	Non-parametric UPL
CF	SVOCs		Di-n-butyl Phthalate	ug/kg	18	16	110	18	N/A	N/A	N/A	N/A	0	0%	110	NonParametric (Max ND)
CF	SVOCs		Di-n-octyl Phthalate	ug/kg	18	11	11	17	32	32	32	32	1	6%	32	Non-parametric UPL
CF	SVOCs		Fluoranthene	ug/kg	18	0.45	0.50	18	N/A	N/A	N/A	N/A	0	0%	0.50	NonParametric (Max ND)

Table 1-7
Statistical Summary for Reference Area Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
CF	SVOCs		Fluorene	ug/kg	18	0.15	0.15	16	0.18	0.22	0.22	0.25	2	11%	0.25	Non-parametric UPL
CF	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	18	0.064	0.064	15	0.087	0.13	0.13	0.18	3	17%	0.18	Non-parametric UPL
CF	SVOCs		p-cresol (4-Methylphenol)	ug/kg	18	7.7	7.7	18	N/A	N/A	N/A	N/A	0	0%	7.7	NonParametric (Max ND)
CF	SVOCs		Phenanthrene	ug/kg	18	0.36	0.36	13	0.45	0.52	0.51	0.59	5	28%	0.59	Non-parametric UPL
CF	SVOCs		Pyrene	ug/kg	18	0.45	0.50	18	N/A	N/A	N/A	N/A	0	0%	0.50	NonParametric (Max ND)
CF	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	18	1.5	1.5	13	0.71	1.4	1.6	2.2	5	28%	2.2	Non-parametric UPL
CF	SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	18	0.69	0.69	13	0.79	0.92	0.92	1.1	5	28%	1.1	Non-parametric UPL
CF	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	18	2.2	2.2	9	0.96	1.9	2.1	3.4	9	50%	3.4	Non-parametric UPL
SB	Butyltins		Dibutyltin Cation	ug/kg	16	0.11	0.11	15	3.0	3.0	3.0	3.0	1	6%	3.0	Non-parametric UPL
SB	Butyltins		Monobutyltin	ug/kg	16	0.18	0.70	16	N/A	N/A	N/A	N/A	0	0%	0.70	NonParametric (Max ND)
SB	Butyltins		Tetrabutyltin	ug/kg	16	0.15	0.15	16	N/A	N/A	N/A	N/A	0	0%	0.15	NonParametric (Max ND)
SB	Butyltins		Tri-n-butyltin	ug/kg	16	0.11	4.1	16	N/A	N/A	N/A	N/A	0	0%	4.1	NonParametric (Max ND)
SB	Metals		Aluminum	mg/kg	38	N/A	N/A	0	0.33	3.3	2.4	11	38	100%	9.0	WH Gamma UPL
SB	Metals		Antimony	mg/kg	38	0.0020	0.0060	15	0.0018	0.0050	0.0033	0.025	23	61%	0.0094	Non-parametric UPL
SB	Metals		Arsenic	mg/kg	38	N/A	N/A	0	0.16	0.40	0.39	0.76	38	100%	0.65	Normal UPL
SB	Metals		Barium	mg/kg	38	N/A	N/A	0	0.43	1.5	1.4	4.5	38	100%	3.1	WH Gamma UPL
SB	Metals		Beryllium	mg/kg	38	5.0E-04	0.0020	38	N/A	N/A	N/A	N/A	0	0%	0.0020	NonParametric (Max ND)
SB	Metals		Cadmium	mg/kg	38	N/A	N/A	0	0.0039	0.045	0.0098	0.14	38	100%	0.14	NonParametric UPL
SB	Metals		Chromium	mg/kg	38	0.020	0.10	13	0.030	0.38	0.080	7.2	25	66%	0.40	Non-parametric UPL
SB	Metals		Cobalt	mg/kg	38	0.025	0.036	7	0.0070	0.031	0.016	0.084	31	82%	0.075	Non-parametric UPL
SB	Metals		Copper	mg/kg	38	N/A	N/A	0	0.25	0.55	0.49	1.4	38	100%	0.92	WH Gamma UPL
SB	Metals		Lead	mg/kg	38	0.013	0.015	7	0.0045	0.63	0.019	1.8	31	82%	1.7	Non-parametric UPL
SB	Metals		Mercury	mg/kg	38	N/A	N/A	0	0.045	0.15	0.11	0.64	38	100%	0.36	WH Gamma UPL
SB	Metals		Nickel	mg/kg	38	0.28	0.31	3	0.026	0.54	0.12	1.8	35	92%	1.5	Non-parametric UPL
SB	Metals		Thallium	mg/kg	38	N/A	N/A	0	0.0075	0.016	0.015	0.029	38	100%	0.024	Normal UPL
SB	Metals		Vanadium	mg/kg	38	0.0060	0.0060	1	0.015	0.051	0.050	0.10	37	97%	0.090	Normal UPL
SB	Metals		Zinc	mg/kg	38	N/A	N/A	0	11	14	14	16	38	100%	16	Normal UPL
SB	PCB Aroclors		Aroclor 1016	ug/kg	38	2.4	9.9	38	N/A	N/A	N/A	N/A	0	0%	9.9	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1221	ug/kg	38	2.6	20	38	N/A	N/A	N/A	N/A	0	0%	20	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1232	ug/kg	38	2.3	11	38	N/A	N/A	N/A	N/A	0	0%	11	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1242	ug/kg	38	2.2	10	34	2.4	7.9	7.6	14	4	11%	6.8	Normal UPL
SB	PCB Aroclors		Aroclor 1248	ug/kg	38	0.51	33	38	N/A	N/A	N/A	N/A	0	0%	33	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1254	ug/kg	38	9.6	130	20	27	61	47	220	18	47%	96	Log UPL
SB	PCB Aroclors		Aroclor 1260	ug/kg	38	1.9	140	38	N/A	N/A	N/A	N/A	0	0%	140	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1262	ug/kg	38	2.5	110	38	N/A	N/A	N/A	N/A	0	0%	110	NonParametric (Max ND)
SB	PCB Aroclors		Aroclor 1268	ug/kg	38	2.0	10	38	N/A	N/A	N/A	N/A	0	0%	10	NonParametric (Max ND)
SB	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	38	12	132	20	29	66	52	220	18	47%	102	WH Gamma-KM UPL
SB	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.013	0.048	0.036	0.20	38	100%	0.11	WH Gamma UPL
SB	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	38	0.0025	0.021	7	7.5E-04	0.0027	0.0019	0.016	31	82%	0.011	WH Gamma UPL
SB	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.45	2.2	1.2	23	38	100%	13	NonParametric UPL
SB	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.029	0.19	0.084	2.9	38	100%	0.73	NonParametric UPL
SB	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	1.2	7.2	3.6	99	38	100%	31	NonParametric UPL
SB	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.023	0.12	0.058	1.8	38	100%	0.51	NonParametric UPL
SB	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	0.011	0.030	5	0.0030	0.012	0.0095	0.075	33	87%	0.025	Log UPL
SB	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.19	1.2	0.48	20	38	100%	4.3	NonParametric UPL
SB	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.077	0.41	0.19	6.5	38	100%	1.2	NonParametric UPL
SB	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	38	8.2E-04	0.011	38	N/A	N/A	N/A	N/A	0	0%	0.011	NonParametric (Max ND)
SB	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	38	N/A	N/A	0	0.010	0.046	0.023	0.53	38	100%	0.12	NonParametric UPL
SB	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	0.0011	0.0041	0.0031	0.023	38	100%	0.0095	HW Gamma UPL
SB	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	2.7E-05	1.2E-04	8.1E-05	0.0012	38	100%	0.00036	NonParametric UPL
SB	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	38	N/A	N/A	0	1.8E-04	0.0014	0.0011	0.012	38	100%	0.0039	Log UPL
SB	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	38	N/A	N/A	0	18	73	45	499	38	100%	408	NonParametric UPL
SB	Pesticides		4,4'-DDD	ug/kg	19	N/A	N/A	0	1.9	5.7	4.8	9.6	19	100%	9.7	Normal UPL
SB	Pesticides		4,4'-DDE	ug/kg	19	N/A	N/A	0	29	66	62	100	19	100%	103	Normal UPL
SB	Pesticides		4,4'-DDT	ug/kg	19	4.1	9.8	4	3.0	5.4	4.4	17	15	79%	17.0	Non-parametric UPL
SB	Pesticides		Aldrin	ug/kg	19	0.74	0.74	19	N/A	N/A	N/A	N/A	0	0%	0.74	NonParametric (Max ND)
SB	Pesticides		BHC (alpha)	ug/kg	19	0.16	0.97	19	N/A	N/A	N/A	N/A	0	0%	0.97	NonParametric (Max ND)

Table 1-7
Statistical Summary for Reference Area Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
SB	Pesticides		BHC (beta)	ug/kg	19	0.54	4.1	5	0.52	2.7	3.0	4.7	14	74%	4.7	Non-parametric UPL
SB	Pesticides		BHC (delta)	ug/kg	19	0.20	1.4	17	0.96	1.3	1.3	1.6	2	11%	1.6	Non-parametric UPL
SB	Pesticides		BHC (gamma) Lindane	ug/kg	19	0.21	2.9	14	0.54	0.85	0.94	1.0	5	26%	1.0	Non-parametric UPL
SB	Pesticides		Chlordane (alpha)	ug/kg	19	0.25	0.97	15	0.28	0.32	0.33	0.36	4	21%	0.36	Non-parametric UPL
SB	Pesticides		Chlordane (gamma)	ug/kg	19	0.26	1.2	6	0.29	0.84	0.44	4.2	13	68%	4.2	Non-parametric UPL
SB	Pesticides		Dieldrin	ug/kg	19	0.75	3.1	17	0.27	0.55	0.55	0.83	2	11%	0.83	Non-parametric UPL
SB	Pesticides		Endosulfan I	ug/kg	19	0.22	3.5	17	0.71	1.4	1.4	2.0	2	11%	2.0	Non-parametric UPL
SB	Pesticides		Endosulfan II	ug/kg	19	0.24	0.65	19	N/A	N/A	N/A	N/A	0	0%	0.65	NonParametric (Max ND)
SB	Pesticides		Endosulfan Sulfate	ug/kg	19	0.53	0.53	17	0.56	0.58	0.58	0.59	2	11%	0.59	Non-parametric UPL
SB	Pesticides		Endrin	ug/kg	19	0.28	0.90	15	0.32	0.48	0.36	0.86	4	21%	0.86	Non-parametric UPL
SB	Pesticides		Endrin Aldehyde	ug/kg	19	0.62	0.62	18	1.1	1.1	1.1	1.1	1	5%	1.1	Non-parametric UPL
SB	Pesticides		Endrin Ketone	ug/kg	19	0.39	0.39	19	N/A	N/A	N/A	N/A	0	0%	0.39	NonParametric (Max ND)
SB	Pesticides		Heptachlor	ug/kg	19	0.27	1.0	19	N/A	N/A	N/A	N/A	0	0%	1.0	NonParametric (Max ND)
SB	Pesticides		Heptachlor Epoxide	ug/kg	19	0.18	1.3	17	0.26	0.28	0.28	0.30	2	11%	0.30	Non-parametric UPL
SB	Pesticides		Methoxychlor	ug/kg	19	0.48	1.1	18	0.75	0.75	0.75	0.75	1	5%	0.75	Non-parametric UPL
SB	Pesticides		Total DDx (MDL-based)	ug/kg	19	N/A	N/A	0	36	78	74	115	19	100%	122	Normal UPL
SB	Pesticides		Toxaphene	ug/kg	19	20	190	19	N/A	N/A	N/A	N/A	0	0%	190	NonParametric (Max ND)
SB	SVOCs		Acenaphthene	ug/kg	38	0.11	0.94	18	0.095	0.75	0.81	1.3	20	53%	1.2	Normal UPL
SB	SVOCs		Anthracene	ug/kg	38	0.065	0.80	20	0.047	2.3	2.5	5.3	18	47%	3.8	Normal UPL
SB	SVOCs		Benzo(a)anthracene	ug/kg	38	0.038	1.5	34	0.56	0.93	0.78	1.6	4	11%	0.71	Normal UPL
SB	SVOCs		Benzo(a)pyrene	ug/kg	38	0.073	1.5	38	N/A	N/A	N/A	N/A	0	0%	1.5	NonParametric (Max ND)
SB	SVOCs		Benzo(b)fluoranthene	ug/kg	38	0.066	1.4	38	N/A	N/A	N/A	N/A	0	0%	1.4	NonParametric (Max ND)
SB	SVOCs		Benzo(g,h,i)perylene	ug/kg	38	0.073	1.9	38	N/A	N/A	N/A	N/A	0	0%	1.9	NonParametric (Max ND)
SB	SVOCs		Benzo(k)fluoranthene	ug/kg	38	0.056	1.2	38	N/A	N/A	N/A	N/A	0	0%	1.2	NonParametric (Max ND)
SB	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	38	66	2500	36	81	116	116	150	2	5%	81	Non-parametric UPL
SB	SVOCs		Butyl Benzyl Phthalate	ug/kg	38	7.3	12	38	N/A	N/A	N/A	N/A	0	0%	12	NonParametric (Max ND)
SB	SVOCs		Carbazole	ug/kg	38	6.2	9.1	38	N/A	N/A	N/A	N/A	0	0%	9.1	NonParametric (Max ND)
SB	SVOCs		Chrysene	ug/kg	38	0.055	1.1	37	0.55	0.55	0.55	0.55	1	3%	0.55	Non-parametric UPL
SB	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	38	0.16	23	34	0.098	1.1	0.21	3.8	4	11%	1.2	Normal UPL
SB	SVOCs		Dibenz(a,h)anthracene	ug/kg	38	0.059	20	38	N/A	N/A	N/A	N/A	0	0%	20	NonParametric (Max ND)
SB	SVOCs		Di-n-butyl Phthalate	ug/kg	38	8.2	280	27	22	45	52	65	11	29%	65	Normal UPL
SB	SVOCs		Di-n-octyl Phthalate	ug/kg	38	5.4	11	35	6.0	9.1	6.4	15	3	8%	8.4	Normal UPL
SB	SVOCs		Fluoranthene	ug/kg	38	0.090	1.2	9	0.16	1.5	1.6	2.5	29	76%	2.5	Normal UPL
SB	SVOCs		Fluorene	ug/kg	38	0.15	2.0	3	0.27	3.2	2.1	6.9	35	92%	6.3	Non-parametric UPL
SB	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	38	0.064	8.1	38	N/A	N/A	N/A	N/A	0	0%	8.1	NonParametric (Max ND)
SB	SVOCs		p-cresol (4-Methylphenol)	ug/kg	38	7.6	11	35	18	22	21	26	3	8%	15	Normal UPL
SB	SVOCs		Phenanthrene	ug/kg	38	N/A	N/A	0	0.78	5.0	4.7	9.6	38	100%	8.6	NonParametric UPL
SB	SVOCs		Pyrene	ug/kg	38	0.098	1.0	34	0.072	0.27	0.29	0.42	4	11%	0.29	Normal UPL
SB	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	38	0.73	14	7	0.56	9.5	12	39	31	82%	15	Non-parametric UPL
SB	SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	38	N/A	N/A	0	1.2	10	7.7	19	38	100%	19	NonParametric UPL
SB	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	38	N/A	N/A	0	1.8	15	12	28	38	100%	28	NonParametric UPL
SC	Metals		Arsenic	mg/kg	18	N/A	N/A	0	0.24	0.38	0.38	0.48	18	100%	0.51	Normal UPL
SC	Metals		Cadmium	mg/kg	18	N/A	N/A	0	0.0087	0.015	0.014	0.026	18	100%	0.024	Normal UPL
SC	Metals		Lead	mg/kg	18	0.021	0.021	1	0.024	0.037	0.032	0.076	17	94%	0.076	Normal UPL
SC	Metals		Mercury	mg/kg	18	N/A	N/A	0	0.045	0.088	0.089	0.14	18	100%	0.13	Normal UPL
SC	PCB Aroclors		Aroclor 1016	ug/kg	18	2.4	2.4	18	N/A	N/A	N/A	N/A	0	0%	2.4	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1221	ug/kg	18	2.6	2.6	18	N/A	N/A	N/A	N/A	0	0%	2.6	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1232	ug/kg	18	2.3	2.3	18	N/A	N/A	N/A	N/A	0	0%	2.3	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1242	ug/kg	18	2.2	2.2	18	N/A	N/A	N/A	N/A	0	0%	2.2	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1248	ug/kg	18	0.51	45	18	N/A	N/A	N/A	N/A	0	0%	45	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1254	ug/kg	18	1.8	44	18	N/A	N/A	N/A	N/A	0	0%	44	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1260	ug/kg	18	1.9	1.9	18	N/A	N/A	N/A	N/A	0	0%	1.9	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1262	ug/kg	18	2.5	2.5	18	N/A	N/A	N/A	N/A	0	0%	2.5	NonParametric (Max ND)
SC	PCB Aroclors		Aroclor 1268	ug/kg	18	2.0	2.0	18	N/A	N/A	N/A	N/A	0	0%	2.0	NonParametric (Max ND)
SC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	18	13	45	18	N/A	N/A	N/A	N/A	0	0%	45	NonParametric (Max ND)
SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0052	0.015	0.014	0.026	18	100%	0.024	Normal UPL
SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	18	7.1E-04	7.1E-04	1	6.9E-04	0.0013	0.0014	0.0022	17	94%	0.0022	Non-parametric UPL

Table 1-7
Statistical Summary for Reference Area Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.36	0.69	0.69	1.0	18	100%	1.0	Normal UPL
SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.025	0.048	0.046	0.082	18	100%	0.078	Normal UPL
SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	1.1	2.3	2.1	3.9	18	100%	3.7	Normal UPL
SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.015	0.031	0.031	0.047	18	100%	0.048	Normal UPL
SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0025	0.0042	0.0039	0.0059	18	100%	0.0061	Normal UPL
SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.14	0.28	0.25	0.46	18	100%	0.47	Normal UPL
SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.052	0.11	0.098	0.18	18	100%	0.18	Normal UPL
SC	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	0.0021	0.0093	18	N/A	N/A	N/A	N/A	0	0%	0.0093	NonParametric (Max ND)
SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	18	3.2E-04	3.2E-04	1	0.0052	0.0093	0.0086	0.017	17	94%	0.017	Non-parametric UPL
SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	6.0E-04	0.0014	0.0013	0.0022	18	100%	0.0021	Normal UPL
SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	2.3E-05	4.0E-05	3.8E-05	5.9E-05	18	100%	6.1E-05	Normal UPL
SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	3.2E-04	5.4E-04	4.9E-04	7.7E-04	18	100%	0.00079	Normal UPL
SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	18	N/A	N/A	0	12	24	23	38	18	100%	38	Normal UPL
TC	Metals		Aluminum	mg/kg	18	N/A	N/A	0	8.0	30	24	83	18	100%	69	Gamma UPL
TC	Metals		Antimony	mg/kg	18	0.0040	0.0050	15	0.0040	0.0057	0.0050	0.0080	3	17%	0.0080	Non-parametric UPL
TC	Metals		Arsenic	mg/kg	18	N/A	N/A	0	2.0	2.3	2.3	2.6	18	100%	2.6	Normal UPL
TC	Metals		Barium	mg/kg	18	N/A	N/A	0	1.7	1.9	1.8	2.4	18	100%	2.4	Non-parametric UPL
TC	Metals		Beryllium	mg/kg	18	4.0E-04	4.0E-04	9	4.0E-04	8.4E-04	9.0E-04	0.0014	9	50%	0.0014	Non-parametric UPL
TC	Metals		Cadmium	mg/kg	18	N/A	N/A	0	0.25	0.33	0.34	0.41	18	100%	0.41	Normal UPL
TC	Metals		Chromium	mg/kg	18	N/A	N/A	0	0.45	0.55	0.50	0.76	18	100%	0.76	Non-parametric UPL
TC	Metals		Cobalt	mg/kg	18	N/A	N/A	0	0.090	0.12	0.12	0.15	18	100%	0.15	Normal UPL
TC	Metals		Copper	mg/kg	18	N/A	N/A	0	8.2	9.7	9.7	12	18	100%	11	Normal UPL
TC	Metals		Lead	mg/kg	18	N/A	N/A	0	0.049	0.062	0.063	0.072	18	100%	0.073	Normal UPL
TC	Metals		Mercury	mg/kg	18	N/A	N/A	0	0.0046	0.0089	0.0074	0.018	18	100%	0.016	Gamma UPL
TC	Metals-Methyl Mercury		Methyl Mercury	mg/kg	18	N/A	N/A	0	0.0014	0.0053	0.0054	0.0099	18	100%	0.0090	Normal UPL
TC	Metals		Nickel	mg/kg	18	N/A	N/A	0	0.27	0.35	0.35	0.48	18	100%	0.45	Normal UPL
TC	Metals		Thallium	mg/kg	18	N/A	N/A	0	0.0053	0.0068	0.0065	0.011	18	100%	0.0091	Lognormal UPL
TC	Metals		Vanadium	mg/kg	18	N/A	N/A	0	0.074	0.15	0.14	0.29	18	100%	0.23	Normal UPL
TC	Metals		Zinc	mg/kg	18	N/A	N/A	0	19	21	21	23	18	100%	24	Normal UPL
TC	PCB Aroclors		Aroclor 1016	ug/kg	18	8.4	15	18	N/A	N/A	N/A	N/A	0	0%	15	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1221	ug/kg	18	6.3	16	18	N/A	N/A	N/A	N/A	0	0%	16	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1232	ug/kg	18	18	35	18	N/A	N/A	N/A	N/A	0	0%	35	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1242	ug/kg	18	7.9	14	18	N/A	N/A	N/A	N/A	0	0%	14	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1248	ug/kg	18	5.5	9.9	18	N/A	N/A	N/A	N/A	0	0%	9.9	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1254	ug/kg	18	N/A	N/A	0	30	35	35	39	18	100%	40	Non-parametric UPL
TC	PCB Aroclors		Aroclor 1260	ug/kg	18	5.7	8.1	18	N/A	N/A	N/A	N/A	0	0%	8.1	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1262	ug/kg	18	3.7	9.9	18	N/A	N/A	N/A	N/A	0	0%	9.9	NonParametric (Max ND)
TC	PCB Aroclors		Aroclor 1268	ug/kg	18	2.0	2.0	18	N/A	N/A	N/A	N/A	0	0%	2.0	NonParametric (Max ND)
TC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	18	N/A	N/A	0	30	35	35	39	18	100%	39	Non-parametric UPL
TC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.033	0.039	0.038	0.047	18	100%	0.047	Normal UPL
TC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	18	N/A	N/A	0	9.6E-04	0.0020	0.0020	0.0028	18	100%	0.0028	Normal UPL
TC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.35	0.45	0.44	0.56	18	100%	0.54	Normal UPL
TC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.021	0.026	0.025	0.033	18	100%	0.032	Normal UPL
TC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	1.9	2.4	2.4	2.8	18	100%	2.8	Normal UPL
TC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.037	0.044	0.043	0.054	18	100%	0.054	Normal UPL
TC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	18	0.0059	0.0059	1	0.0040	0.0048	0.0047	0.0056	17	94%	0.0056	Non-parametric UPL
TC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.12	0.14	0.14	0.17	18	100%	0.17	Normal UPL
TC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.12	0.14	0.14	0.17	18	100%	0.17	Normal UPL
TC	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	18	7.0E-04	0.0017	18	N/A	N/A	N/A	N/A	0	0%	0.0017	NonParametric (Max ND)
TC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	18	N/A	N/A	0	0.0014	0.0020	0.0020	0.0024	18	100%	0.0025	Normal UPL
TC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	0.0023	0.0027	0.0026	0.0033	18	100%	0.0032	Normal UPL
TC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	2.5E-05	4.4E-05	4.3E-05	5.3E-05	18	100%	5.5E-05	Normal UPL
TC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	18	N/A	N/A	0	1.2E-04	5.6E-04	5.6E-04	6.8E-04	18	100%	0.00068	NonParametric UPL
TC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	18	N/A	N/A	0	27	31	31	34	18	100%	35	Normal UPL
TC	SVOCs		Acenaphthene	ug/kg	18	N/A	N/A	0	0.27	0.65	0.63	1.2	18	100%	1.1	Normal UPL
TC	SVOCs		Anthracene	ug/kg	18	1.3	3.2	16	0.85	1.3	1.33	1.8	2	11%	1.8	Non-parametric UPL
TC	SVOCs		Benzo(a)anthracene	ug/kg	18	3.7	27	18	N/A	N/A	N/A	N/A	0	0%	27	NonParametric (Max ND)

Table 1-7
Statistical Summary for Reference Area Tissue Samples
Bradford Island - River Operable Unit

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	Selected UPL	Selected UPL Type
TC	SVOCs		Benzo(a)pyrene	ug/kg	18	0.41	0.41	18	N/A	N/A	N/A	N/A	0	0%	0.41	NonParametric (Max ND)
TC	SVOCs		Benzo(b)fluoranthene	ug/kg	18	0.35	0.35	18	N/A	N/A	N/A	N/A	0	0%	0.35	NonParametric (Max ND)
TC	SVOCs		Benzo(g,h,i)perylene	ug/kg	18	0.37	0.37	13	0.50	0.95	0.85	1.4	5	28%	1.4	Non-parametric UPL
TC	SVOCs		Benzo(k)fluoranthene	ug/kg	18	0.28	0.28	18	N/A	N/A	N/A	N/A	0	0%	0.28	NonParametric (Max ND)
TC	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	18	N/A	N/A	0	310	444	415	680	18	100%	660	Gamma UPL
TC	SVOCs		Butyl Benzyl Phthalate	ug/kg	18	7.3	7.3	15	57	63	57	74	3	17%	74	Non-parametric UPL
TC	SVOCs		Carbazole	ug/kg	18	9.1	9.1	18	N/A	N/A	N/A	N/A	0	0%	9.1	NonParametric (Max ND)
TC	SVOCs		Chrysene	ug/kg	18	1.3	13	18	N/A	N/A	N/A	N/A	0	0%	13	NonParametric (Max ND)
TC	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	18	1.5	3.4	10	0.25	1.5	0.83	3.5	8	44%	3.5	Non-parametric UPL
TC	SVOCs		Dibenz(a,h)anthracene	ug/kg	18	0.30	0.30	18	N/A	N/A	N/A	N/A	0	0%	0.30	NonParametric (Max ND)
TC	SVOCs		Di-n-butyl Phthalate	ug/kg	18	16	48	18	N/A	N/A	N/A	N/A	0	0%	48	NonParametric (Max ND)
TC	SVOCs		Di-n-octyl Phthalate	ug/kg	18	11	11	18	N/A	N/A	N/A	N/A	0	0%	11	NonParametric (Max ND)
TC	SVOCs		Fluoranthene	ug/kg	18	N/A	N/A	0	8.5	12	12	17	18	100%	16	Normal UPL
TC	SVOCs		Fluorene	ug/kg	18	N/A	N/A	0	1.5	2.1	2.0	3.1	18	100%	2.9	Normal UPL
TC	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	18	0.32	0.32	11	0.80	1.4	1.5	2.0	7	39%	2.0	Non-parametric UPL
TC	SVOCs		p-cresol (4-Methylphenol)	ug/kg	18	N/A	N/A	0	13	47	45	110	18	100%	87	Normal UPL
TC	SVOCs		Phenanthrene	ug/kg	18	N/A	N/A	0	6.7	9.6	9.1	14	18	100%	13	Normal UPL
TC	SVOCs		Pyrene	ug/kg	18	2.0	5.6	18	N/A	N/A	N/A	N/A	0	0%	5.6	NonParametric (Max ND)
TC	SVOCs		Total HPAHs (KM-capped, MDL-based)	ug/kg	18	N/A	N/A	0	13	30	29	48	18	100%	56	WH Gamma UPL
TC	SVOCs		Total LPAHs (KM-capped, MDL-based)	ug/kg	18	N/A	N/A	0	11	14	13	20	18	100%	20	NonParametric UPL
TC	SVOCs		Total PAHs (KM-capped, MDL-based)	ug/kg	18	N/A	N/A	0	22	30	29	41	18	100%	39	Normal UPL

Notes:

Data sets with ≤ 19 samples (USEPA 2009):

For analytes with less than 100% detection rate, but at least one detection, the maximum detected value was assessed as the non-parametric UPL.
For analytes with no detections (0% detection rate), the maximum MDL is shown as the non-parametric UPL.

Data sets with 38 samples (USEPA 2009):

For analytes with 100% detection rate and non-parametric distribution, the second highest detected value was assessed as the non-parametric UPL.
For analytes with less than 100% detection rate, but at least two detections, the second highest detected value was assessed as the non-parametric UPL.
For analytes with a single detection, the lower of the maximum MDL and the detected value was assessed as the non-parametric UPL.
For analytes with no detections (0% detection rate), the maximum MDL is shown as the non-parametric UPL.

% = percent
BaPEQ = benzo(a)pyrene equivalents
CF = Crayfish
cPAH = carcinogenic PAH
EPC = exposure point concentration
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SB = Smallmouth bass
SC = Sculpin
SD = standard deviation
SVOC = semi-volatile organic compound
TC = Clam
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in wet weight

Source:

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. Office of Resource Conservation and Recovery, EPA 530-R-09-007.

Table 1-8
Statistical Summary for Ecological River OU-0.1 Mile EUs for Sculpin Tissue Samples
Bradford Island - River Operable Unit

Exposure Unit	Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
EU-02	SC	Metals		Arsenic	mg/kg	2	N/A	N/A	0	0.29	0.31	0.31	0.33	2	100%	0.31	0.032	0.33	Max Detected
EU-02	SC	Metals		Cadmium	mg/kg	2	N/A	N/A	0	0.015	0.017	0.017	0.018	2	100%	0.017	0.0025	0.018	Max Detected
EU-02	SC	Metals		Lead	mg/kg	2	N/A	N/A	0	0.074	0.075	0.075	0.075	2	100%	0.075	7.1E-04	0.075	Max Detected
EU-02	SC	Metals		Mercury	mg/kg	2	N/A	N/A	0	0.12	0.18	0.18	0.24	2	100%	0.18	0.089	0.24	Max Detected
EU-02	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.011	0.015	0.015	0.020	2	100%	0.015	0.0064	0.020	Max Detected
EU-02	SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	4.5E-04	6.3E-04	6.3E-04	8.1E-04	2	100%	6.3E-04	2.5E-04	8.1E-04	Max Detected
EU-02	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.38	0.63	0.63	0.88	2	100%	0.63	0.35	0.88	Max Detected
EU-02	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.045	0.10	0.10	0.16	2	100%	0.10	0.083	0.16	Max Detected
EU-02	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	1.6	4.2	4.2	6.7	2	100%	4.2	3.6	6.7	Max Detected
EU-02	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.023	0.042	0.042	0.061	2	100%	0.042	0.027	0.061	Max Detected
EU-02	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0032	0.0053	0.0053	0.0073	2	100%	0.0053	0.0029	0.0073	Max Detected
EU-02	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.31	0.76	0.76	1.2	2	100%	0.76	0.65	1.2	Max Detected
EU-02	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.098	0.21	0.21	0.32	2	100%	0.21	0.16	0.32	Max Detected
EU-02	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.013	0.051	0.051	0.088	2	100%	0.051	0.053	0.088	Max Detected
EU-02	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	1.0E-03	0.0016	0.0016	0.0021	2	100%	0.0016	7.8E-04	0.0021	Max Detected
EU-02	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	3.0E-05	5.8E-05	5.8E-05	8.6E-05	2	100%	5.8E-05	4.0E-05	8.6E-05	Max Detected
EU-02	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	4.1E-04	7.3E-04	7.3E-04	0.0011	2	100%	7.3E-04	4.5E-04	0.0011	Max Detected
EU-02	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	2	N/A	N/A	0	15	32	32	49	2	100%	32	24	49	Max Detected
EU-04	SC	Metals		Arsenic	mg/kg	5	N/A	N/A	0	0.27	0.34	0.31	0.44	5	100%	0.34	0.074	0.44	Max Detected
EU-04	SC	Metals		Cadmium	mg/kg	5	N/A	N/A	0	0.014	0.025	0.022	0.045	5	100%	0.025	0.013	0.045	Max Detected
EU-04	SC	Metals		Lead	mg/kg	5	N/A	N/A	0	0.050	0.13	0.088	0.31	5	100%	0.13	0.11	0.31	Max Detected
EU-04	SC	Metals		Mercury	mg/kg	5	N/A	N/A	0	0.053	0.14	0.12	0.31	5	100%	0.14	0.10	0.31	Max Detected
EU-04	SC	PCB Aroclors		Aroclor 1254	ug/kg	5	23	35	2	130	767	470	1700	3	60%	469	637	1700	Max Detected
EU-04	SC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	5	23	35	2	130	767	470	1700	3	60%	469	637	1700	Max Detected
EU-04	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.0043	0.13	0.040	0.44	5	100%	0.13	0.18	0.44	Max Detected
EU-04	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.30	66	21	269	5	100%	66	115	269	Max Detected
EU-04	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.021	5.3	2.9	20	5	100%	5.3	8.3	20	Max Detected
EU-04	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.87	192	87	757	5	100%	192	320	757	Max Detected
EU-04	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.013	2.9	0.92	12	5	100%	2.9	5.0	12	Max Detected
EU-04	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.0024	0.10	0.029	0.41	5	100%	0.10	0.17	0.41	Max Detected
EU-04	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.12	33	22	118	5	100%	33	49	118	Max Detected
EU-04	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.043	7.9	3.52	31	5	100%	7.9	13	31	Max Detected
EU-04	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	5	N/A	N/A	0	0.0059	0.68	0.40	2.5	5	100%	0.68	1.0	2.5	Max Detected
EU-04	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	5	N/A	N/A	0	5.1E-04	0.030	0.011	0.12	5	100%	0.030	0.050	0.12	Max Detected
EU-04	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	5	N/A	N/A	0	1.9E-05	0.0021	8.6E-04	0.0082	5	100%	0.0021	0.0035	0.0082	Max Detected
EU-04	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	5	N/A	N/A	0	2.9E-04	0.020	0.0074	0.078	5	100%	0.020	0.033	0.078	Max Detected
EU-04	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	5	N/A	N/A	0	9.9	1260	559	4776	5	100%	1260	2002	4776	Max Detected
EU-05	SC	Metals		Arsenic	mg/kg	2	N/A	N/A	0	0.24	0.32	0.32	0.40	2	100%	0.32	0.11	0.40	Max Detected
EU-05	SC	Metals		Cadmium	mg/kg	2	N/A	N/A	0	0.019	0.026	0.026	0.033	2	100%	0.026	0.0093	0.033	Max Detected
EU-05	SC	Metals		Lead	mg/kg	2	N/A	N/A	0	0.031	0.031	0.031	0.032	2	100%	0.031	1.4E-04	0.032	Max Detected
EU-05	SC	Metals		Mercury	mg/kg	2	N/A	N/A	0	0.13	0.17	0.17	0.22	2	100%	0.17	0.068	0.22	Max Detected
EU-05	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0046	0.010	0.010	0.015	2	100%	0.010	0.0075	0.015	Max Detected
EU-05	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.55	0.77	0.77	1.00	2	100%	0.77	0.32	1.00	Max Detected
EU-05	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.049	0.065	0.065	0.082	2	100%	0.065	0.023	0.082	Max Detected
EU-05	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	1.9	2.8	2.8	3.8	2	100%	2.8	1.3	3.8	Max Detected
EU-05	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.020	0.034	0.034	0.049	2	100%	0.034	0.021	0.049	Max Detected
EU-05	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0029	0.0046	0.0046	0.0063	2	100%	0.0046	0.0024	0.0063	Max Detected
EU-05	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.38	0.43	0.43	0.49	2	100%	0.43	0.074	0.49	Max Detected
EU-05	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.088	0.13	0.13	0.18	2	100%	0.13	0.065	0.18	Max Detected
EU-05	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.016	0.018	0.018	0.021	2	100%	0.018	0.0033	0.021	Max Detected
EU-05	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	6.4E-04	0.0011	0.0011	0.0016	2	100%	0.0011	6.8E-04	0.0016	Max Detected
EU-05	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	3.0E-05	4.6E-05	4.6E-05	6.1E-05	2	100%	4.6E-05	2.2E-05	6.1E-05	Max Detected
EU-05	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	3.9E-04	6.0E-04	6.0E-04	8.2E-04	2	100%	6.0E-04	3.0E-04	8.2E-04	Max Detected
EU-05	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	2	N/A	N/A	0	20	27	27	35	2	100%	27	11	35	Max Detected
EU-06	SC	Metals		Arsenic	mg/kg	1	N/A	N/A	0	0.24	0.24	0.24	0.24	1	100%	N/A	N/A	0.24	Max Detected
EU-06	SC	Metals		Cadmium	mg/kg	1	N/A	N/A	0	0.021	0.021	0.021	0.021	1	100%	N/A	N/A	0.021	Max Detected
EU-06	SC	Metals		Lead	mg/kg	1	N/A	N/A	0	0.092	0.092	0.092	0.092	1	100%	N/A	N/A	0.092	Max Detected
EU-06	SC	Metals		Mercury	mg/kg	1	N/A	N/A	0	0.30	0.30	0.30	0.30	1	100%	N/A	N/A	0.30	Max Detected
EU-06	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0080	0.013	0.013	0.019	2	100%	0.013	0.0076	0.019	Max Detected
EU-06	SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	8.5E-04	8.6E-04	8.6E-04	8.8E-04	2	100%	8.6E-04	2.5E-05	0.00088	Max Detected
EU-06	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.36	0.45	0.45	0.53	2	100%	0.45	0.12	0.53	Max Detected
EU-06	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.02	0.13	0.13	0.24	2	100%	0.13	0.15	0.24	Max Detected
EU-06	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.87	4.1	4.1	7.3	2	100%	4.1	4.6	7.3	Max Detected
EU-06	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.016	0.088	0.088	0.16	2	100%	0.088	0.10	0.16	Max Detected

Table 1-8
Statistical Summary for Ecological River OU-0.1 Mile EUs for Sculpin Tissue Samples
Bradford Island - River Operable Unit

Exposure Unit	Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
EU-06	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0032	0.0052	0.0052	0.0073	2	100%	0.0052	0.0029	0.0073	Max Detected
EU-06	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.11	0.83	0.83	1.6	2	100%	0.83	1.0	1.6	Max Detected
EU-06	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.035	0.35	0.35	0.67	2	100%	0.35	0.45	0.67	Max Detected
EU-06	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0038	0.023	0.023	0.041	2	100%	0.023	0.027	0.041	Max Detected
EU-06	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	8.6E-04	0.0015	0.0015	0.0021	2	100%	0.0015	8.5E-04	0.00206	Max Detected
EU-06	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	2.4E-05	5.8E-05	5.8E-05	9.1E-05	2	100%	5.8E-05	4.8E-05	9.1E-05	Max Detected
EU-06	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	3.6E-04	7.1E-04	7.1E-04	0.0011	2	100%	7.1E-04	4.9E-04	0.0011	Max Detected
EU-06	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	2	N/A	N/A	0	8.2	22	22	36	2	100%	22	19	36	Max Detected
EU-07	SC	Metals		Arsenic	mg/kg	1	N/A	N/A	0	0.18	0.18	0.18	0.18	1	100%	N/A	N/A	0.18	Max Detected
EU-07	SC	Metals		Cadmium	mg/kg	1	N/A	N/A	0	0.027	0.027	0.027	0.027	1	100%	N/A	N/A	0.027	Max Detected
EU-07	SC	Metals		Lead	mg/kg	1	N/A	N/A	0	0.038	0.038	0.038	0.038	1	100%	N/A	N/A	0.038	Max Detected
EU-07	SC	Metals		Mercury	mg/kg	1	N/A	N/A	0	0.11	0.11	0.11	0.11	1	100%	N/A	N/A	0.11	Max Detected
EU-07	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.015	0.015	0.015	0.015	1	100%	N/A	N/A	0.015	Max Detected
EU-07	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	1.6	1.6	1.6	1.6	1	100%	N/A	N/A	1.6	Max Detected
EU-07	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.13	0.13	0.13	0.13	1	100%	N/A	N/A	0.13	Max Detected
EU-07	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	4.8	4.8	4.8	4.8	1	100%	N/A	N/A	4.8	Max Detected
EU-07	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.057	0.057	0.057	0.057	1	100%	N/A	N/A	0.057	Max Detected
EU-07	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.0060	0.0060	0.0060	0.0060	1	100%	N/A	N/A	0.0060	Max Detected
EU-07	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.76	0.76	0.76	0.76	1	100%	N/A	N/A	0.76	Max Detected
EU-07	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.19	0.19	0.19	0.19	1	100%	N/A	N/A	0.19	Max Detected
EU-07	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.025	0.025	0.025	0.025	1	100%	N/A	N/A	0.025	Max Detected
EU-07	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	0.0017	0.0017	0.0017	0.0017	1	100%	N/A	N/A	0.0017	Max Detected
EU-07	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	6.9E-05	6.9E-05	6.9E-05	6.9E-05	1	100%	N/A	N/A	6.9E-05	Max Detected
EU-07	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	8.3E-04	8.3E-04	8.3E-04	8.3E-04	1	100%	N/A	N/A	8.3E-04	Max Detected
EU-07	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	1	N/A	N/A	0	41	41	41	41	1	100%	N/A	N/A	41	Max Detected
EU-10	SC	Metals		Arsenic	mg/kg	2	N/A	N/A	0	0.23	0.28	0.28	0.33	2	100%	0.28	0.071	0.33	Max Detected
EU-10	SC	Metals		Cadmium	mg/kg	2	N/A	N/A	0	0.013	0.016	0.016	0.019	2	100%	0.016	0.0042	0.019	Max Detected
EU-10	SC	Metals		Lead	mg/kg	2	N/A	N/A	0	0.039	0.060	0.060	0.081	2	100%	0.060	0.030	0.081	Max Detected
EU-10	SC	Metals		Mercury	mg/kg	2	N/A	N/A	0	0.13	0.16	0.16	0.19	2	100%	0.16	0.040	0.19	Max Detected
EU-10	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.013	0.021	0.021	0.030	2	100%	0.021	0.012	0.030	Max Detected
EU-10	SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	2	5.5E-04	5.5E-04	1	0.0015	0.0015	0.0015	0.0015	1	50%	0.0010	4.5E-04	0.0015	Max Detected
EU-10	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.60	0.68	0.68	0.75	2	100%	0.68	0.11	0.75	Max Detected
EU-10	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.055	0.064	0.064	0.073	2	100%	0.064	0.013	0.073	Max Detected
EU-10	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	2.4	2.7	2.7	3.0	2	100%	2.7	0.40	3.0	Max Detected
EU-10	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.033	0.035	0.035	0.038	2	100%	0.035	0.0035	0.038	Max Detected
EU-10	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.0044	0.0052	0.0052	0.0060	2	100%	0.0052	0.0012	0.0060	Max Detected
EU-10	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.34	0.38	0.38	0.43	2	100%	0.38	0.062	0.43	Max Detected
EU-10	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.12	0.13	0.13	0.14	2	100%	0.13	0.017	0.14	Max Detected
EU-10	SC	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	2	0.0036	0.0036	1	0.0037	0.0037	0.0037	0.0037	1	50%	0.0036	1.0E-05	0.0037	Max Detected
EU-10	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	2	N/A	N/A	0	0.014	0.015	0.015	0.016	2	100%	0.015	0.0016	0.016	Max Detected
EU-10	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	0.0012	0.0018	0.0018	0.0024	2	100%	0.0018	8.3E-04	0.0024	Max Detected
EU-10	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	4.1E-05	4.9E-05	4.9E-05	5.6E-05	2	100%	4.9E-05	1.0E-05	5.6E-05	Max Detected
EU-10	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	2	N/A	N/A	0	6.5E-04	7.0E-04	7.0E-04	7.5E-04	2	100%	7.0E-04	6.7E-05	7.5E-04	Max Detected
EU-10	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	2	N/A	N/A	0	23	24	24	26	2	100%	24	2.2	26	Max Detected
EU-11	SC	Metals		Arsenic	mg/kg	3	N/A	N/A	0	0.24	0.36	0.41	0.42	3	100%	0.36	0.099	0.42	Max Detected
EU-11	SC	Metals		Cadmium	mg/kg	3	N/A	N/A	0	0.0072	0.012	0.014	0.017	3	100%	0.012	0.0048	0.017	Max Detected
EU-11	SC	Metals		Lead	mg/kg	3	0.021	0.021	1	0.046	0.065	0.065	0.083	2	67%	0.050	0.026	0.083	Max Detected
EU-11	SC	Metals		Mercury	mg/kg	3	N/A	N/A	0	0.033	0.087	0.066	0.16	3	100%	0.087	0.067	0.16	Max Detected
EU-11	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.011	0.025	0.014	0.049	3	100%	0.025	0.021	0.049	Max Detected
EU-11	SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	3	5.2E-04	0.0039	2	3.8E-04	3.8E-04	3.8E-04	3.8E-04	1	33%	3.8E-04	0	0.00038	Max Detected
EU-11	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.33	2.0	0.65	5.1	3	100%	2.0	2.7	5.1	Max Detected
EU-11	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.033	0.15	0.048	0.36	3	100%	0.15	0.18	0.36	Max Detected
EU-11	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	3	N/A	N/A	0	1.4	7.6	2.1	19	3	100%	7.6	10	19	Max Detected
EU-11	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.021	0.11	0.024	0.27	3	100%	0.11	0.14	0.27	Max Detected
EU-11	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.0032	0.006	0.0042	0.012	3	100%	0.0064	0.0046	0.012	Max Detected
EU-11	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.18	0.85	0.34	2.0	3	100%	0.85	1.0	2.0	Max Detected
EU-11	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.072	0.31	0.094	0.77	3	100%	0.31	0.40	0.77	Max Detected
EU-11	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	3	N/A	N/A	0	0.0081	0.022	0.014	0.044	3	100%	0.022	0.019	0.044	Max Detected
EU-11	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	3	N/A	N/A	0	1.0E-03	0.0023	0.0013	0.0046	3	100%	0.0023	0.00202	0.0046	Max Detected
EU-11	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	3	N/A	N/A	0	2.7E-05	9.0E-05	3.9E-05	2.0E-04	3	100%	9.0E-05	9.9E-05	2.0E-04	Max Detected
EU-11	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	3	N/A	N/A	0	3.9E-04	9.9E-04	5.3E-04	2.1E-03	3	100%	9.9E-04	9.2E-04	0.00205	Max Detected
EU-11	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	3	N/A	N/A	0	12	59	23	141	3	100%	59	72	141	Max Detected
EU-12	SC	Metals		Arsenic	mg/kg	1	N/A	N/A	0	0.27	0.27	0.27	0.27	1	100%	N/A	N/A	0.27	Max Detected
EU-12	SC	Metals		Cadmium	mg/kg	1	N/A	N/A	0	0.012	0.012	0.012	0.012	1	100%	N/A	N/A	0.012	Max Detected

Table 1-8
Statistical Summary for Ecological River OU-0.1 Mile EUs for Sculpin Tissue Samples
Bradford Island - River Operable Unit

Exposure Unit	Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Minimum ND	Maximum ND	Number of ND	Minimum Detected	Mean Detected	Median Detected	Maximum Detected	Number of Detections	Detection Rate	KM-Mean	KM SD	UCL	Selected UCL Type
EU-12	SC	Metals		Lead	mg/kg	1	N/A	N/A	0	0.033	0.033	0.033	0.033	1	100%	N/A	N/A	0.033	Max Detected
EU-12	SC	Metals		Mercury	mg/kg	1	N/A	N/A	0	0.21	0.21	0.21	0.21	1	100%	N/A	N/A	0.21	Max Detected
EU-12	SC	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.014	0.014	0.014	0.014	1	100%	N/A	N/A	0.014	Max Detected
EU-12	SC	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	1	N/A	N/A	0	7.1E-04	7.1E-04	7.1E-04	7.1E-04	1	100%	N/A	N/A	7.1E-04	Max Detected
EU-12	SC	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.53	0.53	0.53	0.53	1	100%	N/A	N/A	0.53	Max Detected
EU-12	SC	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.068	0.068	0.068	0.068	1	100%	N/A	N/A	0.068	Max Detected
EU-12	SC	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	2.9	2.9	2.9	2.9	1	100%	N/A	N/A	2.9	Max Detected
EU-12	SC	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.039	0.039	0.039	0.039	1	100%	N/A	N/A	0.039	Max Detected
EU-12	SC	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.0055	0.0055	0.0055	0.0055	1	100%	N/A	N/A	0.0055	Max Detected
EU-12	SC	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.41	0.41	0.41	0.41	1	100%	N/A	N/A	0.41	Max Detected
EU-12	SC	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.17	0.17	0.17	0.17	1	100%	N/A	N/A	0.17	Max Detected
EU-12	SC	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	1	N/A	N/A	0	0.021	0.021	0.021	0.021	1	100%	N/A	N/A	0.021	Max Detected
EU-12	SC	PCB Congeners		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	0.0015	0.0015	0.0015	0.0015	1	100%	N/A	N/A	0.0015	Max Detected
EU-12	SC	PCB Congeners		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	5.0E-05	5.0E-05	5.0E-05	5.0E-05	1	100%	N/A	N/A	5.0E-05	Max Detected
EU-12	SC	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	1	N/A	N/A	0	6.9E-04	6.9E-04	6.9E-04	6.9E-04	1	100%	N/A	N/A	6.9E-04	Max Detected
EU-12	SC	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	1	N/A	N/A	0	24	24	24	24	1	100%	N/A	N/A	24	Max Detected

Notes:
See Appendix A for data quality evaluation of non-detects.

% = percent
EPC = exposure point concentration
EU = exposure unit
KM = Kaplan-Meier
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
N/A = not applicable
ND = non-detect (at the MDL/RDL)
PCB = polychlorinated biphenyl
RDL = reported detection limit
SC = Sculpin
SD = standard deviation
TEQ = toxicity equivalence
UCL = upper confidence limit
ug/kg = micrograms per kilogram, in wet weight

Table 2-1
Comparison of Tissue Data to ATLs for DETM Sediment COPCs

IUPAC	Analyte[1]	Units	ATLs for Subsistence Fisher Exposed to Tissue	ATLs for Recreational Angler Exposed to Tissue	Crayfish: 2008 Lower Max/UCL Detected	Bass: 2006 Lower Max/UCL Detected	Bass: 2011 Max Detected	Retain CF as Bioaccum. Sub or Rec COPC?	Retain SB as Bioaccum. Sub or Rec COPC?
Metals									
	Arsenic	mg/kg	0.00076	0.0062	0.519	0.472[a]	0.53[a]	**Yes**	No
	Lead	mg/kg	0.5	0.5	0.925[a]	0.0142[a]	0.0185[a]	No	No
	Manganese	mg/kg	No ATL	No ATL		--[ab]		No	No
	Zinc	mg/kg	147[c]	1,200[c]	21.2	14.9	16.5	No	No
Butyltins									
	Tributyltin chloride[2]	ug/kg	0.15	1.2	--	--	ND	No	No
PCBs as Aroclors									
	Aroclor 1248	ug/kg	0.57	4.7	ND	ND	ND	No	No
	Aroclor 1254	ug/kg	0.57	4.7	ND	4,047	65,000	No	**Yes**
	Aroclor 1260	ug/kg	0.57	4.7	ND	ND	ND	No	No
	Total PCBs as Aroclors (MDL-based)	ug/kg	0.57	4.7	ND	4,100	65,000	**Yes**	**Yes**
PCBs as Congeners									
77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	0.076	0.62	0.00867	5.64	24.5	No	**Yes**
81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	0.025	0.21	0.000452	0.691	1.53	No	**Yes**
105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	0.25	2.1	0.0908	887	9,040	No	**Yes**
114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	0.25	2.1	0.697	65.6	504	**Yes**	**Yes**
118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	0.25	2.1	11.9	2,310	20,000	**Yes**	**Yes**
123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	0.25	2.1	0.412	38.7	298	**Yes**	**Yes**
126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	0.000076	0.00062	0.00208	1.92	6.44	**Yes**	**Yes**
156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	0.25	2.1	3.53	375	2,640	**Yes**	**Yes**
167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	0.25	2.1	1.49	108	735	**Yes**	**Yes**
169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	0.00025	0.0021	ND	ND	ND	No	No
189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	0.25	2.1	0.0821	8.14	57.8	No	**Yes**
	PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	7.60E-06	6.20E-05	0.001166	0.3072	1.65	**Yes**	**Yes**
	Total PCBs as Congeners (KM-based, capped)	ug/kg	0.57	4.7	36.5	19,314	183,148	**Yes**	**Yes**
Pesticides[2]									
SVOCs									
	Bis(2-ethylhexyl) phthalate	ug/kg	81.9	667	77.4	349	ND	No	**Yes**
	Butyl benzyl phthalate	ug/kg	604	4,912	ND	239	ND	No	No
	Carbazole	ug/kg	No ATL	No ATL	ND	ND	ND	No	No
	Dibenzofuran	ug/kg	0.492[c]	4.00[c]		0.000349[d]		No	No
	Di-n-butyl phthalate	ug/kg	49,157	400,000	ND	150	220	No	No

Notes:

1) Tissue concentrations of analytes identified as potential additional COPCs based on sediment screening in the DETM (see Table 2-2 of DETM) were compared to appropriate ATLs.

2) Tri-n-butyltin tissue was used.

3) Only analyzed in 2011 tissue. Organochlorine pesticides which were detected in sediment and exceeded sediment bioaccumulation SLVs are not listed in this table but are already included as tissue COPCs - See Table 2-2, which screens all detected analytes in 2011 smallmouth bass tissue: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane (gamma), endrin aldehyde, endrin ketone, endrin, and heptachlor epoxide.

a) Tissue concentrations are below the upstream Reference Area UPL, as shown in Table 1-7.

b) In the absence of a site-specific Upstream Reference UPL for manganese in sediment, the ODEQ's regional background level was considered (ODEQ 2013). Since the maximum site concentration of manganese is well below the regional background level, this metal was not retained as a COPC.

c) Calculated ATLs using subsistence and recreational exposure factors and toxicity values from USEPA (2015).

d) Due to lack of tissue analysis, BSAF was applied to sediment concentration to estimate tissue concentration.

Shaded cells show values exceeding ATLs
-- = not analyzed
ATL = acceptable tissue level
BSAF = biota-sediment accumulation factor
CF = crayfish
COPC = chemical of potential concern
DETM = Data Evaluation Technical Memo (URS 2014)
KM = Kaplan-Meier
Max = maximum
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
ND = Not detected
PCBs = polychlorinated biphenyls
RDL = reported detection limit
SB = smallmouth bass
SVOC = semi-volatile organic carbon
TEQ = toxicity equivalence
UCL = 95% upper confidence limit
ug/kg = micrograms per kilogram, in wet weight

Sources:

ODEQ. 2013. Fact Sheet: Background Levels of Metals in Soils for Cleanups. March.
URS. 2014 Data Evaluation Technical Memo. July 3.
USEPA. 2015. Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. RSL Table Update. June.

Table 2-2
Comparison of 2011 Tissue Data to ATLs for all Detected Analytes

Matrix	Analyte Group	IUPAC #	Analyte	Units	Note	2011 Max Detected	SLVs for Subsistence Fishers[1]	SLVs for Recreational Anglers[1]	Site Concentration (C)/Screening Level Value (SLV): Subsistence C_{tissue} SLV	Recreational C_{tissue} SLV	C_{water} SLV (potable water user)	Subsistence Multimedia sum(C/SLVtissue +C/SLVwater)	Recreational Multimedia sum(C/SLVtissue +C/SLVwater)	Retain as COPC for Subsistence Fisher?	Retain as COPC for Recreational Fisher?
Metals															
SB	Metals		Aluminum	mg/kg	n	9.5	NA	NA	No SLV	No SLV	0.00381	--	--	Yes - No SLV	Yes - No SLV
SB	Metals		Antimony	mg/kg	n	0.026	NA	NA	No SLV	No SLV	ND	--	--	Yes - No SLV	Yes - No SLV
SB	Metals		Barium	mg/kg	n	6.4	NA	NA	No SLV	No SLV	0.00370	--	--	Yes - No SLV	Yes - No SLV
SB	Metals		Chromium	mg/kg	c	0.76	NA	NA	No SLV	No SLV	ND	--	--	Yes - No SLV	Yes - No SLV
SB	Metals		Copper	mg/kg	n	2.0	NA	NA	No SLV	No SLV	0.000527	--	--	Yes - No SLV	Yes - No SLV
SB	Metals		Mercury	mg/kg	n	0.45	0.049	0.4	9.23	1.13	ND	--	--	Yes - C/SLV>0.1	Yes - C/SLV>0.1
SB	Metals		Zinc	mg/kg	n	17	147	1,200	0.112	0.0138	0.000682	0.113	0.0144	Yes - C/SLV>0.1	No - C/SLV<0.1
Butyltins															
SB	Butyltins		Monobutyltin	ug/kg	n	0.22	150	1,200	0.00147	0.000183	--	--	--	No - C/SLV<0.1	No - C/SLV<0.1
PCBs as Aroclors															
SB	PCB Aroclors		Aroclor 1254	ug/kg	c	65,000	0.57	4.7	114,035	13,830	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	c	65,000	0.57	4.7	114,035	13,830	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
PCBs as Congeners															
SB	PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	c	25	0.076	0.62	322	39.5	0.0000256	322	39.5	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	c	1.5	0.025	0.21	61.2	7.29	ND	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	c	9,040	0.25	2.1	36,160	4,305	0.000104	36,160	4,305	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	c	504	0.25	2.1	2,016	240	ND	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	c	20,000	0.25	2.1	80,000	9,524	0.000302	80,000	9,524	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	c	298	0.25	2.1	1,192	142	ND	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	c	6.4	0.000076	0.00062	84,737	10,387	ND	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	c	2,640	0.25	2.1	10,560	1,257	0.000355	10,560	1,257	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	c	735	0.25	2.1	2,940	350	0.00000304	2,940	350	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	c	ND	0.00025	0.0021	ND	ND	ND	--	--	Yes[2]	Yes[2]
SB	PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	c	58	0.25	2.1	231	27.5	0.0000127	231	27.5	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	c	1.7	0.0000076	0.000062	217,105	26,613	0.0001	217,105	26,613	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	PCB Congeners		Total PCBs as Congeners (KM-based, capped)	ug/kg	c	183,148	0.57	4.7	321,312	38,968	0.001	321,312	38,968	Yes - carc C/SLV>1	Yes - carc C/SLV>1
Pesticides															
SB	Pesticides		4,4'-DDD	ug/kg	c	8.6	3.4	27	2.53	0.319	--	--	--	Yes - carc C/SLV>1	Yes[2]
SB	Pesticides		4,4'-DDE	ug/kg	c	76	3.4	27	22.4	2.81	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	Pesticides		4,4'-DDT	ug/kg	c	17	3.4	27	5.00	0.630	--	--	--	Yes - carc C/SLV>1	Yes[2]
SB	Pesticides		BHC (beta)	ug/kg	c	2.0	0.72	5.8	2.78	0.345	--	--	--	Yes - carc C/SLV>1	Yes[2]
SB	Pesticides		BHC (gamma) Lindane	ug/kg	c	2.5	0.72	5.8	3.47	0.431	--	--	--	Yes - carc C/SLV>1	Yes[2]
SB	Pesticides		Chlordane (alpha)	ug/kg	c	0.30	3.3	27	0.0909	0.0111	--	--	--	Yes[2]	Yes[2]
SB	Pesticides		Chlordane (gamma)	ug/kg	c	5,000	3.3	27	1,515	185	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	Pesticides		Dieldrin	ug/kg	c	2,900	0.072	0.58	40,278	5,000	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	Pesticides		Endosulfan I	ug/kg	n	210	NA	NA	No SLV	No SLV	--	--	--	Yes - No SLV	Yes - No SLV
SB	Pesticides		Endrin	ug/kg	n	1,200	NA	NA	No SLV	No SLV	--	--	--	Yes - No SLV	Yes - No SLV
SB	Pesticides		Endrin Aldehyde	ug/kg	n	1,200	NA	NA	No SLV	No SLV	--	--	--	Yes - No SLV	Yes - No SLV
SB	Pesticides		Methoxychlor	ug/kg	n	0.90	NA	NA	No SLV	No SLV	--	--	--	Yes - No SLV	Yes - No SLV
SVOCs and PAHs															
SB	SVOCs		Acenaphthene	ug/kg	n	1.1	15,000	120,000	0.0000733	0.00000917	0.000000581	0.0000739	0.00000975	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Anthracene	ug/kg	n	6.7	15,000	120,000	0.000447	0.0000558	0.0000000110	0.000447	0.0000558	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Benzo(a)anthracene	ug/kg	c	4.4	1.57	12.8	2.80	0.344	0.00207	2.80	0.346	Yes - carc C/SLV>1	No - carc C/SLV<1
SB	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	c	4.1	0.157	1.28	26.2	3.21	--	--	--	Yes - carc C/SLV>1	Yes - carc C/SLV>1
SB	SVOCs		Di-n-butyl Phthalate	ug/kg	n	220	49,200	400,000	0.00447	0.000550	ND	--	--	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Di-n-octyl Phthalate	ug/kg	n	23	49,200	400,000	0.000467	0.0000575	ND	--	--	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Fluoranthene	ug/kg	n	2.1	20,000	160,000	0.000105	0.0000131	0.000000523	0.000106	0.0000136	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Fluorene	ug/kg	n	5.2	15,000	120,000	0.000347	0.0000433	--	--	--	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		p-cresol (4-Methylphenol)	ug/kg	n	130	NA	NA	No SLV	No SLV	--	--	--	Yes - No SLV	Yes - No SLV
SB	SVOCs		Phenanthrene	ug/kg	n	8.6	15,000	120,000	0.000573	0.0000717	0.000000146	0.000573	0.0000718	No - C/SLV<0.1	No - C/SLV<0.1
SB	SVOCs		Pyrene	ug/kg	n	0.060	15,000	120,000	0.00000400	0.000000500	--	--	--	No - C/SLV<0.1	No - C/SLV<0.1
SB	--		Sum non-carcinogenic C/RBC (HI)						9.4	1.1					
SB	--		Sum carcinogenic C/RBC (ELCR)						1.0E+00	1.3E-01					

Subsistence COPC
Recreational COPC

Notes:

1) DEQ 2007. Guidance for Evaluation of Bioaccumulative Chemicals of Concern in Sediment. Final. January 31 (see Appendix J in the RI [URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June] for surrogate selections).

2) Individual PCB congeners and individual pesticides less than the ATLs were retained because they are either part of a sum (i.e., Total PCBs as Congeners, PCB TEQs, Total DDx) or due to their potential additive affect within the analytical group (i.e., pesticides).

ATL = acceptable tissue level
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic PAH
Max = maximum
mg/kg = milligrams per kilogram, in wet weight
NA = not available
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SB = smallmouth bass
SLV = screening level value, either acceptable tissue level (ATL) or potable water SLV
SVOC = semi-volatile organic carbon
TEQ = toxicity equivalence
ug/kg = micrograms per kilogram, in wet weight

Table 2-3
Summary of HHRA COPCs

Data Set	Receptor Group	Medium	RI COPCs[2]	Additional Potential COPCs identified in sediment in the DETM[3,4,5]	Add to BHHRA?[4,5]	Additional COPCs in 2011 Tissue Data[4,5,6]	Final HHRA COPCs
River OU[1]	Tribal Subsistence Fisher	Sediment[7]	mercury[#], PCBs, bis(2-ethylhexyl) phthalate*	arsenic, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane (gamma), endrin aldehyde*, endrin ketone*, endrin*, heptachlor epoxide*	See Tissue Evaluations below	--	Same as tissue COPCs below except for Arsenic, endrin ketone and heptachlor epoxide[11]
		Water	arsenic, aluminum, lead, PCBs	--	--	--	Same as tissue COPCs below except for lead[12]
		Bass Tissue	barium, mercury, PCBs, cPAHs, bis(2-ethylhexyl) phthalate	--	--	aluminum*, antimony*, chromium*, copper*, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, BHC(beta), BHC(gamma) lindane, chlordane (alpha)[@], chlordane (gamma), dieldrin, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*	barium, mercury, PCBs, cPAHs, bis(2-ethylhexyl) phthalate, aluminum*, antimony*, chromium*, copper*, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, BHC(beta), BHC(gamma) lindane, chlordane (alpha)@, chlordane (gamma), dieldrin, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*
	Non-tribal Recreational Fisher	Sediment[7]	mercury[#], PCBs, bis(2-ethylhexyl) phthalate*	arsenic, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane (gamma), endrin aldehyde*, endrin ketone*, endrin*, heptachlor epoxide*	See Tissue Evaluations below	--	Same as tissue COPCs below
		Water	aluminum, arsenic, lead, PCBs	--	--	--	Same as tissue COPCs below except for lead[12]
		Crayfish Tissue	arsenic, PCBs	--	--	--	arsenic, PCBs
		Bass Tissue	barium, mercury, PCBs, cPAHs	--	--	aluminum*, antimony*, chromium*, copper*, 4,4'-DDD[@], 4,4'-DDE, 4,4'-DDT[@], BHC(beta)[@], BHC(gamma) lindane[@], chlordane (alpha)[@], chlordane (gamma), dieldrin, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*	barium, mercury, PCBs, cPAHs, aluminum*, antimony*, chromium*, copper*, 4,4'-DDD@, 4,4'-DDE, 4,4'-DDT@, BHC(beta)@, BHC(gamma) lindane@, chlordane (alpha)@, chlordane (gamma), dieldrin, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*
	Recreational Wader	Sediment[7,9]	PCBs, anthracene, fluoranthene, phenanthrene, pyrene, cPAHs, carbazole, diesel range organics	antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, silver, thallium, vanadium, zinc, dibutyltin dichloride, tributyltin chloride, acenaphthene, fluorene, 4,4'-DDE, 4,4'-DDT, BHC (gamma) lindane, chlordane (gamma), endrin aldehyde, endrin, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, p-cresol (4-methylphenol), phenol[8]	See Tissue Evaluations below	--	PCBs, anthracene, fluoranthene, phenanthrene, pyrene, cPAHs, carbazole, diesel range organics, antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, silver, thallium, vanadium, zinc, dibutyltin dichloride, tributyltin chloride, acenaphthene, fluorene, 4,4'-DDE, 4,4'-DDT, BHC (gamma) lindane, chlordane (gamma), endrin aldehyde, endrin, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, p-cresol (4-methylphenol), phenol[8]
	Hypothetical Downstream Potable Water User	Water	arsenic, PCBs[10]	--	--	--	arsenic, PCBs[10]
	Recreational Swimmer	Water	arsenic, PCBs[10]	--	--	--	arsenic, PCBs[10]

Table 2-3
Summary of HHRA COPCs

Notes
1) PCBs were retained as RI COPCs in sediment for all receptors. Although COPC concentrations in media collected from the targeted Goose Island and Eagle Creek samples indicated acceptable risk levels in the RI, Forebay, Goose Island, and Eagle Creek sediment and tissue samples will be maintained as part of the River OU-wide evaluation in the HHRA and are collectively referred to as the River OU.
2) See Table 11-3 and M-35 through M-46 of Final RI (URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June).
3) See Table 2-2 of DETM (URS. 2014. Data Evaluation Technical Memorandum, River Operable Unit. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. July 3) and Table 2-2 (Current BHHRA).
4) See Table 2-1 for comparison of Tissue Data to DEQ's CTLs/ATLs for Subsistence and Recreational Fish Consumption. Only additional COPCs not already identified as RI COPCs are listed.
5) Analytes are only shown if they are in addition to COPCs identified in the RI.
6) See Table 2-2 for comparison of 2011 Tissue Data to ATLs for all detected analytes in tissue.

7) Selection of COPCs differed slightly from the selection of COPCs for the RI and DETM. 2011 tissue data used maximum detected concentration where as COPCs from the RI and DETM used the lower of the maximum detected concentration or the 95% UCL. This was done to be conservative in the COPC selection of additional analytes detected in tissue data.
8) Tribal Subsistence fisher and non-tribal recreational fisher are exposed to sediment that is Forebay wide through consumption of fish exposed to forebay-wide sediments, including Goose Island and Eagle Creek, whereas the recreational wader is only exposed by direct contact to sediment in wadeable locations.
9) This is a condensed list from the DETM based on wadeable locations.
10) Based on potable water user screening in the RI.
11) Arsenic in smallmouth bass tissue did not exceed ATL; endrin ketone and heptachlor epoxide were not detected in tissues.
12) Lead in tissues did not exceed tissue ATL.

* Retained due to lack of SLV or ATL
@ Retained because they are either part of a sum or due to their potential additive affect within the analytical group
# Retained because it is a bioaccumulative chemical that has been retained as a tissue COPC for smallmouth bass
-- = no new COPCs because no samples were collected
ATL = acceptable tissue level
BHC = benzene hexachloride
BHHRA = baseline human health risk assessment
COPCs = chemicals of potential concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
CTL = critical tissue level
DETM = Data Evaluation Technical Memorandum
HHRA = human health risk assessment
PCBs = polychlorinated biphenyls (as Aroclors and 209 congeners)
RI = Remedial Investigation Report
SLV = screening level value

Table 2-4.1
Exposure Factors for Tribal Subsistence Fisher

			Tribal Subsistence Fisher					
			RME			CTE		
Exposure Factors		**Units**	**Value**	note	**Source**	**Value**	note	**Source**
Exposure Frequency	EF	days/yr	365	a	USEPA 2014b & PJ	365	a	USEPA 2014b & PJ
Exposure Duration-adult	EDa	years	20	e	USEPA 2014a	3	c,e	ODEQ 2010
Exposure Duration-child	EDc	years	6	--	USEPA 2014a	6	c,f	ODEQ 2010
FinFish Tissue: Ingestion Rate Factor-adult	FIRFa	g/day	43.8	b	URS 2007 & CRTFC 1994	15.8	b	URS 2007 & CRTFC 1994
FinFish Tissue: Ingestion Rate Factor-child	FIRFc	g/day	18.3	d	URS 2007 & CRTFC 1994	4.9	d	URS 2007 & CRTFC 1994
Shellfish Tissue: Ingestion Rate Factor-adult	SIRFa	g/day	NI	--	USEPA 2002 & CRTFC 1994	NI	--	URS 2007 & CRTFC 1994
Shellfish Tissue: Ingestion Rate Factor-child	SIRFc	g/day	NI	--	USEPA 2002 & CRTFC 1994	NI	--	URS 2007 & CRTFC 1994
Trophic level of fish and shellfish consumed	--	--	TL 3/4 Fish	--	Site Specific	TL 3/4 Fish	--	Site Specific
Time spent at site by Resident Fish - Trophic Level (TL) 3/4	--	--	100%	g	Site Specific	100%	g	Site Specific
Percent of resident fish/shellfish consumed from Site	--	--	100%	--	ODEQ 2010 (Table A-3)	30%	h	Site-specific
Conversion Factor	CF	g/mg	0.001	--	--	0.001	--	--
Body Weight-adult	BWa	kg	80	--	USEPA 2014a	80	--	USEPA 2014a
Body Weight-child	BWc	kg	15	--	USEPA 2014a	15	f	USEPA 2014a
Averaging Time-noncancer	ATnc	days	=ED	--	USEPA 2014a	=ED	f	USEPA 2014a
Averaging Time-cancer	ATc	days	25550	--	USEPA 2014a	25550	f	USEPA 2014a

Notes:

Hierarchy of sources: USEPA (2014a) for RME, then ODEQ (2010); for CTE, generally ODEQ (2010), then USEPA (2014a, 2011), except for BW; for parameters where USEPA RME value is lower than ODEQ's CTE value, USEPA RME value was retained for CTE.

BW = body weight
CTE = Central Tendency Exposure
ED = exposure duration
NI = No shellfish consumption habits indicated in the study for tribal subsistence fishers
PJ = professional judgment based on site specific information
Resident Fish = (non-anadromous) fish that complete their entire life cycle in fresh water
RME = Reasonable Maximum Exposure
TL = trophic level

Footnotes:

a - Noncancer hazards are estimated separately for adult and child exposures.
b - Tribal adult resident finfish consumption rates estimated as 25% of total mean fish consumption rate (63.2 g/day) and 95% UCL fish consumption rate (175 g/day).
c - Based on residential CTE values from ODEQ 2010.
d - Tribal child resident finfish consumption rates estimated as 25% of total mean fish consumption rate (19.6 g/day) and 95% UCL fish consumption rate (73 g/day).
e - Child ED will be used to estimate non-cancer hazards; adult + child ED will be used to estimate cancer risks.
f - CTE values in DEQ (2010) are the same as RME values in USEPA (2014a).
g - The smallmouth bass and crayfish, which represent the TL 3/4 species consumed by this receptor are assumed to spend their entire lifetime in the River OU, based on their home range relative to site area (Table B-9, URS 2007).
h - Percent of site-caught fish ingestion as proportion of total fish ingestion, based on surveys with local anglers indicating that the River OU is not a preferred area for recreational fishing due to poor habitat quality, limited access and general preference for fishing from 2 or 3 locations (Appendix B, URS 2007).

Sources:

CRTFC. 1994. A Fish Consumption Survey of the Umatilla, Nez Perce, Yakima, and Warm Springs Tribes of the Columbia River Basin.
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
USEPA. 2011. Exposure Factors Handbook.
USEPA. 2002. Estimate per Capita Fish Consumption in the United States
USEPA. 2014a. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. http://rais.ornl.gov/documents/OSWER-Directive-9200-1-120-Exposure-Factors_corrected.pdf
USEPA. 2014b. Exposure Factors Handbook: Child Specific Exposure Scenario Examples.
URS. 2007. Remedial Investigation/Management Plan for Bradford Island. Final.

Table 2-4.2
Exposure Factors for Non-Tribal Recreational Fisher

			Non-Tribal Recreational Fisher					
			RME			CTE		
Exposure Factors		**Units**	**Value**	note	**Source**	**Value**	note	**Source**
Exposure Frequency	EF	days/yr	350	a	USEPA 2014b	350	a	USEPA 2014b
Exposure Duration-adult	EDa	years	20	b	USEPA 2014b	3	b	ODEQ 2010
Exposure Duration-child	EDc	years	6	--	USEPA 2014b	6	f	ODEQ 2010
FinFish Tissue: Ingestion Rate Factor-adult	FIRFa	g/day	23.3	c	URS 2007	4.2	c	URS 2007
FinFish Tissue: Ingestion Rate Factor-child	FIRFc	g/day	13.1 (7.4)[1]	d	URS 2007	2.6 (1.46)[2]	d	URS 2007
Shellfish Tissue: Ingestion Rate Factor-adult	SIRFa	g/day	17.9	e	URS 2007	3.3	c	URS 2007
Shellfish Tissue: Ingestion Rate Factor-child	SIRFc	g/day	NN (5.7)[1]	d	URS 2007	NN (1.14)[2]	d	URS 2007
Trophic level of fish and shellfish consumed	--	--	TL 3/4 Fish	--	Site Specific	TL 3/4 Fish	--	Site Specific
Time spent at site by Resident Fish - Trophic Level (TL) 3/4	--	--	100%	g	Site Specific	100%	g	Site Specific
Percent of resident fish/shellfish consumed from Site	--	--	100%	--	ODEQ 2010 (Table A-3)	30%	h	Site-specific
Conversion Factor	CF	g/mg	0.001	--	--	0.001	--	--
Body Weight-adult	BWa	kg	80	--	USEPA 2014a	80	--	USEPA 2014a
Body Weight-child	BWc	kg	15	--	USEPA 2014a	15	f	USEPA 2014a
Averaging Time-noncancer	ATnc	days	=ED	--	USEPA 2014a	=ED	f	USEPA 2014a
Averaging Time-cancer	ATc	days	25550	--	USEPA 2014a	25550	f	USEPA 2014a

Notes:

Hierarchy of sources: USEPA (2014a) for RME, then ODEQ (2010); for CTE, generally ODEQ (2010), then USEPA (2014a, 2011), except for BW; for parameters where USEPA RME value is lower than ODEQ's CTE value, USEPA RME value was retained for CTE.

BW = body weight
CTE = Central Tendency Exposure
ED = exposure duration
NN = Not needed because finfish ingestion rate is based on consumption of both finfish and shellfish, see footnote (e)
PJ = professional judgment based on site specific information
Resident Fish = (non-anadromous) fish that complete their entire life cycle in fresh water
RME = Reasonable Maximum Exposure
TL = trophic level

1 = The rate of 13.1 g/day for the recreator child finfish consumption actually includes both finfish and shellfish. Therefore, the adult percent shellfish (43%) was assumed to apply to the child resulting in the derivation of separate finfish and shellfish ingestion rates shown in parenthesis.
2 = The rate of 2.6 g/day for the recreator child finfish consumption actually includes both finfish and shellfish. Therefore, the adult percent shellfish (44%) was assumed to apply to the child resulting in the derivation of separate finfish and shellfish ingestion rates shown in parenthesis.

a - Noncancer hazards are estimated separately for adult and child exposures.
b - Child ED will be used to estimate non-cancer hazards; adult + child ED will be used to estimate cancer risks.
c - Mean and 95th percentile for uncooked finfish consumption (freshwater and estuarine), U.S. population age 18 and older (USEPA (2002), as cited in URS (2007).
d - Mean and 95th percentile for uncooked finfish + shellfish consumption (freshwater and estuarine), US Population age 14 and younger (USEPA (2002), as cited in URS (2007).
e - Mean and 95th percentile for uncooked shellfish consumption (freshwater and estuarine), US Population age 18 and older (USEPA 2002, as cited in URS 2007).
f - CTE values in ODEQ (2010) are the same as RME values in USEPA (2014a).
g - The smallmouth bass and crayfish, which represent the TL 3/4 species consumed by this receptor are assumed to spend their entire lifetime in the River OU based on their home range relative to site area (Table B-9, URS 2007).
h - Percent of site-caught fish ingestion as proportion of total fish ingestion, based on surveys with local anglers indicating that the River OU is not a preferred area for recreational fishing due to poor habitat quality, limited access and general preference for fishing from 2 or 3 locations (Appendix B, URS 2007).

Sources:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
URS. 2007. Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP), Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon.
USEPA. 2002. Estimate per Capita Fish Consumption in the United States
USEPA. 2011. Exposure Factors Handbook.
USEPA. 2014a. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. http://rais.ornl.gov/documents/OSWER-Directive-9200-1-120-Exposure-Factors_corrected.pdf
USEPA. 2014b. Exposure Factors Handbook: Child Specific Exposure Scenario Examples.

Table 2-4.3
Exposure Factors for Wader

Exposure Factors		Units	Wader					
			RME			CTE		
			Value	note	Source	Value	note	Source
Exposure Frequency - adult, child	EF	days/yr	150	d	ODEQ 2010 & URS 2007	5	--	ODEQ 2010 & URS 2007
Exposure Duration-adult	EDa	years	20	a	USEPA 2014	3	a	ODEQ 2010
Exposure Duration-child	EDc	years	6	--	USEPA 2014	6	e	ODEQ 2010
Sediment Ingestion rate-adult	IRSa	mg/day	100	b	USEPA 2014	50	b	ODEQ 2010
Sediment Ingestion rate-child	IRSc	mg/day	200	b	USEPA 2014	100	b	ODEQ 2010
Sediment :Skin Surface Area-adult	SAa	cm^2	6820	f	USEPA 2011	6820	f	USEPA 2011
Sediment: Skin Surface Area-child	SAc	cm^2	1950	f	USEPA 2011	1950	f	USEPA 2011
Sediment to Skin Adherence factor-adult	AFa	mg/cm^2	0.16	c	USEPA 2011	0.16	c	USEPA 2011
Sediment to Skin Adherence factor-child	AFc	mg/cm^2	0.7	c	USEPA 2011	0.7	c	USEPA 2011
Swimming: Incidental Ingestion of Water-adult	IRWa	L/hour	--	--	--	--	--	--
Swimming: Incidental Ingestion of Water-child	IRWc	L/hour	--	--	--	--	--	--
Number of Wading Events-adult	EVa	events/day	1	d	ODEQ 2010	1	d	ODEQ 2010
Number of Wading Events-child	EVc	events/day	1	d	ODEQ 2010	1	d	ODEQ 2010
Event Time-adult	ETa	hours/event	1	d	ODEQ 2010	0.5	d	ODEQ 2010
Event Time-child	ETc	hours/event	1	d	ODEQ 2010	0.5	d	ODEQ 2010
Body Surface Area - Swimming/Bathing-adult	SSAa	cm2	--	--	--	--	--	--
Body Surface Area-- Swimming/Bathing-child	SSAc	cm2	--	--	--	--	--	--
Intake Rate of Potable Water-adult	IRPWa	L/day	--	--	--	--	--	--
Intake Rate of Potable Water-child	IRPWc	L/day	--	--	--	--	--	--
Bathing Event Time-adult	BETa	hours/event	--	--	--	--	--	--
Bathing Event Time-child	BETc	hours/event	--	--	--	--	--	--
Body Weight-adult	BWa	kg	80	--	USEPA 2014	80	--	USEPA 2014
Body Weight-child	BWc	kg	15	--	USEPA 2014	15	e	USEPA 2014
Averaging Time-noncancer	ATnc	days	=ED	--	USEPA 2014	=ED	e	USEPA 2014
Averaging Time-cancer	ATc	days	25550	--	USEPA 2014	25550	e	USEPA 2014

Notes:

Hierarchy of sources: USEPA (2014) for RME, then ODEQ (2010); for CTE, generally ODEQ (2010), then USEPA (2014, 2011), except for BW; for parameters where USEPA RME value is lower than ODEQ's CTE value, USEPA RME value was retained for CTE.

BW = body weight
CTE = Central Tendency Exposure
ED = exposure duration
PJ = professional judgment based on site specific information
RME = Reasonable Maximum Exposure

Footnotes:

a - Noncancer hazards are estimated separately for adult and child exposures
b - Sediment ingestion rate is assumed to be the same as residential soil ingestion rate from USEPA (2014)
c - Recommended values for adherence to legs for children playing in sediments and adults clamming, Table 7-4, USEPA (2011)
d - Wading event exposure considered comparable to a swimmer.
e - CTE values in ODEQ (2010) are the same as RME values in USEPA (2014).
f - Mean values for whole legs, adult and child (3-6 years age), Table 7-2, USEPA (2011)

Sources:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
URS. 2007. Remedial Investigation/Management Plan for Bradford Island. Final
USEPA. 2011. Exposure Factors Handbook.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. http://rais.ornl.gov/documents/OSWER-Directive-9200-1-120-Exposure-Factors_corrected.pdf

Table 2-4.4
Exposure Factors for Swimmer

Exposure Factors		Units	Swimmer: RME Value	note	Source	Swimmer: CTE Value	note	Source
Exposure Frequency - adult, child	EF	days/yr	150	--	ODEQ 2010 & URS 2007	5	--	ODEQ 2010 and URS 2007
Exposure Duration-adult	EDa	years	20	a	USEPA 2014	3	a	ODEQ 2010
Exposure Duration-child	EDc	years	6	a	USEPA 2014	6	b	ODEQ 2010
Swimming: Incidental Ingestion of Water-adult	IRWa	L/hour	0.05	--	USEPA 2014	0.05	--	ODEQ 2010
Swimming: Incidental Ingestion of Water-child	IRWc	L/hour	0.05	--	USEPA 2014	0.05	--	ODEQ 2010
Number of Swimming Events-adult	EVa	events/day	1	--	ODEQ 2010	1	--	ODEQ 2010
Number of Swimming Events-child	EVc	events/day	1	--	ODEQ 2010	1	--	ODEQ 2010
Event Time-adult	ETa	hours/event	1	--	ODEQ 2010	0.5	--	ODEQ 2010
Event Time-child	ETc	hours/event	1	--	ODEQ 2010	0.5	--	ODEQ 2010
Body Surface Area - Swimming -adult	SSAa	cm^2	20,900	--	USEPA 2014	20,000	--	ODEQ 2010
Body Surface Area-- Swimming -child	SSAc	cm^2	6378	--	USEPA 2014	6378	--	USEPA 2014
Body Weight-adult	BWa	kg	80	--	USEPA 2014	80	--	USEPA 2014
Body Weight-child	BWc	kg	15	--	USEPA 2014	15	b	USEPA 2014
Averaging Time-noncancer	ATnc	days	=ED	--	USEPA 2014	=ED	b	USEPA 2014
Averaging Time-cancer	ATc	days	25550	--	USEPA 2014	25550	b	USEPA 2014

Notes:

Hierarchy of sources: USEPA (2014) for RME, then ODEQ (2010); for CTE, generally ODEQ (2010), then USEPA (2014, 2011), except for BW; for parameters where USEPA RME value is lower than ODEQ's CTE value, USEPA RME value was retained for CTE.

BW = body weight

CTE = central tendency exposure

RME = reasonable maximum exposure

Footnotes:

a - Noncancer hazards are estimated separately for adult and child exposures.
b - CTE values in ODEQ (2010) are the same as RME values in USEPA (2014).

Sources:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
URS. 2007. Remedial Investigation/Management Plan for Bradford Island. Final.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.
http://rais.ornl.gov/documents/OSWER-Directive-9200-1-120-Exposure-Factors_corrected.pdf

Table 2-4.5
Exposure Factors for Hypothetical Downstream Potable Water User

			Hypothetical Downstream Potable Water User					
			RME			CTE		
Exposure Factors		**Units**	**Value**	note	**Source**	**Value**	note	**Source**
Exposure Frequency - adult, child	EF	days/yr	350	--	USEPA 2014	350	b	USEPA 2014
Exposure Duration-adult	EDa	years	20	a	USEPA 2014	3	a	ODEQ 2010
Exposure Duration-child	EDc	years	6	a	USEPA 2014	6	a	ODEQ 2010
Body Surface Area - Bathing-adult	SSAa	cm^2	20,900	--	USEPA 2014	20,000	--	ODEQ 2010
Body Surface Area-- Bathing-child	SSAc	cm^2	6378	--	USEPA 2014	6378	--	USEPA 2014
Intake Rate of Potable Water-adult	IRPWa	L/day	2.5	--	USEPA 2014	1.4	--	ODEQ 2010
Intake Rate of Potable Water-child	IRPWc	L/day	0.78	--	USEPA 2014	0.78	--	USEPA 2014
Bathing Event Time-adult	BETa	hours/event	0.71	--	USEPA 2014	0.16	--	ODEQ 2010
Bathing Event Time-child	BETc	hours/event	0.54	--	USEPA 2014	0.16	--	ODEQ 2010
Body Weight-adult	BWa	kg	80	--	USEPA 2014	80	--	USEPA 2014
Body Weight-child	BWc	kg	15	--	USEPA 2014	15	b	USEPA 2014
Average Time-noncancer	ATnc	days	=ED	--	--	=ED	--	--
Average Time-cancer	ATc	days	25550	--	USEPA 2014	25550	b	USEPA 2014

Notes:
Hierarchy of sources: USEPA (2014) for RME, then ODEQ (2010); for CTE, ODEQ (2010), then USEPA (2014, 2011), as long as ODEQ CTE value is less than EPA RME value.
BW = body weight
CTE = central tendency exposure
RME = reasonable maximum exposure

Footnotes:
a - Noncancer hazards are estimated separately for adult and child exposures.
b - CTE values in ODEQ (2010) are the same as RME values in USEPA (2014).

Sources:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
USEPA. 2011. Exposure Factors Handbook.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. http://rais.ornl.gov/documents/OSWER-Directive-9200-1-120-Exposure-Factors_corrected.pdf

Table 2-5
Toxicity Values for Human Health Risk Assessment

		Cancer-Risk Values: Oral Slope Factor		Cancer-Risk Values: Inhalation Unit Risk		Noncancer Health-Hazard Values: Reference Dose - Oral		Noncancer Health-Hazard Values: Reference Concentration		Oral Absorption Factor		Dermal: Slope Factor	Dermal: Reference Dose	Dermal Absorption Factor	
Analyte	**Mutagen?**	**SFo (mg/kg-d)$^{-1}$**	**Ref.**	**IUR (µg/m3)$^{-1}$**	**Ref.**	**RfDo (mg/kg-d)**	**Ref.**	**RfC (µg/m3)**	**Ref.**	**OAF (dimensionless)**	**Ref.**	**SFD [b] (mg/kg-d)$^{-1}$**	**RfDd [a] (mg/kg-d)**	**ABSd (dimensionless)**	**Ref.**
Inorganic Constituents															
Antimony		No Toxicity Value	--	No Toxicity Value	--	4.00E-04	IRIS	No Toxicity Value	--	1.50E-01	USEPA (2004) (RAGS Part E)	--	6.00E-05	1.00E-02	DTSC (1994)
Arsenic		1.50E+00	IRIS	4.30E-03	IRIS	3.00E-04	IRIS	1.50E-02	CalEPA	1.00E+00	USEPA (2004) (RAGS Part E)	1.50E+00	3.00E-04	3.00E-02	RSL (2013-05)
Cadmium		No Toxicity Value	--	1.80E-03	IRIS	1.00E-03	IRIS	1.00E-02	ATSDR	2.50E-02	USEPA (2004) (RAGS Part E)	--	2.50E-05	1.00E-03	RSL (2013-05)
Chromium		No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	1.30E-02	USEPA (2004) (RAGS Part E)	--	--	1.00E-02	DTSC (1994)
Cobalt		No Toxicity Value	--	9.00E-03	PPRTV	3.00E-04	PPRTV	6.00E-03	PPRTV	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-04	1.00E-02	DTSC (1994)
Copper		No Toxicity Value	--	No Toxicity Value	--	4.00E-02	HEAST	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	4.00E-02	1.00E-02	DTSC (1994)
Lead		No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	--	1.00E-02	DTSC (1994)
Manganese		No Toxicity Value	--	No Toxicity Value	--	2.40E-02	non-diet; IRIS	5.00E-02	IRIS	4.00E-02	USEPA (2004) (RAGS Part E)	--	9.60E-04	1.00E-02	DTSC (1994)
Mercury		No Toxicity Value	--	No Toxicity Value	--	1.60E-04	CalEPA	3.00E-01	IRIS	1.00E+00	USEPA (2004) (RAGS Part E)	--	1.60E-04	1.00E-02	DTSC (1994)
Nickel		No Toxicity Value	--	2.60E-04	CalEPA	2.00E-02	IRIS	9.00E-02	ATSDR	4.00E-02	USEPA (2004) (RAGS Part E)	--	8.00E-04	1.00E-02	DTSC (1994)
Silver		No Toxicity Value	--	No Toxicity Value	--	5.00E-03	IRIS	No Toxicity Value	--	4.00E-02	USEPA (2004) (RAGS Part E)	--	2.00E-04	1.00E-02	DTSC (1994)
Thallium		No Toxicity Value	--	No Toxicity Value	--	1.00E-05	Screening PPRTV	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	1.00E-05	1.00E-02	DTSC (1994)
Vanadium		No Toxicity Value	--	No Toxicity Value	--	5.00E-03	MW-adjusted from vanadium pentoxide; (USEPA RSL table)	1.00E-01	ATSDR	2.60E-02	USEPA (2004) (RAGS Part E)	--	1.30E-04	1.00E-02	DTSC (1994)
Zinc		No Toxicity Value	--	No Toxicity Value	--	3.00E-01	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-01	1.00E-02	DTSC (1994)
PCBs												--	--		
Total PCBs as Aroclors (MDL-based)		2.00E+00	IRIS	5.70E-04	IRIS (high risk)	2.00E-05	(Aroclor 1254) USEPA RSL June 2015	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	2.00E+00	2.00E-05	1.40E-01	USEPA (2004) (Exhibit 3-4)
Total PCBs as Congeners (KM-based, capped)		2.00E+00	IRIS	5.70E-04	IRIS (high risk)	2.00E-05	(Aroclor 1254) USEPA RSL June 2015	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	2.00E+00	2.00E-05	1.40E-01	USEPA (2004) (Exhibit 3-4)
PCBs as Mammal TEQ (KM-capped, RDL-based)		1.30E+05	2,3,7,8-TCDD; CalEPA	3.80E+01	2,3,7,8-TCDD; CalEPA	7.00E-10	IRIS	4.00E-05	2,3,7,8-TCDD; CalEPA	1.00E+00	USEPA (2004) (RAGS Part E)	1.30E+05	7.00E-10	3.00E-02	USEPA (2004) (Exhibit 3-4)
Butyltins												--	--		
Dibutyltin dichloride		No Toxicity Value	--	No Toxicity Value	--	3.00E-04	PPRTV	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-04	1.00E-01	RSL (2013-05)
Tributyltin chloride		No Toxicity Value	--	No Toxicity Value	--	3.00E-04	PPRTV	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-04	1.00E-01	RSL (2013-05)
Pesticides												--	--		
4,4'-DDD		2.40E-01	IRIS	6.90E-05	CalEPA	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	2.40E-01	--	1.00E-01	RSL (2013-05)
4,4'-DDE		3.40E-01	IRIS	9.70E-05	CalEPA	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	3.40E-01	--	1.00E-01	RSL (2013-05)
4,4'-DDT		3.40E-01	IRIS	9.70E-05	IRIS	5.00E-04	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	3.40E-01	5.00E-04	3.00E-02	RSL (2013-05)
BHC (beta)		1.10E+00	CalEPA	3.10E-04	CalEPA	3.00E-04	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	1.10E+00	3.00E-04	4.00E-02	RSL (2013-05)
BHC (gamma) Lindane		1.10E+00	CalEPA	3.10E-04	CalEPA	3.00E-04	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	1.10E+00	3.00E-04	4.00E-02	RSL (2013-05)
Chlordane (alpha)		3.50E-01	technical chlordane; IRIS	1.00E-04	technical chlordane; IRIS	5.00E-04	technical chlordane; IRIS	7.00E-01	technical chlordane; IRIS	1.00E+00	USEPA (2004) (RAGS Part E)	3.50E-01	5.00E-04	4.00E-02	USEPA (2004) (Exhibit 3-4)
Chlordane (gamma)		3.50E-01	technical chlordane; IRIS	1.00E-04	technical chlordane; IRIS	5.00E-04	technical chlordane; IRIS	7.00E-01	technical chlordane; IRIS	1.00E+00	USEPA (2004) (RAGS Part E)	3.50E-01	5.00E-04	4.00E-02	USEPA (2004) (Exhibit 3-4)
Dieldrin		1.60E+01	IRIS	4.60E-03	IRIS	5.00E-05	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	1.60E+01	5.00E-05	1.00E-01	RSL (2013-05)
Endosulfan I		No Toxicity Value	--	No Toxicity Value	--	6.00E-03	Endosulfan; IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	6.00E-03	1.00E-01	USEPA (2004) (Exhibit 3-4)
Endrin Aldehyde		No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	--	1.00E-02	endrin surrogate
Endrin		No Toxicity Value	--	No Toxicity Value	--	3.00E-04	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-04	1.00E-01	RSL (2013-05)
Methoxychlor		No Toxicity Value	--	No Toxicity Value	--	5.00E-03	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	5.00E-03	1.00E-01	RSL (2013-05)
TPH												--	--		
Diesel Range Organics		No Toxicity Value	--	No Toxicity Value	--	2.00E-02	average, USEPA	1.00E+02	average, USEPA	1.00E+00	USEPA (2004) (RAGS Part E)	--	2.00E-02	0.00E+00	RSL (2013-05)
SVOCs and PAHs												--	--		
cPAHs as BaPEQ (KM-capped, MDL-based)	M	7.30E+00	IRIS	1.10E-03	CalEPA	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	7.30E+00	--	1.30E-01	USEPA (2004) (Exhibit 3-4)
Anthracene		No Toxicity Value	--	No Toxicity Value	--	3.00E-01	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-01	1.30E-01	USEPA (2004) (Exhibit 3-4)
Fluoranthene		No Toxicity Value	--	No Toxicity Value	--	4.00E-02	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	4.00E-02	1.30E-01	USEPA (2004) (Exhibit 3-4)
Phenanthrene		No Toxicity Value	--	No Toxicity Value	--	3.00E-01	anthracene surrogate; IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-01	1.30E-01	USEPA (2004) (Exhibit 3-4)
pyrene		No Toxicity Value	--	No Toxicity Value	--	3.00E-02	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-02	1.30E-01	USEPA (2004) (Exhibit 3-4)
Acenaphthene		No Toxicity Value	--	No Toxicity Value	--	6.00E-02	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	6.00E-02	1.30E-01	USEPA (2004) (Exhibit 3-4)
Fluorene		No Toxicity Value	--	No Toxicity Value	--	4.00E-02	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	4.00E-02	1.30E-01	USEPA (2004) (Exhibit 3-4)
Bis(2-ethylhexyl) Phthalate		1.40E-02	IRIS	2.40E-06	CalEPA	2.00E-02	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	1.40E-02	2.00E-02	1.00E-01	RSL (2013-05)
Butyl Benzyl Phthalate		1.90E-03	PPRTV	No Toxicity Value	--	2.00E-01	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	1.90E-03	2.00E-01	1.00E-01	RSL (2013-05)
Carbazole		2.00E-02	HEAST (RAIS)	No Toxicity Value	--	No Toxicity Value	--	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	2.00E-02	--	1.00E-01	USEPA (2004) (Exhibit 3-4)
Di-n-butyl Phthalate		No Toxicity Value	--	No Toxicity Value	--	1.00E-01	IRIS	No Toxicity Value	--	1.00E+00	USEPA (2004) (RAGS Part E)	--	1.00E-01	1.00E-01	RSL (2013-05)
p-cresol (4-Methylphenol)		No Toxicity Value	--	No Toxicity Value	--	1.00E-01	ATSDR	6.00E+02	cresol mixtures; CalEPA	1.00E+00	USEPA (2004) (RAGS Part E)	--	1.00E-01	1.00E-01	RSL (2013-05)
Phenol		No Toxicity Value	--	No Toxicity Value	--	3.00E-01	IRIS	2.00E+02	CalEPA	1.00E+00	USEPA (2004) (RAGS Part E)	--	3.00E-01	1.00E-01	RSL (2013-05)

[a] Reference dose adjusted for oral absorption: RfDd = RfDo × OAF (USEPA. 2004. RAGS Part E. EPA/540/R/99/005).
[b] Slope factor adjusted for oral absorption: SFd = SFo ÷ OAF (USEPA. 2004. RAGS Part E. EPA/540/R/99/005).

Notes:

"--" = quantitative toxicity values are not available
µg/m3 = micrograms per cubic meters
ABSd = Absorption Factor (dermal)
BaPEQ = benzo(a)pyrene equivalent(s)
BHC = benzene hexachloride
cPAH = carcinogenic polycyclic aromatic hydrocarbon
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
IUR = inhalation unit risk
KM = Kaplan-Meier
MDL = method detection limit
mg/kg-d = milligrams per kilogram-day
OAF = oral absorbtion factor
PCBs = polychlorinated biphenyls
RAIS = Risk Assessment Information System
RDL = reported detection limit
RfC = reference concentration
RfDd = reference dose (dermal)
RfDo = reference dose (oral)
SFD = slope factor (dermal)
Sfo = slope factor (oral)
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalence

Sources:

ATSDR = Agency for Toxic Substances and Disease Registry, Minimal Risk Level (MRL) (http://www.atsdr.cdc.gov/mrls/)
CalEPA = California Environmental Protection Agency Office of Environmental Health hazard Assessment (OEHHA) Toxicity Database (Website) available at: http://oehha.ca.gov/tcdb/index.asp
DTSC 1994 = CalEPA Department of Toxic Substances and Control Preliminary Endangerment Assessment (PEA) Gudance Manual January 1994.
HEAST = USEPA Health Effects Assessment Summary Tables, FY 1997 Update (EPA-540-R-97-036)
IRIS = USEPA Integrated Risk Information System (http://www.epa.gov/iris/)
ODEQ 2007= Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Oregon Dept. of Environmental Quality. 07-LQ-023A. Updated April 3.
PPRTV = Provisional Peer-Reviewed Reference Toxicity Value, as cited in USEPA's Regional Screening Level (RSL) tables (http://www.epa.gov/region09/superfund/prg/)
RIVM = Provisional Tolerable Air Concentration (RIVM [Netherlands' National Institute for Public Health and the Environment] value in ITER/TOXNET database; http://toxnet.nlm.nih.gov/)
RSL (2013-05)= EPA Regional Screening Level May 2013
USEPA RSL, 2015 (http://www.epa.gov/region9/superfund/prg/)
USEPA 2004 = Risk Assessment Guidance for Superfund: Human Health Evaluation Manual. Part E: Supplemental Guidance for Dermal Evaluation. Final. PB99-963312. July.

Table 2-6.1
Tribal Subsistence Smallmouth Bass Fisher (Child and Adult): RME Summary

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Aluminum	5.4E+00	No Toxicity Value	--	1.0E+00	2.9E-03	6.5E-03
Antimony	1.0E-02	No Toxicity Value	--	4.0E-04	1.4E-02	3.2E-02
Barium	2.6E+00	No Toxicity Value	--	2.0E-01	7.2E-03	1.6E-02
Chromium (III)	1.9E-01	No Toxicity Value	--	1.5E+00	7.0E-05	1.6E-04
Copper	9.3E-01	No Toxicity Value	--	4.0E-02	1.3E-02	2.8E-02
Mercury	2.5E-01	No Toxicity Value	--	1.0E-04	**1.3E+00**	**3.0E+00**
Zinc	1.4E+01	No Toxicity Value	--	3.0E-01	2.6E-02	5.8E-02
PCB Aroclors						
Total PCBs as Aroclors (MDL-based)	2.5E+01	2.0E+00	**1.3E-02**	2.0E-05	**6.8E+02**	**1.5E+03**
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	1.3E+05	**1.6E-02**	7.0E-10	**3.6E+02**	**8.1E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	2.0E+00	**2.5E-02**	2.0E-05	**1.3E+03**	**2.9E+03**
Pesticides						
4,4'-DDD	4.5E-03	2.4E-01	2.8E-07	No Toxicity Value	--	--
4,4'-DDE	3.9E-02	3.4E-01	**3.5E-06**	No Toxicity Value	--	--
4,4'-DDT	5.2E-03	3.4E-01	4.6E-07	5.0E-04	5.7E-03	1.3E-02
BHC (beta)	7.9E-04	1.8E+00	3.7E-07	No Toxicity Value	--	--
BHC (gamma) Lindane	6.7E-04	1.1E+00	1.9E-07	3.0E-04	1.2E-03	2.7E-03
Chlordane (alpha)	3.0E-04	3.5E-01	2.7E-08	5.0E-04	3.3E-04	7.3E-04
Chlordane (gamma)	3.2E+00	3.5E-01	**2.9E-04**	5.0E-04	**3.5E+00**	**7.8E+00**
Dieldrin	5.5E-01	1.6E+01	**2.3E-03**	5.0E-05	**6.0E+00**	**1.3E+01**
Endosulfan I	5.4E-02	No Toxicity Value	--	6.0E-03	5.0E-03	1.1E-02
Endrin	8.3E-01	No Toxicity Value	--	3.0E-04	**1.5E+00**	**3.4E+00**
Endrin Aldehyde	2.6E-01	No Toxicity Value	--	No Toxicity Value	--	--
Methoxychlor	6.1E-04	No Toxicity Value	--	5.0E-03	6.7E-05	1.5E-04
SVOCs and PAHs						
bis(2-ethylhexyl) phthalate	2.1E-01	1.4E-02	7.7E-07	2.0E-02	5.7E-03	1.3E-02
cPAHs as BaPEQ (KM-capped, MDL-based)	2.8E-03	7.3E+00	**1.8E-05**	No Toxicity Value	--	--
p-cresol (4-Methylphenol)	3.7E-02	No Toxicity Value	--	1.0E-01	2.0E-04	4.5E-04

Table 2-6.1
Tribal Subsistence Smallmouth Bass Fisher (Child and Adult): RME Summary

	Cancer Risk	Adult Hazard Index	Child Hazard Index
Pathway Sum Excluding PCBs:	**3E-03**	**12**	**28**
Pathway Sum with Total PCBs as Aroclors:	**2E-02**	**692**	**1,542**
Pathway Sum with PCBs as TEQ:	**2E-02**	**375**	**835**
Pathway Sum with Total PCBs as Congeners:	**3E-02**	**1303**	**2,904**

Notes:
Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
Cfish = concentration in fish
COPC = chemical of potential concern
cPAH = carcinogenic PAH
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
RME = reasonable maximum exposure
Sf_o = oral slope factor
SVOC = semivolatile organic compound
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1.

Table 2-6.2
Tribal Subsistence Smallmouth Bass Fisher (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

Analyte	C_{fish} (mg/kg)	Mother		Infant	
		Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.5E+01	7.8E-03	6.8E+02	7.8E-03	**1.7E+04**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	9.4E-03	3.6E+02	**9.4E-03**	**7.2E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	1.5E-02	1.3E+03	**1.5E-02**	**3.2E+04**
Pesticides					
4,4'-DDD	4.5E-03	1.7E-07	--	1.2E-09	--
4,4'-DDE	3.9E-02	2.1E-06	--	1.5E-08	--
4,4'-DDT	5.2E-03	2.8E-07	5.7E-03	1.9E-09	1.1E-02
			Pathway Sum Excluding PCBs:	2E-08	0.011
			Pathway Sum with Total PCBs as Aroclors:	**8E-03**	**16,985**
			Pathway Sum with PCBs as TEQ:	**9E-03**	**724**
			Pathway Sum with Total PCBs as Congeners:	**1E-02**	**32,268**

Table 2-6.2
Tribal Subsistence Smallmouth Bass Fisher (Nursing Infant): RME Summary

Notes:

Nursing infant’s risks and hazards are presented as a function of Mother’s risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
C_{fish} = concentration in fish
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
RME = reasonable maximum exposure
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-6.3
Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary

Analyte	C_{fish} (mg/kg)	SF_o (mg/kg-day)$^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Aluminum	5.4E+00	No Toxicity Value	--	1.0E+00	1.1E-03	1.7E-03
Antimony	1.0E-02	No Toxicity Value	--	4.0E-04	5.1E-03	8.5E-03
Barium	2.6E+00	No Toxicity Value	--	2.0E-01	2.6E-03	4.3E-03
Chromium (III)	1.9E-01	No Toxicity Value	--	1.5E+00	2.5E-05	4.2E-05
Copper	9.3E-01	No Toxicity Value	--	4.0E-02	4.6E-03	7.6E-03
Mercury	2.5E-01	No Toxicity Value	--	1.0E-04	4.9E-01	8.0E-01
Zinc	1.4E+01	No Toxicity Value	--	3.0E-01	9.3E-03	1.5E-02
PCB Aroclors						
Total PCBs as Aroclors (MDL-based)	2.5E+01	2.0E+00	**1.8E-03**	2.0E-05	**2.5E+02**	**4.1E+02**
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	1.3E+05	**2.2E-03**	7.0E-10	**1.3E+02**	**2.2E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	2.0E+00	**3.4E-03**	2.0E-05	**4.7E+02**	**7.7E+02**
Pesticides						
4,4'-DDD	4.5E-03	2.4E-01	4.0E-08	No Toxicity Value	--	--
4,4'-DDE	3.9E-02	3.4E-01	4.8E-07	No Toxicity Value	--	--
4,4'-DDT	5.2E-03	3.4E-01	6.4E-08	5.0E-04	2.0E-03	3.4E-03
BHC (beta)	7.9E-04	1.8E+00	5.2E-08	No Toxicity Value	--	--
BHC (gamma) Lindane	6.7E-04	1.1E+00	2.7E-08	3.0E-04	4.4E-04	7.2E-04
Chlordane (alpha)	3.0E-04	3.5E-01	3.8E-09	5.0E-04	1.2E-04	2.0E-04
Chlordane (gamma)	3.2E+00	3.5E-01	**4.1E-05**	5.0E-04	**1.3E+00**	**2.1E+00**
Dieldrin	5.5E-01	1.6E+01	**3.2E-04**	5.0E-05	**2.2E+00**	**3.6E+00**
Endosulfan I	5.4E-02	No Toxicity Value	--	6.0E-03	1.8E-03	3.0E-03
Endrin	8.3E-01	No Toxicity Value	--	3.0E-04	5.4E-01	9.0E-01
Endrin Aldehyde	2.6E-01	No Toxicity Value	--	No Toxicity Value	--	--
Methoxychlor	6.1E-04	No Toxicity Value	--	5.0E-03	2.4E-05	4.0E-05
SVOCs and PAHs						
bis(2-ethylhexyl) phthalate	2.1E-01	1.4E-02	1.1E-07	2.0E-02	2.1E-03	3.4E-03
cPAHs as BaPEQ (KM-capped, MDL-based)	2.8E-03	7.3E+00	**5.4E-06**	No Toxicity Value	--	--
p-cresol (4-Methylphenol)	3.7E-02	No Toxicity Value	--	1.0E-01	7.3E-05	1.2E-04

Table 2-6.3
Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary

	Cancer Risk	Adult Hazard Index	Child Hazard Index
Pathway Sum Excluding PCBs:	**4E-04**	**4.5**	**7.4**
Pathway Sum with Total PCBs as Aroclors:	**2E-03**	**250**	**413**
Pathway Sum with PCBs as TEQ:	**3E-03**	**135**	**223**
Pathway Sum with Total PCBs as Congeners:	**4E-03**	**470**	**778**

Notes:
Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
Cfish = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
Sf_o = oral slope factor
SVOC = semivolatile organic compound
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-6.4
Tribal Subsistence Smallmouth Bass Fisher (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

Analyte	C_{fish} (mg/kg)	Mother		Infant	
		Cancer Risk	**Hazard Quotient**	**Cancer Risk**	**Hazard Quotient**
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.5E+01	4.2E-04	2.5E+02	**4.2E-04**	**6.1E+03**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	5.1E-04	1.3E+02	**5.1E-04**	**2.6E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	8.0E-04	4.7E+02	**8.0E-04**	**1.2E+04**
Pesticides					
4,4'-DDD	4.5E-03	9.2E-09	--	6.5E-11	--
4,4'-DDE	3.9E-02	1.1E-07	--	7.9E-10	--
4,4'-DDT	5.2E-03	1.5E-08	2.0E-03	1.0E-10	4.1E-03
			Pathway Sum Excluding PCBs:	1E-09	4.1E-03
			Pathway Sum with Total PCBs as Aroclors:	**4E-04**	**6,127**
			Pathway Sum with PCBs as TEQ:	**5E-04**	**261**
			Pathway Sum with Total PCBs as Congeners:	**8E-04**	**11,640**

Table 2-6.4
Tribal Subsistence Smallmouth Bass Fisher (Nursing Infant): CTE Summary

Notes:
Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.

"--" = data not available or not calculated
Cfish = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PCB = polychlorinated biphenyl
RBC = risk-based concentration
RDL = reported detection limit
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-7.1
Non-Tribal Recreational Smallmouth Bass Fisher (Child and Adult): RME Summary

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Aluminum	5.4E+00	No Toxicity Value	--	1.0E+00	1.5E-03	2.5E-03
Antimony	1.0E-02	No Toxicity Value	--	4.0E-04	7.3E-03	1.2E-02
Barium	2.6E+00	No Toxicity Value	--	2.0E-01	3.7E-03	6.2E-03
Chromium (III)	1.9E-01	No Toxicity Value	--	1.5E+00	3.6E-05	6.1E-05
Copper	9.3E-01	No Toxicity Value	--	4.0E-02	6.5E-03	1.1E-02
Mercury	2.5E-01	No Toxicity Value	--	1.0E-04	6.9E-01	1.2E+00
PCB Aroclors						
Total PCBs as Aroclors (MDL-based)	2.5E+01	2.0E+00	**6.0E-03**	2.0E-05	**3.5E+02**	**5.9E+02**
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	1.3E+05	**7.2E-03**	7.0E-10	**1.8E+02**	**3.1E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	2.0E+00	**1.1E-02**	2.0E-05	**6.6E+02**	**1.1E+03**
Pesticides						
4,4'-DDD	4.5E-03	2.4E-01	1.3E-07	No Toxicity Value	--	--
4,4'-DDE	3.9E-02	3.4E-01	**1.6E-06**	No Toxicity Value	--	--
4,4'-DDT	5.2E-03	3.4E-01	2.1E-07	5.0E-04	2.9E-03	4.9E-03
BHC (beta)	7.9E-04	1.8E+00	1.7E-07	No Toxicity Value	--	--
BHC (gamma) Lindane	6.7E-04	1.1E+00	8.8E-08	3.0E-04	6.2E-04	1.0E-03
Chlordane (alpha)	3.0E-04	3.5E-01	1.3E-08	5.0E-04	1.7E-04	2.8E-04
Chlordane (gamma)	3.2E+00	3.5E-01	**1.3E-04**	5.0E-04	**1.8E+00**	**3.0E+00**
Dieldrin	5.5E-01	1.6E+01	**1.1E-03**	5.0E-05	**3.1E+00**	**5.2E+00**
Endosulfan I	5.4E-02	No Toxicity Value	--	6.0E-03	2.5E-03	4.3E-03
Endrin	8.3E-01	No Toxicity Value	--	3.0E-04	7.7E-01	1.3E+00
Endrin Aldehyde	2.6E-01	No Toxicity Value	--	No Toxicity Value	--	--
Methoxychlor	6.1E-04	No Toxicity Value	--	5.0E-03	3.4E-05	5.8E-05
SVOCs and PAHs						
cPAHs as BaPEQ (KM-capped, MDL-based)	2.8E-03	7.3E+00	**7.8E-06**	No Toxicity Value	--	--
p-cresol (4-Methylphenol)	3.7E-02	No Toxicity Value	--	1.0E-01	1.0E-04	1.7E-04

	Cancer Risk	Adult Hazard Index	Child Hazard Index
Pathway Sum Excluding PCBs:	**1E-03**	**6.3**	**11**
Pathway Sum with Total PCBs as Aroclors:	**7E-03**	**353**	**598**
Pathway Sum with PCBs as TEQ:	**8E-03**	**191**	**324**
Pathway Sum with Total PCBs as Congeners:	**1E-02**	**665**	**1126**

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.

EPCs from Table 1-6.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5

Table 2-7.1
Non-Tribal Recreational Smallmouth Bass Fisher (Child and Adult): RME Summary

"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
C_{fish} = concentration in fish
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
RME = reasonable maximum exposure
Sf_o = oral slope factor
SVOC = semivolatile organic compound
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-7.2
Non-Tribal Recreational Smallmouth Bass Fisher (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010	
Carcinogenic IRAFc				
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk = Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010	
PCB TEQ	IRAFc_teq	1	ODEQ 2010	
Noncancer IRAFnc				
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard = Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010	
PCB TEQ	IRAFnc_teq	2	ODEQ 2010	

Analyte	C_{fish} (mg/kg)	Mother		Infant	
		Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.5E+01	4.0E-03	3.5E+02	**4.0E-03**	**8.7E+03**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	4.8E-03	1.8E+02	**4.8E-03**	**3.7E+02**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	7.5E-03	6.6E+02	**7.5E-03**	**1.6E+04**
Pesticides					
4,4'-DDD	4.5E-03	8.7E-08	--	6.1E-10	--
4,4'-DDE	3.9E-02	1.1E-06	--	7.4E-09	--
4,4'-DDT	5.2E-03	1.4E-07	2.9E-03	9.9E-10	5.8E-03
			Pathway Sum Excluding PCBs:	9E-09	6E-03
			Pathway Sum with Total PCBs as Aroclors:	**4E-03**	**8,664**
			Pathway Sum with PCBs as TEQ:	**5E-03**	**369**
			Pathway Sum with Total PCBs as Congeners:	**8E-03**	**16,460**

Notes:

Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.

EPCs from Table 1-6.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5.

Table 2-7.2
Non-Tribal Recreational Smallmouth Bass Fisher (Nursing Infant): RME Summary

"--" = data not available or not calculated
C_{fish} = concentration in fish
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
RME = reasonable maximum exposure
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-7.3
Non-Tribal Recreational Smallmouth Bass Fisher (Child and Adult): CTE Summary

Analyte	C_{fish} (mg/kg)	SF_o (mg/kg-day)$^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Aluminum	5.4E+00	No Toxicity Value	--	1.0E+00	2.7E-04	5.0E-04
Antimony	1.0E-02	No Toxicity Value	--	4.0E-04	1.3E-03	2.4E-03
Barium	2.6E+00	No Toxicity Value	--	2.0E-01	6.6E-04	1.2E-03
Chromium (III)	1.9E-01	No Toxicity Value	--	1.5E+00	6.4E-06	1.2E-05
Copper	9.3E-01	No Toxicity Value	--	4.0E-02	1.2E-03	2.2E-03
Mercury	2.5E-01	No Toxicity Value	--	1.0E-04	1.2E-01	2.3E-01
PCB Aroclors						
Total PCBs as Aroclors (MDL-based)	2.5E+01	2.0E+00	**5.0E-04**	2.0E-05	**6.2E+01**	**1.2E+02**
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	1.3E+05	**6.1E-04**	7.0E-10	**3.3E+01**	**6.2E+01**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	2.0E+00	**9.6E-04**	2.0E-05	**1.2E+02**	**2.2E+02**
Pesticides						
4,4'-DDD	4.5E-03	2.4E-01	1.1E-08	No Toxicity Value	--	--
4,4'-DDE	3.9E-02	3.4E-01	1.4E-07	No Toxicity Value	--	--
4,4'-DDT	5.2E-03	3.4E-01	1.8E-08	5.0E-04	5.2E-04	9.7E-04
BHC (beta)	7.9E-04	1.8E+00	1.4E-08	No Toxicity Value	--	--
BHC (gamma) Lindane	6.7E-04	1.1E+00	7.4E-09	3.0E-04	1.1E-04	2.1E-04
Chlordane (alpha)	3.0E-04	3.5E-01	1.1E-09	5.0E-04	3.0E-05	5.6E-05
Chlordane (gamma)	3.2E+00	3.5E-01	**1.1E-05**	5.0E-04	3.2E-01	6.0E-01
Dieldrin	5.5E-01	1.6E+01	**8.9E-05**	5.0E-05	5.5E-01	1.0E+00
Endosulfan I	5.4E-02	No Toxicity Value	--	6.0E-03	4.6E-04	8.5E-04
Endrin	8.3E-01	No Toxicity Value	--	3.0E-04	1.4E-01	2.6E-01
Endrin Aldehyde	2.6E-01	No Toxicity Value	--	No Toxicity Value	--	--
Methoxychlor	6.1E-04	No Toxicity Value	--	5.0E-03	6.2E-06	1.1E-05
SVOCs and PAHs						
cPAHs as BaPEQ (KM-capped, MDL-based)	2.8E-03	7.3E+00	**1.5E-06**	No Toxicity Value	--	--
p-cresol (4-Methylphenol)	3.7E-02	No Toxicity Value	--	1.0E-01	1.9E-05	3.4E-05
			Cancer Risk		Adult Hazard Index	Child Hazard Index
		Pathway Sum Excluding PCBs:	**1E-04**		**1.1**	**2.1**
		Pathway Sum with Total PCBs as Aroclors:	**6E-04**		**64**	**118**
		Pathway Sum with PCBs as TEQ:	**7E-04**		**34**	**64**
		Pathway Sum with Total PCBs as Congeners:	**1E-03**		**120**	**222**

Table 2-7.3
Non-Tribal Recreational Smallmouth Bass Fisher (Child and Adult): CTE Summary

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.
"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
C_{fish} = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
Sf_o = oral slope factor
SVOC = semivolatile organic compound
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-7.4
Non-Tribal Recreational Smallmouth Bass Fisher (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	nfant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

		Mother		Infant	
Analyte	C_{fish} (mg/kg)	Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.5E+01	1.1E-04	6.2E+01	**1.1E-04**	**1.6E+03**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.6E-04	1.3E-04	3.3E+01	**1.3E-04**	**6.7E+01**
Total PCBs as Congeners (KM-based, capped)	4.7E+01	2.0E-04	1.2E+02	**2.0E-04**	**3.0E+03**
Pesticides					
4,4'-DDD	4.5E-03	2.4E-09	--	1.6E-11	--
4,4'-DDE	3.9E-02	2.9E-08	--	2.0E-10	--
4,4'-DDT	5.2E-03	3.8E-09	5.2E-04	2.7E-11	1.0E-03
			Pathway Sum Excluding PCBs:	2E-10	1.0E-03
			Pathway Sum with Total PCBs as Aroclors:	**1E-04**	**1562**
			Pathway Sum with PCBs as TEQ:	**1E-04**	**67**
			Pathway Sum with Total PCBs as Congeners:	**2E-04**	**2967**

Notes:
Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.

Table 2-7.4
Non-Tribal Recreational Smallmouth Bass Fisher (Nursing Infant): CTE Summary

"--" = data not available or not calculated
C_{fish} = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
TEQ = toxicity equivalence

B**olded** values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-8.1
Non-Tribal Recreational Crayfish Fisher (Child and Adult): RME Summary

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Arsenic	5.2E-01	1.5E+00	**7.2E-05**	3.0E-04	3.7E-01	6.3E-01
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based	1.1E-06	1.3E+05	**1.3E-05**	7.0E-10	3.4E-01	5.7E-01
Total PCBs as Congeners (KM-based, capped)	1.9E-02	2.0E+00	**3.5E-06**	2.0E-05	2.0E-01	3.4E-01
			Cancer Risk		**Adult Hazard Index**	**Child Hazard Index**
		Pathway Sum Excluding PCBs:	**7E-05**		0.37	0.63
		Pathway Sum with PCBs as TEQ:	**9E-05**		0.71	1.2
		Pathway Sum with Total PCBs as Congeners:	**8E-05**		0.57	0.97

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
C_{fish} = concentration in fish
EPC = exposure point concentration
HQ = hazard quotient
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
RME = reasonable maximum exposure
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-8.2
Non-Tribal Recreational Crayfish Fisher (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010	
Carcinogenic IRAFc				
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk = Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010	
PCB TEQ	IRAFc_teq	1	ODEQ 2010	
Noncancer IRAFnc				
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	fant Noncancer Hazard = Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010	
PCB TEQ	IRAFnc_teq	2	ODEQ 2010	

Analyte	C_{fish} (mg/kg)	Mother		Infant	
		Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-06	8.8E-06	3.4E-01	**8.8E-06**	6.7E-01
Total PCBs as Congeners (KM-based, capped)	1.9E-02	2.3E-06	2.0E-01	**2.3E-06**	**5.0E+00**
			Pathway Sum with PCBs as TEQ:	**9E-06**	7E-01
			Pathway Sum with Total PCBs as Congeners:	**2E-06**	**5.0**

Notes:

Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.

C_{fish} = concentration in fish
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
PCB = poly
PCB = polychlorinated biphenyl
RDL = reported detection limit
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-8.3
Non-Tribal Recreational Crayfish Fisher (Child and Adult): CTE Summary

Analyte	C_{fish} (mg/kg)	SF_o (mg/kg-day)$^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Adult Noncancer Hazard (dimensionless)	Child Noncancer Hazard (dimensionless)
Metals						
Arsenic	5.2E-01	1.5E+00	**6.2E-06**	3.0E-04	6.8E-02	1.3E-01
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-06	1.3E+05	1.1E-06	7.0E-10	6.2E-02	1.1E-01
Total PCBs as Congeners (KM-based, capped)	1.9E-02	2.0E+00	3.0E-07	2.0E-05	3.7E-02	6.8E-02

	Cancer Risk		Adult Hazard Index	Child Hazard Index
Pathway Sum Excluding PCBs:	**6E-06**		0.068	0.13
Pathway Sum with PCBs as TEQ:	**7E-06**		0.13	0.24
Pathway Sum with Total PCBs as Congeners:	**6E-06**		0.11	0.19

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-3.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.

"--" = data not available or not calculated
C_{fish} = concentration in fish
CTE = central tendency exposure
EPC = exposure point concentration
HQ = hazard quotient
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
PCB = polychlorinated biphenyl
RDL = reported detection limit
RfD_o = oral reference dose
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-8.4
Non-Tribal Recreational Crayfish Fisher (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	fant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

Analyte	C_{fish} (mg/kg)	Mother		Infant	
		Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-06	2.4E-07	6.2E-02	2.4E-07	1.2E-01
Total PCBs as Congeners (KM-based, capped)	1.9E-02	6.3E-08	3.7E-02	6.3E-08	9.2E-01
			Pathway Sum with PCBs as TEQ:	2E-07	0.12
			Pathway Sum with Total PCBs as Congeners:	6E-08	0.92

Notes:
Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-3.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
C_{fish} = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped

Table 2-8.4
Non-Tribal Recreational Crayfish Fisher (Nursing Infant): CTE Summary

mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-9.1
Wader (Child and Adult): RME Summary

Analyte	Soil EPC (mg/kg)	Mutagen?	Cancer-Risk Estimate Ingestion	Cancer-Risk Estimate Dermal	Cancer-Risk Estimate Multi-Pathway	Noncancer Hazard Estimate (Child) Ingestion	Noncancer Hazard Estimate (Child) Dermal	Noncancer Hazard Estimate (Child) Multi-Pathway	Noncancer Hazard Estimate (Adult) Ingestion	Noncancer Hazard Estimate (Adult) Dermal	Noncancer Hazard Estimate (Adult) Multi-Pathway
Inorganic Constituents											
Antimony	0.42	0	--	--		5.7E-03	2.6E-03	8.3E-03	5.4E-04	3.9E-04	9.3E-04
Arsenic	7.7	0	**7.1E-06**	**1.7E-06**	**8.8E-06**	1.4E-01	2.9E-02	1.7E-01	1.3E-02	4.3E-03	1.7E-02
Cadmium	0.54	0	--	--		3.0E-03	8.1E-04	3.8E-03	2.8E-04	1.2E-04	4.0E-04
Chromium	145	0	--	--		--	--	--	--	--	--
Cobalt	11	0	--	--		2.0E-01	1.4E-02	2.2E-01	1.9E-02	2.1E-03	2.1E-02
Copper	33	0	--	--		4.5E-03	3.1E-04	4.9E-03	4.3E-04	4.6E-05	4.7E-04
Lead	--	0	--	--		--	--	--	--	--	--
Manganese	511	0	--	--		1.2E-01	2.0E-01	3.2E-01	1.1E-02	3.0E-02	4.1E-02
Mercury	0.11	0	--	--		3.9E-03	2.6E-04	4.1E-03	3.6E-04	4.0E-05	4.0E-04
Nickel	119	0	--	--		3.3E-02	5.6E-02	8.8E-02	3.1E-03	8.3E-03	1.1E-02
Silver	2.0	0	--	--		2.2E-03	3.7E-03	5.9E-03	2.1E-04	5.6E-04	7.7E-04
Thallium	0.24	0	--	--		1.3E-01	9.1E-03	1.4E-01	1.3E-02	1.4E-03	1.4E-02
Vanadium	55	0	--	--		6.1E-02	1.6E-01	2.2E-01	5.7E-03	2.4E-02	3.0E-02
Zinc	124	0	--	--		2.3E-03	1.5E-04	2.4E-03	2.1E-04	2.3E-05	2.4E-04
PCBs											
Total PCBs as Aroclors (MDL-based)	0.17	0	2.1E-07	2.3E-07	4.4E-07	4.7E-02	4.5E-02	9.2E-02	4.4E-03	6.7E-03	1.1E-02
Total PCBs as Congeners (KM-based, capped)	0.81	0	1.0E-06	1.1E-06	**2.1E-06**	2.2E-01	2.1E-01	4.3E-01	2.1E-02	3.2E-02	5.2E-02
PCBs as Mammal TEQ (KM-capped, RDL-based)	0.0000030	0	2.4E-07	5.6E-08	2.9E-07	2.3E-02	4.8E-03	2.8E-02	2.2E-03	7.1E-04	2.9E-03
Butyltins											
Dibutyltin dichloride	0.0046	0	--	--		8.4E-05	5.7E-05	1.4E-04	7.9E-06	8.6E-06	1.6E-05
Tributyltin chloride	0.013	0	--	--		2.4E-04	1.6E-04	4.0E-04	2.2E-05	2.4E-05	4.7E-05
Pesticides											
4,4'-DDE	0.0012	0	2.5E-10	2.0E-10	4.5E-10	--	--	--	--	--	--
4,4'-DDT	0.041	0	8.6E-09	2.0E-09	1.1E-08	4.5E-04	9.2E-05	5.4E-04	4.2E-05	1.4E-05	5.6E-05
BHC (gamma) Lindane	0.000080	0	5.4E-11	1.7E-11	7.1E-11	1.5E-06	4.0E-07	1.9E-06	1.4E-07	6.0E-08	2.0E-07
Chlordane (gamma)	0.010	0	2.2E-09	6.7E-10	2.8E-09	1.1E-04	3.0E-05	1.4E-04	1.0E-05	4.5E-06	1.5E-05
Endrin Aldehyde	0.0032	0	--	--		--	--	--	--	--	--
Endrin	0.0027	0	--	--		4.9E-05	3.4E-05	8.3E-05	4.6E-06	5.0E-06	9.7E-06
TPH											
Diesel Range Organics	26	0	--	--		7.0E-03	0.0E+00	7.0E-03	6.6E-04	0.0E+00	6.6E-04
SVOCs and PAHs											
cPAHs as BaPEQ (KM-capped, MDL-based)	0.17	M	**3.5E-06**	**3.3E-06**	**6.9E-06**	--	--	--	--	--	--
Anthracene	0.017	0	--	--		3.1E-07	2.7E-07	5.8E-07	2.9E-08	4.1E-08	7.0E-08
Fluoranthene	0.65	0	--	--		8.9E-05	7.9E-05	1.7E-04	8.4E-06	1.2E-05	2.0E-05
Phenanthrene	0.075	0	--	--		1.4E-06	1.2E-06	2.6E-06	1.3E-07	1.8E-07	3.1E-07
pyrene	0.76	0	--	--		1.4E-04	1.2E-04	2.6E-04	1.3E-05	1.8E-05	3.1E-05
Acenaphthene	0.0059	0	--	--		5.4E-07	4.8E-07	1.0E-06	5.0E-08	7.2E-08	1.2E-07
Fluorene	0.014	0	--	--		1.9E-06	1.7E-06	3.6E-06	1.8E-07	2.6E-07	4.3E-07
Bis(2-ethylhexyl) Phthalate	2.8	0	2.4E-08	1.9E-08	4.2E-08	7.6E-04	5.2E-04	1.3E-03	7.1E-05	7.8E-05	1.5E-04
Butyl Benzyl Phthalate	0.010	0	1.2E-11	9.1E-12	2.1E-11	2.7E-07	1.9E-07	4.6E-07	2.6E-08	2.8E-08	5.4E-08
Carbazole	0.021	0	2.6E-10	2.0E-10	4.6E-10	--	--	--	--	--	--
Di-n-butyl Phthalate	0.022	0	--	--		1.2E-06	8.3E-07	2.0E-06	1.1E-07	1.2E-07	2.4E-07
p-cresol (4-Methylphenol)	0.036	0	--	--		2.0E-06	1.4E-06	3.3E-06	1.9E-07	2.0E-07	3.9E-07
Phenol	0.024	0	--	--		4.4E-07	3.0E-07	7.4E-07	4.1E-08	4.5E-08	8.6E-08

Table 2-9.1
Wader (Child and Adult): RME Summary

Analyte	Soil EPC (mg/kg)	Mutagen?	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer Hazard Estimate (Child): Ingestion	Noncancer Hazard Estimate (Child): Dermal	Noncancer Hazard Estimate (Child): Multi-Pathway	Noncancer Hazard Estimate (Adult): Ingestion	Noncancer Hazard Estimate (Adult): Dermal	Noncancer Hazard Estimate (Adult): Multi-Pathway
					Cancer Risk			**Hazard Index (Child)**			**Hazard Index (Adult)**
		Pathway Sum Excluding PCBs:			**1.6E-05**			1.2			0.14
		Pathway Sum with Total PCBs as Aroclors:			**1.6E-05**			1.3			0.15
		Pathway Sum with Total PCBs as Congeners:			**1.8E-05**			1.6			0.19
		Pathway Sum with PCBs as TEQ:			**1.6E-05**			1.2			0.14

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-3.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
RME = reasonable maximum exposure
SVOC = semivolatile organic compound
TEQ = toxicity equivalence
TPH = total petroleum hydrocarbons

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-9.2
Wader (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.004	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	0.6	ODEQ 2010		
PCB TEQ	IRAFc_teq	0.7	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	0.3	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	4	ODEQ 2010		
PCB TEQ	IRAFnc_teq	0.3	ODEQ 2010		

		Mother		Infant	
Analyte	$C_{sediment}$ (mg/kg)	**Cancer Risk**	**Hazard Quotient**	**Cancer Risk**	**Hazard Quotient**
DDx					
4,4'-DDE	1.2E-03	4.5E-10	--	1.8E-12	--
4,4'-DDT	4.1E-02	1.1E-08	5.4E-04	4.2E-11	1.6E-04
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	3.0E-06	2.9E-07	2.8E-02	2.1E-07	8.4E-03
Total PCBs as Congeners (KM-based, capped)	8.1E-01	2.1E-06	4.3E-01	**1.3E-06**	**1.7E+00**
Total PCBs as Aroclors (MDL-based)	1.7E-01	4.4E-07	9.2E-02	2.7E-07	3.7E-01
			Pathway Sum Excluding PCBs:	4.4E-11	1.6E-04
			Pathway Sum with Total PCBs as Aroclors:	2.7E-07	0.37
			Pathway Sum with Total PCBs as Congeners:	1.3E-06	**1.7**
			Pathway Sum with PCBs as TEQ:	2.1E-07	8.6E-03

Notes

Nursing infant’s risks and hazards are presented as a function of Mother’s risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-3.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

Table 2-9.2
Wader (Nursing Infant): RME Summary

"--" = data not available or not calculated
$C_{sediment}$ = concentration in sediment
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
RME = reasonable maximum exposure
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-9.3
Wader (Child and Adult): CTE Summary

Analyte	Soil EPC (mg/kg)	Mutagen?	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer Hazard Estimate (Child): Ingestion	Noncancer Hazard Estimate (Child): Dermal	Noncancer Hazard Estimate (Child): Multi-Pathway	Noncancer Hazard Estimate (Adult): Ingestion	Noncancer Hazard Estimate (Adult): Dermal	Noncancer Hazard Estimate (Adult): Multi-Pathway
Inorganic Constituents											
Antimony	0.42	0	--	--		9.5E-05	8.7E-05	1.8E-04	1.3E-06	1.9E-06	3.3E-06
Arsenic	7.7	0	9.4E-08	4.0E-08	1.3E-07	2.3E-03	9.6E-04	3.3E-03	3.3E-05	2.2E-05	5.4E-05
Cadmium	0.54	0	--	--		4.9E-05	2.7E-05	7.6E-05	6.9E-07	6.1E-07	1.3E-06
Chromium	145	0	--	--		--	--	--	--	--	--
Cobalt	11	0	--	--		3.4E-03	4.7E-04	3.9E-03	4.8E-05	1.0E-05	5.8E-05
Copper	33	0	--	--		7.6E-05	1.0E-05	8.6E-05	1.1E-06	2.3E-07	1.3E-06
Lead	--	0	--	--		--	--	--	--	--	--
Manganese	511	0	--	--		1.9E-03	6.6E-03	8.6E-03	2.7E-05	1.5E-04	1.8E-04
Mercury	0.11	0	--	--		6.4E-05	8.8E-06	7.3E-05	9.1E-07	2.0E-07	1.1E-06
Nickel	119	0	--	--		5.4E-04	1.9E-03	2.4E-03	7.6E-06	4.2E-05	4.9E-05
Silver	2.0	0	--	--		3.7E-05	1.2E-04	1.6E-04	5.1E-07	2.8E-06	3.3E-06
Thallium	0.24	0	--	--		2.2E-03	3.0E-04	2.5E-03	3.1E-05	6.8E-06	3.8E-05
Vanadium	55	0	--	--		1.0E-03	5.3E-03	6.3E-03	1.4E-05	1.2E-04	1.3E-04
Zinc	124	0	--	--		3.8E-05	5.1E-06	4.3E-05	5.3E-07	1.2E-07	6.5E-07
PCBs											
Total PCBs as Aroclors (MDL-based)	0.17	0	2.8E-09	5.5E-09	8.3E-09	7.8E-04	1.5E-03	2.3E-03	1.1E-05	3.4E-05	4.5E-05
Total PCBs as Congeners (KM-based, capped)	0.81	0	1.3E-08	2.6E-08	3.9E-08	3.7E-03	7.0E-03	1.1E-02	5.2E-05	1.6E-04	2.1E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	0.0000030	0	3.2E-09	1.3E-09	4.5E-09	3.9E-04	1.6E-04	5.5E-04	5.4E-06	3.6E-06	9.0E-06
Butyltins											
Dibutyltin dichloride	0.0046	0	--	--		1.4E-06	1.9E-06	3.3E-06	2.0E-08	4.3E-08	6.3E-08
Tributyltin chloride	0.013	0	--	--		4.0E-06	5.4E-06	9.4E-06	5.6E-08	1.2E-07	1.8E-07
Pesticides											
4,4'-DDE	0.0012	0	3.3E-12	4.7E-12	8.0E-12	--	--	--	--	--	--
4,4'-DDT	0.041	0	1.1E-10	4.8E-11	1.6E-10	7.5E-06	3.1E-06	1.1E-05	1.1E-07	6.9E-08	1.7E-07
BHC (gamma) Lindane	0.000080	0	7.2E-13	4.0E-13	1.1E-12	2.4E-08	1.3E-08	3.8E-08	3.4E-10	3.0E-10	6.4E-10
Chlordane (gamma)	0.010	0	2.9E-11	1.6E-11	4.5E-11	1.8E-06	1.0E-06	2.8E-06	2.6E-08	2.2E-08	4.8E-08
Endrin Aldehyde	0.0032	0	--	--		--	--	--	--	--	--
Endrin	0.0027	0	--	--		8.2E-07	1.1E-06	1.9E-06	1.2E-08	2.5E-08	3.7E-08
TPH											
Diesel Range Organics	26	0	--	--		1.2E-04	0.0E+00	1.2E-04	1.6E-06	0.0E+00	1.6E-06
SVOCs and PAHs											
cPAHs as BaPEQ (KM-capped, MDL-based)	0.17	M	5.9E-08	1.1E-07	1.7E-07	--	--	--	--	--	--
Anthracene	0.017	0	--	--		5.2E-09	9.1E-09	1.4E-08	7.2E-11	2.1E-10	2.8E-10
Fluoranthene	0.65	0	--	--		1.5E-06	2.6E-06	4.1E-06	2.1E-08	5.9E-08	8.0E-08
Phenanthrene	0.075	0	--	--		2.3E-08	4.1E-08	6.3E-08	3.2E-10	9.1E-10	1.2E-09
pyrene	0.76	0	--	--		2.3E-06	4.1E-06	6.4E-06	3.2E-08	9.2E-08	1.2E-07
Acenaphthene	0.0059	0	--	--		9.0E-09	1.6E-08	2.5E-08	1.3E-10	3.6E-10	4.8E-10
Fluorene	0.014	0	--	--		3.2E-08	5.7E-08	8.9E-08	4.5E-10	1.3E-09	1.7E-09
Bis(2-ethylhexyl) Phthalate	2.8	0	3.2E-10	4.4E-10	7.6E-10	1.3E-05	1.7E-05	3.0E-05	1.8E-07	3.9E-07	5.7E-07
Butyl Benzyl Phthalate	0.010	0	1.6E-13	2.2E-13	3.7E-13	4.6E-09	6.2E-09	1.1E-08	6.4E-11	1.4E-10	2.0E-10
Carbazole	0.021	0	3.4E-12	4.8E-12	8.2E-12	--	--	--	--	--	--
Di-n-butyl Phthalate	0.022	0	--	--		2.0E-08	2.8E-08	4.8E-08	2.8E-10	6.2E-10	9.1E-10
p-cresol (4-Methylphenol)	0.036	0	--	--		3.3E-08	4.5E-08	7.8E-08	4.6E-10	1.0E-09	1.5E-09
Phenol	0.024	0	--	--		7.3E-09	1.0E-08	1.7E-08	1.0E-10	2.2E-10	3.3E-10

Table 2-9.3
Wader (Child and Adult): CTE Summary

Analyte	Soil EPC (mg/kg)	Mutagen?	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer Hazard Estimate (Child): Ingestion	Noncancer Hazard Estimate (Child): Dermal	Noncancer Hazard Estimate (Child): Multi-Pathway	Noncancer Hazard Estimate (Adult): Ingestion	Noncancer Hazard Estimate (Adult): Dermal	Noncancer Hazard Estimate (Adult): Multi-Pathway
					Cancer Risk			**Hazard Index (Child)**			**Hazard Index (Adult)**
		Pathway Sum Excluding PCBs:			3.0E-07			0.028			0.00052
		Pathway Sum with Total PCBs as Aroclors:			3.1E-07			0.030			0.00057
		Pathway Sum with Total PCBs as Congeners:			3.4E-07			0.039			0.00073
		Pathway Sum with PCBs as TEQ:			3.1E-07			0.028			0.00053

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.

EPCs from Table 1-3.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
BaPEQ = benzo(a)pyrene equivalents
BHC = benzene hexachloride
CTE = central tendency exposure
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDL = reported detection limit
SVOC = semivolatile organic compound
TEQ = toxicity equivalence
TPH = total petroleum hydrocarbon

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-9.4
Wader (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.004	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	0.6	ODEQ 2010		
PCB TEQ	IRAFc_teq	0.7	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	IRAFnc_ddx	0.3	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	4	ODEQ 2010		
PCB TEQ	IRAFnc_teq	0.3	ODEQ 2010		

Analyte	$C_{sediment}$ (mg/kg)	Mother		Infant	
		Cancer Risk	**Hazard Quotient**	**Cancer Risk**	**Hazard Quotient**
DDx					
4,4'-DDE	1.2E-03	8.0E-12	--	3.2E-14	--
4,4'-DDT	4.1E-02	1.6E-10	1.1E-05	6.5E-13	3.2E-06
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	3.0E-06	4.5E-09	5.5E-04	3.1E-09	1.6E-04
Total PCBs as Congeners (KM-based, capped)	8.1E-01	3.9E-08	1.1E-02	**2.4E-08**	**4.3E-02**
Total PCBs as Aroclors (MDL-based)	1.7E-01	8.3E-09	2.3E-03	5.0E-09	9.1E-03
			Pathway Sum Excluding PCBs:	6.8E-13	3.2E-06
			Pathway Sum with Total PCBs as Aroclors:	5.0E-09	0.0091
			Pathway Sum with Total PCBs as Congeners:	2.4E-08	0.043
			Pathway Sum with PCBs as TEQ:	3.1E-09	1.7E-04

Notes:

Nursing infant’s risks and hazards are presented as a function of Mother’s risks and hazards, assuming an infant exposure duration of 1 year.

EPCs from Table 1-3.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5

Table 2-9.4
Wader (Nursing Infant): CTE Summary

"--" = data not available or not calculated
$C_{sediment}$ = concentration in sediment
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RME = reasonable maximum exposure
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-10.1
Swimmer (Child and Adult): RME Summary

Compound	Water EPC (µg/L)	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer-Hazard Estimate (Child): Ingestion	Noncancer-Hazard Estimate (Child): Dermal	Noncancer-Hazard Estimate (Child): Multi-Pathway	Noncancer-Hazard Estimate (Adult): Ingestion	Noncancer-Hazard Estimate (Adult): Dermal	Noncancer-Hazard Estimate (Adult): Multi-Pathway
COPCs										
Arsenic	1.0.E+00	2.9.E-07	1.1.E-07	4.0.E-07	4.6.E-03	9.6.E-04	5.6.E-03	8.6.E-04	5.9.E-04	1.5.E-03
Total PCBs as Congeners (KM-based, capped)	2.1.E-04	8.0.E-11	2.0.E-07	2.0.E-07	1.4.E-05	1.9.E-02	1.9.E-02	2.7.E-06	1.2.E-02	1.2.E-02
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1.E-10	2.7.E-12	3.5.E-09	3.6.E-09	2.1.E-07	1.5.E-04	1.5.E-04	4.0.E-08	9.2.E-05	9.2.E-05

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	4.0E-07	5.6E-03	1.5E-03
Pathway Sum with Total PCBs as Congeners:	6.0E-07	0.025	0.013
Pathway Sum with PCBs as TEQ:	4.1E-07	5.7E-03	1.5E-03

Notes:
Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
µg/L = microgram per liter
COPC = chemical of potential concern
EPC = exposure point concentration
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
PCB = polychlorinated biphenyl
RDL = reported detection limit
RME = reasonable maximum exposure
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-10.2
Swimmer (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	RAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	RAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

Analyte	Water EPC ($\mu g/L$)	SFo	Mother		Infant	
			Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	1.3E+05	3.6E-09	1.5E-04	3.6E-09	3.0E-04
Total PCBs as Congeners (KM-based, capped)	2.1E-04	2.0E+00	2.0E-07	1.9E-02	2.0E-07	4.8E-01
			Pathway Sum with Total PCBs as Congeners:		2.0E-07	0.48
			Pathway Sum with PCBs as TEQ:		3.6E-09	3.0E-04

Notes:
Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

Table 2-10.2
Swimmer (Nursing Infant): RME Summary

"--" = data not available or not calculated
µg/L = microgram per liter
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
PCB = polychlorinated biphenyl
RDL = reported detection limit
RME = reasonable maximum exposure
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-10.3
Swimmer (Child and Adult): CTE Summary

Compound	Water EPC (μg/L)	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer-Hazard Estimate (Child): Ingestion	Noncancer-Hazard Estimate (Child): Dermal	Noncancer-Hazard Estimate (Child): Multi-Pathway	Noncancer-Hazard Estimate (Adult): Ingestion	Noncancer-Hazard Estimate (Adult): Dermal	Noncancer-Hazard Estimate (Adult): Multi-Pathway
COPCs										
Arsenic	1.0.E+00	6.5.E-09	8.0.E-10	7.3.E-09	1.5.E-04	1.6.E-05	1.7.E-04	2.9.E-05	9.4.E-06	3.8.E-05
Total PCBs as Congeners (KM-based, capped)	2.1.E-04	1.8.E-12	2.0.E-09	2.0.E-09	4.8.E-07	4.5.E-04	4.5.E-04	9.0.E-08	2.7.E-04	2.7.E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1.E-10	6.1.E-14	3.6.E-11	3.6.E-11	7.1.E-09	3.5.E-06	3.5.E-06	1.3.E-09	2.1.E-06	2.1.E-06

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	7.3E-09	1.7E-04	3.8E-05
Pathway Sum with Total PCBs as Congeners:	9.3E-09	6.2E-04	3.0E-04
Pathway Sum with PCBs as TEQ:	7.3E-09	1.7E-04	4.0E-05

Notes:

Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

µg/L = microgram per liter
COPC = chemical of potential concern
CTE = central tendency exposure
EPC = exposure point concentration
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
PCB = polychlorinated biphenyl
RDL = reported detection limit
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-10.4
Swimmer (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations	
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010		
Carcinogenic IRAFc					
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk =	Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010		
PCB TEQ	IRAFc_teq	1	ODEQ 2010		
Noncancer IRAFnc					
DDT/DDE/DDD	RAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard =	Mother HQ x IRAFnc
Total PCB	RAFnc_pcb	25	ODEQ 2010		
PCB TEQ	IRAFnc_teq	2	ODEQ 2010		

Analyte	Water EPC ($\mu g/L$)	SFo	Mother		Infant	
			Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	1.3E+05	3.6E-11	3.5E-06	3.6E-11	7.1E-06
Total PCBs as Congeners (KM-based, capped)	2.1E-04	2.0E+00	2.0E-09	4.5E-04	2.0E-09	1.1E-02
				Pathway Sum with Total PCBs as Congeners:	2.0E-09	0.011
				Pathway Sum with PCBs as TEQ:	3.6E-11	7.1E-06

Notes:

Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.

EPCs from Table 1-4.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5

Table 2-10.4
Swimmer (Nursing Infant): CTE Summary

µg/L = microgram per liter
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
PCB = polychlorinated biphenyl
RDL = reported detection limit
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-11.1
Hypothetical Downstream Potable Water User (Child and Adult): RME Summary

Analyte	Water EPC (*µg/L*)	Cancer-Risk Estimate: Ingestion	Cancer-Risk Estimate: Inhalation	Cancer-Risk Estimate: Dermal	Cancer-Risk Estimate: Multi-Pathway	Noncancer-Hazard Estimate (Child): Ingestion	Noncancer-Hazard Estimate (Child): Inhalation	Noncancer-Hazard Estimate (Child): Dermal	Noncancer-Hazard Estimate (Child): Multi-Pathway	Noncancer-Hazard Estimate (Adult): Ingestion	Noncancer-Hazard Estimate (Adult): Inhalation	Noncancer-Hazard Estimate (Adult): Dermal	Noncancer-Hazard Estimate (Adult): Multi-Pathway
COPCs													
Arsenic	1.0E+00	**1.9E-05**	--	1.1E-07	**2.0E-05**	1.7E-01	--	7.4E-04	1.7E-01	1.0E-01	--	6.0E-04	1.0E-01
Total PCBs as Congeners (KM-based, capped)	2.1E-04	5.4E-09	--	--	5.4E-09	5.2E-04	--	--	5.2E-04	3.1E-04	--	--	3.1E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	1.8E-10	--	--	1.8E-10	7.8E-06	--	--	7.8E-06	4.7E-06	--	--	4.7E-06

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	**2.0E-05**	0.17	0.10
Pathway Sum with PCBs as TEQ:	**2.0E-05**	0.17	0.10
Pathway Sum with Total PCBs as Congeners:	**2.0E-05**	0.17	0.10

Notes:
Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
µg/L = microgram per liter
COPC = chemical of potential concern
EPC = exposure point concentration
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
PCB = polychlorinated biphenyl
RDL = reported detection limit
RME = reasonable maximum exposure
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-11.2
Hypothetical Downstream Potable Water User (Nursing Infant): RME Summary

Definition	Variable	Value	Source	Equations
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010	
Carcinogenic IRAFc				
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk = Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010	
PCB TEQ	IRAFc_teq	1	ODEQ 2010	
Noncancer IRAFnc				
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard = Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010	
PCB TEQ	IRAFnc_teq	2	ODEQ 2010	

Analyte	C_{fish} (mg/kg)	SFo	Mother		Infant	
			Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	1.3E+05	1.8E-10	7.8E-06	1.8E-10	1.6E-05
Total PCBs as Congeners (KM-based, capped)	2.1E-04	2.0E+00	5.4E-09	5.2E-04	5.4E-09	1.3E-02
				Pathway Sum with PCBs as TEQ:	1.8E-10	1.6E-05
				Pathway Sum with Total PCBs as Congeners:	5.4E-09	0.013

Notes:

Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.

EPCs from Table 1-4.

Toxicity values from Table 2-5.

Exposure Factors from Tables 2-4.1 through Tables 2-4.5

RME = reasonable maximum exposure
"--" = data not available or not calculated
C_{fish} = concentration in fish
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RDL = reported detection limit
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-11.3
Hypothetical Downstream Potable Water User (Child and Adult): CTE Summary

Analyte	Water EPC (*µg/L*)	Cancer-Risk Estimate: Ingestion	Inhalation	Dermal	Multi-Pathway	Noncancer-Hazard Estimate (Child): Ingestion	Inhalation	Dermal	Multi-Pathway	Noncancer-Hazard Estimate (Adult): Ingestion	Inhalation	Dermal	Multi-Pathway
COPCs													
Arsenic	1.0E+00	7.6E-06	--	1.1E-08	**7.6E-06**	1.7E-01	--	2.2E-04	1.7E-01	5.6E-02	--	1.3E-04	5.7E-02
Total PCBs as Congeners (KM-based, capped)	2.1E-04	2.1E-09	--	--	2.1E-09	5.2E-04	--	--	5.2E-04	1.8E-04	--	--	1.8E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	7.1E-11	--	--	7.1E-11	7.8E-06	--	--	7.8E-06	2.6E-06	--	--	2.6E-06
					Cancer Risk				**Hazard Index**				**Hazard Index**
		Pathway Sum Excluding PCBs:			**7.6E-06**				0.17				0.057
		Pathway Sum with PCBs as TEQ:			**7.6E-06**				0.17				0.057
		Pathway Sum with Total PCBs as Congeners:			**7.6E-06**				0.17				0.057

Notes:
Cancer risks are presented for time-integrated adult+child exposure. Noncancer hazards are presented separately for exposure during adulthood and exposure during childhood.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
µg/L = microgram per liter
CTE = central tendency exposure
EPC = exposure point concentration
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
PCB = polychlorinated biphenyl
RDL = reported detection limit
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Table 2-11.4
Hypothetical Downstream Potable Water User (Nursing Infant): CTE Summary

Definition	Variable	Value	Source	Equations
Infant Risk Adjustment Factor	IRAF	Chemical Specific	ODEQ 2010	
Carcinogenic IRAFc				
DDT/DDE/DDD	IRAFc_ddx	0.007	ODEQ 2010	Infant Cancer Risk = Mother Risk x IRAFc
Total PCB	IRAFc_pcb	1	ODEQ 2010	
PCB TEQ	IRAFc_teq	1	ODEQ 2010	
Noncancer IRAFnc				
DDT/DDE/DDD	IRAFnc_ddx	2	ODEQ 2010	Infant Noncancer Hazard = Mother HQ x IRAFnc
Total PCB	IRAFnc_pcb	25	ODEQ 2010	
PCB TEQ	IRAFnc_teq	2	ODEQ 2010	

Analyte	C_{fish} (mg/kg)	SFo	Mother		Infant	
			Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient
PCB Congeners						
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1E-10	1.3E+05	7.1E-11	7.8E-06	7.1E-11	1.6E-05
Total PCBs as Congeners (KM-based, capped)	2.1E-04	2.0E+00	2.1E-09	5.2E-04	2.1E-09	1.3E-02
				Pathway Sum with PCBs as TEQ:	7.1E-11	2E-05
				Pathway Sum with Total PCBs as Congeners:	2.1E-09	0.013

Notes:
Nursing infant's risks and hazards are presented as a function of Mother's risks and hazards, assuming an infant exposure duration of 1 year.
EPCs from Table 1-4.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5

"--" = data not available or not calculated
C_{fish} = concentration in fish
CTE = central tendency exposure
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
EPC = exposure point concentration
HQ = hazard quotient
IRAF = Infant Risk Adjustment Factor
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
RME = reasonable maximum exposure
Sf_o = oral slope factor
TEQ = toxicity equivalence

Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1

Source:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.

Table 2-12
Summary of River OU Cancer Risk and Noncancer Health Hazard

Receptors	Media	Receptor Type	Risk / Hazard	RME			RME Risk Drivers	CTE			CTE Risk Drivers
				Cancer	Adult Noncancer	Child Noncancer		Cancer	Adult Noncancer	Child Noncancer	
Tribal Subsistence Fisher	Tissue (smallmouth bass)	Child and Adult	Pathway Sum Excluding PCBs:	**3E-03**	**12**	**28**	PCBs, Mercury, 4,4'-DDE,	**4E-04**	**4.5**	**7.4**	PCBs, 4,4'-DDE,
			Pathway Sum with Total PCBs as Aroclors:	**2E-02**	**692**	**1542**	Chlordane, Dieldrin,	**2E-03**	**250**	**413**	Chlordane, Dieldrin,
			Pathway Sum with PCBs as TEQ:	**2E-02**	**375**	**835**	Endrin, cPAHs	**3E-03**	**135**	**223**	Endrin, cPAHs
			Pathway Sum with Total PCBs as Congeners:	**3E-02**	**1303**	**2904**		**4E-03**	**470**	**778**	
		Nursing Infant	Pathway Sum Excluding PCBs:	2E-08	NA	0.011	PCBs	1E-09	NA	4.1E-03	PCBs
			Pathway Sum with Total PCBs as Aroclors:	**8E-03**	NA	**16985**		**4E-04**	NA	**6127**	
			Pathway Sum with PCBs as TEQ:	**9E-03**	NA	**724**		**5E-04**	NA	**261**	
			Pathway Sum with Total PCBs as Congeners:	**1E-02**	NA	**32268**		**8E-04**	NA	**11640**	
Non-Tribal Recreational Fisher	Tissue (smallmouth bass)	Child and Adult	Pathway Sum Excluding PCBs:	**1E-03**	**6.3**	**10.7**	PCBs, 4,4'-DDE,	**1E-04**	**1.1**	**2.1**	PCBs,
			Pathway Sum with Total PCBs as Aroclors:	**7E-03**	**353**	**598**	Chlordane, Dieldrin,	**6E-04**	**64**	**118**	Chlordane, Dieldrin,
			Pathway Sum with PCBs as TEQ:	**8E-03**	**191**	**324**	cPAHs, (Mercury HQ 1.1),	**7E-04**	**34**	**64**	cPAHs
			Pathway Sum with Total PCBs as Congeners:	**1E-02**	**665**	**1126**	(Endrin: HQ 1.3)	**1E-03**	**120**	**222**	
		Nursing Infant	Pathway Sum Excluding PCBs:	9E-09	NA	5.8E-03	PCBs	2E-10	NA	1.0E-03	PCBs
			Pathway Sum with Total PCBs as Aroclors:	**4E-03**	NA	**8664**		**1E-04**	NA	**1562**	
			Pathway Sum with PCBs as TEQ:	**5E-03**	NA	**369**		**1E-04**	NA	**67**	
			Pathway Sum with Total PCBs as Congeners:	**8E-03**	NA	**16460**		**2E-04**	NA	**2967**	
	Tissue (crayfish) (1)	Child and Adult	Pathway Sum Excluding PCBs:	**7E-05**	0.37	0.63	PCBs, Arsenic	**6E-06**	0.068	0.13	PCBs
			Pathway Sum with PCBs as TEQ:	**9E-05**	0.71	1.2		**7E-06**	0.13	0.24	
			Pathway Sum with Total PCBs as Congeners:	**8E-05**	0.57	0.97		6E-06	0.11	0.19	
		Nursing Infant	Pathway Sum Excluding PCBs:	NA	NA	NA	PCBs	NA	NA	NA	none
			Pathway Sum with PCBs as TEQ:	**9E-06**	NA	0.67		2E-07	NA	0.12	
			Pathway Sum with Total PCBs as Congeners:	**2E-06**	NA	**5.0**		6E-08	NA	0.92	
	Total Tissue (bass + crayfish)	Child and Adult	Pathway Sum Excluding PCBs:	**1E-03**	**6.7**	**11.4**	PCBs, Arsenic, 4,4'-DDE,	**1E-04**	**1.2**	**2.2**	PCBs, 4,4'-DDE,
			Pathway Sum with Total PCBs as Aroclors:	See finfish	See finfish	See finfish	Chlordane, Dieldrin,	See finfish	See finfish	See finfish	Chlordane, Dieldrin,
			Pathway Sum with PCBs as TEQ:	**9E-03**	**192**	**325**	cPAHs, (Mercury HQ 1.1),	**7E-04**	**35**	**64**	cPAHs
			Pathway Sum with Total PCBs as Congeners:	**1E-02**	**665**	**1127**	(Endrin: HQ 1.3)	**1E-03**	**120**	**222**	
		Nursing Infant	Pathway Sum Excluding PCBs:	NA	NA	NA	PCBs	NA	NA	NA	PCBs
			Pathway Sum with Total PCBs as Aroclors:	See finfish	NA	See finfish		See finfish	NA	See finfish	
			Pathway Sum with PCBs as TEQ:	**5E-03**	NA	**370**		**1E-04**	NA	**67**	
			Pathway Sum with Total PCBs as Congeners:	**8E-03**	NA	**16465**		**2E-04**	NA	**2968**	

Table 2-12
Summary of River OU Cancer Risk and Noncancer Health Hazard

Receptors	Media	Receptor Type	Risk / Hazard	RME			RME Risk Drivers	CTE			CTE Risk Drivers
				Cancer	Adult Noncancer	Child Noncancer		Cancer	Adult Noncancer	Child Noncancer	
Wader	Sediment	Child and Adult	Pathway Sum Excluding PCBs:	2E-05	0.14	1.2	PCBs, Arsenic, cPAHs	3E-07	5.2E-04	0.028	none
			Pathway Sum with Total PCBs as Aroclors:	2E-05	0.15	1.3		3E-07	5.7E-04	0.030	
			Pathway Sum with PCBs as TEQ:	2E-05	0.14	1.2		3E-07	5.3E-04	0.028	
			Pathway Sum with Total PCBs as Congeners:	2E-05	0.19	1.6		3E-07	7.3E-04	0.039	
		Nursing Infant	Pathway Sum Excluding PCBs:	4E-11	NA	1.6E-04	PCBs	7E-13	NA	3.2E-06	none
			Pathway Sum with Total PCBs as Aroclors:	3E-07	NA	0.37		5E-09	NA	9.1E-03	
			Pathway Sum with PCBs as TEQ:	2E-07	NA	8.6E-03		3E-09	NA	1.7E-04	
			Pathway Sum with Total PCBs as Congeners:	1E-06	NA	1.7		2E-08	NA	0.043	
Swimmer	Surface Water (1)	Child and Adult	Pathway Sum Excluding PCBs:	4E-07	1.5E-03	5.6E-03	none	7E-09	3.8E-05	1.7E-04	none
			Pathway Sum with PCBs as TEQ:	4E-07	1.5E-03	5.7E-03		7E-09	4.0E-05	1.0E-03	
			Pathway Sum with Total PCBs as Congeners:	6E-07	1.3E-02	2.5E-02		9E-09	3.0E-04	1.7E-04	
		Nursing Infant	Pathway Sum Excluding PCBs:	NA	NA	NA	none	NA	NA	NA	none
			Pathway Sum with PCBs as TEQ:	4E-09	NA	1.8E-04		4E-11	NA	7.1E-06	
			Pathway Sum with Total PCBs as Congeners:	2E-07	NA	0.29		2E-09	NA	1.0E-02	
Hypothetical Downstream Potable Water User	Surface Water (1)	Child and Adult	Pathway Sum Excluding PCBs:	2E-05	0.10	0.17	Arsenic	8E-06	0.057	0.17	Arsenic
			Pathway Sum with PCBs as TEQ:	2E-05	0.10	0.17		8E-06	0.057	0.17	
			Pathway Sum with Total PCBs as Congeners:	2E-05	0.10	0.17		8E-06	0.057	0.17	
		Nursing Infant	Pathway Sum Excluding PCBs:	NA	NA	NA	none	NA	NA	NA	none
			Pathway Sum with PCBs as TEQ:	2E-10	NA	1.6E-05		7E-11	NA	1.6E-05	
			Pathway Sum with Total PCBs as Congeners:	5E-09	NA	1.3E-02		2E-09	NA	1.3E-02	

Notes:
BOLD = cancer risk exceeds 1 x 10^{-6} and/or HQ >1
Cancer risks are presented for time-integrated child + adult exposure.
Noncancer health hazards are presented separately for exposure during adulthood and exposure during childhood.
Nursing infant risks and hazards are presented as a function of mother's risks, assuming a one-year exposure duration

( ) identifies "fringe" analytes that would not be a COC based on only 1 significant figure
(1) No Aroclor data for this media
cPAH = carcinogenic polycyclic aromatic hydrocarbon
CTE = central tendency exposure
DDE = dichloro-diphenyl-dichloroethylene
NA = not available or not applicable
PCB = polychlorinated biphenyl
RME = reasonable maximum exposure
TEQ = toxicity equivalence

Table 2-13
Risk-Based Concentrations for Smallmouth Bass Tissue

Human Health COCs	TRIBAL SUBSISTENCE FISHER (mg/kg wet wt)						NON-TRIBAL RECREATIONAL FISHER (mg/kg wet wt)						Lowest Tissue RBC (mg/kg wet wt)	Upstream Reference UPLs (mg/kg wet wt) Smallmouth Bass	
	Child RBC	Adult RBC	Child + Adult RBC	Nursing Infant RBC	Lowest RBC	RBC Basis	Child RBC	Adult RBC	Child + Adult RBC	Nursing Infant RBC	Lowest RBC	RBC Basis			
Inorganics															
Mercury	8.2E-02	1.8E-01	8.2E-02	--	**8.2E-02**	**noncancer**	2.1E-01	3.6E-01	2.1E-01	--	**2.1E-01**	**noncancer**	**8.2E-02**	3.6E-01	WH Gamma UPL
PCBs as Aroclors															
Total PCBs as Aroclors (MDL-based)	4.8E-03	3.2E-03	1.9E-03	1.5E-03	**1.5E-03**	**noncancer**	1.2E-02	6.3E-03	4.2E-03	2.9E-03	**2.9E-03**	**noncancer**	**1.5E-03**	1.0E-01	WH Gamma-KM UPL
PCBs as Congeners															
PCBs as Mammal TEQ (KM-capped, RDL-based)	7.4E-08	4.9E-08	2.9E-08	4.9E-08	**2.9E-08**	**cancer**	1.9E-07	9.6E-08	6.4E-08	9.6E-08	**6.4E-08**	**cancer**	**2.9E-08**	3.9E-06	Log UPL
Total PCBs as Congeners (KM-based, capped)	4.8E-03	3.2E-03	1.9E-03	1.5E-03	**1.5E-03**	**noncancer**	1.2E-02	6.3E-03	4.2E-03	2.9E-03	**2.9E-03**	**noncancer**	**1.5E-03**	4.1E-01	NonParametric UPL
Pesticides															
4,4'-DDE	2.8E-02	1.9E-02	1.1E-02	2.7E+00	**1.1E-02**	**cancer**	7.3E-02	3.7E-02	2.4E-02	5.3E+00	**2.4E-02**	**cancer**	**1.1E-02**	1.0E-01	Normal UPL
Chlordane (gamma)	2.7E-02	1.8E-02	1.1E-02	--	**1.1E-02**	**cancer**	7.0E-02	3.6E-02	2.4E-02	--	**2.4E-02**	**cancer**	**1.1E-02**	4.2E-03	Non-parametric UPL
Dieldrin	6.0E-04	4.0E-04	2.4E-04	--	**2.4E-04**	**cancer**	1.5E-03	7.8E-04	5.2E-04	--	**5.2E-04**	**cancer**	**2.4E-04**	8.3E-04	Non-parametric UPL
Endrin	2.5E-01	5.5E-01	2.5E-01	--	**2.5E-01**	**noncancer**	6.3E-01	1.1E+00	6.3E-01	--	**6.3E-01**	**noncancer**	**2.5E-01**	8.6E-04	Non-parametric UPL
PAHs															
cPAHs as BaPEQ (KM-capped, MDL-based)	2.5E-04	4.4E-04	1.6E-04	--	**1.6E-04**	**cancer**	6.3E-04	8.6E-04	3.6E-04	--	**3.6E-04**	**cancer**	**1.6E-04**	1.2E-03	Non-parametric UPL

Notes:
Not all listed RBCs are applicable to all receptors.
Child - RBC calculated for 6 years exposure duration, per USEPA 2014 and ODEQ 2010 guidance
Child + Adult - RBC calculated for 26 years exposure duration (Child 6 years + Adult 20 years) per USEPA 2014 guidance
Adult - RBC calculated for 20 years exposure duration per USEPA 2014 guidance
Infant - RBC calculated assuming 1 year exposure duration, per ODEQ 2010 guidance

-- = not calculated
BaPEQ = benzo(a)pyrene equivalents
COC = chemical of concern
DDE = dichloro-diphenyl-dichloroethylene
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg wet wt = milligrams per kilogram of wet tissue weight
NA = not available or not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RBC = Risk Based Concentration (lower of cancer and noncancer risk based values) Target Cancer Risk of 1E-06 and Target HQ - 1.0
RDL = reported detection limit
TEQ = toxicity equivalence
UPL = upper prediction limit

Sources:
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.

Table 2-14
Risk-Based Concentrations for Crayfish Tissue

Human Health COCs	Non-Tribal Recreational Fisher (mg/kg wet wt)						Upstream Reference UPLs (mg/kg wet wt)	
	Child RBC	Adult RBC	Child + Adult RBC	Nursing Infant RBC	Lowest RBC	RBC Basis	Crayfish	
Inorganics								
Arsenic	2.1E-02	1.1E-02	7.2E-03	--	**7.2E-03**	**cancer**	5.4E-01	Gamma UPL
PCBs as Congeners								
PCBs as Mammal TEQ (KM-capped, RDL-based)	2.5E-07	1.3E-07	8.3E-08	1.3E-07	**8.3E-08**	**cancer**	6.4E-08	Normal UPL
Total PCBs as Congeners (KM-based, capped)	1.6E-02	8.2E-03	5.4E-03	3.7E-03	**3.7E-03**	**noncancer**	1.4E-03	Normal UPL

Notes:
Not all listed RBCs are applicable to all receptors.
Child - RBC calculated for 6 years exposure duration, per USEPA 2014 and ODEQ 2010 guidance
Child + Adult - RBC calculated for 26 years exposure duration (Child 6 years + Adult 20 years) per USEPA 2014 guidance
Adult - RBC calculated for 20 years exposure duration per USEPA 2014 guidance
Infant - RBC calculated assuming 1 year exposure duration, per ODEQ 2010 guidance

-- = Not Calculated
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
mg/kg wet wt = milligrams per kilogram of wet tissue weight
NA = Not available
PCB = polychlorinated biphenyl
RBC = Risk Based Concentration (lower of cancer and noncancer risk based values) Target Cancer Risk of 1E-06 and Target HQ - 1.0
RDL = reported detection limit
TEQ = toxicity equivalence
UPL = upper prediction limit

Sources:

ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.

Table 2-15
Risk-Based Concentrations for Sediment

Human Health COCs	Direct Contact: Wader (mg/kg dry wt) RBC	Direct Contact: Wader (mg/kg dry wt) Basis	Bioaccumulative Pathway: Tribal Subsistence Smallmouth Bass Fisher (mg/kg dry wt) Tissue RBC	Basis	Sediment RBC	Non-Tribal Recreational Smallmouth Bass Fisher (mg/kg dry wt) Tissue RBC	Basis	Sediment RBC	Non-Tribal Recreational Crayfish Fisher (mg/kg dry wt) Tissue RBC	Basis	Sediment RBC	Lowest Human Health RBC (mg/kg dry wt)	Upstream Reference UPLs (mg/kg dry wt)
Inorganics													
Arsenic	8.8E-01	C+A, Cancer	NA	NA	NA[a]	NA	NA	NA[b]	7.2E-03	C+A, cancer	NA[b]	**8.8E-01**	5.9E+00
Mercury	NA	NA	8.2E-02	Child, noncancer	NA[a]	2.1E-01	Child, noncancer	NA[b]	NA	NA	NA[b]	**NA[b]**	2.1E-01
PCBs													
Total PCBs as Aroclors (MDL-based)	NA	NA	1.5E-03	Infant, noncancer	1.2E-04	2.9E-03	Infant, noncancer	2.4E-04	NA	NA	NA	**1.2E-04**	1.6E-02
Total PCBs as Congeners (KM-based, capped)	3.9E-01	C+A, Cancer	1.5E-03	Infant, noncancer	1.3E-05	2.9E-03	Infant, noncancer	2.5E-05	3.7E-03	C+A, cancer	1.3E-04	**1.3E-05**	9.4E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	NA	NA	2.9E-08	C+A, cancer	2.6E-10	6.4E-08	C+A, cancer	5.7E-10	8.3E-08	C+A, cancer	3.1E-09	**2.6E-10**	3.1E-08
Pesticides													
4,4'-DDE	NA	NA	1.1E-02	C+A, Cancer	6.5E-04	2.4E-02	C+A, cancer	1.4E-03	NA	NA	NA	**6.5E-04**	NA
Chlordane (gamma) [a]	NA	NA	1.1E-02	C+A, Cancer	5.9E-01	2.4E-02	C+A, Cancer	1.3E+00	NA	NA	NA	**5.9E-01**	NA
Dieldrin [a]	NA	NA	2.4E-04	C+A, Cancer	8.2E-03	5.2E-04	C+A, Cancer	1.8E-02	NA	NA	NA	**8.2E-03**	NA
Endrin [a]	NA	NA	2.5E-01	Child, noncancer	6.3E+00	6.3E-01	Child, noncancer	1.6E+01	NA	NA	NA	**6.3E+00**	NA
PAHs													
cPAHs as BaPEQ (KM-capped, MDL-based)	2.5E-02	C+A, Cancer	1.6E-04	C+A, Cancer	4.4E-02	3.6E-04	C+A, cancer	1.0E-01	NA	NA	NA	**2.5E-02**	1.5E-02

Notes:

Diet Risk-Based Sediment Concentration = f_{oc} x (RBC_{tissue} ÷ [BSAF x f_{lipid}]) (ODEQ 2007; Equation D-1). See Appendix D for BSAF development.

f_{oc} = fraction of organic carbon (site-specific) = 0.0084 median of all River OU data
f_{lipid} = fraction of lipid (bass) = 0.03 median of all River OU bass data
f_{lipid} = fraction of lipid (crayfish) = 0.0073 median of all River OU crayfish data

Not all listed RBCs are applicable to all receptors.
Upstream Reference UPLs are from Table 1-2.
Adult - RBC calculated for 20 years exposure duration per USEPA 2014 guidance
Child - RBC calculated for 6 years exposure duration, per USEPA 2014 and ODEQ 2010 guidance
Infant - RBC calculated assuming 1 year exposure duration, per ODEQ 2010 guidance
Child + Adult (C+A) - RBC calculated for 26 years exposure duration (Child 6 years + Adult 20 years) per USEPA 2014 guidance

BaPEQ = benzo(a)pyrene equivalent(s)
COC = constituent of concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
DDE = dichloro-diphenyl-dichloroethylene
KM = Kaplan-Meier
MDL = method detection limit
mg/kg dry wt = milligrams per kilogram of dry sediment weight
NA = not applicable (not a COC for that receptor/receptor group)
PCBs = polychlorinated biphenyls
RBC = Risk Based Concentration (lower of cancer and noncancer risk based values) at Target Cancer Risk of 1E-06 and Target Noncancer Hazard Quotient of 1.0
RDL = reported detection limit
TEQ = toxicity equivalence

Footnotes:

a) Bioaccumulative pathway based sediment RBCs developed for the following COCs because they demonstrated risk from tissue consumption and have tissue RBCs (see Table 2-13). However, these sediment RBCs are not depicted on the figures due to the following:
Dieldrin was not detected in sediment.
Chlordane (gamma) and Endrin did not have any detections in sediment above their respective calculated RBCs.

b) For dietary RBCs, due to the uncertainty associated with establishing correlations between concentrations of metals in sediment versus tissue, default to Upstream Reference UPLs.

Sources:

ODEQ. 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.
ODEQ. 2010. Oregon DEQ Human Health Risk Assessment Guidance. October.
USEPA. 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120.

Table 2-16
River OU COCs Recommended for Further Evaluation in the FS

Media	Contaminants of Concern[a] (COCs)	Calculated RBC[b] (At target risk of 1E-06 or HQ of 1)	units	Reference Area UPL
Smallmouth Bass Tissue	PCB-Aro	1.5	ug/kg	102
	PCB-Cong	1.5	ug/kg	408
	PCB TEQ-Mam	2.9E-05	ug/kg	3.9E-03
	Chlordane (gamma)	11	ug/kg	4.2
	Dieldrin	0.24	ug/kg	0.83
Crayfish Tissue	PCB TEQ-Mam (c)	8.3E-05	ug/kg	6.4E-05
Sediment (Direct Contact)	None	--	--	--
Sediment (Bioaccumulation)	PCB-Aro	0.12	ug/kg	16
	PCB-Cong	0.013	ug/kg	0.94
	PCB TEQ-Mam	2.6E-07	ug/kg	3.1E-05

Notes:
COC = contaminant of concern
HQ = hazard quotient
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
PCB TEQ-Mam = PCBs as Mammal TEQ
ug/kg = micrograms per kilogram
UPL = upper prediction limit
-- = not applicable

Footnotes:
a) Final list of chemicals that are recommended for further evaluation in the Feasibility Study (see Section 2.8).
b) Presented RBC is the lowest among receptors evaluated and corresponds to target cancer risk of 1E-06 or noncancer HQ of 1.
c) Tentatively identified COC. See Section 2.8.

Table 3-1
Comparison of Tissue Data to CTLs/ATLs for DETM Sediment CPECs

Analyte[1]	Units	CTLs for Fish & Shellfish Exposed to Tissue[2]	ATLs for Individual Birds Exposed to Tissue[2]	ATLs for Individual Mammals Exposed to Tissue[2]	Clam		Crayfish	Sculpin	Bass		Retain as Bio. Fish/ Shellfish CPEC?	Retain as Bioaccum. Bird or Mammal CPEC?
					2008 Max Detected	2011 Max Detected	2008 Max Detected	2008 Max Detected	2006 Max Detected	2011 Max Detected		
Metals												
Arsenic	mg/kg	6.6	13	7.6	2.5	2.2	0.68	0.44	0.70	0.53	No	No
Lead	mg/kg	0.12	9.3	34	0.089	0.15	2.7	0.31	0.036	0.019	**Yes**	No
Manganese	mg/kg	NA	NA	NA	--	--	--	--	--	--	No[4]	No[4]
Zinc	mg/kg	NA	NA	NA	27	25	23	--	18	17	**Yes-No CTL**	**Yes-No ATL**
Butyltins [3]												
Pesticides [3]												
SVOCs												
Bis(2-ethylhexyl) phthalate	ug/kg	1,760	6,260	55,500	890	ND	110	--	1,600	ND	No	No
Butyl benzyl phthalate	ug/kg	310	6,260	55,500	15	ND	ND	--	440	ND	**Yes**	No
Carbazole	ug/kg	NA	NA	NA	ND	ND	ND	--	ND	ND	No	No
Dibenzofuran	ug/kg	NA	NA	NA	--	--	--	--	--	--	**Yes**[5]	**Yes**[5]
Di-n-butyl phthalate	ug/kg	3,120	626	1,670,000	ND	ND	ND	--	150	220	No	No
p-cresol (4-Methylphenol)	ug/kg	NA	NA	NA	31	ND	ND	--	ND	130	**Yes-No CTL**	**Yes-No ATL**
				Comparison to:	CTL	CTL	CTL	CTL	CTL	CTL		
							Mammal ATL	Mammal ATL	Mammal ATL	Mammal ATL		
									Bird ATL	Bird ATL		

[max] > CTL
[max] > Bird ATL
[max] > Mammal ATL
Detected; No CTL/ATL

Notes:

1) Detected tissue concentrations of analytes identified as potential additional bioaccumulative CPECs based on sediment screening in the DETM (see Table 2-3 of DETM; URS 2014) were compared to appropriate CTLs/ATLs.
2) Oregon Department of Environmental Quality (ODEQ) 2007. (see Appendix J in the RI [URS 2012] for surrogate selections).
3) Only analyzed in 2011 tissue. See Table 3-3, which screens all detected analytes in 2011, including butyltins and pesticides, in clam and smallmouth bass tissue.

4) In the absence of a site-specific Upstream Reference UPL for manganese in sediment, the ODEQ's regional background level was considered (ODEQ 2013). Since the maximum site concentration of manganese is well below the regional background level, this metal was not retained as a CPEC.
5) Retained due to lack of tissue analysis, will be evaluated quantitatively by estimating benthic invertebrate and fish tissue concentrations from sediment via BSAFs.

-- = not analyzed
ATL = acceptable tissue level
CPEC = contaminant of potential ecological concern
CTL = critical tissue level
DETM = Data Evaluation Technical Memorandum
Max = maximum
mg/kg = milligrams per kilogram, in wet weight
NA = not available
ND = Not detected
SVOC = semi-volatile organic carbon
ug/kg = micrograms per kilogram, in wet weight

Sources:

ODEQ 2013. Fact Sheet: Background Levels of Metals in Soils for Cleanups. March.

ODEQ 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Final. April.

URS 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

URS 2014. Data Evaluation Technical Memorandum, River Operable Unit. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. July 3.

Table 3-2
Comparison of 2011 Tissue Data to CTLs/ATLs for all Detected Analytes

Matrix	IUPAC #	Analyte	Units	2011 Max Detected	CTLs for Fish & Shellfish Exposed to Tissue[1]	ATLs for Individual Birds Exposed to Tissue[1]	ATLs for Individual Mammals Exposed to Tissue[1]	Retain as Bioaccumulative CPEC? Fish/ Shellfish	Bird	Mammal
Metals										
SB		Aluminum	mg/kg	9.5	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Antimony	mg/kg	0.026	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Barium	mg/kg	6.4	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Chromium	mg/kg	0.76	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Copper	mg/kg	2.0	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Mercury	mg/kg	0.45	0.088	0.074	0.12	**Yes**	**Yes**	**Yes**
SB		Zinc	mg/kg	17	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
Butyltins										
SB		Monobutyltin	ug/kg	0.22	55	39,000	17,000	No	No	No
PCB Aroclors										
SB		Aroclor 1254	ug/kg	65,000	430	35	880	**Yes**	**Yes**	**Yes**
SB		Total PCBs as Aroclors (MDL-based)	ug/kg	65,000	430	35	880	**Yes**	**Yes**	**Yes**
PCB Congeners										
SB	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	25	430	0.16	5.8	**Yes[2]**	**Yes**	**Yes**
SB	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	1.5	430	0.08	2	**Yes[2]**	**Yes**	**Yes[2]**
SB	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	9,040	430	80	20	**Yes**	**Yes**	**Yes**
SB	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	504	430	800	20	**Yes**	**Yes[2]**	**Yes**
SB	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	20,000	430	800	20	**Yes**	**Yes**	**Yes**
SB	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	298	430	800	20	**Yes[2]**	**Yes[2]**	**Yes**
SB	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	6.4	430	0.08	0.0058	**Yes[2]**	**Yes**	**Yes**
SB	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	2,640	430	80	20	**Yes**	**Yes**	**Yes**
SB	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	735	430	800	20	**Yes**	**Yes[2]**	**Yes**
SB	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	ND	430	8	0.02	**Yes[2]**	**Yes[2]**	**Yes[2]**
SB	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	58	430	800	20	**Yes[2]**	**Yes[2]**	**Yes**
SB		PCBs as Bird TEQ (KM-capped, RDL-based)	ug/kg	3.5	--	0.008	--	--	**Yes**	--
SB		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	0.20	0.0064	--	--	**Yes**	--	--
SB		PCBs as Mammal TEQ (KM-capped, RDL-based)	ug/kg	1.7	--	--	0.00058	--	--	**Yes**
SB		Total PCBs as Congeners (KM-based, capped)	ug/kg	183,148	430	35	880	**Yes**	**Yes**	**Yes**
Pesticides										
SB		4,4'-DDD	ug/kg	8.6	54	13	580	**Yes[2]**	**Yes[2]**	**Yes[2]**
SB		4,4'-DDE	ug/kg	76	54	13	580	**Yes**	**Yes**	**Yes[2]**
SB		4,4'-DDT	ug/kg	17	54	13	580	**Yes[2]**	**Yes**	**Yes[2]**
SB		BHC (beta)	ug/kg	2.0	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		BHC (gamma) Lindane	ug/kg	2.5	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Chlordane (alpha)	ug/kg	0.30	60	1,200	3,300	**Yes[2]**	**Yes[2]**	**Yes[2]**
SB		Chlordane (gamma)	ug/kg	5,000	60	1,200	3,300	**Yes**	**Yes**	**Yes**
SB		Dieldrin	ug/kg	2,900	260	44	150	**Yes**	**Yes**	**Yes**
SB		Endosulfan I	ug/kg	210	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Endrin	ug/kg	1,200	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**

Table 3-2
Comparison of 2011 Tissue Data to CTLs/ATLs for all Detected Analytes

Matrix	IUPAC #	Analyte	Units	2011 Max Detected	CTLs for Fish & Shellfish Exposed to Tissue[1]	ATLs for Individual Birds Exposed to Tissue[1]	ATLs for Individual Mammals Exposed to Tissue[1]	Retain as Bioaccumulative CPEC?		
								Fish/ Shellfish	Bird	Mammal
SB		Endrin Aldehyde	ug/kg	1,200	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Methoxychlor	ug/kg	0.90	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Total DDx (MDL-based)	ug/kg	16,040	54	13	580	**Yes**	**Yes**	**Yes**
SVOCs and PAHs										
SB		p-cresol (4-Methylphenol)	ug/kg	130	NA	NA	NA	**Yes-No CTL**	**Yes-No ATL**	**Yes-No ATL**
SB		Acenaphthene	ug/kg	1.1	19,000	--	190,000	No	No	No
SB		Anthracene	ug/kg	6.7	19,000	--	190,000	No	No	No
SB		Benzo(a)anthracene	ug/kg	4.4	1,000	--	9,500,000	No	No	No
SB		Di-n-butyl Phthalate	ug/kg	220	3,120	626	1,672,000	No	No	No
SB		Di-n-octyl Phthalate	ug/kg	23	63,000	626	1,672,000	No	No	No
SB		Fluoranthene	ug/kg	2.1	19,000	--	190,000	No	No	No
SB		Fluorene	ug/kg	5.2	19,000	--	190,000	No	No	No
SB		Phenanthrene	ug/kg	8.6	19,000	--	190,000	No	No	No
SB		Pyrene	ug/kg	0.060	1,000	--	9,500,000	No	No	No
Metals										
TC		Aluminum	mg/kg	262	NA	--	--	**Yes-No CTL**	--	--
TC		Barium	mg/kg	3.2	NA	--	--	**Yes-No CTL**	--	--
TC		Beryllium	mg/kg	0.0072	NA	--	--	**Yes-No CTL**	--	--
TC		Chromium	mg/kg	1.0	NA	--	--	**Yes-No CTL**	--	--
TC		Lead	mg/kg	0.15	0.12	--	--	**Yes**	--	--
TC		Thallium	mg/kg	0.011	NA	--	--	**Yes-No CTL**	--	--
TC		Vanadium	mg/kg	0.61	NA	--	--	**Yes-No CTL**	--	--
TC		Zinc	mg/kg	25	NA	--	--	**Yes-No CTL**	--	--
PCB Aroclors										
TC		Aroclor 1254	ug/kg	1,200	430	--	--	**Yes**	--	--
TC		Total PCBs as Aroclors (MDL-based)	ug/kg	1,200	430	--	--	**Yes**	--	--
PCB Congeners										
TC	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	0.29	430	--	--	No	--	--
TC	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	0.067	430	--	--	No	--	--
TC	105	2,3,3',4,4'-Pentachlorobiphenyl	ug/kg	57	430	--	--	No	--	--
TC	114	2,3,4,4',5-Pentachlorobiphenyl	ug/kg	3.3	430	--	--	No	--	--
TC	118	2,3',4,4',5-Pentachlorobiphenyl	ug/kg	237	430	--	--	No	--	--
TC	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	3.9	430	--	--	No	--	--
TC	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	0.057	430	--	--	No	--	--
TC	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	16	430	--	--	No	--	--
TC	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	9.1	430	--	--	No	--	--
TC	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	0.085	430	--	--	No	--	--
TC		PCBs as Fish TEQ (KM-capped, RDL-based)	ug/kg	0.0019	0.0064	--	--	No	--	--
TC		Total PCBs as Congeners (KM-based, capped)	ug/kg	2029	430	--	--	**Yes**	--	--
Pesticides										
TC		4,4'-DDD	ug/kg	2.7	54	--	--	**Yes[2]**	--	--

Table 3-2
Comparison of 2011 Tissue Data to CTLs/ATLs for all Detected Analytes

Matrix	IUPAC #	Analyte	Units	2011 Max Detected	CTLs for Fish & Shellfish Exposed to Tissue[1]	ATLs for Individual Birds Exposed to Tissue[1]	ATLs for Individual Mammals Exposed to Tissue[1]	Retain as Bioaccumulative CPEC?		
								Fish/ Shellfish	Bird	Mammal
TC		4,4'-DDE	ug/kg	10	54	--	--	**Yes[2]**	--	--
TC		4,4'-DDT	ug/kg	110	54	--	--	**Yes**	--	--
TC		BHC (alpha)	ug/kg	0.81	NA	--	--	**Yes-No CTL**	--	--
TC		BHC (beta)	ug/kg	1.5	NA	--	--	**Yes-No CTL**	--	--
TC		BHC (delta)	ug/kg	0.61	NA	--	--	**Yes-No CTL**	--	--
TC		BHC (gamma) Lindane	ug/kg	0.36	NA	--	--	**Yes-No CTL**	--	--
TC		Chlordane (gamma)	ug/kg	18	60	--	--	**Yes[2]**	--	--
TC		Endosulfan I	ug/kg	2.7	NA	--	--	**Yes-No CTL**	--	--
TC		Endrin	ug/kg	4.1	NA	--	--	**Yes-No CTL**	--	--
TC		Endrin Aldehyde	ug/kg	2.9	NA	--	--	**Yes-No CTL**	--	--
TC		Total DDx (MDL-based)	ug/kg	121	54	--	--	**Yes**	--	--
PAHs										
TC		Acenaphthene	ug/kg	0.74	19,000	--	--	No	--	--
TC		Anthracene	ug/kg	2.7	19,000	--	--	No	--	--
TC		Benzo(a)anthracene	ug/kg	3.5	1,000	--	--	No	--	--
TC		Benzo(a)pyrene	ug/kg	2.7	1,000	--	--	No	--	--
TC		Benzo(b)fluoranthene	ug/kg	3.2	1,000	--	--	No	--	--
TC		Benzo(g,h,i)perylene	ug/kg	2.5	1,000	--	--	No	--	--
TC		Benzo(k)fluoranthene	ug/kg	2.5	1,000	--	--	No	--	--
TC		Chrysene	ug/kg	6.1	1,000	--	--	No	--	--
TC		Dibenz(a,h)anthracene	ug/kg	4.2	1,000	--	--	No	--	--
TC		Fluoranthene	ug/kg	12	19,000	--	--	No	--	--
TC		Fluorene	ug/kg	2.2	19,000	--	--	No	--	--
TC		Indeno(1,2,3-cd)pyrene	ug/kg	2.6	1,000	--	--	No	--	--
TC		Phenanthrene	ug/kg	10	19,000	--	--	No	--	--
TC		Pyrene	ug/kg	6.5	1,000	--	--	No	--	--

Notes:

1) ODEQ 2007. (see Appendix J in the RI [URS 2012] for surrogate selections).

2) Individual PCB congeners and individual pesticides less than the CTLs/ATLs were retained because they are either part of a sum (i.e., Total PCBs as Congeners, PCB TEQs, Total DDx) or due to their potential additive effect within the analytical group (i.e., pesticides).

[max] > CTL
[max] > Bird ATL
[max] > Mammal ATL

-- = not applicable
ATL = acceptable tissue level
CTL = critical tissue level
Max = maximum
mg/kg = milligrams per kilogram, in wet weight
NA = not available

Table 3-2
Comparison of 2011 Tissue Data to CTLs/ATLs for all Detected Analytes

PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SB = Smallmouth bass
SVOC = semi-volatile organic carbon
TC = Clam
TEQ = toxicity equivalence
ug/kg = micrograms per kilogram, in wet weight

Sources:

ODEQ 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Final. April.

URS 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table 3-3
Summary of BERA CPECs

Data Set	Receptor Group	Medium	RI CPECs[2]	Additional Potential CPECs identified in sediment in the DETM[3]	Add to BERA?[4]	Additional CPECs in 2011 Tissue Data[5]	Final BERA CPECs
River OU[1]	Benthic Community	Sediment	PCBs	Arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, thallium, vanadium, zinc, dibutyltin dichloride*, tributyltin chloride*, DDT, Total DDx, chlordane (gamma), endrin aldehyde, endrin, PAHs, bis(2-ethylhexyl) phthalate, p-cresol (4-methylphenol), benzoic acid*, benzyl alcohol*	Yes (all) - direct toxicity		PCBs, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, thallium, vanadium, zinc, dibutyltin dichloride*, tributyltin chloride*, 4,4'-DDT, Total DDx, chlordane (gamma), endrin aldehyde, endrin, PAHs, bis(2-ethylhexyl) phthalate, p-cresol (4-methylphenol), benzoic acid*, benzyl alcohol*
	Fish and Shellfish	Sediment	Cadmium, lead, mercury and PCBs	Arsenic, lead, zinc, dibutyltin dichloride, tributyltin chloride, pesticides, bis(2-ethylhexyl) phthalate*, butyl benzyl phthalate*, carbazole*, dibenzofuran*, di-n-butyl phthalate*	See tissue evaluations below		Same as Tissues Below
		Clam Tissue	Cadmium		Lead, zinc*, p-cresol (4-methylphenol)*, dibenzofuran[#]	Lead, PCBs, 4,4'-DDT, total DDx, 4,4'-DDD[@], 4,4'-DDE[@], chlordane (gamma)[@], aluminum*, barium*, beryllium*, chromium*, thallium*, vanadium*, zinc*, BHC (alpha)*, BHC (beta)*, BHC (delta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*	Cadmium, lead, PCBs, 4,4'-DDT, total DDx, 4,4'-DDD[@], 4,4'-DDE[@], chlordane (gamma)[@], aluminum*, barium*, beryllium*, chromium*, thallium*, vanadium*, zinc*, BHC (alpha)*, BHC (beta)*, BHC (delta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, p-cresol (4-methylphenol)*, dibenzofuran[#]
		Crayfish Tissue			Lead, zinc*, dibenzofuran[#]		Lead, zinc*, dibenzofuran[#]
		Sculpin Tissue	Cadmium, lead, mercury and PCBs		Dibenzofuran[#]		Cadmium, lead, mercury, PCBs, dibenzofuran[#]
		Bass Tissue	Mercury and PCBs		Butyl benzyl phthalte, zinc*, p-cresol (4-methylphenol)*, dibenzofuran[#]	4,4'-DDE, total DDx, chlordane (gamma), dieldrin, 4,4'-DDD[@], 4,4'-DDT[@], chlordane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*	Mercury, PCBs, butyl benzyl phthalate, 4,4'-DDE, total DDx, chlordane (gamma), dieldrin, 4,4'-DDD[@], 4,4'-DDT[@], chlordane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*, dibenzofuran[#]

Table 3-3
Summary of BERA CPECs

Data Set	Receptor Group	Medium	RI CPECs[2]	Additional Potential CPECs identified in sediment in the DETM[3]	Add to BERA?[4]	Additional CPECs in 2011 Tissue Data[5]	Final BERA CPECs
River OU[1]	Birds	Sediment	Mercury and PCBs	Arsenic, lead, zinc, pesticides, heptachlor epoxide*, bis(2-ethylhexyl) phthalate*, butyl benzyl phthalate*, carbazole*, dibenzofuran*, di-n-butyl phthalate*	See Tissue Evaluations Below		Same as tissues below
		Bass Tissue	Mercury and PCBs		Zinc*, p-cresol (4-methylphenol)*, dibenzofuran[#]	4,4'-DDE, 4,4'-DDT, total DDx, chlordane (gamma), dieldrin, 4,4'-DDD[@], chlordane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*	Mercury, PCBs, 4,4'-DDE, 4,4'-DDT, total DDx, chlordane (gamma), dieldrin, 4,4'-DDD[@], chlordane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*, dibenzofuran[#]
	Mammals	Sediment	Mercury and PCBs	Arsenic, lead, zinc, pesticides, bis(2-ethylhexyl) phthalate*, butyl benzyl phthalate*, carbazole*, dibenzofuran*, di-n-butyl phthalate*	See tissue evaluations below		Same as tissues below
		Crayfish Tissue			Zinc*, dibenzofuran[#]		Zinc*, dibenzofuran[#]
		Sculpin Tissue	Mercury and PCBs		Dibenzofuran[#]		Mercury, PCBs, dibenzofuran[#]
		Bass Tissue	Mercury and PCBs		Zinc*, p-cresol (4-methylphenol)*, dibenzofuran[#]	Total DDx, chlordane (gamma), dieldrin, 4,4'-DDD[@], 4,4'-DDE[@], 4,4'-DDT[@], chlrodane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*	Mercury, PCBs, total DDX, chlordane (gamma), dieldrin, 4,4'-DDD[@], 4,4'-DDE[@], 4,4'-DDT[@], chlordane (alpha)[@], aluminum*, antimony*, barium*, chromium*, copper*, zinc*, BHC (beta)*, BHC (gamma) lindane*, endosulfan I*, endrin*, endrin aldehyde*, methoxychlor*, p-cresol (4-methylphenol)*, dibenzofuran[#]

Notes:
1) PCBs were retained as a RI CPECs in sediment for all receptors. Although CPEC concentrations in media collected from the targeted Goose Island samples indicated acceptable risk levels in the RI, the Forebay, Goose Island, and Eagle Creek were all maintained as part of the River OU evaluation in the BERA.
2) See Table 12-2 of Final RI (URS 2012).
3) See Table 2-3 of DETM (URS 2014).
4) See Table 3-1 for comparison of Tissue Data to ODEQ's CTLs/ATLs for Shellfish/Fish and Wildlife for DETM sediment CPECs. Only additional CPECs not already identified as RI CPEC are listed.
5) See Table 3-2 for comparison of 2011 Tissue Data to ODEQs CTLs/ATLs for Shellfish/Fish and Wildlife for all analytes detected in tissue.

* Retained due to lack of SLV (benthic community), bioaccumulative and lack of dietary SLV (wildlife), or lack of CTL/ATL
[@] Retained because they are either part of a sum or due to their potential additive affect within the analytical group
[#] Retained due to lack of tissue analysis; were qualitatively evaluated by estimating benthic invertebrate and fish tissue concentrations using BSAFs

Table 3-3
Summary of BERA CPECs

ATL = acceptable tissue level
BSAF = biota-sediment accumulation factor
CPECs = chemicals of potential ecological concern
CTL = critical tissue level
DETM = Data Evaluation Technical Memo
PCBs = polychlorinated biphenyls (as Aroclors and 209 congeners)
RI = Remedial Investigation
SLV = screening level value
TBD = to be determined

Sources:

URS 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

URS 2014. Data Evaluation Technical Memorandum, River Operable Unit. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. July 3.

Table 3-4
Exposure Assumptions and Dose Equations for the Osprey (*Pandion haliaetus*)

Equation:

$$D = \frac{AUF \times [(C_{F1} \times P_{F1} \times IR_F) + (C_W \times IR_W)]}{BW}$$

Where:

D = Chemical dose (mg/kg-bw/day)
C_W = Analytical data OR estimated concentrations (see Table 3-7)
IR_F = 0.638 x BW in grams ^0.685 *0.001 [a]
IR_W= 0.059 x BW^0.67

Parameter	Definition	Value	Units	Source [b]
C_{F1}	Chemical concentration in food item 1 (Trophic level 3-4 fish)	food-specific chemical concentration	mg/kg ww	River OU analytical smallmouth bass data
C_W	Concentration in river water	chemical-specific	mg/L	River OU surface water data, if available; otherwise, River OU calculated water (via equilibrium partitioning calculation from sediment)
HR	Home Range	1.7	km	USEPA 1993
AUF	Area Use Factor	0.71	unitless	Area of site (1.2 km) divided by area of HR
P_{F1}	Proportion of food item 1 - Trophic level 3-4 fish	1	unitless	Diet assumed 100% upper trophic fish
IR_F	Food Ingestion Rate - Trophic level 3-4 fish	0.37	kg/day ww	Nagy 2001 for all birds
IR_S	Incidental Ingestion Rate - sediment	NA	kg dry/day	Assumed to be negligible; not expected to come in contact with sediment.
IR_W	Ingestion Rate - water	0.090	L/day	USEPA 1993
BW	Body weight	1.88	kg	USEPA 1993

Notes:

a) Allometric relationships with gram body weight.
b) See Appendix D, Table D-1 of Remedial Investigation/Feasibility Study Management Plan (RI/FS MP) (URS 2007).

BAF = bioaccumulation factor
foc = fraction of organic carbon
Kd = soil-water partition coefficient (cm^3/g)
kg = kilograms
kg dry/day = kilograms per day in dry weight
km = kilometers
K_{oc} = organic carbon partition coefficient (L/kg)
L/day = liters per day
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/kg dry = milligrams per kilogram in dry weight
mg/L = milligrams per liter
OU = operational unit
UCL = upper confidence limit
USEPA = U.S. Environmental Protection Agency
ww = wet weight

Sources:

Nagy, K.A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B 71, 21R-31R.

URS. 2007. Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP), Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon. September.

U.S. Environmental Protection Agency (USEPA). 1993. "Wildlife Exposure Factors Handbook." December. 1993.

Table 3-5
Exposure Assumptions and Dose Equations for the Bald Eagle (*Haliaeetus leucocephalus*)

Equation:

$$D = \frac{AUF \times [(C_{F1} \times P_{F1} \times IR_F) + (C_W \times IR_W)]}{BW}$$

Where:

D = Chemical dose (mg/kg-bw/day)
C_W = Analytical data OR estimated concentrations (see Table 3-7)
IR_F = 0.638 x BW in grams ^0.685 *0.001 [a]
IR_W = 0.059 x BW^0.67

Parameter	Definition	Value	Units	Source [b]
C_{F1}	Chemical concentration in food item 1 (Trophic level 3-4 fish)	food-specific chemical concentration	mg/kg ww	River OU analytical smallmouth bass data
C_W	Concentration in river water	chemical-specific	mg/L	River OU surface water data, if available; otherwise, River OU calculated water (via equilibrium partitioning calculation from sediment)
HR	Home Range	1.4	km	USEPA 1993
AUF	Area Use Factor	0.86	unitless	Area of site (1.2 km) divided by area of HR
P_{F1}	Proportion of food item 1 - Trophic level 3-4 fish	1	unitless	Diet assumed 100% upper trophic fish
IR_F	Food Ingestion Rate - Trophic level 3-4 fish	0.68	kg/day ww	Nagy 2001 for all birds
IR_S	Incidental Ingestion Rate - sediment	NA	kg dry/day	Assumed to be negligible; not expected to come in contact with sediment.
IR_W	Ingestion Rate - water	0.16	L/day	USEPA 1993
BW	Body weight	4.5	kg	USEPA 1993

Notes:

a) Allometric relationships with gram body weight.

b) See Appendix D, Table D-1 of Remedial Investigation/Feasibility Study Management Plan (RI/FS MP) (URS 2007).

BAF = bioaccumulation factor
foc = fraction of organic carbon
Kd = soil-water partition coefficient (cm^3/g)
kg = kilograms
kg dry/day = kilograms per day in dry weight
km = kilometers
K_{oc} = organic carbon partition coefficient (L/kg)
L/day = liters per day
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/kg dry = milligrams per kilogram in dry weight
mg/L = milligrams per liter
OU = operational unit
UCL = upper confidence limit
USEPA = U.S. Environmental Protection Agency
ww = wet weight

Sources:

Nagy, K.A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B 71, 21R-31R.

URS. 2007. Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP), Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon. September.

U.S. Environmental Protection Agency (USEPA). 1993. "Wildlife Exposure Factors Handbook." December. 1993

Table 3-6
Exposure Assumptions and Dose Equations For the American Mink (*Neovison vison*)

Equation:

$$D = \frac{AUF \times [(C_{F1} \times P_{F1} \times IR_F) + (CF2 \times PF2 \times IRF) + (CF3 \times PF3 \times IRF) + (C_S \times IR_S) + (C_W \times IR_W)]}{BW}$$

Where:

D = Chemical dose (mg/kg-bw/day)

C_W = Analytical data OR estimated concentrations (see Table 3-7)

IR_F = 0.323 x BW in grams ^0.744 *0.001 [a]

IR_S = 0.094 x IR_F

IR_W = 0.099 x BW^0.9

Parameter	Definition	Value	Units	Source [b]
C_{F1}	Chemical concentration in food item 1 (Trophic level 2-3 fish)	food-specific chemical concentration	mg/kg ww	River OU analytical sculpin data
C_{F2}	Chemical concentration in food item 2 (Trophic level 3-4 fish)	food-specific chemical concentration	mg/kg ww	River OU analytical smallmouth bass data
C_{F3}	Chemical concentration in food item 3 (Benthic invertebrates)	food-specific chemical concentration	mg/kg ww	River OU analytical crayfish data
C_S	EPC in sediment	chemical-specific	mg/kg dry	River OU analytical data (lower of 95% UCL and max)
C_W	Concentration in river water	chemical-specific	mg/L	River OU surface water data, if available; otherwise, River OU calculated water (via equilibrium partitioning calculation from sediment)
HR	Home Range	1.85	km	USEPA 1993
AUF	Area Use Factor	0.65	unitless	Area of site (1.2 km) divided by area of HR
P_{F1}	Proportion of food item 1 - Trophic level 2-3 fish	0.33	unitless	1/3 mid trophic level fish diet
P_{F2}	Proportion of food item 2 - Trophic level 3-4 fish	0.33	unitless	1/3 upper trophic level fish diet
P_{F3}	Proportion of food item 3 - Benthic invertebrates	0.33	unitless	1/3 benthic invertebrate diet
IR_F	Food ingestion rate	0.162	kg/day ww	Nagy 2001 for all mammals
IR_S	Incidental Ingestion Rate - sediment	0.0152	kg dry /day	Based on 9.4% of total food ingestion rate for raccoon (Beyer et al. 1994)
IR_W	Ingestion Rate - water	0.097	L/day	USEPA 1993
BW	Body weight	0.974	kg	USEPA 1993

Notes:

a) Allometric relationships with gram body weight.

b) See Appendix D, Table D-1 of Remedial Investigation/Feasibility Study Management Plan (RI/FS MP) (URS 2007).

BAF = bioaccumulation factor
EPC = exposure point concentration
foc = fraction of organic carbon
Kd = soil-water partition coefficient (cm^3/g)
kg = kilograms
kg dry/day = kilograms per day in dry weight
km = kilometers
K_{oc} = organic carbon partition coefficient (L/kg)
L/day = liters per day
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/kg dry = milligrams per kilogram in dry weight
mg/L = milligrams per liter
OU = operational unit
UCL = upper confidence limit
USEPA = U.S. Environmental Protection Agency
ww = wet weight

Sources:

Beyer, W.N., Connor, E.E. and Gerould, S. 1994. Estimates of soil ingestion by wildlife. *J. Wildl. Manage*. 58:375-382.

Nagy, K.A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B 71, 21R-31R.

URS. 2007. Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP), Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon. September.

U.S. Environmental Protection Agency (USEPA). 1993. “Wildlife Exposure Factors Handbook.” December. 1993.

Table 3-7
Analytical and Estimated Surface Water Concentrations

3-7a. Analytical Surface Water Concentrations		
Analyte	**Analytical SW EPC (mg/L)** [a]	**Source of Analytical Data**
Metal		
Aluminum	1.4E-01	Maximum detected concentration
Antimony	5.0E-02	All ND; maximum MDL of NDs
Barium	2.7E-02	Maximum detected concentration
Chromium	2.0E-03	All ND; maximum MDL of NDs
Copper	7.9E-04	Maximum detected concentration
Mercury	3.0E-05	All ND; maximum MDL of NDs
Zinc	7.0E-03	Maximum detected concentration
PCBs as Congeners		
PCBs as Bird TEQ (KM-capped)	6.8E-12	Maximum calculated TEQ
PCBs as Mammal TEQ (KM-capped)	1.1E-13	Maximum calculated TEQ
Total PCBs as Congeners	2.1E-07	Maximum detected concentration

3-7b. Estimated Surface Water Concentrations				
Analyte	**Analytical SW EPC (mg/L)** [a]	**Estimated Surface Water Concentrations**		
		Sediment EPC (mg/kg dw) [b]	**K_{oc} (L/kg)** [c]	**Water Concentration (mg/L)** [d]
PCBs as Aroclors				
Total PCBs as Aroclors (MDL-based)	N/A	2.2	78,100	3.3E-03
Pesticides				
4,4'-DDD	N/A	0.00015	118,000	1.5E-07
4,4'-DDE	N/A	0.00037	118,000	3.7E-07
4,4'-DDT	N/A	0.022	169,000	1.6E-05
BHC (beta)[f]	N/A	0.029	2,810	1.2E-03
BHC (gamma) Lindane	N/A	0.000075	2,810	3.2E-06
Chlordane (alpha)[f]	N/A	0.74	67,500	1.3E-03
Chlordane (gamma)	N/A	0.0069	67,500	1.2E-05
Dieldrin[f]	N/A	5.8	20,100	3.4E-02
Endosulfan I[f]	N/A	0.026	6,760	4.6E-04
Endrin	N/A	0.0015	20,100	8.8E-06
Endrin Aldehyde	N/A	0.0018	3,270	6.7E-05
Methoxychlor[f]	N/A	0.29	41,300	8.4E-04
SVOCs				
Dibenzofuran	N/A	0.011	9,160	1.4E-04
p-Cresol (4-methylphenol)	N/A	0.014	300	5.6E-03

Notes:

a) See Table 1-4. Preparation fractions: Metals = total; PCB congeners = C + F (column + filter)

b) See Table 1-1 . For detected analytes, the EPC was the River OU-wide 95% UCL (if calculated) or the River OU-wide maximum detected concentration (if UCL not calc.) See note 'f' for analytes not detected in sediment.

c) Oak Ridge National Laboratory Risk Assessment Information System Database Chemical Parameters: http://rais.ornl.gov/

d) For the eagle, osprey, and mink, CPEC concentrations in surface water for those CPECs lacking analytical data were calculated using the equilibrium partitioning calculation:

Concentration in water (organics) = Concentration soil / (foc * K_{oc}), where foc = 0.0084 River OU sediment median)

e) DDT K_{oc} used as surrogate for Total DDx

f) All sediment samples were ND, so the EPC was the River OU maximum MDL of the NDs (Table A-3).

dw = dry weight
EPC = exposure point concentration
foc = fraction of organic carbon
kg = kilogram
K_{oc} = organic carbon partition coefficient (L/kg)
L = liter
MDL = method detection limit
mg = milligrams
N/A = not analyzed
ND = non-detect
SVOC = semivolatile organic compound

Table 3-8
Estimated Tissue and Egg Concentrations

3-8a. Estimated Benthic and Fish Tissue for Dibenzofuran						
CPEC	EPC in Sediment (mg/kg dw)[a]	Fish BSAF [b,c]	Estimated Concentrations (mg/kg ww)[d]			
			Clam	Crayfish	Sculpin	Smallmouth Bass
Dibenzofuran	0.011	0.032	0.0011	0.00030	0.0017	0.0012

3-8b. Osprey/Eagle Egg Concentrations					
CPEC	EPC in Smallmouth Bass Tissue (mg/kg ww)[e]	BMF_{egg} Osprey [f]	BMF_{egg} Eagle [f]	Estimated Osprey C_{egg} (mg/kg ww)	Estimated Eagle C_{egg} (mg/kg ww)
Mercury	0.25	2.8	2.8	0.69	0.69
Total PCBs as Aroclors	25	11	113	273	2804
Total PCBs as Congeners	47	11	113	519	5328
PCBs as Bird TEQ[g]	0.00096	10	16	0.0096	0.015
4,4'-DDD	0.0045	87	75	0.40	0.34
4,4'-DDE	0.039	87	75	3.40	2.93
4,4'-DDT	0.0052	87	75	0.45	0.39
Sum DDx for Egg[h]	--	--	--	4.2	3.7

Notes:

a) The River OU sediment EPCs (Table 1-1).

b) USEPA 2009. BSAF Data Set. Dibenzofuran median freshwater BSAF for available whole body fish (smallmouth bass, white sucker, and American eel). Online at: www.epa.gov/med/Prods_Pubs/bsaf.htm.

c) In the absence of benthic BSAF data, the fish BSAF was used to estimate benthic tissue concentrations.

d) Tissue concentrations were estimated using site-specific organic-carbon (median) and lipid (median per media) content.

e) The River OU-wide tissue EPCs are 95% UCLs (Table 1-6).

f) BMFs from ODEQ 2007. Guidance for Evaluation of Bioaccumulative Chemicals of Concern in Sediment. Final. January 31, updated April.

g) The following BMF was used as surrogates: 2,3,7,8-TCDD for PCBs as Bird TEQ.

h) For each bird: Sum DDx for Egg = Sum of estimated egg concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

-- = Not applicable
BMF = Biomagnification factor
BSAF = Biota-Sediment Accumulation Factor
Cegg = concentration in egg
dw = dry weight
EPC = exposure point concentration (lower of 95% UCL and maximum detected concentration)
kg = kilogram
mg = milligrams
NA = not available
PCB = polychlorinated biphenyl
TEQ = toxicity equivalence
UCL = upper confidence limit
ww = wet weight

Table 3-9
Calculation of Dose and Hazard Quotient for the Osprey

CPEC	EPCs		Exposure Factors					Dose	TRVs[e]		Hazard Quotients	
	Smallmouth Bass Tissue (mg/kg ww)[a]	Concen-tration in Water (mg/L)[b]	Food Ingestion Rate (kg/day ww)	Water Ingestion Rate (L/day)	PF Bass	AUF	BW (kg)	(mg/kg-bw/day)	NOAEL TRV (mg/kg-bw/day)	LOAEL TRV (mg/kg-bw/day)	NOAEL HQ	LOAEL HQ
Inorganics												
Aluminum	5.4	1.4E-01	0.37	0.090	1	0.71	1.88	0.8	157	785	4.8E-03	9.6E-04
Antimony[c]	0.010	5.0E-02	0.37	0.090	1	0.71	1.88	0.0031	No TRV	No TRV	No TRV	No TRV
Barium	2.6	2.7E-02	0.37	0.090	1	0.71	1.88	0.37	21	42	1.8E-02	8.8E-03
Chromium	0.19	2.0E-03	0.37	0.090	1	0.71	1.88	0.027	2.7	16	1.0E-02	1.7E-03
Copper	0.93	7.9E-04	0.37	0.090	1	0.71	1.88	0.13	4.1	12	3.2E-02	1.1E-02
Mercury	0.25	3.0E-05	0.37	0.090	1	0.71	1.88	0.034	0.013	0.026	**2.6E+00**	**1.3E+00**
Zinc	14	7.0E-03	0.37	0.090	1	0.71	1.88	2.0	66	171	3.0E-02	1.2E-02
PCBs as Aroclors												
Total PCBs as Aroclors	25	3.3E-03	0.37	0.090	1	0.71	1.88	3.5	0.20	0.60	**1.7E+01**	**5.8E+00**
PCBs as Congeners												
PCBs as Bird TEQ	0.00096	6.8E-12	0.37	0.090	1	0.71	1.88	0.00013	1.4E-06	7.0E-06	**9.6E+01**	**1.9E+01**
Total PCBs as Congeners	47	2.1E-07	0.37	0.090	1	0.71	1.88	6.58964	2.0E-01	6.0E-01	**3.3E+01**	**1.1E+01**
Pesticides												
4,4'-DDD	0.0045	1.5E-07	0.37	0.090	1	0.71	1.88	0.00063	0.032	0.32	2.0E-02	2.0E-03
4,4'-DDE	0.039	3.7E-07	0.37	0.090	1	0.71	1.88	0.0055	0.032	0.32	1.7E-01	1.7E-02
4,4'-DDT	0.0052	1.6E-05	0.37	0.090	1	0.71	1.88	0.0007	0.0090	0.027	8.1E-02	2.7E-02
BHC (beta)	0.00079	1.2E-03	0.37	0.090	1	0.71	1.88	0.00015	2.0	20	7.6E-05	7.6E-06
BHC (gamma) Lindane	0.00067	3.2E-06	0.37	0.090	1	0.71	1.88	0.00009	2.0	20	4.7E-05	4.7E-06
Chlordane (alpha)	0.00030	1.3E-03	0.37	0.090	1	0.71	1.88	0.00009	2.0	20	4.3E-05	4.3E-06
Chlordane (gamma)	3.2	1.2E-05	0.37	0.090	1	0.71	1.88	0.45	0.21	1.1	**2.1E+00**	4.2E-01
Dieldrin	0.55	3.4E-02	0.37	0.090	1	0.71	1.88	0.08	0.0077	0.039	**1.0E+01**	**2.0E+00**
Endosulfan I	0.054	4.6E-04	0.37	0.090	1	0.71	1.88	0.008	10	50	7.6E-04	1.5E-04
Endrin	0.83	8.8E-06	0.37	0.090	1	0.71	1.88	0.12	0.010	0.10	**1.2E+01**	**1.2E+00**
Endrin Aldehyde	0.26	6.7E-05	0.37	0.090	1	0.71	1.88	0.036	0.010	0.10	**3.6E+00**	3.6E-01
Methoxychlor	0.00061	8.4E-04	0.37	0.090	1	0.71	1.88	0.00011	20	100	5.7E-06	1.1E-06
SVOCs												
Dibenzofuran[d]	0.0012	1.4E-04	0.37	0.090	1	0.71	1.88	0.000179	1.0	5.1	1.8E-04	3.5E-05
p-Cresol (4-methylphenol)	0.037	5.6E-03	0.37	0.090	1	0.71	1.88	0.0053	0.96	4.8	5.6E-03	1.1E-03

Metals HI	**2.7E+00**	**1.4E+00**
DDx HI	2.7E-01	4.6E-02
Pesticides HI	**2.8E+01**	**4.0E+00**

Notes:
a) The tissue EPCs are shown on Table 1-6, with exception of dibenzofuran.
b) Maximum detected concentrations in River OU surface water were used if available, otherwise concentrations were estimated (see Table 3-7).
c) Antimony does not have TRVs, but will be evaluated qualitatively.
d) Not analyzed in tissue; therefore, the tissue is estimated (see Table 3-8).
e) Selected TRVs and sources are shown on Table 3-14.
Bold indicates hazard quotient greater than 1.0.

Table 3-9
Calculation of Dose and Hazard Quotient for the Osprey

AUF = Area Use Factor
BW = body weight
CPEC = chemical of potential ecological concern
Dose = average daily dose (mg/kg-bw/day)
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
kg = kilogram
kg/day = kilograms per day
L/day = liters per day
LOAEL = lowest observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
PF = portion of food item
SVOC = semivolatile organic compound
TEQ = toxicity equivalence
TRV = toxicity reference value
UCL = upper confidence limit
ww = wet weight

Table 3-10
Calculation of Dose and Hazard Quotient for the Bald Eagle

CPEC	EPCs		Exposure Factors					Dose	TRVs[e]		Hazard Quotients	
	Smallmouth Bass Tissue (mg/kg ww)[a]	Concen-tration in Water (mg/L)[b]	Food Ingestion Rate (kg/day ww)	Water Ingestion Rate (L/day)	PF Bass	AUF	BW (kg)	(mg/kg-bw/day)	NOAEL TRV (mg/kg-bw/day)	LOAEL TRV (mg/kg-bw/day)	NOAEL HQ	LOAEL HQ
Inorganics												
Aluminum	5.4	1.4E-01	0.68	0.16	1	0.86	4.50	0.70	157	785	4.4E-03	8.9E-04
Antimony[c]	0.010	5.0E-02	0.68	0.16	1	0.86	4.50	0.0029	No TRV	No TRV	No TRV	No TRV
Barium	2.6	2.7E-02	0.68	0.16	1	0.86	4.50	0.34	21	42	1.6E-02	8.2E-03
Chromium	0.19	2.0E-03	0.68	0.16	1	0.86	4.50	0.025	2.7	16	9.4E-03	1.6E-03
Copper	0.93	7.9E-04	0.68	0.16	1	0.86	4.50	0.12	4.1	12	3.0E-02	1.0E-02
Mercury	0.25	3.0E-05	0.68	0.16	1	0.86	4.50	0.032	0.013	0.026	**2.4E+00**	**1.2E+00**
Zinc	14	7.0E-03	0.68	0.16	1	0.86	4.50	1.8	66	171	2.8E-02	1.1E-02
PCBs as Aroclors												
Total PCBs as Aroclors	25	3.3E-03	0.68	0.16	1	0.86	4.50	3.2	0.20	0.60	**1.6E+01**	**5.4E+00**
PCBs as Congeners												
PCBs as Bird TEQ	0.00096	6.8E-12	0.68	0.16	1	0.86	4.50	0.00012	1.4E-06	7.0E-06	**8.9E+01**	**1.8E+01**
Total PCBs as Congeners	47	2.1E-07	0.68	0.16	1	0.86	4.50	6.09953	2.0E-01	6.0E-01	**3.0E+01**	**1.0E+01**
Pesticides												
4,4'-DDD	0.0045	1.5E-07	0.68	0.16	1	0.86	4.50	0.00059	0.032	0.32	1.8E-02	1.8E-03
4,4'-DDE	0.039	3.7E-07	0.68	0.16	1	0.86	4.50	0.0051	0.032	0.32	1.6E-01	1.6E-02
4,4'-DDT	0.0052	1.6E-05	0.68	0.16	1	0.86	4.50	0.00067	0.0090	0.027	7.5E-02	2.5E-02
BHC (beta)	0.00079	1.2E-03	0.68	0.16	1	0.86	4.50	0.00014	2.0	20	7.0E-05	7.0E-06
BHC (gamma) Lindane	0.00067	3.2E-06	0.68	0.16	1	0.86	4.50	0.00009	2.0	20	4.3E-05	4.3E-06
Chlordane (alpha)	0.00030	1.3E-03	0.68	0.16	1	0.86	4.50	0.000079	0.2	1	3.7E-04	7.4E-05
Chlordane (gamma)	3.2	1.2E-05	0.68	0.16	1	0.86	4.50	0.41	0.21	1.1	**1.9E+00**	3.9E-01
Dieldrin	0.55	3.4E-02	0.68	0.16	1	0.86	4.50	0.072	0.0077	0.039	**9.4E+00**	**1.8E+00**
Endosulfan I	0.054	4.6E-04	0.68	0.16	1	0.86	4.50	0.0071	10	50	7.1E-04	1.4E-04
Endrin	0.83	8.8E-06	0.68	0.16	1	0.86	4.50	0.11	0.010	0.10	**1.1E+01**	**1.1E+00**
Endrin Aldehyde	0.26	6.7E-05	0.68	0.16	1	0.86	4.50	0.034	0.010	0.10	**3.4E+00**	3.4E-01
Methoxychlor	0.00061	8.4E-04	0.68	0.16	1	0.86	4.50	0.00011	20	100	5.3E-06	1.1E-06
SVOCs												
Dibenzofuran[d]	0.0012	1.4E-04	0.68	0.16	1	0.86	4.50	0.000166	1.0	5.1	1.6E-04	3.2E-05
p-Cresol (4-methylphenol)	0.037	5.6E-03	0.68	0.16	1	0.86	4.50	0.0049	0.96	4.8	5.1E-03	1.0E-03

Metals HI	**2.5E+00**	**1.3E+00**
DDx HI	2.5E-01	4.3E-02
Pesticides HI	**2.6E+01**	**3.7E+00**

Notes:
a) The tissue EPCs are shown on Table 1-6, with exception of dibenzofuran.
b) Maximum detected concentrations in River OU surface water were used if available, otherwise concentrations were estimated (see Table 3-7).
c) Antimony does not have TRVs, but will be evaluated qualitatively.
d) Not analyzed in tissue; therefore, the tissue concentration is estimated (see Table 3-8).
e) Selected TRVs and sources are shown on Table 3-14.
Bold indicates hazard quotient greater than 1.0.

Table 3-10
Calculation of Dose and Hazard Quotient for the Bald Eagle

AUF = Area Use Factor
BW = body weight
CPEC = chemical of potential ecological concern
Dose = average daily dose (mg/kg-bw/day)
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
kg = kilogram
kg/day = kilograms per day
L/day = liters per day
LOAEL = lowest observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
PF = portion of food item
SVOC = semivolatile organic compound
TEQ = toxicity equivalence
TRV = toxicity reference value
UCL = upper confidence limit
ww = wet weight

Table 3-11
Calculation of Dose and Hazard Quotient for the American Mink

CPEC	EPCs[c]					Exposure Factors								Dose	TRVs[e]		Hazard Quotients	
	Crayfish Tissue (mg/kg ww)[a]	Sculpin Tissue (mg/kg ww)[a]	Smallmouth Bass Tissue (mg/kg ww)[a]	Concentration in Sediment (mg/kg dw)[b]	Concentration in Water (mg/L)[c]	Food Ingestion Rate (kg/day ww)	Sediment Incidental Ingestion Rate (kg/day dw)	Water Ingestion Rate (L/day)	PF Crayfish	PF Sculpin	PF Bass	AUF	BW (kg)	(mg/kg-bw/day)	NOAEL TRV (mg/kg-bw/day)	LOAEL TRV (mg/kg-bw/day)	NOAEL HQ	LOAEL HQ
Inorganics																		
Aluminum[f]	116	--	5.4	15,767	1.4E-01	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	167	34	76	**4.8E+00**	**2.2E+00**
Antimony[f]	0.042	--	0.010	0.32	5.0E-02	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	0.009	0.059	0.59	1.6E-01	1.6E-02
Barium[f]	69	--	2.6	138	2.7E-02	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	5.3	52	83	1.0E-01	6.4E-02
Chromium[f]	0.76	--	0.19	37	2.0E-03	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	0.43	2.4	37	1.8E-01	1.2E-02
Copper[f]	22	--	0.93	38	7.9E-04	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	1.6	5.6	9.3	2.9E-01	1.7E-01
Mercury	0.024	0.19	0.25	0.14	3.0E-05	0.162	0.0152	0.097	0.33	0.33	0.33	0.65	0.974	0.018	0.016	0.027	**1.1E+00**	6.5E-01
Zinc[f]	21	--	14	110	7.0E-03	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	3.0	20	101	1.5E-01	3.0E-02
PCBs as Aroclors																		
Total PCBs as Aroclors	0.019	0.44	25	2.2	3.3E-03	0.162	0.0152	0.097	0.33	0.33	0.33	0.65	0.974	0.9	0.12	0.23	**7.7E+00**	**4.0E+00**
PCBs as Congeners																		
PCBs as Mammal TEQ	0.0000011	0.000025	0.00046	0.0000054	1.1E-13	0.162	0.0152	0.097	0.33	0.33	0.33	0.65	0.974	0.000017	8.0E-08	2.2E-06	**2.2E+02**	**7.9E+00**
Total PCBs as Congeners	0.019	3.0	47	1.7	2.1E-07	0.162	0.0152	0.097	0.33	0.33	0.33	0.65	0.974	1.8	1.2E-01	2.3E-01	**1.5E+01**	**7.9E+00**
Pesticides[f]																		
4,4'-DDD	--	--	0.0045	0.00015	1.5E-07	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.00049	0.080	0.40	6.2E-03	1.2E-03
4,4'-DDE	--	--	0.039	0.00037	3.7E-07	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.0042	0.080	0.40	5.3E-02	1.1E-02
4,4'-DDT	--	--	0.0052	0.022	1.6E-05	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.0008	0.080	0.40	9.8E-03	2.0E-03
BHC (beta)	--	--	0.00079	0.029	1.2E-03	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.00046	0.014	0.14	3.3E-02	3.3E-03
BHC (gamma) Lindane	--	--	0.00067	0.000075	3.2E-06	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.00007	0.014	0.14	5.2E-03	5.2E-04
Chlordane (alpha)	--	--	0.00030	0.74	1.3E-03	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.008	0.46	0.92	1.7E-02	8.3E-03
Chlordane (gamma)	--	--	3.2	0.0069	1.2E-05	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.34	0.46	0.92	7.5E-01	3.8E-01
Dieldrin	--	--	0.55	5.8	3.4E-02	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.12	0.020	0.10	**6.0E+00**	**1.2E+00**
Endosulfan I	--	--	0.054	0.026	4.6E-04	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.0062	0.15	0.75	4.1E-02	8.2E-03
Endrin	--	--	0.83	0.0015	8.8E-06	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.09	0.092	0.92	9.7E-01	9.7E-02
Endrin Aldehyde	--	--	0.26	0.0018	6.7E-05	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.028	0.092	0.92	3.1E-01	3.1E-02
Methoxychlor	--	--	0.00061	0.29	8.4E-04	0.162	0.0152	0.097	0	0	1	0.65	0.974	0.0031	4.0	8.0	7.7E-04	3.8E-04
SVOCs																		
Dibenzofuran[b]	0.00030	0.0017	0.0012	0.011	1.4E-04	0.162	0.0152	0.097	0.33	0.33	0.33	0.65	0.974	0.00024	3.0	30.0	7.9E-05	7.9E-06
p-Cresol (4-methylphenol)[f]	0.011	--	0.037	0.014	5.6E-03	0.162	0.0152	0.097	0.5	0	0.5	0.65	0.974	0.0031	219	1096	1.4E-05	2.8E-06

Metals HI	**6.8E+00**	**3.1E+00**
DDx HI	6.9E-02	1.4E-02
Pesticides HI	**8.2E+00**	**1.7E+00**

Notes:

a) The tissue EPCs are shown on Table 1-6, with exception of dibenzofuran. The EPC of non-detects is the maximum method detection limit of the non-detects.

b) The sediment EPCs are shown on Table 1-1. The EPC of non-detects is the maximum method detection limit of the non-detects.

c) Maximum detected concentrations in River OU surface water were used if available, otherwise concentrations were estimated (see Table 3-7).

d) Not analyzed in tissue; therefore, the tissue concentration is estimated (see Table 3-8).

e) Selected TRVs and sources are shown on Table 3-14.

f) In cases where a CPEC was not analyzed in one or two tissues, the dietary fraction was divided between the tissues for which the CPEC was analyzed (PF changes are noted above).

Bold indicates hazard quotient greater than 1.0.

Non-detect; EPC = maximum method detection limit of non-detects

Table 3-11
Calculation of Dose and Hazard Quotient for the American Mink

-- = not analyzed
AUF = Area Use Factor
BW = body weight
CPEC = chemical of potential ecological concern
Dose = average daily dose (mg/kg-bw/day)
dw = dry weight
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
kg = kilogram
kg/day = kilograms per day
L/day = liters per day
LOAEL = lowest observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg-bw/day = milligrams per kilogram body weight per day
mg/L = milligrams per liter
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
PF = portion of food item
SVOC = semivolatile organic compound
TRV = toxicity reference value
TEQ = toxicity equivalence
UCL = upper confidence limit
ww = wet weight

Table 3-12
Calculation of Hazard Quotient for the Osprey/Eagle Eggs

CPEC	Estimated Concentrations[a]		TRVs[b]		Hazard Quotients			
	Estimated Osprey C_{egg} (mg/kg ww)	Estimated Eagle C_{egg} (mg/kg ww)	Bird-egg NOAEL TRV (mg/kg ww)	Bird-egg LOAEL TRV (mg/kg ww)	Osprey Egg NOAEL HQ	Osprey Egg LOAEL HQ	Eagle Egg NOAEL HQ	Eagle Egg LOAEL HQ
Mercury	0.69	0.69	0.50	2.5	**1.4**	0.28	**1.4**	0.28
Total PCBs as Aroclors	273	2804	4.0	20	**68**	**14**	**701**	**140**
Total PCBs as Congeners	519	5328	4.0	20	**130**	**26**	**1,332**	**266**
PCBs as Bird TEQ	0.0096	0.015	0.00030	0.00040	**32**	**24**	**51**	**38**
Sum DDx	4.2	3.7	1.0	4.2	**4.2**	**1.0**	**3.7**	0.9

Notes:
a) Egg concentrations were estimated (see Table 3-8).
b) Selected TRVs and sources are shown on Table 3-14.
Bold indicates hazard quotient greater than 1.0.

C_{egg} = concentration in egg
CPEC = chemical of potential ecological concern
HQ = hazard quotient
LOAEL = lowest observed adverse effect level
mg/kg = milligrams per kilogram
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
TEQ = toxicity equivalence
TRV = toxicity reference value
ww = wet weight

Table 3-13
Benthic Invertebrate and Fish Toxicity Benchmarks

CPEC	Sediment Reference Area 95% UPL[a] (mg/kg dw)	Benthic Invertebrate Sediment NOAEC (mg/kg dw)	Source	Benthic Invertebrate Sediment LOAEC (mg/kg dw)	Source	Fish/Shellfish Tissue NOAEC (mg/kg ww)	Source	Fish/Shellfish Tissue LOAEC (mg/kg ww)	Source
Inorganics									
Aluminum	--	--		--		44	q	218	b
Antimony	--	--		--		160	q	800	b
Arsenic	5.86	6.0	c	33	u	--		--	
Barium	--	--		--		0.016	q	0.080	b
Beryllium	--	--		--		0.53	q	2.7	b
Cadmium	0.674	0.6	c	4.98	u	0.15	d	0.75	b
Chromium	28.0	37	c	111	u	15	q	74	b
Cobalt	15.2	NA		NA		--		--	
Copper	55.6	36	c	149	u	1.8	q	9.0	b
Lead	14.5	35	c	128	u	0.12	d	0.60	b
Mercury	0.214	0.2	c	1.06	u	0.088	d	0.44	b
Nickel	21.1	18	c	48.6	u	--		--	
Thallium	0.354	NA		NA		400	q	2000	b
Vanadium	70.6	NA		NA		NA	q	NA	
Zinc	106	123	c	459	u	120	q	600	b
PCBs as Aroclors									
Total PCBs as Aroclors	--	0.034	c	0.676	u	0.43	d	2.2	b
PCBs as Congeners									
PCBs as Fish TEQ	--	--		--		0.0000064	d,n	0.000032	b
Total PCBs as Congeners	--	0.034	c	0.676	u	0.43	d,k	2.2	b
Butyltins									
Dibutyltin dichloride	--	3	c,p	15	b	--		--	
Tributyltin chloride	--	3	c,p	15	b	--		--	
Pesticides									
4,4'-DDD	--	--		--		0.054	d	0.27	b
4,4'-DDE	--	--		--		0.054	d	0.27	b
4,4'-DDT	--	0.004	c	0.0629	u	0.054	d	0.27	b
BHC (alpha)	--	--		--		0.82	q	4.1	b
BHC (beta)	--	--		--		0.82	q	4.1	b
BHC (delta)	--	--		--		0.82	q	4.1	b
BHC (gamma) Lindane	--	--		--		0.030	q	0.15	b
Chlordane (alpha)	--	--		--		0.06	d,m	0.3	b
Chlordane (gamma)	--	0.0045	f	0.0176	u	0.06	d,m	0.3	b
Dieldrin	--	--		--		0.26	d	1.3	b
Endosulfan I	--	--		--		0.0087	q	0.044	b
Endrin	--	0.003	c	0.207	u	0.27	q	1.3	b
Endrin Aldehyde	--	0.003	g	0.207	g	0.27	q	1.3	b
Methoxychlor	--	--		--		0.0095	q	0.047	b
PAHs									
Benzo(a)anthracene	--	0.032	c	1.05	u	--		--	
Benzo(a)pyrene	--	0.032	c	1.45	u	--		--	
Benzo(b)fluoranthene	--	0.027	h	0.14	b	--		--	
Benzo(g,h,i)perylene	--	0.3	c	1.5	b	--		--	
Benzo(k)fluoranthene	--	0.027	c	0.14	b	--		--	
Benzofluoranthenes, Total	--	0.027	h	0.14	b	--		--	
Chrysene	--	0.057	c	1.29	u	--		--	
Dibenz(a,h)anthracene	--	0.033	c	0.17	b	--		--	
Fluoranthene	--	0.111	c	2.23	u	--		--	
Indeno(1,2,3-cd)pyrene	--	0.017	c	0.085	b	--		--	
Pyrene	--	0.053	c	1.52	u	--		--	
Total HPAHs	--	0.193	c	0.97	b	--		--	
2-Methylnaphthalene	--	0.176	i	0.88	b	--		--	
Acenaphthene	--	0.29	c	1.45	b	--		--	
Acenaphthylene	--	0.16	c	0.80	b	--		--	
Anthracene	--	0.057	c	0.845	u	--		--	
Fluorene	--	0.077	c	0.536	u	--		--	

Table 3-13
Benthic Invertebrate and Fish Toxicity Benchmarks

CPEC	Sediment Reference Area 95% UPL[a] (mg/kg dw)	Benthic Invertebrate Sediment NOAEC (mg/kg dw)	Source	Benthic Invertebrate Sediment LOAEC (mg/kg dw)	Source	Fish/Shellfish Tissue NOAEC (mg/kg ww)	Source	Fish/Shellfish Tissue LOAEC (mg/kg ww)	Source
Naphthalene	--	0.176	c	0.561	u	--		--	
Phenanthrene	--	0.042	c	1.17	u	--		--	
Total LPAHs	--	0.076	c	0.38	b	--		--	
Total PAHs	--	1.61	c	22.8	u	--		--	
SVOCs									
Benzoic Acid	--	NA		NA		--		--	
Benzyl Alcohol	--	NA		NA		--		--	
Bis(2-ethylhexyl) Phthalate	--	0.75	c	3.8	b	--		--	
Butyl benzyl phthalate	--	--		--		0.31	q	1.5	b
Dibenzofuran	--	--		--		5.6	q	28	b
p-Cresol (4-methylphenol)	--	0.048	c,j	0.24	b	0.12	q	0.58	b

Notes:
-- = not applicable
BCF = bioconcentration factor
CPEC = chemical of potential ecological concern
CTL = critical tissue level
dw = dry weight
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
LOAEC = lowest observed adverse effect concentration
LPAHs = low molecular weight polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilogram
NA = not available; no NOAEC/LOAEC
NOAEC = no observed adverse effect concentration
PAHs = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SLV = screening level value
TEQ = toxicity equivalence
UPL = 95 % upper prediction limit
WQC = water quality criteria (fresh)
ww = wet weight

Sources:
a) The Reference Area 95% UPL sediment concentrations are shown in Table 1-2.
b) LOAECs were calculated by multiplying the NOAECs by 5.
c) Level II SLVs from DEQ 1998. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management and Cleanup Division. Final. April. Updated December 2001.
d) CTLs from DEQ 2007. Guidance for Evaluation of Bioaccumulative Chemicals of Concern in Sediment. Final. January 31, updated April.
f) The SLV for chlordane (technical) was used as a surrogate.
g) The SLV for endrin was used as a surrogate.
h) The SLV for benzo(k)fluoranthene was used as a surrogate.
i) The SLV for naphthalene was used as a surrogate.
j) The SLV for phenol was used as a surrogate.
k) The CTL for Total PCBs as Aroclors was used as a surrogate.
l) The CTL for 4,4'-DDT was used as a surrogate.
m) The CTL for chlordane was used as a surrogate.
n) The CTL for Dioxin and Furan Congeners (as 2,3,7,8-TCDD TEQs) was used as a surrogate.
p) The Tributyltin marine sediment CTL was used as a surrogate, in the absence of available freshwater CTLs.

Table 3-13
Benthic Invertebrate and Fish Toxicity Benchmarks

q) CTLs were developed per DEQ (2007), where CTL = WQC x BCF:

	Freshwater WQC (mg/L)[c]	BCF (L/kg)[s]	CTL (mg/kg)
Aluminum =	0.087	500	44
Antimony =	1.6	100	160
Barium =	0.0040	4	0.016
Beryllium =	0.0053	100	0.53
Chromium =	0.074	200	15
Copper =	0.0090	200	1.8
Thallium =	0.040	10000	400
Vanadium =	0.020	NA	NA
Zinc =	0.12	1000	120
BHC (alpha) =	0.0022	372	0.82
BHC (beta) =	0.0022	372	0.82
BHC (delta) =	BHC (alpha/beta) used as surrogate		
BHC (gamma) Lindane =	0.000080	372	0.030
Endosulfan I =	0.000056	156[t]	0.0087
Endrin =	0.000036	7480	0.27
Endrin Aldehyde =	Endrin used as a surrogate		
Methoxychlor =	0.00003	315	0.0095
Butyl benzyl phthalate =	0.019	16.3	0.31
Dibenzofuran =	0.0037	1520	5.6
p-Cresol (4-methylphenol) =	0.013[r]	8.85	0.12

r) The surface water (fresh) Level II SLV for o-Cresol was used as a surrogate.
s) Oak Ridge National Laboratory Risk Assessment Information System Database Chemical Parameters: http://rais.ornl.gov/
t) The BCF for endosulfan was used as a surrogate.
u) MacDonald et al. 2000. Probable Effect Concentrations. Arch ET&C 39(1):20.

Table 3-14
Toxicity Reference Values for Birds and Mammals

CPEC	NOAEL TRV for Birds (mg/kg-bw/day)	Source	LOAEL TRV for Birds (mg/kg-bw/day)	Source	NOAEL TRV for Mammals (mg/kg-bw/day)	Source	LOAEL TRV for Mammals (mg/kg-bw/day)	Source
Inorganics								
Aluminum	157	b	785	i	34	b	76	b
Antimony	No TRV		No TRV		0.059	b	0.59	b
Barium	21	d	42	d	52	c	83	c
Chromium	2.7	b	16	b	2.4	c	37	c
Copper	4.1	b	12	b	5.6	b	9.3	b
Mercury - fish tissue	0.013	a	0.026	a	0.016	a	0.027	a
Mercury - bird egg	0.50	a	2.5	a	--		--	
Zinc	66	b	171	b	20	c	101	i
PCBs as Aroclors								
Total PCBs as Aroclors - fish tissue	0.20	a	0.60	a	0.12	a	0.23	a
Total PCBs as Aroclors - bird egg	4.0	a	20	a	--		--	
PCBs as Congeners								
PCBs as Bird TEQ - fish tissue	1.4E-06	a	7.0E-06	a	--		--	
PCBs as Bird TEQ - bird egg	0.0003	a,j	0.00040	a,j	--		--	
PCBs as Mammal TEQ	--		--		8.0E-08	a	2.2E-06	a
Total PCBs as Congeners	0.20	a,j	0.60	a,j	0.12	a	0.23	a
Total PCBs as Congeners - bird egg	4.0	a,j	20	a,j	--		--	
Pesticides								
4,4'-DDD	0.032	b,j	0.32	b,j	0.080	a,j	0.40	a,j
4,4'-DDE	0.032	b	0.32	b	0.080	a,j	0.40	a,j
4,4'-DDT	0.009	a,j	0.027	a,j	0.080	a,j	0.40	a,j
Total DDx - fish tissue	0.009	a	0.027	a	0.080	a	0.40	a
Total DDx - bird egg	1.0	a	4.2	a	--		--	
BHC (beta)	2.0	d,j	20	d,j	0.014	d,j	0.14	d,j
BHC (gamma) Lindane	2.0	d	20	d	0.014	d,j	0.14	d,j
Chlordane (alpha)	0.21	a,j	1.07	a,j	0.458	a,j	0.92	a,j
Chlordane (gamma)	0.21	a,j	1.07	a,j	0.458	a,j	0.92	a,j
Dieldrin	0.0077	a	0.039	a	0.02	a	0.10	a
Endosulfan I	10	d,j	50	i	0.15	d	0.75	i
Endrin	0.010	d	0.1	d	0.092	d	0.92	d
Endrin Aldehyde	0.010	d,j	0.1	d,j	0.092	d,j	0.92	d,j
Methoxychlor	20	e	100	e	4.0	d	8.0	d
SVOCs								
Dibenzofuran	1.0	f	5.1	f	3.0	h	30	g
p-Cresol (4-methylphenol)	0.96	f	4.8	f	219	d	1,096	i

Notes:
-- = not applicable
LD50 = lethal dose, 50%
LOAEL = lowest observed adverse effect level
LWG = Lower Willamette Group
mg/kg-bw/day = milligrams per kilogram body weight per day
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
TEQ = toxicity equivalence
TRV = toxicity reference value
UF = uncertainty factor

Table 3-14
Toxicity Reference Values for Birds and Mammals

Sources:

a) DEQ. 2007. Guidance for Evaluation of Bioaccumulative Chemicals of Concern in Sediment. Final. January 31, updated April. Tables A-6A and A-6b.

b) LWG. 2013. Portland Harbor RI/FS, Final Remedial Investigation Report, Appendix G: BERA, Final. Tables 8-9 and 8-10.

c) EPA Ecological Soil Screening Levels (Eco-SSL) at http://www.epa.gov/ecotox/ecossl/:

EPA 2005. Eco-SSL for Barium. OSWER Directive 9285.7- 63. February. Geometric mean for mammals

EPA 2008. Eco-SSL for Chromium. OSWER Directive 9285.7- 66. April. Geometric mean for mammals.

EPA 2007. Eco-SSL for Zinc. OSWER Directive 9285.7-73. June. Mink TRV (growth; Brandt 1983) for mammals.

d) Sample et al. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ORNL. ES/ER/TM-86/R3.

Barium chicken TRV for birds.

Aroclor 1242 TRVs: screech owl for birds & mink for mammals.

BHC TRVs: mallard duck for birds & mink for mammals.

Endosulfan TRVs: gray partridge for birds & rat for mammals.

Endrin TRVs: screech owl for birds & mouse for mammals.

Methoxyclor rat TRV for mammals.

o-Cresol (2-methylphenol) mink TRV for mammals.

e) Hudson et al. 1984. Handbook of Toxicity of Pesticides to Wildlife, 2nd edition, U.S. Department of the Interior, Fish and Wildlife Service Resource Publication 153, Washington, DC. Methoxyclor LD50 of 2000 for mallard/quail, adjusted with UFs of 100/20 for NOAEL/LOEAL (USACHPPM, 2005).

f) Schafer, et al. 1983. The acute oral toxicity, repellency, and hazard potential of 998 chemicals to one or more species of wild and domestic birds. Arch. Environ. Contam. Toxicol. 12:355-382.

Dibenzofuran LD50 of 102 and Methylphenols LD50 of 96 for red-winged blackbird, adjusted with UFs of 100/20 for NOAEL/LOAEL (USACHPPM 2000. USACHPPM Technical Guide 254. Standard Practice for Wildlife TRVs, Environmental Health Risk Assessment Program and Health Effects Research Program, Aberdeen Proving Ground, MD. October).

g) NTP. 1989. National Toxicology Program - technical report series no. 370. Toxicology and carcinogenesis studies of benzofuran (CAS No. 271-89-6) in F344/N rats and B6C3F1 mice (gavage studies). Research Triangle Park, NC: U.S. Dept of Health and Human Services. Public Health Service, National Institutes of Health. Rat LOAEL.

h) An uncertainty factor of 10 was used to adjust chronic LOAELs to NOAELs (USACHPPM, 2000).

i) An uncertainty factor of 5 was used to adjust chronic NOAELs to LOAELs.

j) Surrogates used:

BHC (gamma) Lindane TRV (mallard) for BHC (beta) for birds; BHC (mixed-isomer) TRV (mink) for BHC (beta) and Lindane for mammals.

Chlordane TRVs for chlordane (alpha) and chlordane (gamma) for birds and mammals.

DDT (Total) TRV for 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT for mammals.

DDT (Total) TRV for 4,4'-DDT and 4,4'-DDE TRV for 4,4'-DDD for birds.

Endosulfan TRVs for endosulfan I for birds and mammals

Endrin TRVs for endrin aldehyde for birds and mammals

Dioxin/furan Congeners TEQ - bird egg TRVs for PCBs as Bird TEQ - bird egg.

Total PCBs as Aroclors for Total PCBs as Congeners

Total PCBs as Aroclors - bird egg for Total PCBs as Congeners - bird egg

Table 3-15
Hazard Quotients for Benthic Community – Direct Toxicity via Exposure to Sediment

CPEC	EPC in Sediment (mg/kg dw)[a]	Benchmarks[b]		Hazard Quotients	
		Sediment NOAEC (mg/kg dw)	Sediment LOAEC (mg/kg dw)	Sediment NOAEC HQ	Sediment LOAEC HQ
Inorganics					
Arsenic	32	6.0	33	**5.3E+00**	9.7E-01
Cadmium[d]	4.1	0.67	5.0	**6.1E+00**	8.2E-01
Chromium	620	37	111	**1.7E+01**	**5.6E+00**
Cobalt[c]	23	NA	NA	No SLV	No SLV
Copper[d]	284	56	149	**5.1E+00**	**1.9E+00**
Lead	121	35	128	**3.5E+00**	9.5E-01
Mercury[d]	0.54	0.21	1.1	**2.5E+00**	5.1E-01
Nickel[d]	520	21	48.6	**2.5E+01**	**1.1E+01**
Thallium[c]	0.60	NA	NA	No SLV	No SLV
Vanadium[c]	90	NA	NA	No SLV	No SLV
Zinc	226	123	459	**1.8E+00**	4.9E-01
Total Metals HI	--	--	--	**6.6E+01**	**2.2E+01**
PCBs as Aroclors					
Total PCBs as Aroclors	22	0.034	0.676	**6.5E+02**	**3.3E+01**
PCBs as Congeners					
Total PCBs as Congeners	4.3	0.034	0.676	**1.3E+02**	**6.4E+00**
Butyltins					
Dibutyltin dichloride	0.0046	3.0	15	1.5E-03	3.1E-04
Tributyltin chloride	0.013	3.0	15	4.3E-03	8.7E-04
Pesticides					
4,4'-DDT	0.14	0.0040	0.063	**3.5E+01**	**2.2E+00**
Chlordane (gamma)	0.044	0.0045	0.018	**9.8E+00**	**2.5E+00**
Endrin	0.0074	0.0030	0.207	**2.5E+00**	3.6E-02
Endrin Aldehyde	0.0082	0.0030	0.207	**2.7E+00**	4.0E-02
Total Pesticides HI	--	--	--	**5.0E+01**	**4.8E+00**
PAHs					
Benzo(a)anthracene	0.89	0.032	1.05	**2.8E+01**	8.5E-01
Benzo(a)pyrene	1.3	0.032	1.45	**4.1E+01**	9.0E-01
Benzo(b)fluoranthene	0.75	0.027	0.14	**2.8E+01**	**5.6E+00**
Benzo(g,h,i)perylene	0.87	0.30	1.5	**2.9E+00**	5.8E-01
Benzo(k)fluoranthene	0.72	0.027	0.14	**2.6E+01**	**5.3E+00**
Chrysene	1.2	0.057	1.29	**2.1E+01**	9.3E-01
Dibenz(a,h)anthracene	0.32	0.033	0.17	**9.7E+00**	**1.9E+00**
Fluoranthene	1.7	0.11	2.23	**1.5E+01**	7.6E-01
Indeno(1,2,3-cd)pyrene	0.96	0.017	0.085	**5.6E+01**	**1.1E+01**
Pyrene	2.0	0.053	1.52	**3.8E+01**	**1.3E+00**
Total HPAHs	8.2	0.19	0.97	**4.2E+01**	**8.5E+00**
Acenaphthene	0.053	0.29	1.5	1.8E-01	3.7E-02
Anthracene	0.14	0.057	0.85	**2.5E+00**	1.7E-01
Fluorene	0.029	0.077	0.54	3.8E-01	5.4E-02
Phenanthrene	0.51	0.042	1.17	**1.2E+01**	4.4E-01
Total LPAHs	0.69	0.076	0.38	**9.1E+00**	**1.8E+00**
Total PAHs	8.7	1.61	22.8	**5.4E+00**	3.8E-01
SVOCs					
Benzoic Acid	0.30	NA	NA	No SLV	No SLV
Benzyl Alcohol	0.022	NA	NA	No SLV	No SLV
Bis(2-ethylhexyl) Phthalate	3.8	0.75	3.8	**5.1E+00**	**1.0E+00**
p-Cresol (4-methylphenol)	0.18	0.048	0.24	**3.8E+00**	7.5E-01

Table 3-15
Hazard Quotients for Benthic Community – Direct Toxicity via Exposure to Sediment

Notes:
a) The sediment EPCs are the maximum detected concentrations (see Table 1-1).
b) Selected benthic NOAEC/LOAEC values and sources are shown on Table 3-13.
c) Those chemicals that do not have established SLVs will be evaluated qualitatively.
d) The background sediment concentration (95% UPL) is higher than the risk-based SLV and replaced the NOAEC in this table.
Bold indicates hazard quotient greater than 1.0.

-- = not applicable
CPEC = chemical of potential ecological concern
dw = dry weight
EPC = exposure point concentration
HI = (cumulative) hazard index
HPAH = high molecular weight polycyclic aromatic hydrocarbons
HQ = hazard quotient
LOAEC = lowest observed adverse effect concentration
LPAH = low molecular weight polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilogram
NA = not available
NOAEC = no observed adverse effect concentration
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
UCL = upper confidence limit
UPL = upper prediction limit

Table 3-16
Hazard Quotients for Clam Tissue – Dietary Exposure

CPEC	EPC in Clam Tissue (mg/kg ww)[a]	Benchmarks[b]		Hazard Quotients	
		Shellfish NOAEC (mg/kg ww)	Shellfish LOAEC (mg/kg ww)	Clam NOAEC HQ	Clam LOAEC HQ
Inorganics					
Aluminum[d]	262	69	218	**3.8E+00**	**1.2E+00**
Barium[d]	3.2	2.4	NA	**1.3E+00**	N/A
Beryllium	0.0072	0.53	2.7	1.4E-02	2.7E-03
Cadmium[d]	0.46	0.41	0.75	**1.1E+00**	6.1E-01
Chromium	1.2	15	74	8.1E-02	1.6E-02
Lead	0.18	0.12	0.60	**1.5E+00**	3.1E-01
Thallium	0.019	400	2,000	4.8E-05	9.7E-06
Vanadium[c]	0.61	NA	NA	No SLV	No SLV
Zinc	28	120	600	2.4E-01	4.7E-02
Total Metals HI	--	--	--	**8.1E+00**	**2.2E+00**
PCBs as Aroclors					
Total PCBs as Aroclors	1.2	0.43	2.2	**2.8E+00**	5.6E-01
PCBs as Aroclors					
Total PCBs as Congeners	2.0	0.43	2.2	**4.7E+00**	9.4E-01
Pesticides					
4,4'-DDD	0.0027	0.054	0.27	5.0E-02	1.0E-02
4,4'-DDE	0.010	0.054	0.27	1.9E-01	3.7E-02
4,4'-DDT	0.11	0.054	0.27	**2.0E+00**	4.1E-01
BHC (alpha)	0.00081	0.82	4.1	9.9E-04	2.0E-04
BHC (beta)	0.0015	0.82	4.1	1.8E-03	3.7E-04
BHC (delta)	0.00061	0.82	4.1	7.5E-04	1.5E-04
BHC (gamma) Lindane	0.00036	0.030	0.15	1.2E-02	2.4E-03
Chlordane (gamma)	0.018	0.0600	0.300	3.0E-01	6.0E-02
Endosulfan I	0.0027	0.0087	0.044	3.1E-01	6.2E-02
Endrin	0.0041	0.27	1.3	1.5E-02	3.0E-03
Endrin Aldehyde	0.0029	0.27	1.3	1.1E-02	2.2E-03
Total DDx HI	--	--	--	**2.3E+00**	4.5E-01
Total Pesticides HI	--	--	--	**2.9E+00**	5.8E-01
SVOCs					
Dibenzofuran[e]	0.0011	5.6	28	1.9E-04	3.8E-05
p-Cresol (4-methylphenol)	0.031	0.12	0.58	2.7E-01	5.4E-02

Notes:
a) The tissue EPCs are the maximum detected concentrations (see Table 1-6), with exception of dibenzofuran.
b) Selected fish/shellfish NOAEC/LOAEC values and sources are shown on Table 3-13.
c) Those chemicals that do not have established CTLs will be evaluated qualitatively.
d) The background tissue concentration (95% UPL, see Table 1-7) is higher than the risk-based CTL and replaced the NOAEC in this table. If UPL also higher than LOAEC, then LOAEC changed to 'NA.'
e) Not analyzed in tissue; therefore, the tissue is estimated (see Table 3-8).
Bold indicates hazard quotient greater than 1.0.

-- = not applicable
CPEC = chemical of potential ecological concern
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
LOAEC = lowest observed adverse effect concentration
mg/kg = milligrams per kilogram
NA = not available or not applicable
NOAEC = no observed adverse effect concentration
PCB = polychlorinated biphenyl
SLV = screening level value
TEQ = toxicity equivalence
UCL = upper confidence limit
UPL = upper prediction limit
ww = wet weight

Table 3-17
Hazard Quotients for Crayfish Tissue – Dietary Exposure

CPEC	EPC in Crayfish Tissue (mg/kg ww)[a]	Benchmarks[b]		Hazard Quotients	
		Shellfish NOAEC (mg/kg ww)	Shellfish LOAEC (mg/kg ww)	Crayfish NOAEC HQ	Crayfish LOAEC HQ
Inorganics					
Lead[c]	2.7	1.1	NA	**2.3E+00**	N/A
Zinc	23	120	600	1.9E-01	3.9E-02
Total Metals HI	--	--	--	**2.5E+00**	3.9E-02
SVOCs					
Dibenzofuran[d]	0.0017	5.6	28	3.1E-04	6.1E-05

Notes:
a) The tissue EPCs are the maximum detected concentrations (see Table 1-6), with exception of dibenzofuran.
b) Selected benthic NOAEC/LOAEC values and sources are shown on Table 3-13.
c) The background tissue concentration (95% UPL, see Table 1-7) is higher than the risk-based CTL and replaced the NOAEC in this table. If UPL also higher than LOAEC, then LOAEC changed to 'NA.'
d) Not analyzed in tissue; therefore, the tissue is estimated (see Table 3-8).
Bold indicates hazard quotient greater than 1.0.

-- = not applicable
CPEC = chemical of potential ecological concern
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
LOAEC = lowest observed adverse effect concentration
mg/kg = milligrams per kilogram
NA = not available or not applicable
NOAEC = no observed adverse effect concentration
PCB = polychlorinated biphenyl
TRV = toxicity reference value
UCL = upper confidence limit
UPL = upper prediction limit
ww = wet weight

Table 3-18
Hazard Quotients for Sculpin Tissue – Dietary Exposure

CPEC	EPC in Sculpin Tissue[a] (mg/kg ww)	Benchmarks[b] Fish NOAEC (mg/kg ww)	Fish LOAEC (mg/kg ww)	Hazard Quotients Sculpin NOAEC HQ	Sculpin LOAEC HQ
EU-02					
Inorganics					
Cadmium	0.018	0.15	0.75	1.2E-01	2.4E-02
Lead	0.075	0.12	0.60	6.3E-01	1.3E-01
Mercury[c]	0.24	0.13	0.44	**1.8E+00**	5.5E-01
Total Metals HI	--	--	--	**2.5E+00**	6.9E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000086	0.0000064	0.000032	1.4E-02	2.7E-03
Total PCBs as Congeners	0.049	0.43	2.2	1.1E-01	2.3E-02
SVOCs					
Dibenzofuran[d]	0.0017	5.6	28	3.1E-04	6.1E-05
EU-04					
Inorganics					
Cadmium	0.045	0.15	0.75	3.0E-01	6.0E-02
Lead	0.31	0.12	0.60	**2.6E+00**	5.1E-01
Mercury[c]	0.31	0.13	0.44	**2.3E+00**	7.0E-01
Total Metals HI	--	--	--	**5.2E+00**	**1.3E+00**
PCBs as Aroclors					
Total PCBs as Aroclors	1.7	0.43	2.2	**4.0E+00**	7.9E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.0000082	0.0000064	0.000032	**1.3E+00**	2.6E-01
Total PCBs as Congeners	4.8	0.43	2.2	**1.1E+01**	**2.2E+00**
EU-05					
Inorganics					
Cadmium	0.033	0.15	0.75	2.2E-01	4.3E-02
Lead	0.032	0.12	0.60	2.6E-01	5.3E-02
Mercury[c]	0.22	0.13	0.44	**1.6E+00**	5.0E-01
Total Metals HI	--	--	--	**2.1E+00**	6.0E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000061	0.0000064	0.000032	9.6E-03	1.9E-03
Total PCBs as Congeners	0.035	0.43	2.2	8.2E-02	1.6E-02
EU-06					
Inorganics					
Cadmium	0.021	0.15	0.75	1.4E-01	2.9E-02
Lead	0.092	0.12	0.60	7.7E-01	1.5E-01
Mercury[c]	0.30	0.13	0.44	**2.2E+00**	6.8E-01
Total Metals HI	--	--	--	**3.1E+00**	8.6E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000091	0.0000064	0.000032	1.4E-02	2.9E-03
Total PCBs as Congeners	0.036	0.43	2.2	8.3E-02	1.7E-02
EU-07					
Inorganics					
Cadmium	0.027	0.15	0.75	1.8E-01	3.6E-02
Lead	0.038	0.12	0.60	3.2E-01	6.4E-02
Mercury[c]	0.11	0.13	0.44	8.2E-01	2.5E-01
Total Metals HI	--	--	--	**1.3E+00**	3.5E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000069	0.0000064	0.000032	1.1E-02	2.2E-03
Total PCBs as Congeners	0.041	0.43	2.2	9.5E-02	1.9E-02

Table 3-18
Hazard Quotients for Sculpin Tissue – Dietary Exposure

CPEC	EPC in Sculpin Tissue[a] (mg/kg ww)	Benchmarks[b] Fish NOAEC (mg/kg ww)	Fish LOAEC (mg/kg ww)	Hazard Quotients Sculpin NOAEC HQ	Sculpin LOAEC HQ
EU-10					
Inorganics					
Cadmium	0.019	0.15	0.75	1.3E-01	2.6E-02
Lead	0.081	0.12	0.60	6.8E-01	1.4E-01
Mercury[c]	0.19	0.13	0.44	**1.4E+00**	4.3E-01
Total Metals HI	--	--	--	**2.2E+00**	5.9E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000056	0.0000064	0.000032	8.7E-03	1.7E-03
Total PCBs as Congeners	0.026	0.43	2.2	6.1E-02	1.2E-02
EU-11					
Inorganics					
Cadmium	0.017	0.15	0.75	1.1E-01	2.2E-02
Lead	0.083	0.12	0.60	6.9E-01	1.4E-01
Mercury[c]	0.16	0.13	0.44	**1.2E+00**	3.7E-01
Total Metals HI	--	--	--	**2.0E+00**	5.3E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.00000020	0.0000064	0.000032	3.2E-02	6.4E-03
Total PCBs as Congeners	0.141	0.43	2.2	3.3E-01	6.6E-02
EU-12					
Inorganics					
Cadmium	0.012	0.15	0.75	8.1E-02	1.6E-02
Lead	0.033	0.12	0.60	2.8E-01	5.6E-02
Mercury[c]	0.21	0.13	0.44	**1.6E+00**	4.8E-01
Total Metals HI	--	--	--	**1.9E+00**	5.5E-01
PCBs as Congeners					
PCBs as Fish TEQ	0.000000050	0.0000064	0.000032	7.8E-03	1.6E-03
Total PCBs as Congeners	0.024	0.43	2.2	5.6E-02	1.1E-02

Notes:
a) The tissue EPCs are shown on Table 1-8, with exception of dibenzofuran.
b) Selected fish/shellfish NOAEC/LOAEC values and sources are shown on Table 3-13.

c) The background tissue concentration (95% UPL, see Table 1-7) is higher than the risk-based CTL and replaced the NOAEC in this table
d) Not analyzed in tissue; therefore, the tissue is estimated (see Table 3-8).
Bold indicates hazard quotient greater than 1.0.

-- = not applicable
CPEC = chemical of potential ecological concern
EPC = exposure point concentration
EU = exposure unit
HI = (cumulative) hazard index
HQ = hazard quotient
LOAEC = lowest observed adverse effect concentration
mg/kg = milligrams per kilogram
NOAEC = no observed adverse effect concentration
PCB = polychlorinated biphenyl
TEQ = toxicity equivalence
TRV = toxicity reference value
UCL = upper confidence limit
UPL = upper prediction limit
ww = wet weight

Table 3-19
Hazard Quotients for Smallmouth Bass Tissue – Dietary Exposure

CPEC	EPC in Smallmouth Bass Tissue[a] (mg/kg ww)	Benchmarks[b]		Hazard Quotients	
		Fish NOEAC (mg/kg ww)	Fish LOAEC (mg/kg ww)	Smallmouth Bass NOAEC HQ	Smallmouth Bass LOAEC HQ
Inorganics					
Aluminum	5.4	44	218	1.2E-01	2.5E-02
Antimony	0.010	160	800	6.5E-05	1.3E-05
Barium[c]	2.6	3.1	N/A	8.5E-01	N/A
Chromium	0.19	15	74	1.3E-02	2.6E-03
Copper	0.93	1.8	9.0	5.2E-01	1.0E-01
Mercury[c]	0.25	0.36	0.44	6.9E-01	5.6E-01
Zinc	14	120	600	1.2E-01	2.4E-02
Total Metals HI	--	--	--	**2.3E+00**	7.1E-01
PCBs as Aroclors					
Total PCBs as Aroclors	25	0.43	2.2	**5.8E+01**	**1.2E+01**
PCBs as Congeners					
PCBs as Fish TEQ	0.000055	0.0000064	0.000032	**8.6E+00**	**1.7E+00**
Total PCBs as Congeners	47	0.43	2.2	**1.1E+02**	**2.2E+01**
Pesticides					
4,4'-DDD	0.0045	0.054	0.27	8.4E-02	1.7E-02
4,4'-DDE	0.039	0.054	0.27	7.2E-01	1.4E-01
4,4'-DDT	0.0052	0.054	0.27	9.6E-02	1.9E-02
BHC (beta)	0.00079	0.82	4.1	9.6E-04	1.9E-04
BHC (gamma) Lindane	0.00067	0.030	0.15	2.2E-02	4.5E-03
Chlordane (alpha)	0.00030	0.060	0.30	5.0E-03	1.0E-03
Chlordane (gamma)	3.2	0.060	0.30	**5.3E+01**	**1.1E+01**
Dieldrin	0.55	0.26	1.3	**2.1E+00**	4.2E-01
Endosulfan I	0.054	0.0087	0.044	**6.2E+00**	**1.2E+00**
Endrin	0.83	0.27	1.3	**3.1E+00**	6.1E-01
Endrin Aldehyde	0.26	0.27	1.3	9.7E-01	1.9E-01
Methoxychlor	0.00061	0.0095	0.047	6.5E-02	1.3E-02
Total DDx HI	--	--	--	9.0E-01	1.8E-01
Total Pesticides HI	--	--	--	**6.7E+01**	**1.3E+01**
SVOCs					
Butyl benzyl phthalate	0.12	0.31	1.5	3.8E-01	7.7E-02
Dibenzofuran[d]	0.0012	5.6	28	2.2E-04	4.4E-05
p-Cresol (4-methylphenol)	0.037	0.12	0.58	3.2E-01	6.4E-02

Notes:
a) The tissue EPCs are shown on Table 1-6, with exception of dibenzofuran.
b) Sources listed on Table 3-12.
c) The background tissue concentration (95% UPL) is higher than the risk-based CTL and replaced the NOAEC in this table.
d) Not analyzed in tissue; therefore, the tissue is estimated (see Table 3-8).
Bold indicates hazard quotient greater than 1.0.

-- = not applicable
CPEC = chemical of potential ecological concern
EPC = exposure point concentration
HI = (cumulative) hazard index
HQ = hazard quotient
LOAEC = lowest observed adverse effect concentration
mg/kg = milligrams per kilogram
NOAEC = no observed adverse effect concentration
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TEQ = toxicity equivalence
TRV = toxicity reference value
UCL = upper confidence limit
UPL = upper prediction limit
ww = wet weight

Table 3-20
Summary of Site-Specific Risk-Based Tissue Concentrations

CEC	Risk-Based Tissue Concentrations (mg/kg ww)						Upstream Reference UPLs (mg/kg ww)			
	Osprey	Eagle	Bird	Mink	Fish	Lowest RBC	Clams	Crayfish	Sculpin	Bass
	Diet	Diet	Bird Egg	Diet	Diet					
Inorganics										
Lead	--	--	--	--	0.12	**0.12**	0.073	1.1	0.076	1.7
Total Mercury	0.19	0.20	--	--	0.13	**0.13**	0.016	0.023	0.13	0.36
PCBs as Aroclors										
Total PCBs as Aroclors	4.3	5.6	0.18	2.1	0.43	**0.18**	0.039	0.0052	0.045	0.10
PCBs as Congeners										
PCBs as Fish TEQ	--	--	--	--	6.4E-06	**6.4E-06**	--	--	6.1E-08	3.6E-07
PCBs as Bird TEQ	5.0E-05	6.6E-05	2.5E-05	see mammal TEQ	--	**2.5E-05**	--	--	--	9.5E-06
PCBs as Mammal TEQ	see bird TEQ	see bird TEQ	see bird TEQ	2.0E-05	--	**2.0E-05**	--	6.4E-08	7.9E-07	3.9E-06
Total PCBs as Congeners	4.3	5.6	0.18	2.1	0.43	**0.18**	0.035	0.0014	0.038	0.41
Pesticides										
Chlordane (gamma)	--	--	--	--	0.060	**0.060**	NA	NA	NA	0.0042
Dieldrin	0.28	0.37	--	0.93	0.26	**0.26**	NA	NA	NA	0.00083
Endosulfan I	--	--	--	--	0.0087	**0.0087**	NA	NA	NA	0.002
Endrin	0.72	0.94	--	--	0.27	**0.27**	NA	NA	NA	0.00086

Notes:

Wildlife Risk-Based Tissue Concentration Fish-Diet = LOAEL TRV ÷ ((FIR÷BW)*AUF) (ODEQ 2007; Equation C-3). See Tables 3-4, 3-5, and 3-6 for FIRs, BWs, and AUFs.
Fish Risk-Based Tissue Concentration Diet = NOAEC TRV (see Table 3-13).
Risk-Based Tissue Concentration Fish-Bird Egg = LOAEL Bird Egg ATL ÷ BMF (see LOAEL TRVs in Table 3-12 and BMFs in Table 3-8).
Upstream Reference UPLs are from Table 1-7.

-- = Not a CEC for that receptor/receptor group
AUF = area use factor
BMF = biomagnification factor
BW = body weight
CEC = constituent of ecological concern
FIR = food ingestion rate
LOAEL = lowest observed adverse effect level
mg/kg ww = milligrams per kilogram in wet weight
NA = not available
NOAEC = no observed adverse effect concentration
PCB = polychlorinated biphenyl
RBC = risk based concentration
TEQ = toxicity equivalence
TRV = toxicity reference value
UPL = upper prediction limit

Source:
ODEQ 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Final. April.

Table 3-21
Summary of Site-Specific Risk-Based Sediment Concentrations

CEC	Risk-Based Sediment Concentrations (mg/kg dw)							Upstream Reference UPLs (mg/kg dw)
	Osprey Diet	Eagle Diet	Bird Bird Egg	Mink Diet	Benthic Invertebrate Direct Toxicity	Fish Diet	Lowest RBC	
Inorganics								
Chromium	--	--	--	--	111	--	**111**	28
Copper	--	--	--	--	149	--	**149**	56
Lead [a]	--	--	--	--	--	see UPL	**see UPL**	15
Nickel	--	--	--	--	48.6	--	**48.6**	21
Total Mercury [a]	see UPL	see UPL	--	--	--	see UPL	**see UPL**	0.21
PCBs as Aroclors								
Total PCBs as Aroclors	0.36	0.48	0.015	0.19	0.676	0.042	**0.015**	0.016
PCBs as Congeners								
PCBs as Fish TEQ	--	--	--	--	NA	8.1E-08	**8.1E-08**	2.0E-09
PCBs as Bird TEQ	1.0E-06	1.3E-06	5.0E-07	see mammal TEQ	NA	--	**5.0E-07**	1.2E-07
PCBs as Mammal TEQ	see bird TEQ	see bird TEQ	see bird TEQ	2.0E-07	NA	--	**2.0E-07**	3.1E-08
Total PCBs as Congeners	0.038	0.049	0.0016	0.020	0.676	0.0044	**0.0016**	0.00094
PAHs								
Total HPAHs (KM-capped, MDL-based)	--	--	--	--	0.97	--	**0.97**	0.12
Total LPAHs (KM-capped, MDL-based)	--	--	--	--	0.38	--	**0.38**	0.010
Pesticides								
4,4'-DDT	--	--	--	--	0.0629	--	**0.063**	NA
Chlordane (gamma)	--	--	--	--	0.0176	3.8	**0.018**	NA
Dieldrin[b]	9.5	13	--	34	--	10	**9.5**	NA
Endosulfan I[b]	--	--	--	--	--	0.17	**0.17**	NA
Endrin[b]	19	25	--	--	--	8.2	**8.2**	NA

Notes:

Diet/Egg Risk-Based Sediment Concentration = f_{oc} x (RBC_{tissue} ÷ [BSAF x f_{lipid}]) (ODEQ 2007; Equation D-1). See Appendix D for BSAF development.

Direct Toxicity Risk-Based Sediment Concentration = Benthic Invertebrate LOAEC TRV (see Table 3-13).

Upstream Reference UPLs are from Table 1-2.

-- = Not a CEC for that receptor/receptor group
BSAF = biota-sediment accumulation factor
CEC = constituent of ecological concern
HPAH = high molecular weight polycyclic aromatic hydrocarbon
KM-capped = Kaplan–Meier-based with Efron's bias correction, capped
LOAEC = lowest observed adverse effect concentration
LPAH = low molecular weight polycyclic aromatic hydrocarbon
MDL = method detection limit

Table 3-21
Summary of Site-Specific Risk-Based Sediment Concentrations

mg/kg dw = milligrams per kilogram in dry weight
NA = not available
PCB = polychlorinated biphenyl
RBC = risk based concentration
TEQ = toxicity equivalence
TRV = toxicity reference value
UPL = upper prediction limit

f_{oc} = fraction of organic carbon (site-specific) =	0.0084	median of all River OU data
f_{lipid} = fraction of lipid (bass) =	0.03	median of all River OU bass data (used for Bird RBCs)
f_{lipid} = fraction of lipid (bass+sculpin+crayfish) =	0.028	median of all River OU bass, sculpin, and crayfish data (used for Mink RBC)
f_{lipid} = fraction of lipid (all four tissue) =	0.026	median of all River OU bass, sculpin, crayfish, and clam data (used for Fish Diet RBC)

NA = Not available

a) For dietary RBCs, due to the potentially high uncertainty associated with establishing correlations between concentrations of metals in sediment versus tissue, default is to Upstream Reference UPLs.

b) Dietary sediment RBCs developed for these CECs because they have demonstrated risk from tissue consumption and have tissue RBCs (see Table 3-20).
However, these dietary sediment RBCs are not depicted on the figures due to the following:
Dieldrin and endosulfan I are non-detect in sediment and their maximum MDLs are less than their RBCs.
Endrin RBC is three orders of magnitude greater than the maximum detected concentration in sediment.

Source:

ODEQ 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Final. April.

Table 3-22
River OU CECs Recommended for Further Evaluation in the FS

Target Receptor	Medium	Chemical of Ecological Concern	Lowest RBC[d,e] (mg/kg)	Reference Area UPL(s) (mg/kg)
Benthic Community	Sediment	PCBs[a]	0.68	0.016 & 0.00094
		HPAHs	0.97	0.12
Fish Community	Sculpin Tissue	PCBs[a]	0.43	0.045 & 0.038
	Bass Tissue	PCBs[b]	6.4E-06	3.6E-07
		OCPs[c]	0.0087	0.0020
Osprey	Bass Tissue	PCBs[b]	5.0E-05	9.5E-06
		Dieldrin	0.28	0.00083
Eagle	Bass Tissue	PCBs[b]	6.6E-05	9.5E-06
		Dieldrin	0.37	0.00083
Mink	Sculpin Tissue	PCBs[a]	2.1	0.045 & 0.038
	Bass Tissue	PCBs[b]	2.0E-05	3.9E-06

Notes:

CECs = chemicals of ecological concern

LOAEC = lowest observed adverse effect concentration

LOAEL = lowest observed adverse effect level

mg/kg = milligrams per kilogram

NOAEC = no observed adverse effect concentration

OCP = organochlorine pesticides

PCBs = polychlorinated biphenyls

TEQ = toxicity equivalence

UPL = upper prediction limit

No exceedances of sediment risk-based concentrations protective of fish consumption pathways were observed for OCPs, only for PCBs. Therefore, sediment is also a medium of concern for PCBs.

a) PCBs as total Aroclors and total (209) congeners

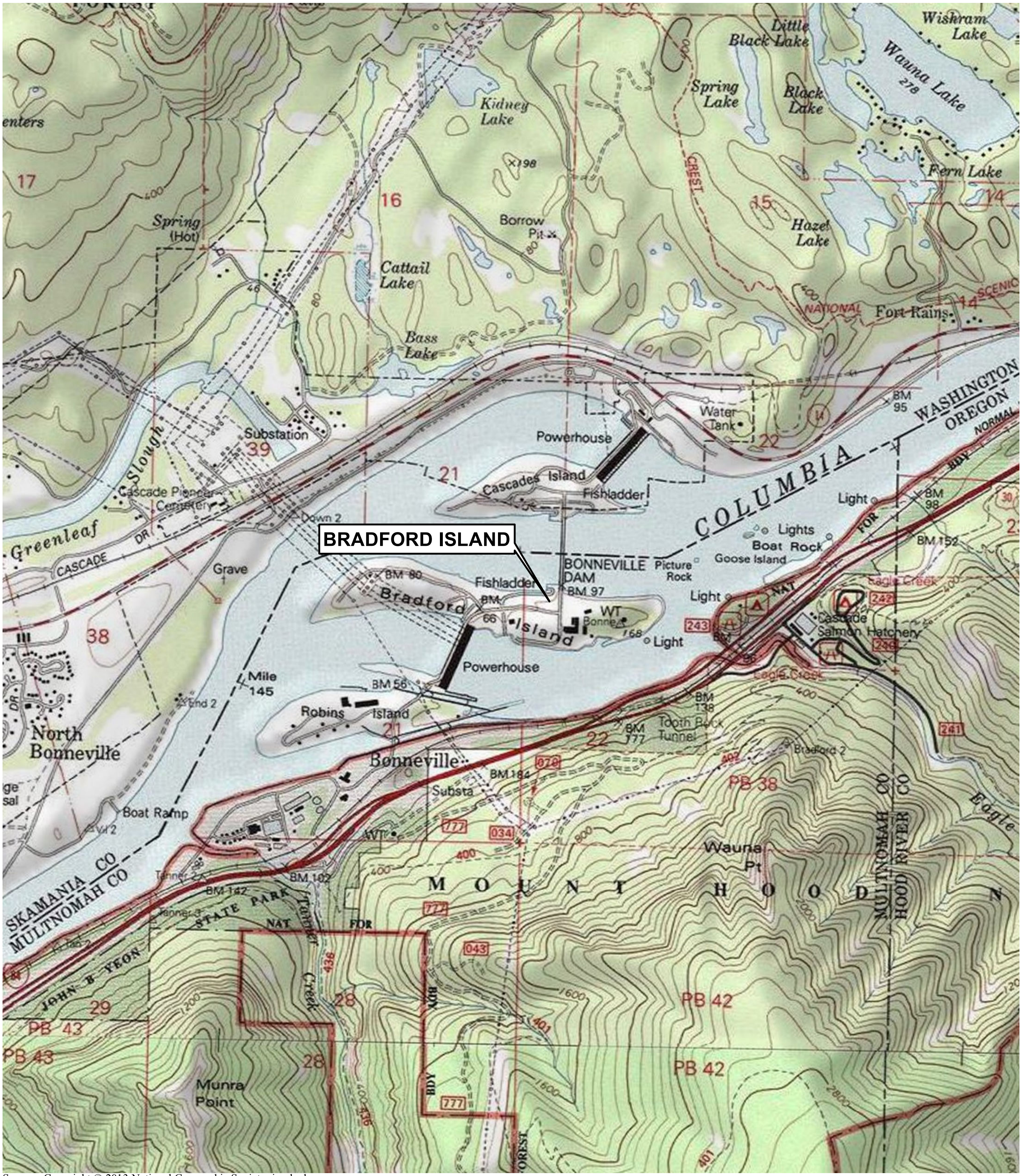
b) PCBs as total Aroclors, total (209) congeners, and PCB TEQ

c) OCPs gamma-chlordane, dieldrin, and endosulfan I

d) For PCBs and OCPs, the lowest RBC of applicable CECs is shown, see Tables 3-20 and Table 3-21 for individual RBCs.

e) RBCs protective of fish based on NOAECs and RBCs for other receptors based on LOAECs/LOAELs.

FIGURES



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VICINITY MAP

![URS]

25696528

BRADFORD ISLAND
CASCADE LOCKS, OREGON

FIGURE 1-1

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	DRAWN BY: SB	APPROVED BY: DW	111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292 www.aecom.com	CASCADE LOCKS, OREGON		GIS FILE NUMBER: FIG 1-2
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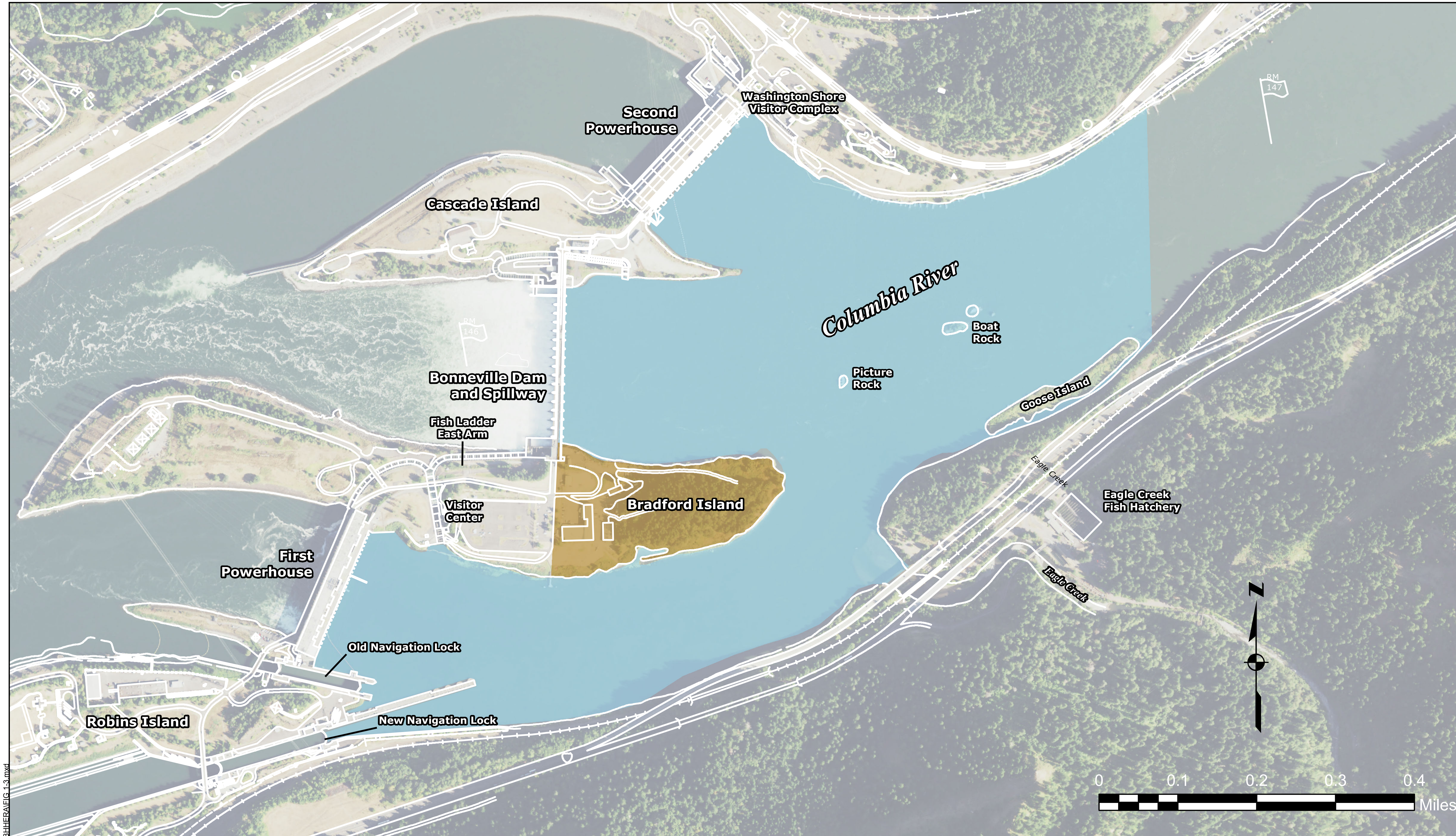

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Legend

Upland OU

River OU

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CASCADE LOCKS, OREGON

LOCATION OF OPERABLE UNITS

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RIVER OPERABLE UNIT

RIVER OU AND REFERENCE AREA

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RIVER OPERABLE UNIT

SAMPLING LOCATIONS

DRAWING NUMBER: FIGURE 1-5A

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RIVER OPERABLE UNIT

SAMPLING LOCATIONS

DRAWING NUMBER: FIGURE 1-5B

GIS FILE NUMBER: FIG 1-5B

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Notes:
All River OU Shoreline (i.e., Cascade Island, Bradford Island, Mouth of Eagle Creek, and Goose Island) sediment sample locations were selected to be 10 feet or shallower when compared to the "Normal Pool Elevation" for the Columbia River, as listed for this area by the US Geologic Survey (www.waterdata.usgs.gov). Ten feet was selected to account for seasons when the water may be shallower, making more of the shoreline accessible.

Legend

● River OU Shoreline Samples Locations (Swimmer/Wader Sediment Exposure Scenario)

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CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

SEDIMENT SAMPLES WITHIN WADEABLE LOCATIONS IN THE RIVER OU

DRAWING NUMBER: FIGURE 2-1A

GIS FILE NUMBER: FIG 2-1A

SHEET: REV.

Notes:
All River OU Shoreline (i.e., Cascade Island, Bradford Island, Mouth of Eagle Creek, and Goose Island) sediment sample locations were selected to be 10 feet or shallower when compared to the "Normal Pool Elevation" for the Columbia River, as listed for this area by the US Geologic Survey (www.waterdata.usgs.gov). Ten feet was selected to account for seasons when the water may be shallower, making more of the shoreline accessible.

Legend

River OU Shoreline Samples Locations (Swimmer/Wader Sediment Exposure Scenario)

K:\bradford island\GIS\2015\BHERA\Fig 2-1B Bradford Island Inset - Sediment Samples Within Wadeable Locations in the Forebay Area.mxd

JOB No. 25697943	DESIGNED: HP	PROJ. ENGINEER: DW	
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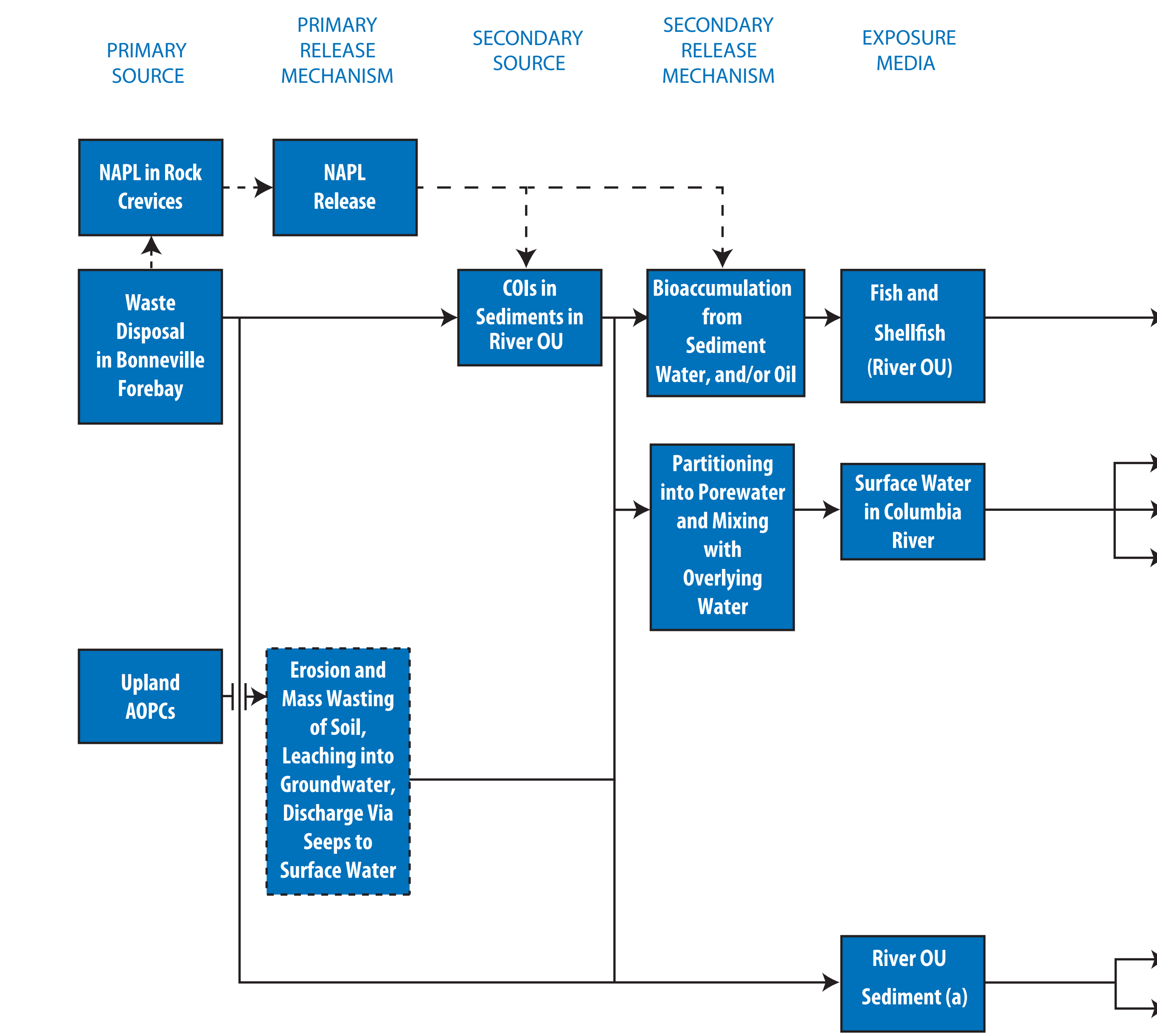
RIVER OPERABLE UNIT

BRADFORD ISLAND INSET- SEDIMENT SAMPLES WITHIN WADEABLE LOCATIONS IN THE RIVER OU

DRAWING NUMBER: FIGURE 2-1B
GIS FILE NUMBER: FIG 2-1B
SHEET: REV.



EXPOSURE ROUTE	TRIBAL SUBSISTENCE FISHER ADULT/CHILD/ NURSING INFANT*	NON-TRIBAL RECREATIONAL FISHER ADULT/CHILD/ NURSING INFANT*	WADER ADULT/CHILD/ NURSING INFANT*	SWIMMER ADULT/CHILD/ NURSING INFANT*	HYPOTHETICAL DOWNSTREAM POTABLE WATER USER ADULT/CHILD/ NURSING INFANT*
Consumption	●	●	-	-	-
Incidental Ingestion	○	○	○	●	-
Potable Ingestion	-	-	-	-	● (b)
Dermal Contact	○	○	○	●	● (b)
Incidental Ingestion	○	○	● (c)	-	-
Dermal Contact	○	○	● (c)	-	-

CURRENT AND FUTURE RECEPTORS

LEGEND

● Potentially complete exposure pathway
○ Potentially complete but incidental exposure only and considered insignificant
- Incomplete exposure pathway

a River OU sediments include Forebay, Goose Island, and Mouth of Eagle Creek.
b Based on hypothetical use of untreated riverwater as a potable water supply.
c Direct contact while wading in shallow sediments.

- - - Potential Source/transport mechanism
—— Known/likely source/transport mechanism
* The Nursing Infant Pathway is based on the mother's exposure using DEQ (2010) approach (see Section 2.4)

AOPC Area of Potential Concern
COI Chemical of Interest
NAPL Non-aqueous phase liquid

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	CHECKED BY: HP	DATE: JULY 2010

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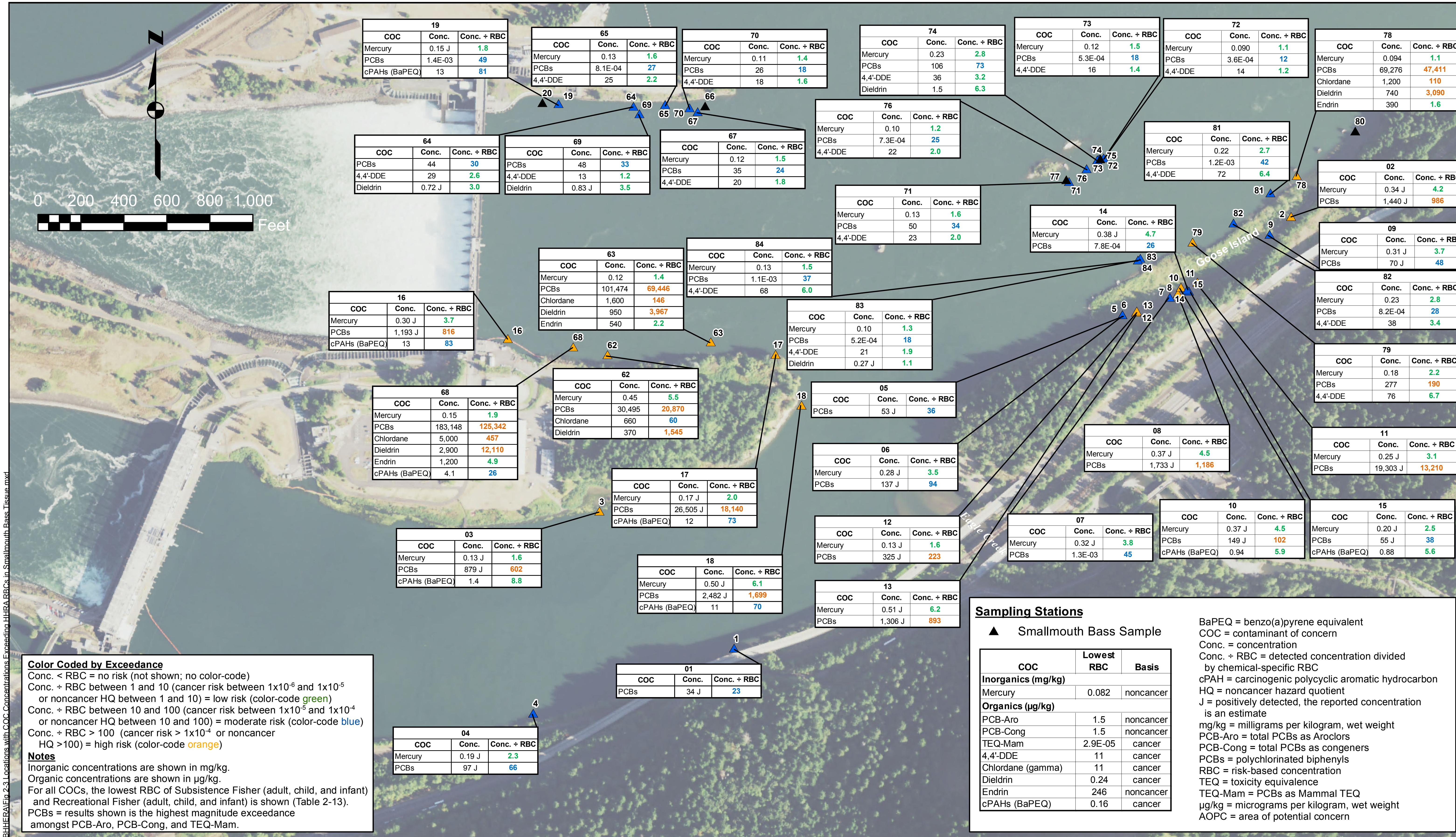
HUMAN HEALTH CONCEPTUAL EXPOSURE MODEL

DRAWING NUMBER: FIGURE 2-2
GIS FILE NUMBER: FIG 2-2
SHEET: REV.

O:\25692709 USACE\53-F0072173.00 Brdford1\Ft Worth DT-02\RI Report_Working Folder\RI Text\Figures\FIG 2-2.ai



19

COC	Conc.	Conc. ÷ RBC
Mercury	0.15 J	1.8
PCBs	1.4E-03	49
cPAHs (BaPEQ)	13	81

65

COC	Conc.	Conc. ÷ RBC
Mercury	0.13	1.6
PCBs	8.1E-04	27
4,4'-DDE	25	2.2

70

COC	Conc.	Conc. ÷ RBC
Mercury	0.11	1.4
PCBs	26	18
4,4'-DDE	18	1.6

74

COC	Conc.	Conc. ÷ RBC
Mercury	0.23	2.8
PCBs	106	73
4,4'-DDE	36	3.2
Dieldrin	1.5	6.3

73

COC	Conc.	Conc. ÷ RBC
Mercury	0.12	1.5
PCBs	5.3E-04	18
4,4'-DDE	16	1.4

72

COC	Conc.	Conc. ÷ RBC
Mercury	0.090	1.1
PCBs	3.6E-04	12
4,4'-DDE	14	1.2

78

COC	Conc.	Conc. ÷ RBC
Mercury	0.094	1.1
PCBs	69,276	47,411
Chlordane	1,200	110
Dieldrin	740	3,090
Endrin	390	1.6

64

COC	Conc.	Conc. ÷ RBC
PCBs	44	30
4,4'-DDE	29	2.6
Dieldrin	0.72 J	3.0

69

COC	Conc.	Conc. ÷ RBC
PCBs	48	33
4,4'-DDE	13	1.2
Dieldrin	0.83 J	3.5

67

COC	Conc.	Conc. ÷ RBC
Mercury	0.12	1.5
PCBs	35	24
4,4'-DDE	20	1.8

76

COC	Conc.	Conc. ÷ RBC
Mercury	0.10	1.2
PCBs	7.3E-04	25
4,4'-DDE	22	2.0

81

COC	Conc.	Conc. ÷ RBC
Mercury	0.22	2.7
PCBs	1.2E-03	42
4,4'-DDE	72	6.4

02

COC	Conc.	Conc. ÷ RBC
Mercury	0.34 J	4.2
PCBs	1,440 J	986

71

COC	Conc.	Conc. ÷ RBC
Mercury	0.13	1.6
PCBs	50	34
4,4'-DDE	23	2.0

14

COC	Conc.	Conc. ÷ RBC
Mercury	0.38 J	4.7
PCBs	7.8E-04	26

09

COC	Conc.	Conc. ÷ RBC
Mercury	0.31 J	3.7
PCBs	70 J	48

63

COC	Conc.	Conc. ÷ RBC
Mercury	0.12	1.4
PCBs	101,474	69,446
Chlordane	1,600	146
Dieldrin	950	3,967
Endrin	540	2.2

84

COC	Conc.	Conc. ÷ RBC
Mercury	0.13	1.5
PCBs	1.1E-03	37
4,4'-DDE	68	6.0

82

COC	Conc.	Conc. ÷ RBC
Mercury	0.23	2.8
PCBs	8.2E-04	28
4,4'-DDE	38	3.4

16

COC	Conc.	Conc. ÷ RBC
Mercury	0.30 J	3.7
PCBs	1,193 J	816
cPAHs (BaPEQ)	13	83

83

COC	Conc.	Conc. ÷ RBC
Mercury	0.10	1.3
PCBs	5.2E-04	18
4,4'-DDE	21	1.9
Dieldrin	0.27 J	1.1

79

COC	Conc.	Conc. ÷ RBC
Mercury	0.18	2.2
PCBs	277	190
4,4'-DDE	76	6.7

62

COC	Conc.	Conc. ÷ RBC
Mercury	0.45	5.5
PCBs	30,495	20,870
Chlordane	660	60
Dieldrin	370	1,545

05

COC	Conc.	Conc. ÷ RBC
PCBs	53 J	36

68

COC	Conc.	Conc. ÷ RBC
Mercury	0.15	1.9
PCBs	183,148	125,342
Chlordane	5,000	457
Dieldrin	2,900	12,110
Endrin	1,200	4.9
cPAHs (BaPEQ)	4.1	26

08

COC	Conc.	Conc. ÷ RBC
Mercury	0.37 J	4.5
PCBs	1,733 J	1,186

11

COC	Conc.	Conc. ÷ RBC
Mercury	0.25 J	3.1
PCBs	19,303 J	13,210

06

COC	Conc.	Conc. ÷ RBC
Mercury	0.28 J	3.5
PCBs	137 J	94

17

COC	Conc.	Conc. ÷ RBC
Mercury	0.17 J	2.0
PCBs	26,505 J	18,140
cPAHs (BaPEQ)	12	73

10

COC	Conc.	Conc. ÷ RBC
Mercury	0.37 J	4.5
PCBs	149 J	102
cPAHs (BaPEQ)	0.94	5.9

15

COC	Conc.	Conc. ÷ RBC
Mercury	0.20 J	2.5
PCBs	55 J	38
cPAHs (BaPEQ)	0.88	5.6

12

COC	Conc.	Conc. ÷ RBC
Mercury	0.13 J	1.6
PCBs	325 J	223

07

COC	Conc.	Conc. ÷ RBC
Mercury	0.32 J	3.8
PCBs	1.3E-03	45

03

COC	Conc.	Conc. ÷ RBC
Mercury	0.13 J	1.6
PCBs	879 J	602
cPAHs (BaPEQ)	1.4	8.8

18

COC	Conc.	Conc. ÷ RBC
Mercury	0.50 J	6.1
PCBs	2,482 J	1,699
cPAHs (BaPEQ)	11	70

13

COC	Conc.	Conc. ÷ RBC
Mercury	0.51 J	6.2
PCBs	1,306 J	893

01

COC	Conc.	Conc. ÷ RBC
PCBs	34 J	23

04

COC	Conc.	Conc. ÷ RBC
Mercury	0.19 J	2.3
PCBs	97 J	66

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between 1×10^{-6} and 1×10^{-5} or noncancer HQ between 1 and 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between 1×10^{-5} and 1×10^{-4} or noncancer HQ between 10 and 100) = moderate risk (color-code blue)
Conc. ÷ RBC > 100 (cancer risk > 1×10^{-4} or noncancer HQ >100) = high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all COCs, the lowest RBC of Subsistence Fisher (adult, child, and infant) and Recreational Fisher (adult, child, and infant) is shown (Table 2-13).
PCBs = results shown is the highest magnitude exceedeance amongst PCB-Aro, PCB-Cong, and TEQ-Mam.

Sampling Stations

▲ Smallmouth Bass Sample

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Mercury	0.082	noncancer
Organics (µg/kg)		
PCB-Aro	1.5	noncancer
PCB-Cong	1.5	noncancer
TEQ-Mam	2.9E-05	cancer
4,4'-DDE	11	cancer
Chlordane (gamma)	11	cancer
Dieldrin	0.24	cancer
Endrin	246	noncancer
cPAHs (BaPEQ)	0.16	cancer

BaPEQ = benzo(a)pyrene equivalent
COC = contaminant of concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
cPAH = carcinogenic polycyclic aromatic hydrocarbon
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, wet weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, wet weight
AOPC = area of potential concern

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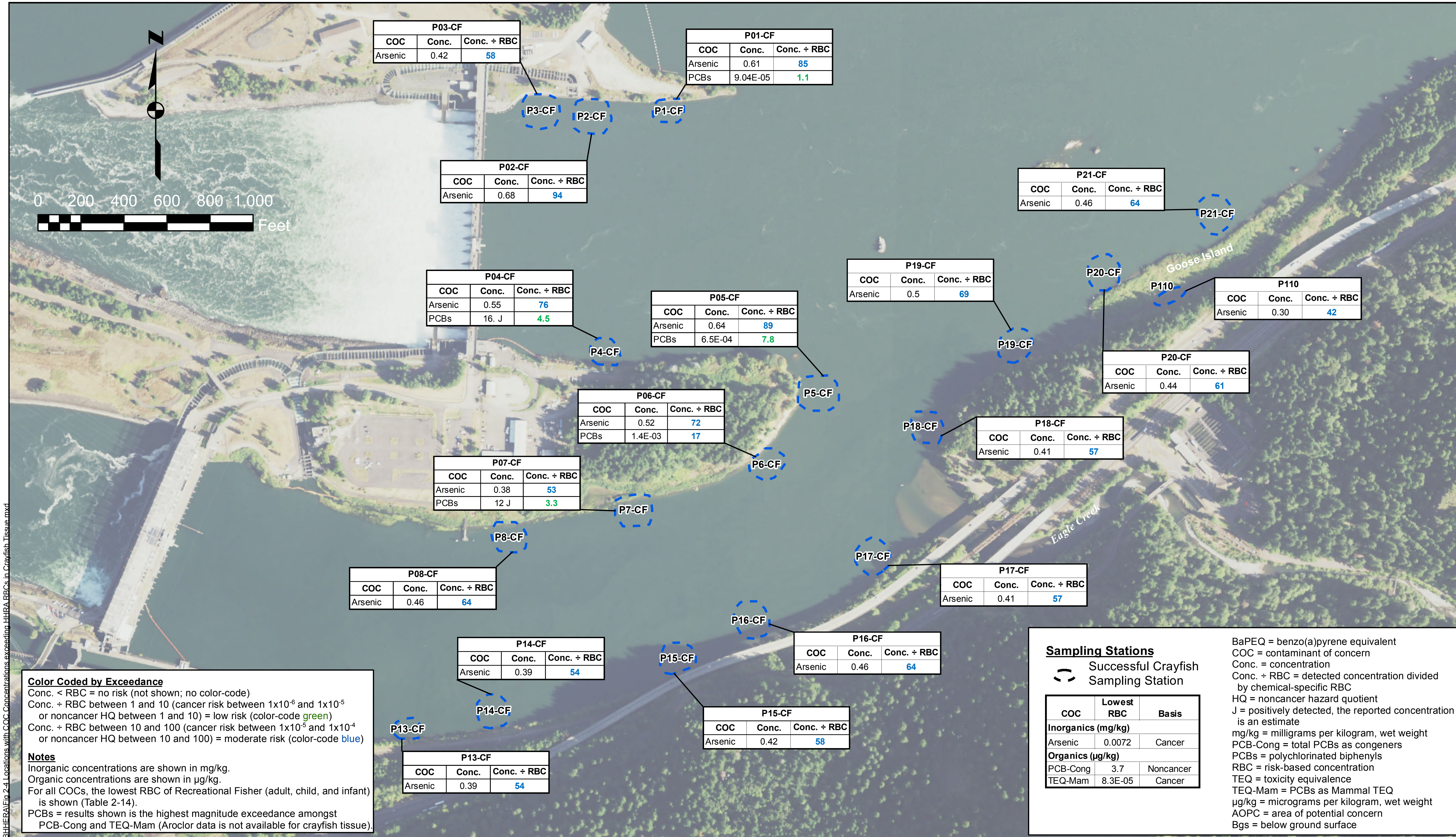
RIVER OPERABLE UNIT

LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN SMALLMOUTH BASS TISSUE

DRAWING NUMBER: FIGURE 2-3
GIS FILE NUMBER: FIG 2-3
SHEET: REV.

K:\bradford_island\GIS\2015\BIHHERA\Fig 2-3 Locations with COC Concentrations Exceeding HHRA RBCs in Smallmouth Bass Tissue.mxd



P01-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.61	85
PCBs	9.04E-05	1.1

P02-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.68	94

P03-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.42	58

P04-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.55	76
PCBs	16. J	4.5

P05-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.64	89
PCBs	6.5E-04	7.8

P06-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.52	72
PCBs	1.4E-03	17

P07-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.38	53
PCBs	12 J	3.3

P08-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.46	64

P13-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.39	54

P14-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.39	54

P15-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.42	58

P16-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.46	64

P17-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.41	57

P18-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.41	57

P19-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.5	69

P20-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.44	61

P21-CF

COC	Conc.	Conc. ÷ RBC
Arsenic	0.46	64

P110

COC	Conc.	Conc. ÷ RBC
Arsenic	0.30	42

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between $1x10^{-6}$ and $1x10^{-5}$ or noncancer HQ between 1 and 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between $1x10^{-5}$ and $1x10^{-4}$ or noncancer HQ between 10 and 100) = moderate risk (color-code blue)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all COCs, the lowest RBC of Recreational Fisher (adult, child, and infant) is shown (Table 2-14).
PCBs = results shown is the highest magnitude exceedance amongst PCB-Cong and TEQ-Mam (Aroclor data is not available for crayfish tissue).

Sampling Stations

Successful Crayfish Sampling Station

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Arsenic	0.0072	Cancer
Organics (µg/kg)		
PCB-Cong	3.7	Noncancer
TEQ-Mam	8.3E-05	Cancer

BaPEQ = benzo(a)pyrene equivalent
COC = contaminant of concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, wet weight
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, wet weight
AOPC = area of potential concern
Bgs = below ground surface

K:\bradford_island\GIS\2015\BHHERA\Fig 2-4 Locations with COC Concentrations exceeding HHRA RBCs in Crayfish Tissue.mxd

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RIVER OPERABLE UNIT

LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN CRAYFISH TISSUE

DRAWING NUMBER: FIGURE 2-4
GIS FILE NUMBER: FIG 2-4
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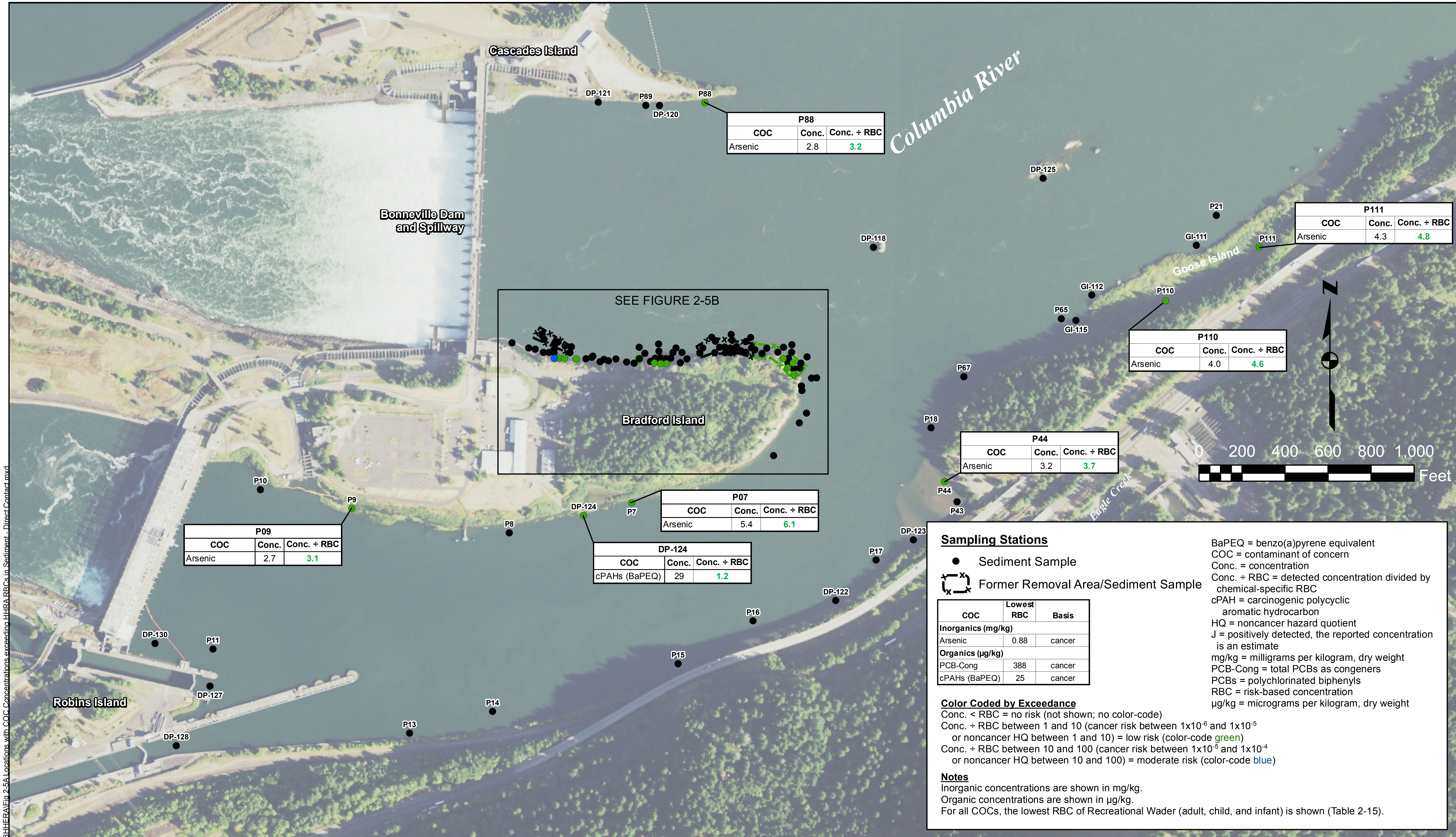

P88

COC	Conc.	Conc. ÷ RBC
Arsenic	2.8	3.2

P111

COC	Conc.	Conc. ÷ RBC
Arsenic	4.3	4.8

P110

COC	Conc.	Conc. ÷ RBC
Arsenic	4.0	4.6

P44

COC	Conc.	Conc. ÷ RBC
Arsenic	3.2	3.7

P07

COC	Conc.	Conc. ÷ RBC
Arsenic	5.4	6.1

P09

COC	Conc.	Conc. ÷ RBC
Arsenic	2.7	3.1

DP-124

COC	Conc.	Conc. ÷ RBC
cPAHs (BaPEQ)	29	1.2

Sampling Stations

- Sediment Sample
- Former Removal Area/Sediment Sample

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Arsenic	0.88	cancer
Organics (µg/kg)		
PCB-Cong	388	cancer
cPAHs (BaPEQ)	25	cancer

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between $1x10^{-6}$ and $1x10^{-5}$ or noncancer HQ between 1 and 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between $1x10^{-5}$ and $1x10^{-4}$ or noncancer HQ between 10 and 100) = moderate risk (color-code blue)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all COCs, the lowest RBC of Recreational Wader (adult, child, and infant) is shown (Table 2-15).

BaPEQ = benzo(a)pyrene equivalent
COC = contaminant of concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
cPAH = carcinogenic polycyclic aromatic hydrocarbon
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, dry weight
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
µg/kg = micrograms per kilogram, dry weight

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	CHECKED BY: DK	DATE: JULY 2015

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RIVER OPERABLE UNIT

LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN SEDIMENT (DIRECT CONTACT)

DRAWING NUMBER: FIGURE 2-5A
GIS FILE NUMBER: FIG 2-5A
SHEET: REV.

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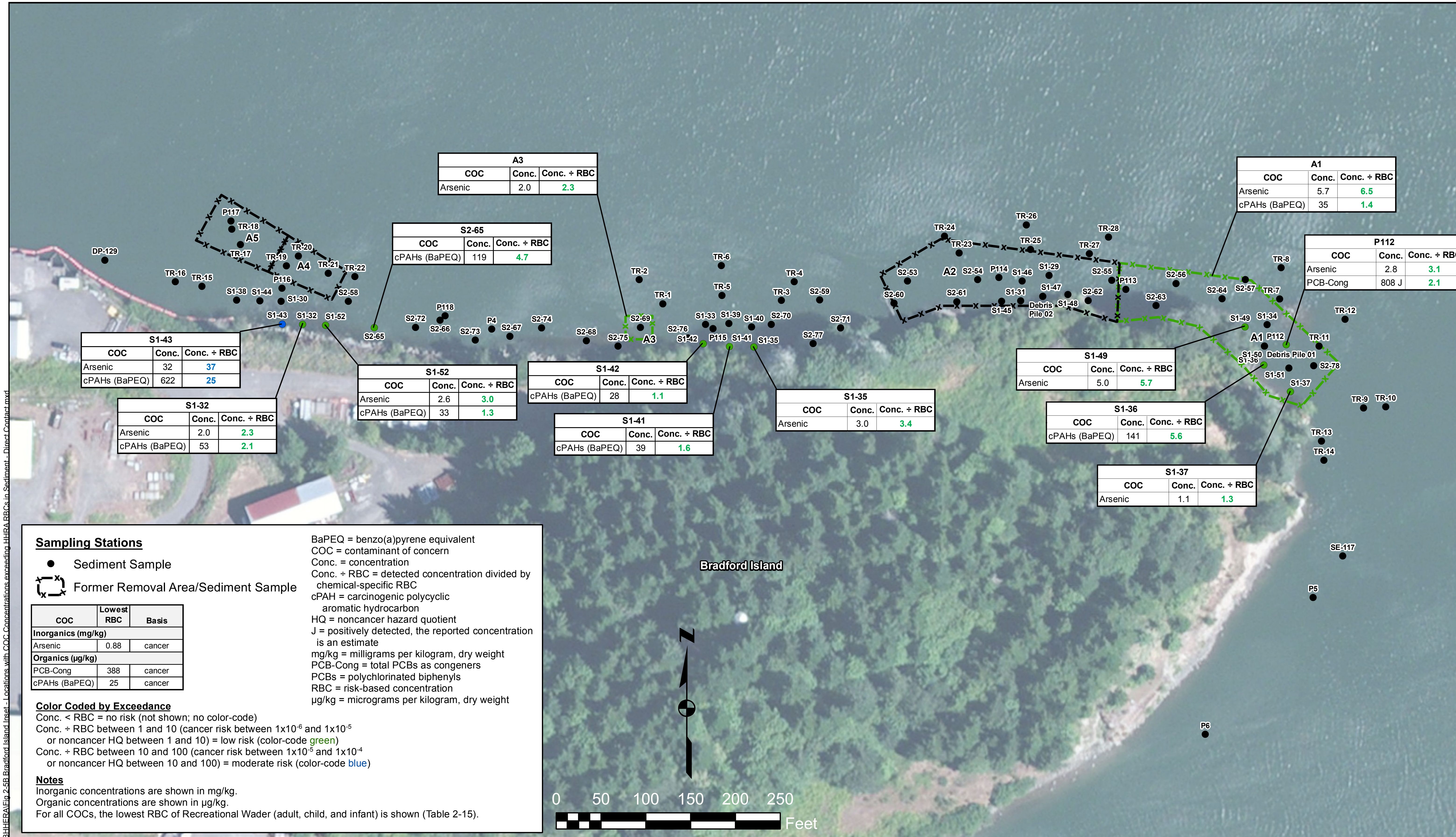

A3

COC	Conc.	Conc. ÷ RBC
Arsenic	2.0	2.3

S2-65

COC	Conc.	Conc. ÷ RBC
cPAHs (BaPEQ)	119	4.7

A1

COC	Conc.	Conc. ÷ RBC
Arsenic	5.7	6.5
cPAHs (BaPEQ)	35	1.4

P112

COC	Conc.	Conc. ÷ RBC
Arsenic	2.8	3.1
PCB-Cong	808 J	2.1

S1-43

COC	Conc.	Conc. ÷ RBC
Arsenic	32	37
cPAHs (BaPEQ)	622	25

S1-32

COC	Conc.	Conc. ÷ RBC
Arsenic	2.0	2.3
cPAHs (BaPEQ)	53	2.1

S1-52

COC	Conc.	Conc. ÷ RBC
Arsenic	2.6	3.0
cPAHs (BaPEQ)	33	1.3

S1-42

COC	Conc.	Conc. ÷ RBC
cPAHs (BaPEQ)	28	1.1

S1-41

COC	Conc.	Conc. ÷ RBC
cPAHs (BaPEQ)	39	1.6

S1-35

COC	Conc.	Conc. ÷ RBC
Arsenic	3.0	3.4

S1-49

COC	Conc.	Conc. ÷ RBC
Arsenic	5.0	5.7

S1-36

COC	Conc.	Conc. ÷ RBC
cPAHs (BaPEQ)	141	5.6

S1-37

COC	Conc.	Conc. ÷ RBC
Arsenic	1.1	1.3

Sampling Stations

- Sediment Sample
- Former Removal Area/Sediment Sample

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Arsenic	0.88	cancer
Organics (µg/kg)		
PCB-Cong	388	cancer
cPAHs (BaPEQ)	25	cancer

BaPEQ = benzo(a)pyrene equivalent
COC = contaminant of concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
cPAH = carcinogenic polycyclic aromatic hydrocarbon
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, dry weight
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
µg/kg = micrograms per kilogram, dry weight

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between 1×10^{-6} and 1×10^{-5} or noncancer HQ between 1 and 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between 1×10^{-5} and 1×10^{-4} or noncancer HQ between 10 and 100) = moderate risk (color-code blue)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all COCs, the lowest RBC of Recreational Wader (adult, child, and infant) is shown (Table 2-15).

K:\bradford_island\GIS\2015\BHHERA\Fig 2-5B Bradford Island Inset - Locations with COC Concentrations exceeding HHRA RBCs in Sediment - Direct Contact.mxd

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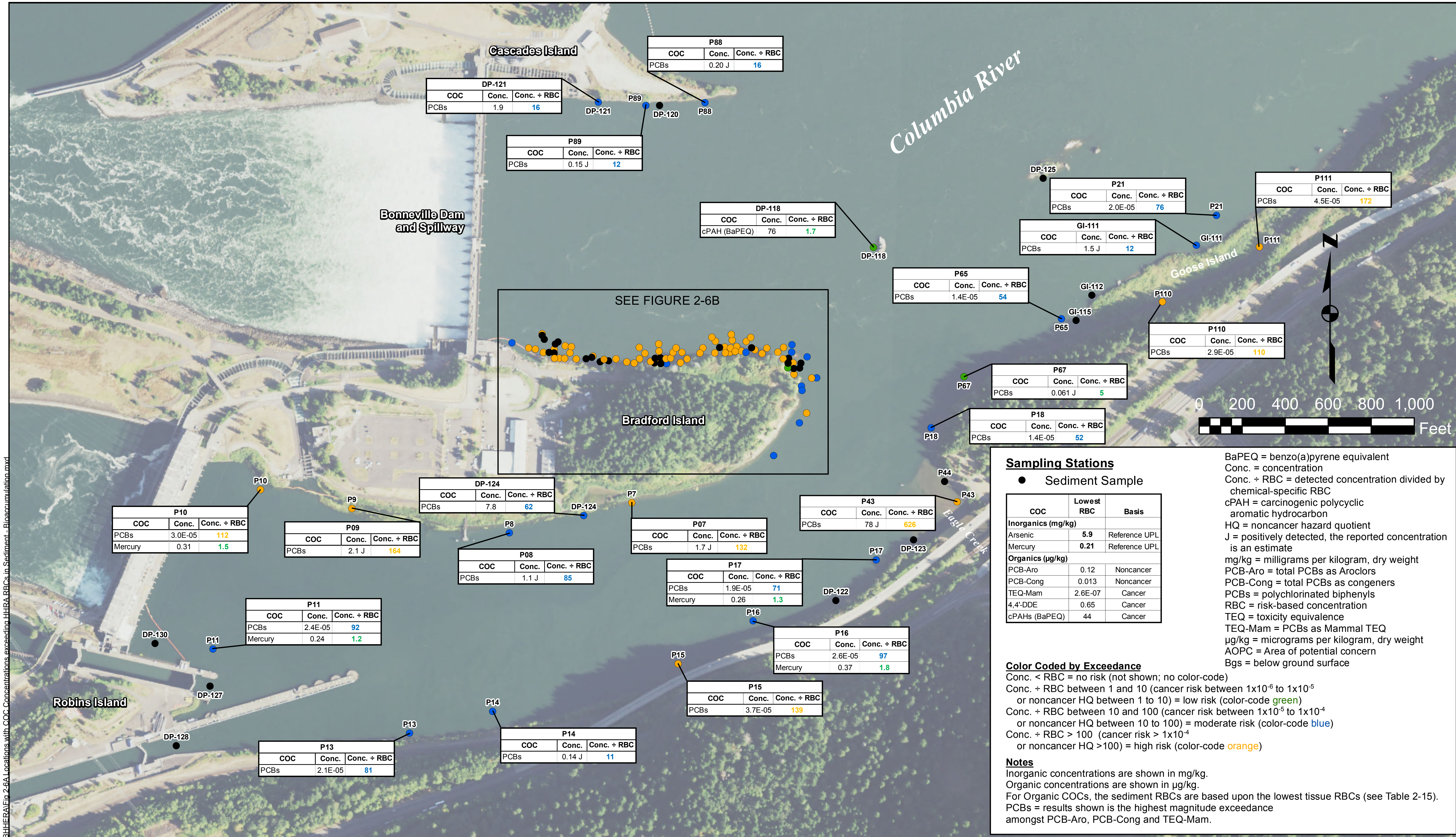
BRADFORD ISLAND

CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

BRADFORD ISLAND INSET: LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN SEDIMENT (DIRECT CONTACT)

DRAWING NUMBER: FIGURE 2-5B
GIS FILE NUMBER: FIG 2-5B
SHEET:
REV.



Sampling Stations

● Sediment Sample

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Arsenic	5.9	Reference UPL
Mercury	0.21	Reference UPL
Organics (µg/kg)		
PCB-Aro	0.12	Noncancer
PCB-Cong	0.013	Noncancer
TEQ-Mam	2.6E-07	Cancer
4,4'-DDE	0.65	Cancer
cPAHs (BaPEQ)	44	Cancer

BaPEQ = benzo(a)pyrene equivalent
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
cPAH = carcinogenic polycyclic aromatic hydrocarbon
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, dry weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, dry weight
AOPC = Area of potential concern
Bgs = below ground surface

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between $1x10^{-6}$ to $1x10^{-5}$ or noncancer HQ between 1 to 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between $1x10^{-5}$ to $1x10^{-4}$ or noncancer HQ between 10 to 100) = moderate risk (color-code blue)
Conc. ÷ RBC > 100 (cancer risk > $1x10^{-4}$ or noncancer HQ >100) = high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For Organic COCs, the sediment RBCs are based upon the lowest tissue RBCs (see Table 2-15).
PCBs = results shown is the highest magnitude exceedance amongst PCB-Aro, PCB-Cong and TEQ-Mam.

K:\bradford_island\GIS\2015\BHHERA\Fig 2-6A Locations with COC Concentrations exceeding HHRA RBCs in Sediment - Bioaccumulation.mxd

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25698014	HP	HP
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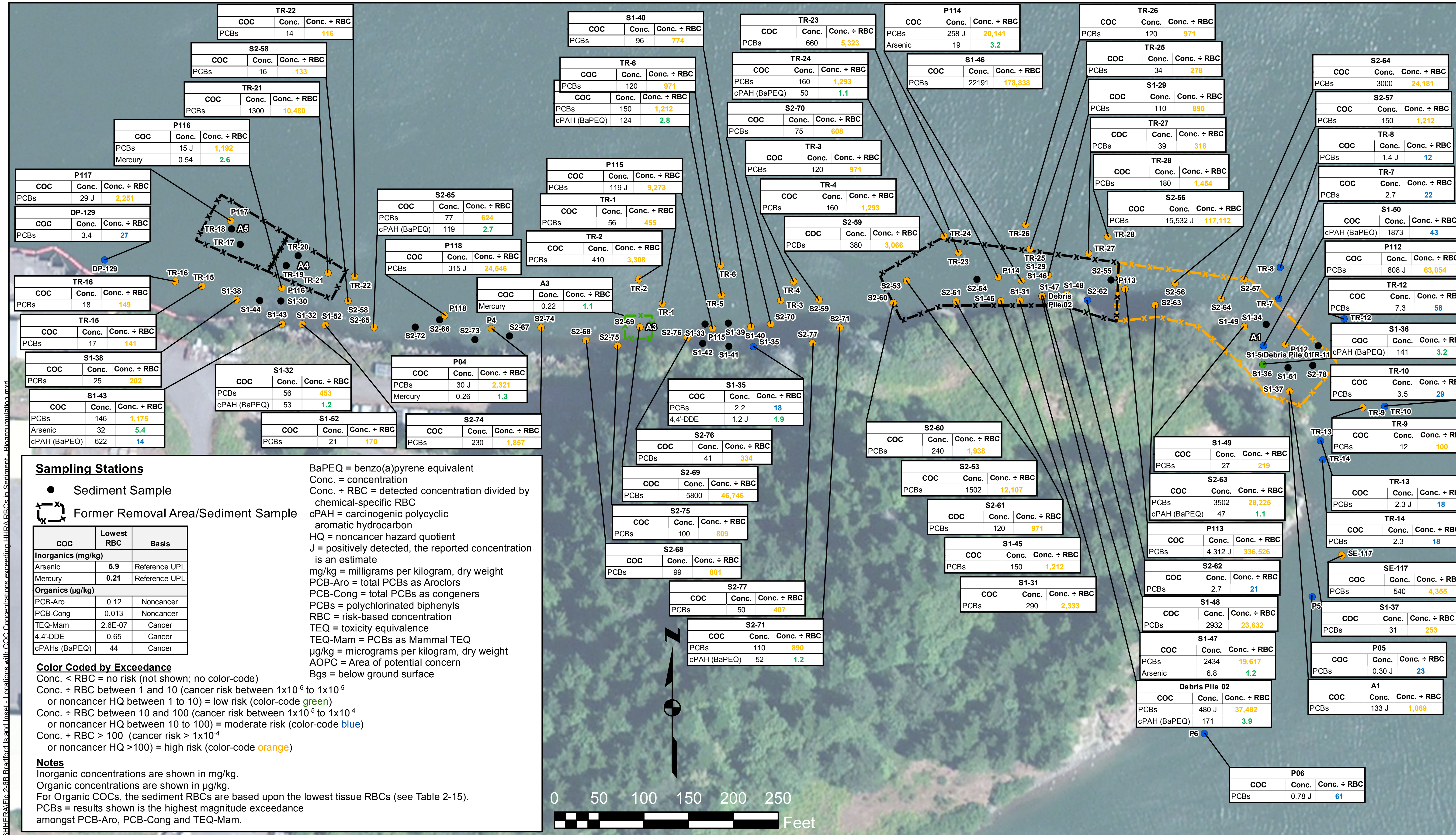
BRADFORD ISLAND

CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN SEDIMENT (BIOACCUMULATION)

DRAWING NUMBER: FIGURE 2-6A
GIS FILE NUMBER: FIG 2-6A
SHEET:
REV.



Sampling Stations

- Sediment Sample
- Former Removal Area/Sediment Sample

COC	Lowest RBC	Basis
Inorganics (mg/kg)		
Arsenic	5.9	Reference UPL
Mercury	0.21	Reference UPL
Organics (µg/kg)		
PCB-Aro	0.12	Noncancer
PCB-Cong	0.013	Noncancer
TEQ-Mam	2.6E-07	Cancer
4,4'-DDE	0.65	Cancer
cPAHs (BaPEQ)	44	Cancer

BaPEQ = benzo(a)pyrene equivalent
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
cPAH = carcinogenic polycyclic aromatic hydrocarbon
HQ = noncancer hazard quotient
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, dry weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, dry weight
AOPC = Area of potential concern
Bgs = below ground surface

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 10 (cancer risk between 1×10^{-6} to 1×10^{-5} or noncancer HQ between 1 to 10) = low risk (color-code green)
Conc. ÷ RBC between 10 and 100 (cancer risk between 1×10^{-5} to 1×10^{-4} or noncancer HQ between 10 to 100) = moderate risk (color-code blue)
Conc. ÷ RBC > 100 (cancer risk > 1×10^{-4} or noncancer HQ >100) = high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For Organic COCs, the sediment RBCs are based upon the lowest tissue RBCs (see Table 2-15).
PCBs = results shown is the highest magnitude exceedance amongst PCB-Aro, PCB-Cong and TEQ-Mam.

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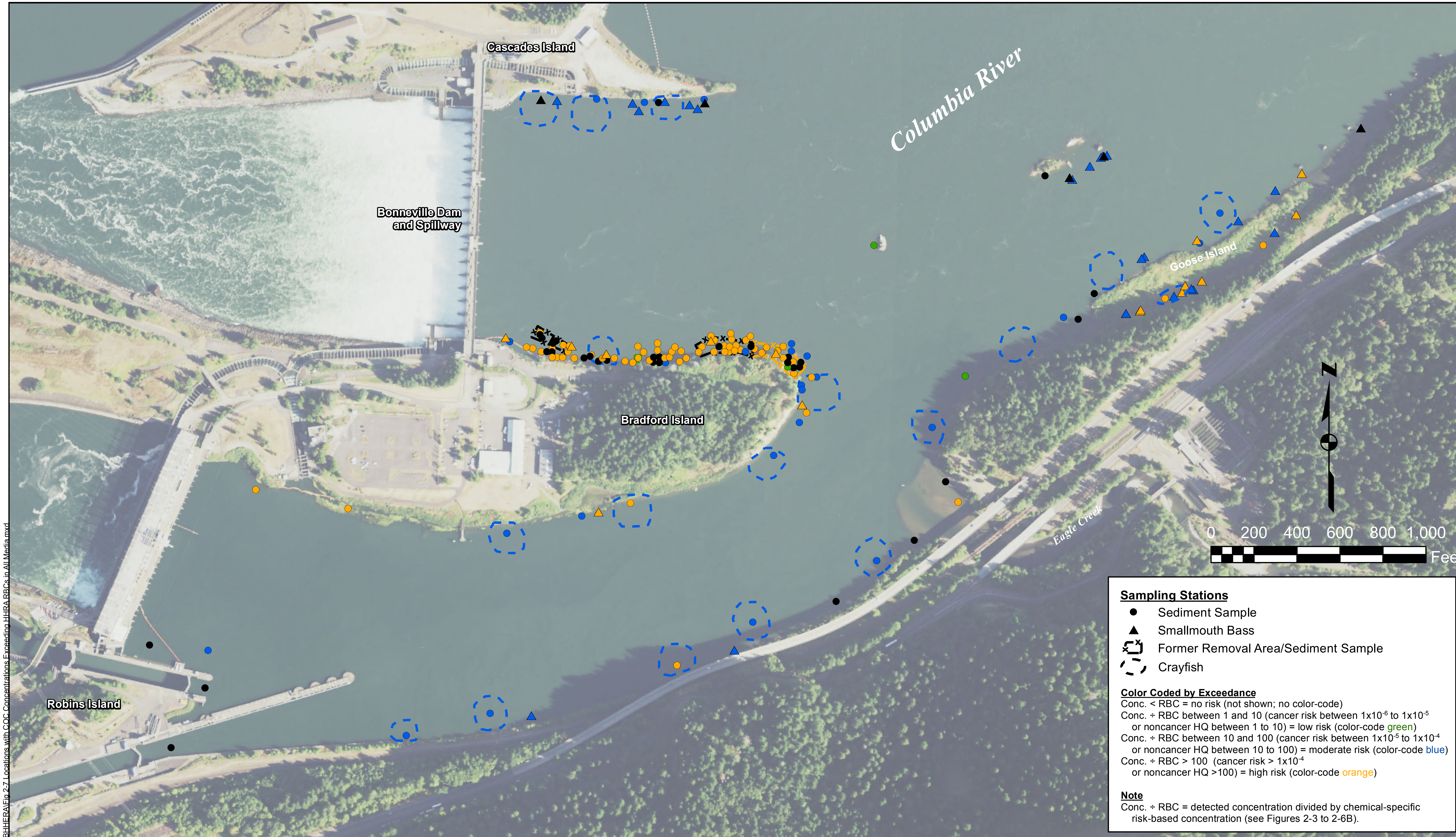
BRADFORD ISLAND

CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

BRADFORD ISLAND INSET: LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN SEDIMENT (BIOACCUMULATION)

DRAWING NUMBER: FIGURE 2-6B
GIS FILE NUMBER: FIG 2-6B
SHEET: REV.



K:\bradford_island\GIS\2015\BHHERA\Fig 2-7 Locations with COC Concentrations Exceeding HHRA RBCs in All Media.mxd

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	CHECKED BY: DK	DATE: APRIL 2016

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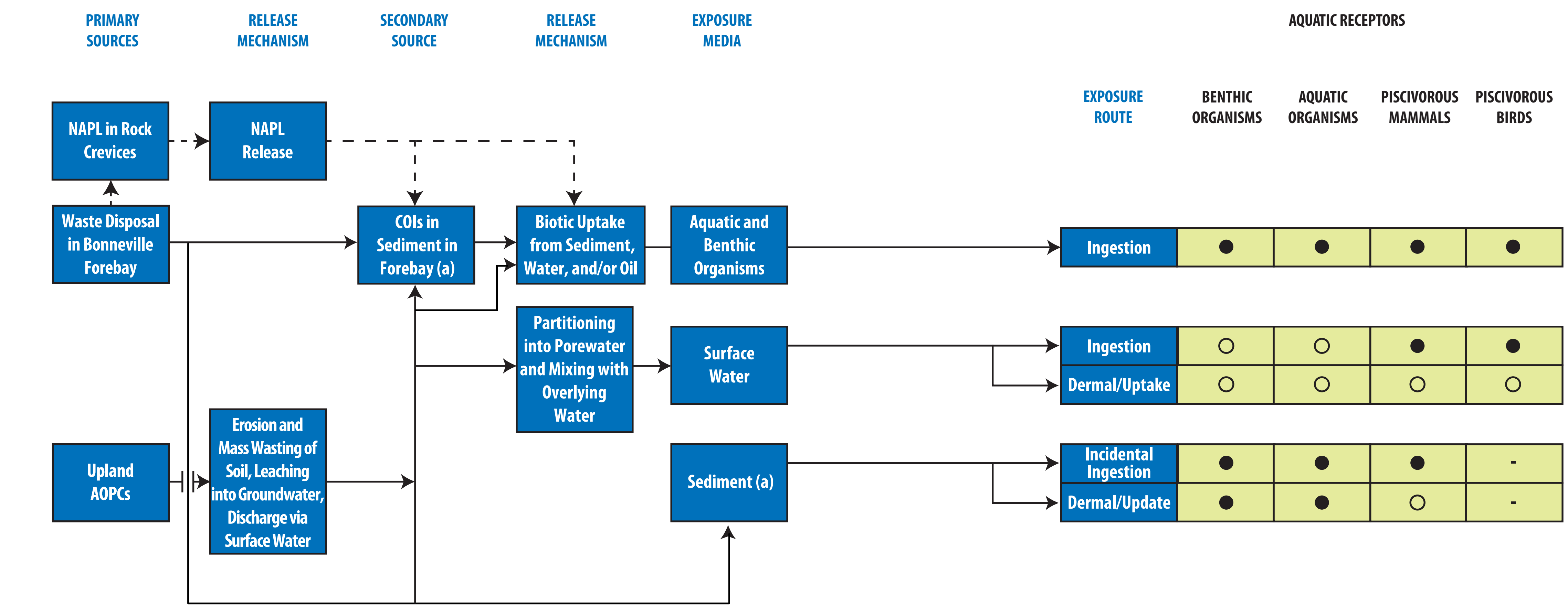
BRADFORD ISLAND

CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

LOCATIONS WITH COC CONCENTRATIONS EXCEEDING HHRA RBCs IN ALL MEDIA

DRAWING NUMBER: FIGURE 2-7
GIS FILE NUMBER: FIG 2-7
SHEET: REV.



LEGEND

- ● Complete and potentially significant pathway
- ○ Complete but likely minor pathway
- \- Incomplete pathway
- - - - Potential source/transport mechanism
- —— Known/likely source/transport mechanism
- (a) Forebay sediments include Goose Island and mouth of Eagle Creek

Aquatic Organisms defined as aquatic plants, plankton, invertebrates, fish (resident species: smallmouth bass; anadromous species: salmon, sturgeon)
Benthic Organisms defined as benthic invertebrates (infaunal invertebrates, clams, crayfish) and demersal fish (sculpin)
Piscivorous Mammals and Birds defined as those aquatic-dependent species that consume fish or shellfish from the river (mink, bald eagle, osprey)

AOPC	Area of Potential Concern
COI	Chemical of Interest
NAPL	Non-aqueous phase liquid

O:\25692709 USACE\53-F0072173.00 Brdford1\Ft.Worth DT-02\RI Report Working Folder\RI Text\Figures\FIG 3-1.ai

JOB No. 25696528	DESIGNED: LSM	PROJ. ENGINEER: LSM
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	CHECKED BY: HP	DATE: JULY 2010

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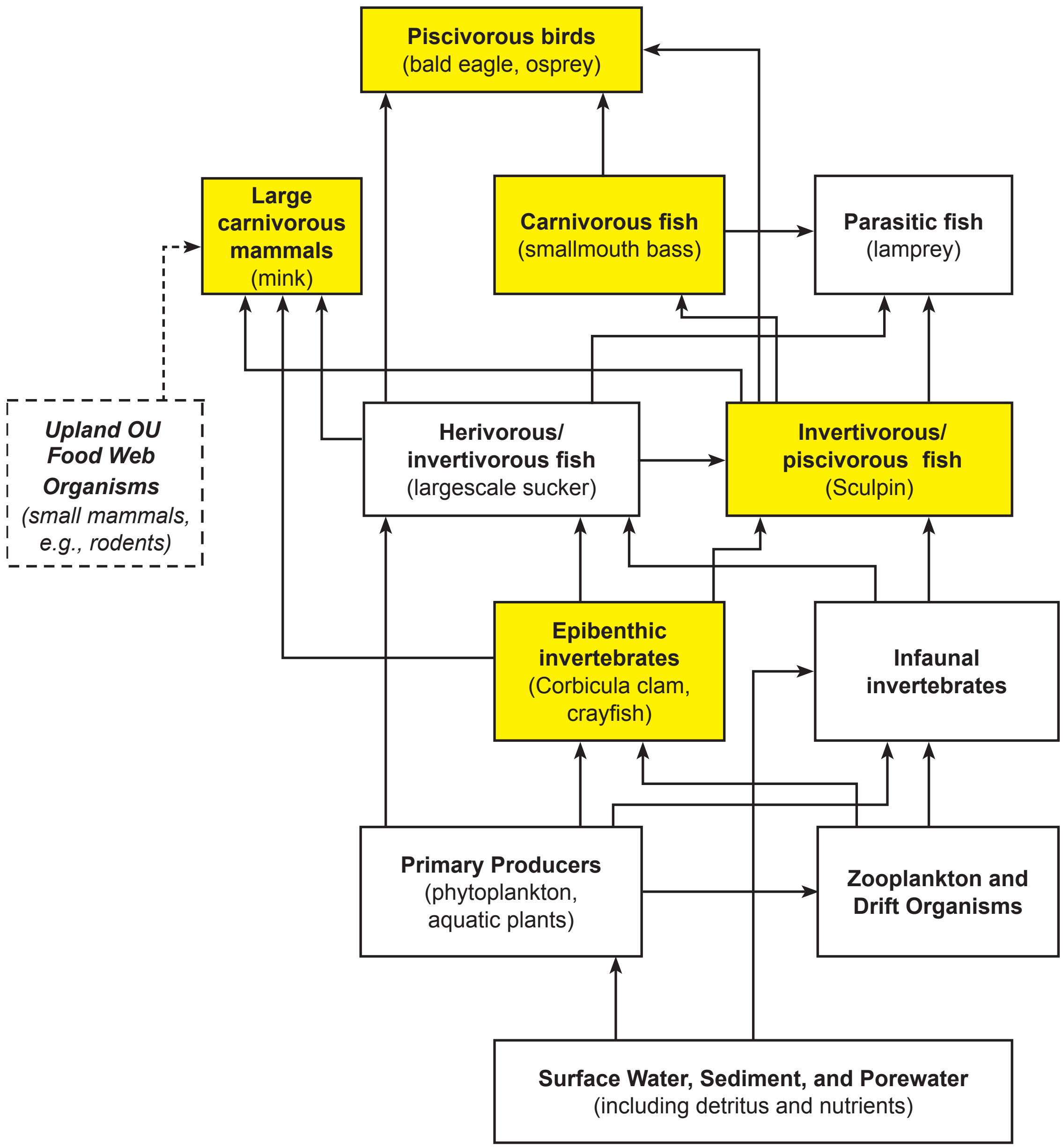
BRADFORD ISLAND

CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

ECOLOGICAL CONCEPTUAL EXPOSURE MODEL

DRAWING NUMBER: FIGURE 3-1
GIS FILE NUMBER: FIG 3-1
SHEET:
REV.



Organisms in the shaded boxes were evaluated for risk using representative species shown.

RIVER OU FOOD WEB

BRADFORD ISLAND
CASCADE LOCKS, OREGON

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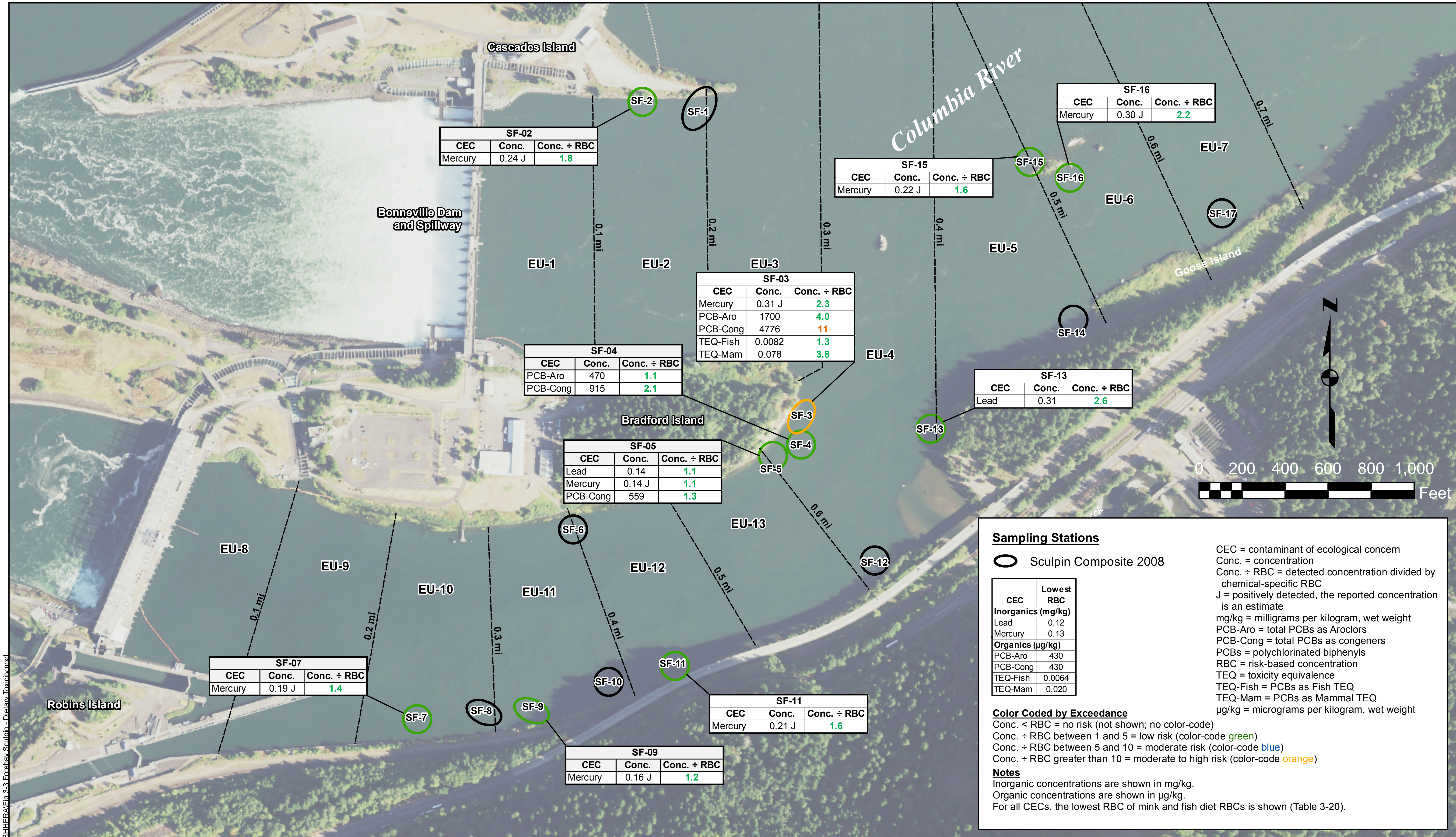
FIGURE 3-2



SF-02		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.24 J	1.8

SF-03		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.31 J	2.3
PCB-Aro	1700	4.0
PCB-Cong	4776	11
TEQ-Fish	0.0082	1.3
TEQ-Mam	0.078	3.8

SF-04		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	470	1.1
PCB-Cong	915	2.1

SF-05		
CEC	Conc.	Conc. ÷ RBC
Lead	0.14	1.1
Mercury	0.14 J	1.1
PCB-Cong	559	1.3

SF-07		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.19 J	1.4

SF-09		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.16 J	1.2

SF-11		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.21 J	1.6

SF-13		
CEC	Conc.	Conc. ÷ RBC
Lead	0.31	2.6

SF-15		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.22 J	1.6

SF-16		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.30 J	2.2

Sampling Stations

Sculpin Composite 2008

CEC	Lowest RBC
Inorganics (mg/kg)	
Lead	0.12
Mercury	0.13
Organics (µg/kg)	
PCB-Aro	430
PCB-Cong	430
TEQ-Fish	0.0064
TEQ-Mam	0.020

CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, wet weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Fish = PCBs as Fish TEQ
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, wet weight

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all CECs, the lowest RBC of mink and fish diet RBCs is shown (Table 3-20).

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BRADFORD ISLAND

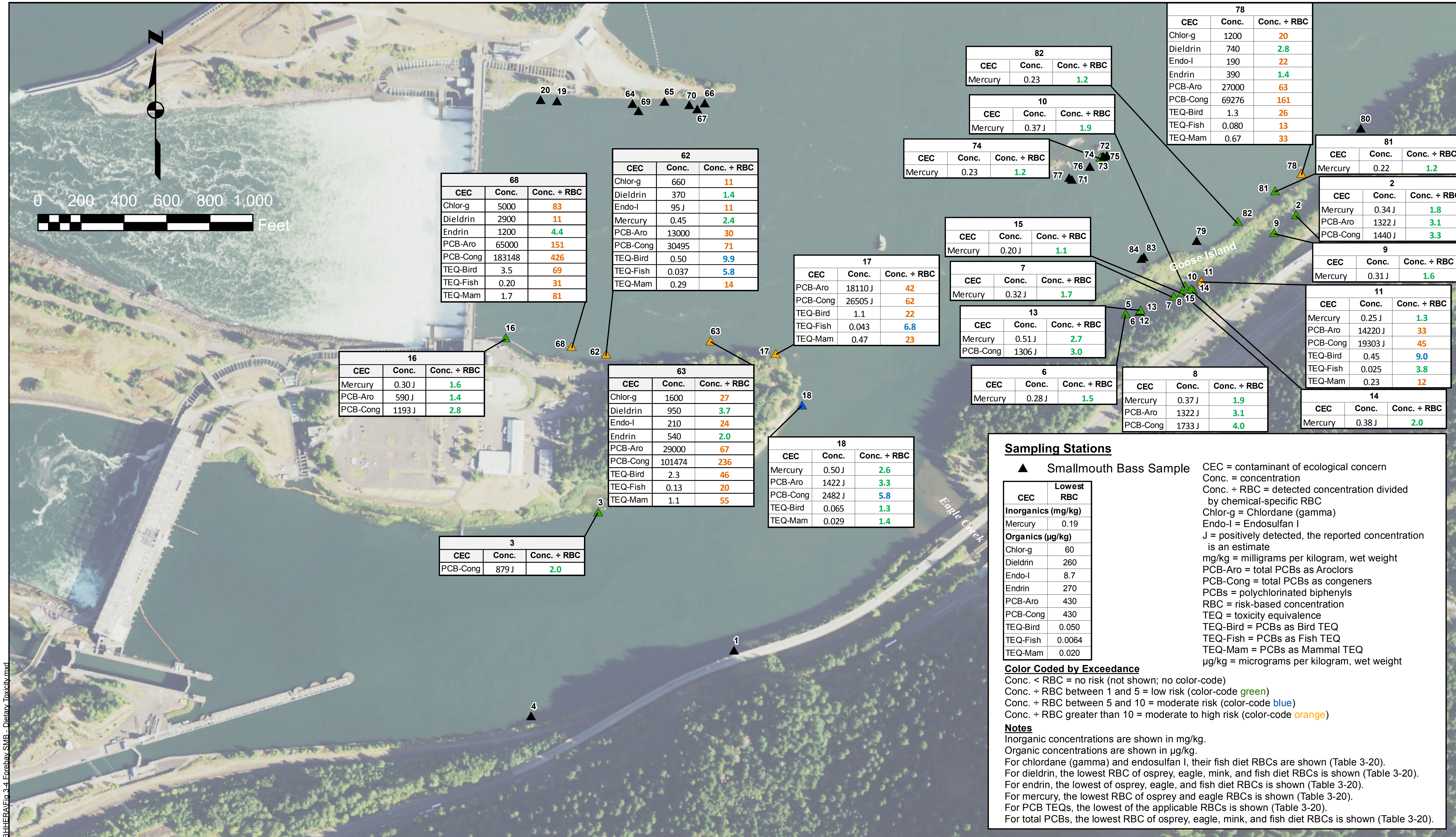
CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

RIVER OU SCULPIN - DIETARY TOXICITY

DRAWING NUMBER: FIGURE 3-3
GIS FILE NUMBER: FIG 3-3
SHEET: REV.

K:\bradford_island\GIS\2015\BHERA\Fig 3-3 Forebay Sculpin - Dietary Toxicity.mxd



68		
CEC	Conc.	Conc. ÷ RBC
Chlor-g	5000	83
Dieldrin	2900	11
Endrin	1200	4.4
PCB-Aro	65000	151
PCB-Cong	183148	426
TEQ-Bird	3.5	69
TEQ-Fish	0.20	31
TEQ-Mam	1.7	81

62		
CEC	Conc.	Conc. ÷ RBC
Chlor-g	660	11
Dieldrin	370	1.4
Endo-I	95 J	11
Mercury	0.45	2.4
PCB-Aro	13000	30
PCB-Cong	30495	71
TEQ-Bird	0.50	9.9
TEQ-Fish	0.037	5.8
TEQ-Mam	0.29	14

16		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.30 J	1.6
PCB-Aro	590 J	1.4
PCB-Cong	1193 J	2.8

63		
CEC	Conc.	Conc. ÷ RBC
Chlor-g	1600	27
Dieldrin	950	3.7
Endo-I	210	24
Endrin	540	2.0
PCB-Aro	29000	67
PCB-Cong	101474	236
TEQ-Bird	2.3	46
TEQ-Fish	0.13	20
TEQ-Mam	1.1	55

3		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	879 J	2.0

17		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	18110 J	42
PCB-Cong	26505 J	62
TEQ-Bird	1.1	22
TEQ-Fish	0.043	6.8
TEQ-Mam	0.47	23

18		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.50 J	2.6
PCB-Aro	1422 J	3.3
PCB-Cong	2482 J	5.8
TEQ-Bird	0.065	1.3
TEQ-Mam	0.029	1.4

82		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.23	1.2

10		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.37 J	1.9

74		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.23	1.2

78		
CEC	Conc.	Conc. ÷ RBC
Chlor-g	1200	20
Dieldrin	740	2.8
Endo-I	190	22
Endrin	390	1.4
PCB-Aro	27000	63
PCB-Cong	69276	161
TEQ-Bird	1.3	26
TEQ-Fish	0.080	13
TEQ-Mam	0.67	33

81		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.22	1.2

2		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.34 J	1.8
PCB-Aro	1322 J	3.1
PCB-Cong	1440 J	3.3

15		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.20 J	1.1

9		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.31 J	1.6

7		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.32 J	1.7

11		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.25 J	1.3
PCB-Aro	14220 J	33
PCB-Cong	19303 J	45
TEQ-Bird	0.45	9.0
TEQ-Fish	0.025	3.8
TEQ-Mam	0.23	12

13		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.51 J	2.7
PCB-Cong	1306 J	3.0

6		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.28 J	1.5

8		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.37 J	1.9
PCB-Aro	1322 J	3.1
PCB-Cong	1733 J	4.0

14		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.38 J	2.0

Sampling Stations

▲ Smallmouth Bass Sample

CEC	Lowest RBC
Inorganics (mg/kg)	
Mercury	0.19
Organics (µg/kg)	
Chlor-g	60
Dieldrin	260
Endo-I	8.7
Endrin	270
PCB-Aro	430
PCB-Cong	430
TEQ-Bird	0.050
TEQ-Fish	0.0064
TEQ-Mam	0.020

CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
Chlor-g = Chlordane (gamma)
Endo-I = Endosulfan I
J = positively detected, the reported concentration is an estimate
mg/kg = milligrams per kilogram, wet weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Bird = PCBs as Bird TEQ
TEQ-Fish = PCBs as Fish TEQ
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, wet weight

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For chlordane (gamma) and endosulfan I, their fish diet RBCs are shown (Table 3-20).
For dieldrin, the lowest RBC of osprey, eagle, mink, and fish diet RBCs is shown (Table 3-20).
For endrin, the lowest of osprey, eagle, mink, and fish diet RBCs is shown (Table 3-20).
For mercury, the lowest RBC of osprey and eagle RBCs is shown (Table 3-20).
For PCB TEQs, the lowest of the applicable RBCs is shown (Table 3-20).
For total PCBs, the lowest RBC of osprey, eagle, mink, and fish diet RBCs is shown (Table 3-20).

K:\bradford_island\GIS\2015\BHERA\Fig 3-4 Forebay SMB - Dietary Toxicity.mxd

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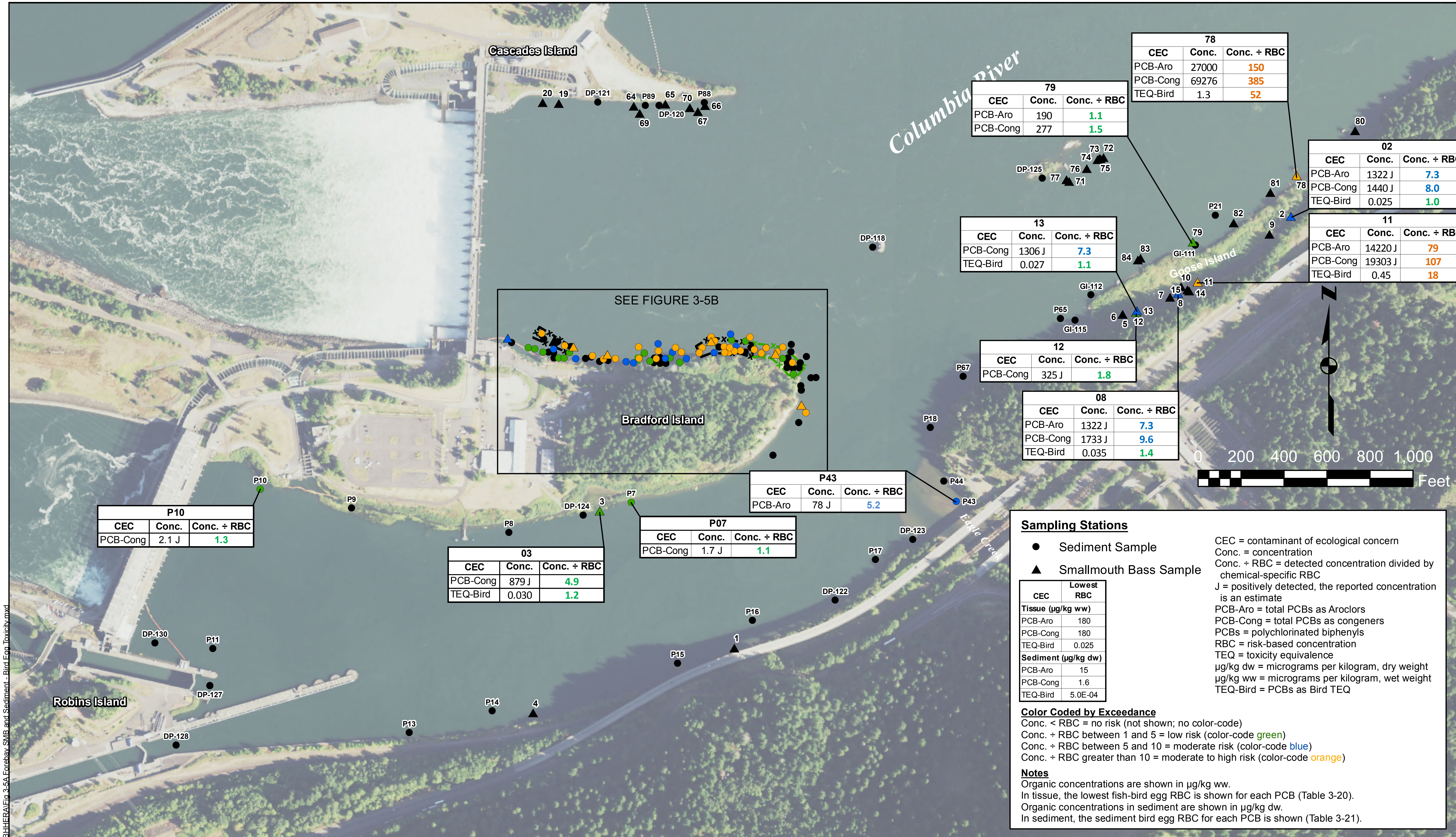
CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

RIVER OU SMALLMOUTH BASS - DIETARY TOXICITY

DRAWING NUMBER: FIGURE 3-4
GIS FILE NUMBER: FIG 3-4
SHEET:
REV.



78		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	27000	150
PCB-Cong	69276	385
TEQ-Bird	1.3	52

79		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	190	1.1
PCB-Cong	277	1.5

02		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1322 J	7.3
PCB-Cong	1440 J	8.0
TEQ-Bird	0.025	1.0

11		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	14220 J	79
PCB-Cong	19303 J	107
TEQ-Bird	0.45	18

13		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	1306 J	7.3
TEQ-Bird	0.027	1.1

12		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	325 J	1.8

08		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1322 J	7.3
PCB-Cong	1733 J	9.6
TEQ-Bird	0.035	1.4

P43		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	78 J	5.2

P10		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	2.1 J	1.3

03		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	879 J	4.9
TEQ-Bird	0.030	1.2

P07		
CEC	Conc.	Conc. ÷ RBC
PCB-Cong	1.7 J	1.1

Sampling Stations

● Sediment Sample

▲ Smallmouth Bass Sample

CEC	Lowest RBC
Tissue (µg/kg ww)	
PCB-Aro	180
PCB-Cong	180
TEQ-Bird	0.025
Sediment (µg/kg dw)	
PCB-Aro	15
PCB-Cong	1.6
TEQ-Bird	5.0E-04

CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
J = positively detected, the reported concentration is an estimate
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
µg/kg dw = micrograms per kilogram, dry weight
µg/kg ww = micrograms per kilogram, wet weight
TEQ-Bird = PCBs as Bird TEQ

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Organic concentrations are shown in µg/kg ww.
In tissue, the lowest fish-bird egg RBC is shown for each PCB (Table 3-20).
Organic concentrations in sediment are shown in µg/kg dw.
In sediment, the sediment bird egg RBC for each PCB is shown (Table 3-21).

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	CHECKED BY: HP	DATE: AUGUST 2015	

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BRADFORD ISLAND

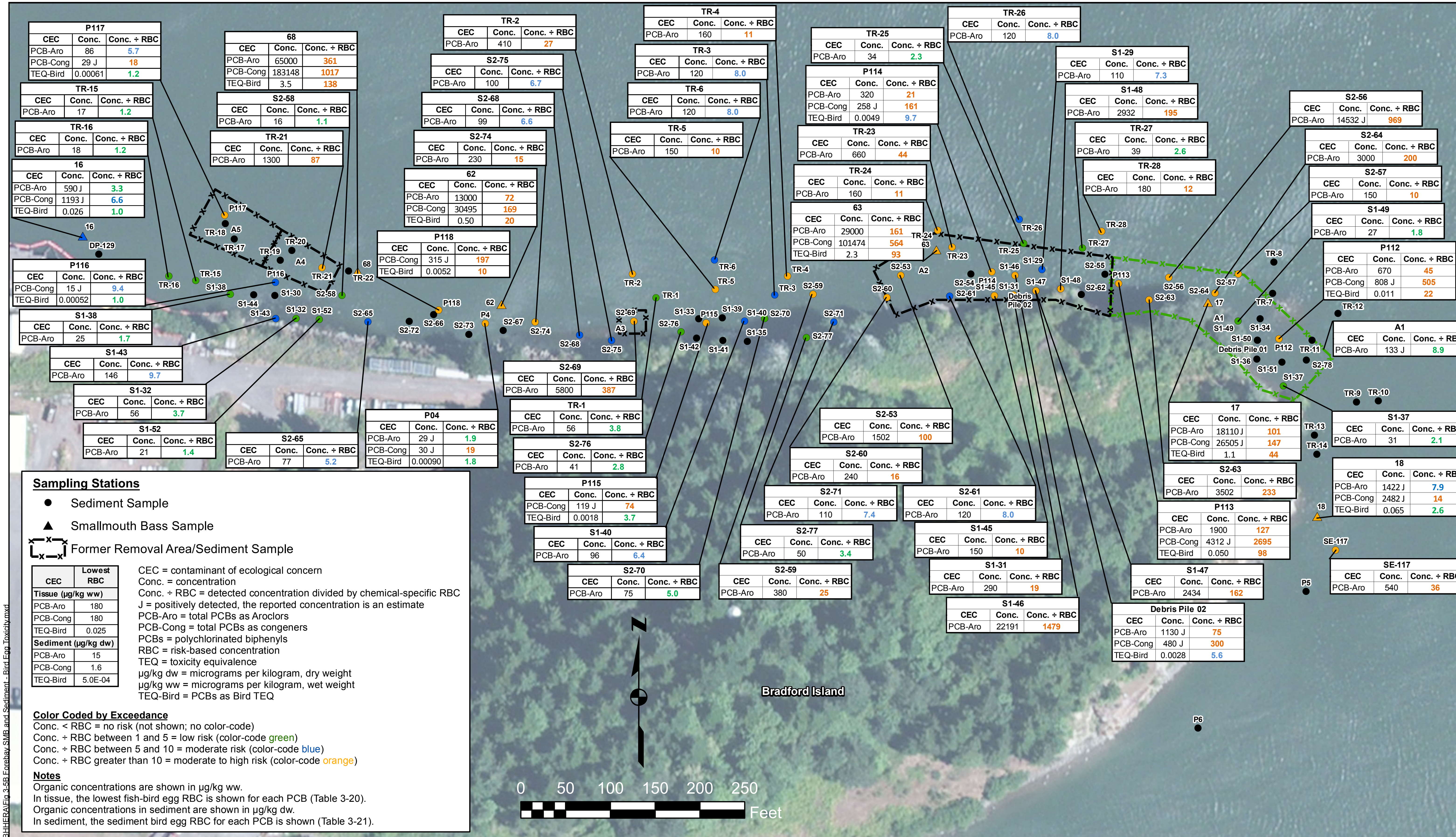
CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT

RIVER OU SMALLMOUTH BASS AND SEDIMENT - BIRD EGG TOXICITY

DRAWING NUMBER: FIGURE 3-5A
GIS FILE NUMBER: FIG 3-5A
SHEET: REV.:

K:\bradford_island\GIS\2015\BHERA\Fig 3-5A Forebay SMB and Sediment - Bird Egg Toxicity.mxd



P117

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	86	5.7
PCB-Cong	29 J	18
TEQ-Bird	0.00061	1.2

TR-15

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	17	1.2

TR-16

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	18	1.2

16

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	590 J	3.3
PCB-Cong	1193 J	6.6
TEQ-Bird	0.026	1.0

P116

CEC	Conc.	Conc. ÷ RBC
PCB-Cong	15 J	9.4
TEQ-Bird	0.00052	1.0

S1-38

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	25	1.7

S1-43

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	146	9.7

S1-32

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	56	3.7

S1-52

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	21	1.4

68

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	65000	361
PCB-Cong	183148	1017
TEQ-Bird	3.5	138

S2-58

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	16	1.1

TR-21

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1300	87

S2-65

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	77	5.2

TR-2

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	410	27

S2-75

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	100	6.7

S2-68

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	99	6.6

S2-74

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	230	15

62

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	13000	72
PCB-Cong	30495	169
TEQ-Bird	0.50	20

P118

CEC	Conc.	Conc. ÷ RBC
PCB-Cong	315 J	197
TEQ-Bird	0.0052	10

P04

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	29 J	1.9
PCB-Cong	30 J	19
TEQ-Bird	0.00090	1.8

S2-69

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	5800	387

TR-1

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	56	3.8

S2-76

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	41	2.8

P115

CEC	Conc.	Conc. ÷ RBC
PCB-Cong	119 J	74
TEQ-Bird	0.0018	3.7

S1-40

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	96	6.4

S2-70

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	75	5.0

TR-4

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	160	11

TR-3

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	8.0

TR-6

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	8.0

TR-5

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	10

TR-25

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	34	2.3

P114

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	320	21
PCB-Cong	258 J	161
TEQ-Bird	0.0049	9.7

TR-23

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	660	44

TR-24

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	160	11

63

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	29000	161
PCB-Cong	101474	564
TEQ-Bird	2.3	93

TR-26

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	8.0

S1-29

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	110	7.3

S1-48

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	2932	195

TR-27

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	39	2.6

TR-28

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	180	12

S2-56

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	14532 J	969

S2-64

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	3000	200

S2-57

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	10

S1-49

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	27	1.8

P112

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	670	45
PCB-Cong	808 J	505
TEQ-Bird	0.011	22

A1

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	133 J	8.9

S2-53

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1502	100

S2-60

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	240	16

S2-71

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	110	7.4

S2-61

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	8.0

S2-77

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	50	3.4

S1-45

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	10

S2-59

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	380	25

S1-31

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	290	19

S1-46

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	22191	1479

17

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	18110 J	101
PCB-Cong	26505 J	147
TEQ-Bird	1.1	44

S2-63

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	3502	233

P113

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1900	127
PCB-Cong	4312 J	2695
TEQ-Bird	0.050	98

S1-47

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	2434	162

Debris Pile 02

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1130 J	75
PCB-Cong	480 J	300
TEQ-Bird	0.0028	5.6

S1-37

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	31	2.1

18

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1422 J	7.9
PCB-Cong	2482 J	14
TEQ-Bird	0.065	2.6

SE-117

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	540	36

Sampling Stations

- ● Sediment Sample
- ▲ Smallmouth Bass Sample
- Former Removal Area/Sediment Sample

CEC	Lowest RBC
Tissue (µg/kg ww)	
PCB-Aro	180
PCB-Cong	180
TEQ-Bird	0.025
Sediment (µg/kg dw)	
PCB-Aro	15
PCB-Cong	1.6
TEQ-Bird	5.0E-04

CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
J = positively detected, the reported concentration is an estimate
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
µg/kg dw = micrograms per kilogram, dry weight
µg/kg ww = micrograms per kilogram, wet weight
TEQ-Bird = PCBs as Bird TEQ

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Organic concentrations are shown in µg/kg ww.
In tissue, the lowest fish-bird egg RBC is shown for each PCB (Table 3-20).
Organic concentrations in sediment are shown in µg/kg dw.
In sediment, the sediment bird egg RBC for each PCB is shown (Table 3-21).

K:\bradford_island\GIS\2015\BHERA\Fig 3-5B Forebay SMB and Sediment - Bird Egg Toxicity.mxd

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25696528	HP	HP
	DRAWN BY: SB	APPROVED BY: DW
	CHECKED BY: HP	DATE: AUGUST 2015

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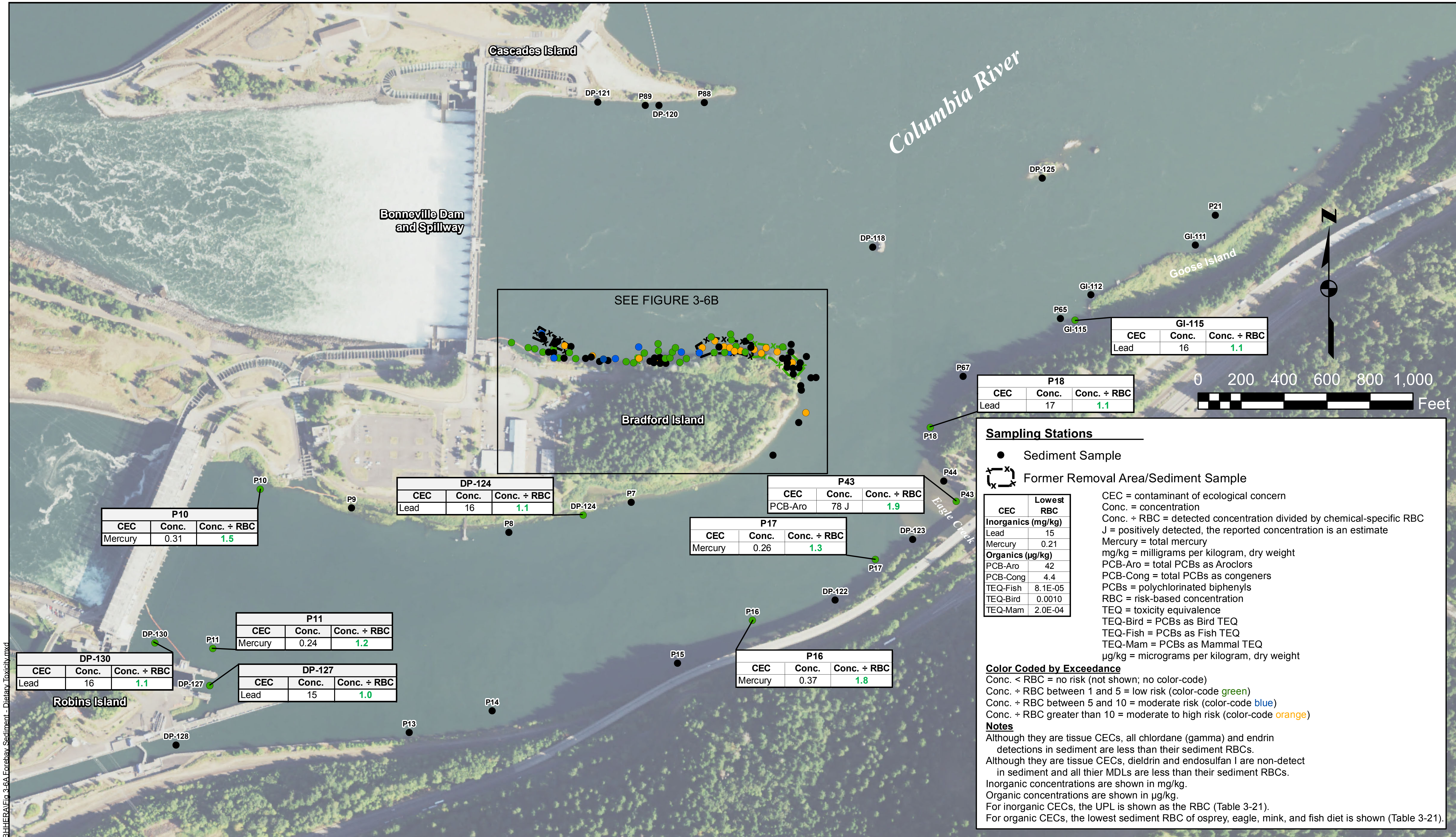
BRADFORD ISLAND
CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT
RIVER OU SMALLMOUTH BASS AND SEDIMENT - BIRD EGG TOXICITY

DRAWING NUMBER: FIGURE 3-5B
GIS FILE NUMBER: FIG 3-5B
SHEET: REV.



GI-115		
CEC	Conc.	Conc. ÷ RBC
Lead	16	1.1

P18		
CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1

DP-124		
CEC	Conc.	Conc. ÷ RBC
Lead	16	1.1

P43		
CEC	Conc.	Conc. ÷ RBC
PCB-Aro	78 J	1.9

P10		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.31	1.5

P17		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.26	1.3

P11		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.24	1.2

DP-130		
CEC	Conc.	Conc. ÷ RBC
Lead	16	1.1

DP-127		
CEC	Conc.	Conc. ÷ RBC
Lead	15	1.0

P16		
CEC	Conc.	Conc. ÷ RBC
Mercury	0.37	1.8

Sampling Stations

● Sediment Sample

Former Removal Area/Sediment Sample

CEC	Lowest RBC
Inorganics (mg/kg)	
Lead	15
Mercury	0.21
Organics (µg/kg)	
PCB-Aro	42
PCB-Cong	4.4
TEQ-Fish	8.1E-05
TEQ-Bird	0.0010
TEQ-Mam	2.0E-04

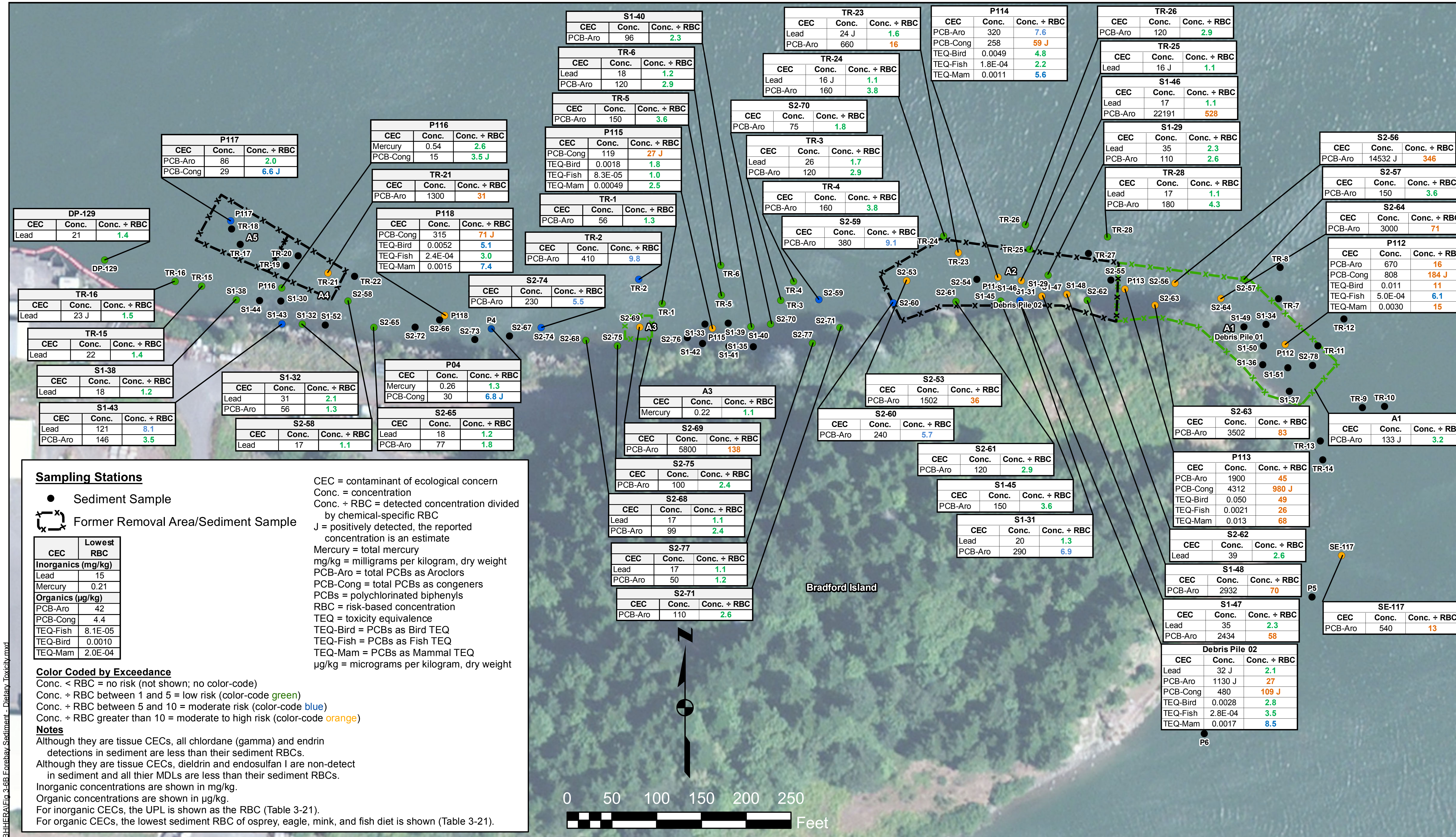
CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
J = positively detected, the reported concentration is an estimate
Mercury = total mercury
mg/kg = milligrams per kilogram, dry weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Bird = PCBs as Bird TEQ
TEQ-Fish = PCBs as Fish TEQ
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, dry weight

Color Coded by Exceedance
Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes
Although they are tissue CECs, all chlordane (gamma) and endrin detections in sediment are less than their sediment RBCs.
Although they are tissue CECs, dieldrin and endosulfan I are non-detect in sediment and all thier MDLs are less than their sediment RBCs.
Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For inorganic CECs, the UPL is shown as the RBC (Table 3-21).
For organic CECs, the lowest sediment RBC of osprey, eagle, mink, and fish diet is shown (Table 3-21).

K:\bradford_island\GIS\2015\BHERA\Fig 3-6A Forebay Sediment - Dietary Toxicity.mxd

JOB No. 25696528	DESIGNED: HP	PROJ. ENGINEER: HP	URS	BRADFORD ISLAND	RIVER OPERABLE UNIT	DRAWING NUMBER: FIGURE 3-6A
	DRAWN BY: SB	APPROVED BY: DW	111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292 www.aecom.com	CASCADE LOCKS, OREGON	RIVER OU SEDIMENT - DIETARY TOXICITY	GIS FILE NUMBER: FIG 3-6A
	CHECKED BY: HP	DATE: JULY 2015				SHEET: REV.



S1-40

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	96	2.3

TR-6

CEC	Conc.	Conc. ÷ RBC
Lead	18	1.2
PCB-Aro	120	2.9

TR-5

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	3.6

P115

CEC	Conc.	Conc. ÷ RBC
PCB-Cong	119	27 J
TEQ-Bird	0.0018	1.8
TEQ-Fish	8.3E-05	1.0
TEQ-Mam	0.00049	2.5

TR-1

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	56	1.3

TR-2

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	410	9.8

S2-74

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	230	5.5

TR-23

CEC	Conc.	Conc. ÷ RBC
Lead	24 J	1.6
PCB-Aro	660	16

TR-24

CEC	Conc.	Conc. ÷ RBC
Lead	16 J	1.1
PCB-Aro	160	3.8

S2-70

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	75	1.8

TR-3

CEC	Conc.	Conc. ÷ RBC
Lead	26	1.7
PCB-Aro	120	2.9

TR-4

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	160	3.8

S2-59

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	380	9.1

P114

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	320	7.6
PCB-Cong	258	59 J
TEQ-Bird	0.0049	4.8
TEQ-Fish	1.8E-04	2.2
TEQ-Mam	0.0011	5.6

TR-26

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	2.9

TR-25

CEC	Conc.	Conc. ÷ RBC
Lead	16 J	1.1

S1-46

CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1
PCB-Aro	22191	528

S1-29

CEC	Conc.	Conc. ÷ RBC
Lead	35	2.3
PCB-Aro	110	2.6

TR-28

CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1
PCB-Aro	180	4.3

S2-56

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	14532 J	346

S2-57

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	3.6

S2-64

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	3000	71

P112

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	670	16
PCB-Cong	808	184 J
TEQ-Bird	0.011	11
TEQ-Fish	5.0E-04	6.1
TEQ-Mam	0.0030	15

P117

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	86	2.0
PCB-Cong	29	6.6 J

P116

CEC	Conc.	Conc. ÷ RBC
Mercury	0.54	2.6
PCB-Cong	15	3.5 J

TR-21

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1300	31

P118

CEC	Conc.	Conc. ÷ RBC
PCB-Cong	315	71 J
TEQ-Bird	0.0052	5.1
TEQ-Fish	2.4E-04	3.0
TEQ-Mam	0.0015	7.4

DP-129

CEC	Conc.	Conc. ÷ RBC
Lead	21	1.4

TR-16

CEC	Conc.	Conc. ÷ RBC
Lead	23 J	1.5

TR-15

CEC	Conc.	Conc. ÷ RBC
Lead	22	1.4

S1-38

CEC	Conc.	Conc. ÷ RBC
Lead	18	1.2

S1-43

CEC	Conc.	Conc. ÷ RBC
Lead	121	8.1
PCB-Aro	146	3.5

S1-32

CEC	Conc.	Conc. ÷ RBC
Lead	31	2.1
PCB-Aro	56	1.3

S2-58

CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1

P04

CEC	Conc.	Conc. ÷ RBC
Mercury	0.26	1.3
PCB-Cong	30	6.8 J

S2-65

CEC	Conc.	Conc. ÷ RBC
Lead	18	1.2
PCB-Aro	77	1.8

A3

CEC	Conc.	Conc. ÷ RBC
Mercury	0.22	1.1

S2-69

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	5800	138

S2-75

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	100	2.4

S2-68

CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1
PCB-Aro	99	2.4

S2-77

CEC	Conc.	Conc. ÷ RBC
Lead	17	1.1
PCB-Aro	50	1.2

S2-71

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	110	2.6

S2-53

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1502	36

S2-60

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	240	5.7

S2-61

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	120	2.9

S1-45

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	150	3.6

S1-31

CEC	Conc.	Conc. ÷ RBC
Lead	20	1.3
PCB-Aro	290	6.9

S2-63

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	3502	83

A1

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	133 J	3.2

P113

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	1900	45
PCB-Cong	4312	980 J
TEQ-Bird	0.050	49
TEQ-Fish	0.0021	26
TEQ-Mam	0.013	68

S2-62

CEC	Conc.	Conc. ÷ RBC
Lead	39	2.6

S1-48

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	2932	70

S1-47

CEC	Conc.	Conc. ÷ RBC
Lead	35	2.3
PCB-Aro	2434	58

SE-117

CEC	Conc.	Conc. ÷ RBC
PCB-Aro	540	13

Debris Pile 02

CEC	Conc.	Conc. ÷ RBC
Lead	32 J	2.1
PCB-Aro	1130 J	27
PCB-Cong	480	109 J
TEQ-Bird	0.0028	2.8
TEQ-Fish	2.8E-04	3.5
TEQ-Mam	0.0017	8.5

Sampling Stations

● Sediment Sample

Former Removal Area/Sediment Sample

CEC	Lowest RBC
Inorganics (mg/kg)	
Lead	15
Mercury	0.21
Organics (µg/kg)	
PCB-Aro	42
PCB-Cong	4.4
TEQ-Fish	8.1E-05
TEQ-Bird	0.0010
TEQ-Mam	2.0E-04

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Although they are tissue CECs, all chlordane (gamma) and endrin detections in sediment are less than their sediment RBCs.
Although they are tissue CECs, dieldrin and endosulfan I are non-detect in sediment and all thier MDLs are less than their sediment RBCs.
Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For inorganic CECs, the UPL is shown as the RBC (Table 3-21).
For organic CECs, the lowest sediment RBC of osprey, eagle, mink, and fish diet is shown (Table 3-21).

CEC = contaminant of ecological concern
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
J = positively detected, the reported concentration is an estimate
Mercury = total mercury
mg/kg = milligrams per kilogram, dry weight
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
TEQ = toxicity equivalence
TEQ-Bird = PCBs as Bird TEQ
TEQ-Fish = PCBs as Fish TEQ
TEQ-Mam = PCBs as Mammal TEQ
µg/kg = micrograms per kilogram, dry weight

JOB No.	DESIGNED:	PROJ. ENGINEER:
25696528	HP	HP
	DRAWN BY: SB	APPROVED BY: DW
	CHECKED BY: HP	DATE: AUGUST 2015

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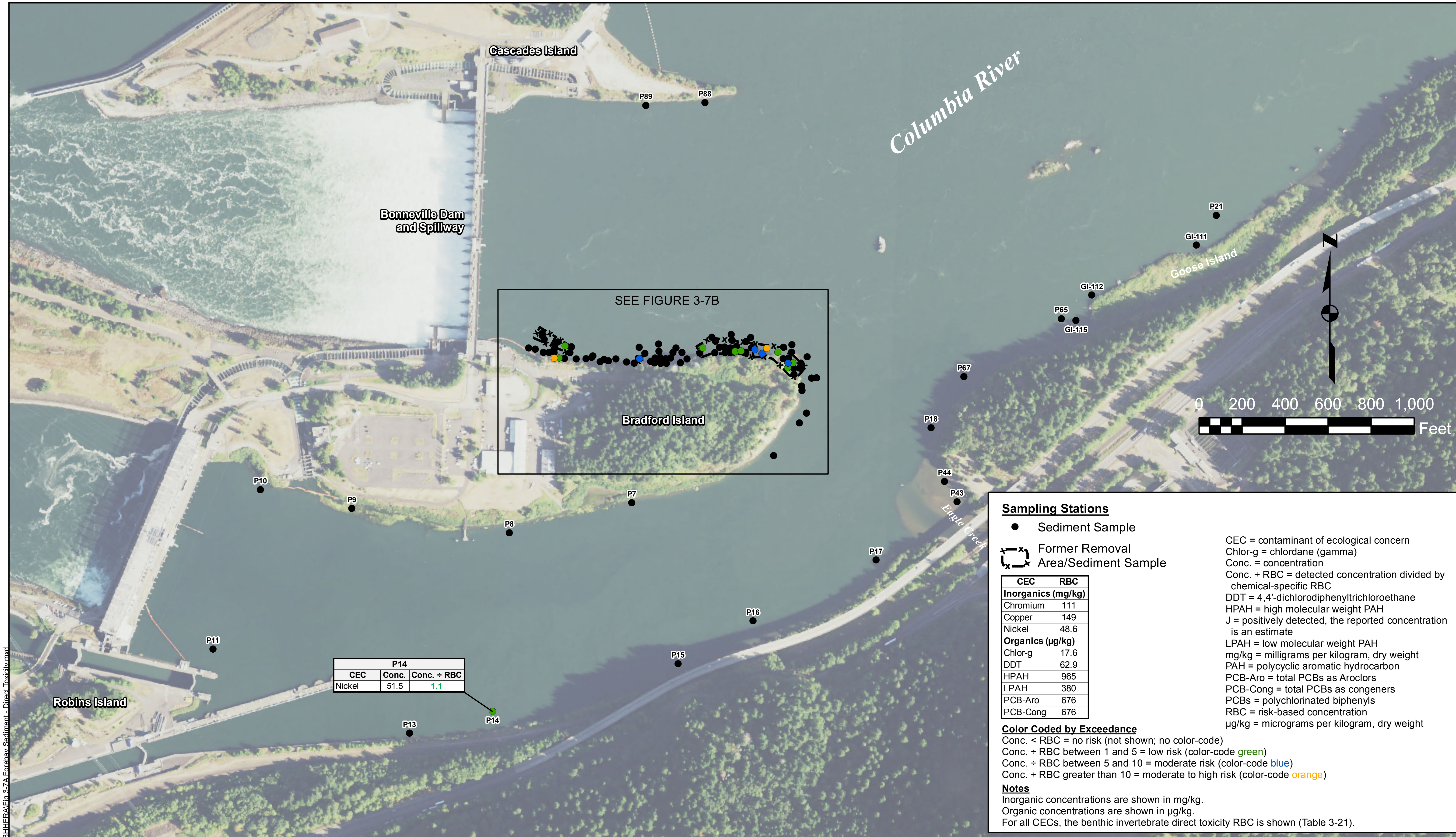
BRADFORD ISLAND
CASCADE LOCKS, OREGON

RIVER OPERABLE UNIT
RIVER OU SEDIMENT - DIETARY TOXICITY

DRAWING NUMBER: FIGURE 3-6B
GIS FILE NUMBER: FIG 3-6B
SHEET: REV.

K:\bradford_island\GIS\2015\BHHERA\Fig 3-6B Forebay Sediment - Dietary Toxicity.mxd



P14		
CEC	Conc.	Conc. ÷ RBC
Nickel	51.5	1.1

Sampling Stations

- Sediment Sample
- Former Removal Area/Sediment Sample

CEC	RBC
Inorganics (mg/kg)	
Chromium	111
Copper	149
Nickel	48.6
Organics (µg/kg)	
Chlor-g	17.6
DDT	62.9
HPAH	965
LPAH	380
PCB-Aro	676
PCB-Cong	676

CEC = contaminant of ecological concern
Chlor-g = chlordane (gamma)
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
DDT = 4,4'-dichlorodiphenyltrichloroethane
HPAH = high molecular weight PAH
J = positively detected, the reported concentration is an estimate
LPAH = low molecular weight PAH
mg/kg = milligrams per kilogram, dry weight
PAH = polycyclic aromatic hydrocarbon
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
µg/kg = micrograms per kilogram, dry weight

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all CECs, the benthic invertebrate direct toxicity RBC is shown (Table 3-21).

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BRADFORD ISLAND
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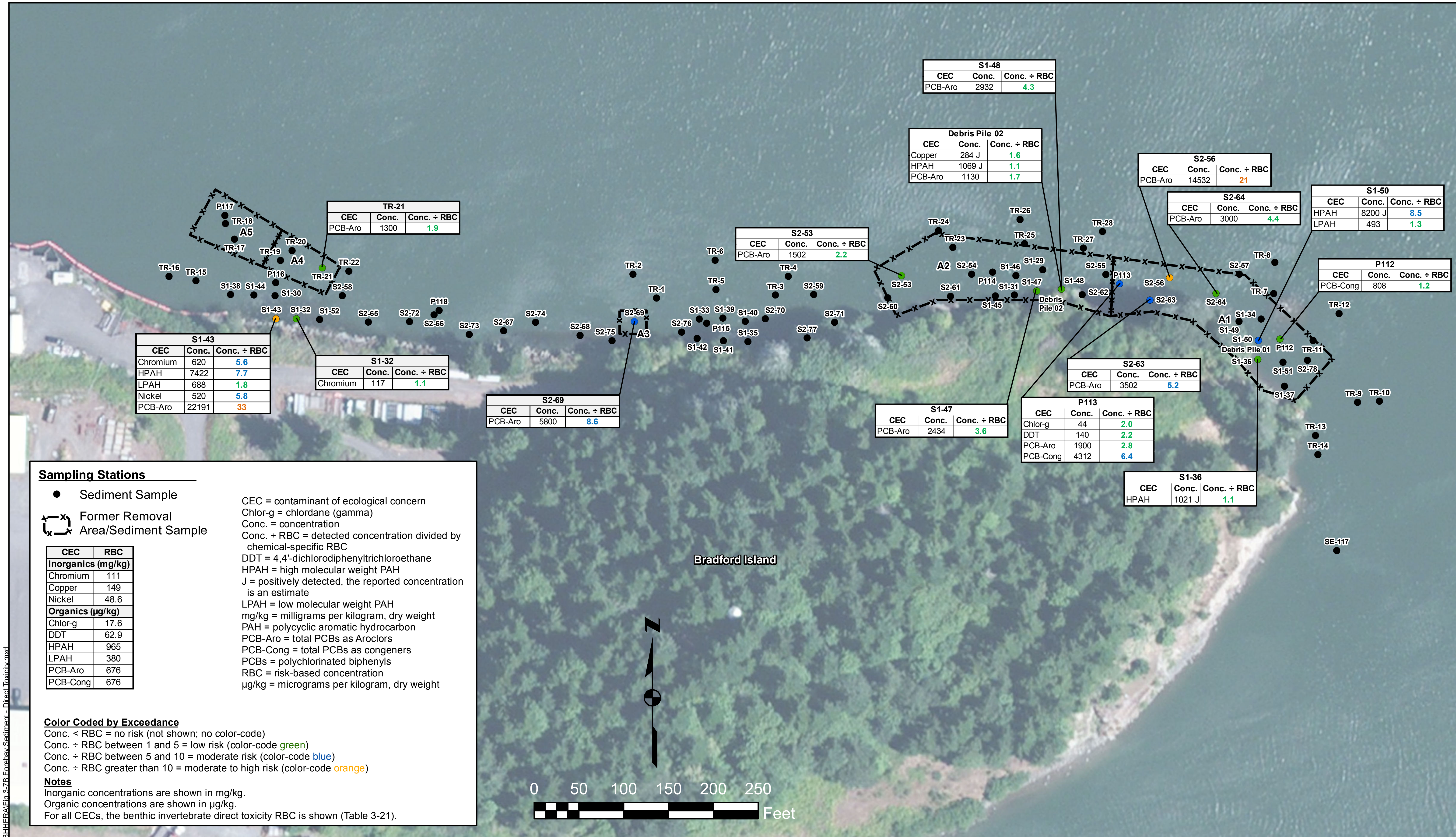
RIVER OPERABLE UNIT
RIVER OU SEDIMENT - DIRECT TOXICITY

DRAWING NUMBER: FIGURE 3-7A
GIS FILE NUMBER: FIG 3-7A
SHEET:
REV.



Sampling Stations

- Sediment Sample
- Former Removal Area/Sediment Sample

CEC	RBC
Inorganics (mg/kg)	
Chromium	111
Copper	149
Nickel	48.6
Organics (µg/kg)	
Chlor-g	17.6
DDT	62.9
HPAH	965
LPAH	380
PCB-Aro	676
PCB-Cong	676

CEC = contaminant of ecological concern
Chlor-g = chlordane (gamma)
Conc. = concentration
Conc. ÷ RBC = detected concentration divided by chemical-specific RBC
DDT = 4,4'-dichlorodiphenyltrichloroethane
HPAH = high molecular weight PAH
J = positively detected, the reported concentration is an estimate
LPAH = low molecular weight PAH
mg/kg = milligrams per kilogram, dry weight
PAH = polycyclic aromatic hydrocarbon
PCB-Aro = total PCBs as Aroclors
PCB-Cong = total PCBs as congeners
PCBs = polychlorinated biphenyls
RBC = risk-based concentration
µg/kg = micrograms per kilogram, dry weight

Color Coded by Exceedance

Conc. < RBC = no risk (not shown; no color-code)
Conc. ÷ RBC between 1 and 5 = low risk (color-code green)
Conc. ÷ RBC between 5 and 10 = moderate risk (color-code blue)
Conc. ÷ RBC greater than 10 = moderate to high risk (color-code orange)

Notes

Inorganic concentrations are shown in mg/kg.
Organic concentrations are shown in µg/kg.
For all CECs, the benthic invertebrate direct toxicity RBC is shown (Table 3-21).

K:\bradford_island\GIS\2015\BHERA\Fig 3-7B Forebay Sediment - Direct Toxicity.mxd

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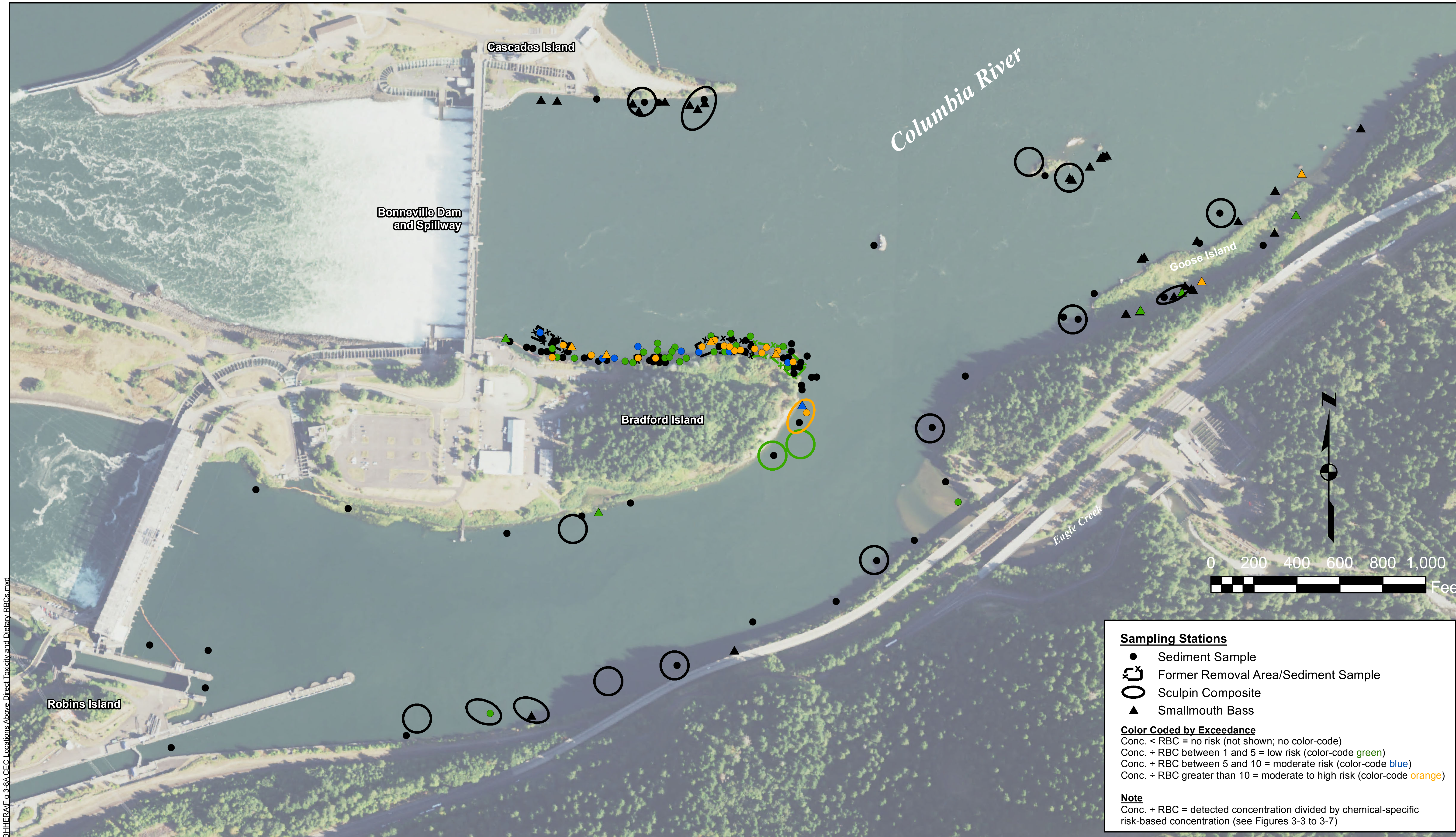
RIVER OPERABLE UNIT

RIVER OU SEDIMENT - DIRECT TOXICITY

DRAWING NUMBER: FIGURE 3-7B
GIS FILE NUMBER: FIG 3-7B
SHEET: REV.



K:\bradford_island\GIS\2015\BHHERA\Fig 3-8A CEC Locations Above Direct Toxicity and Dietary RBCs.mxd

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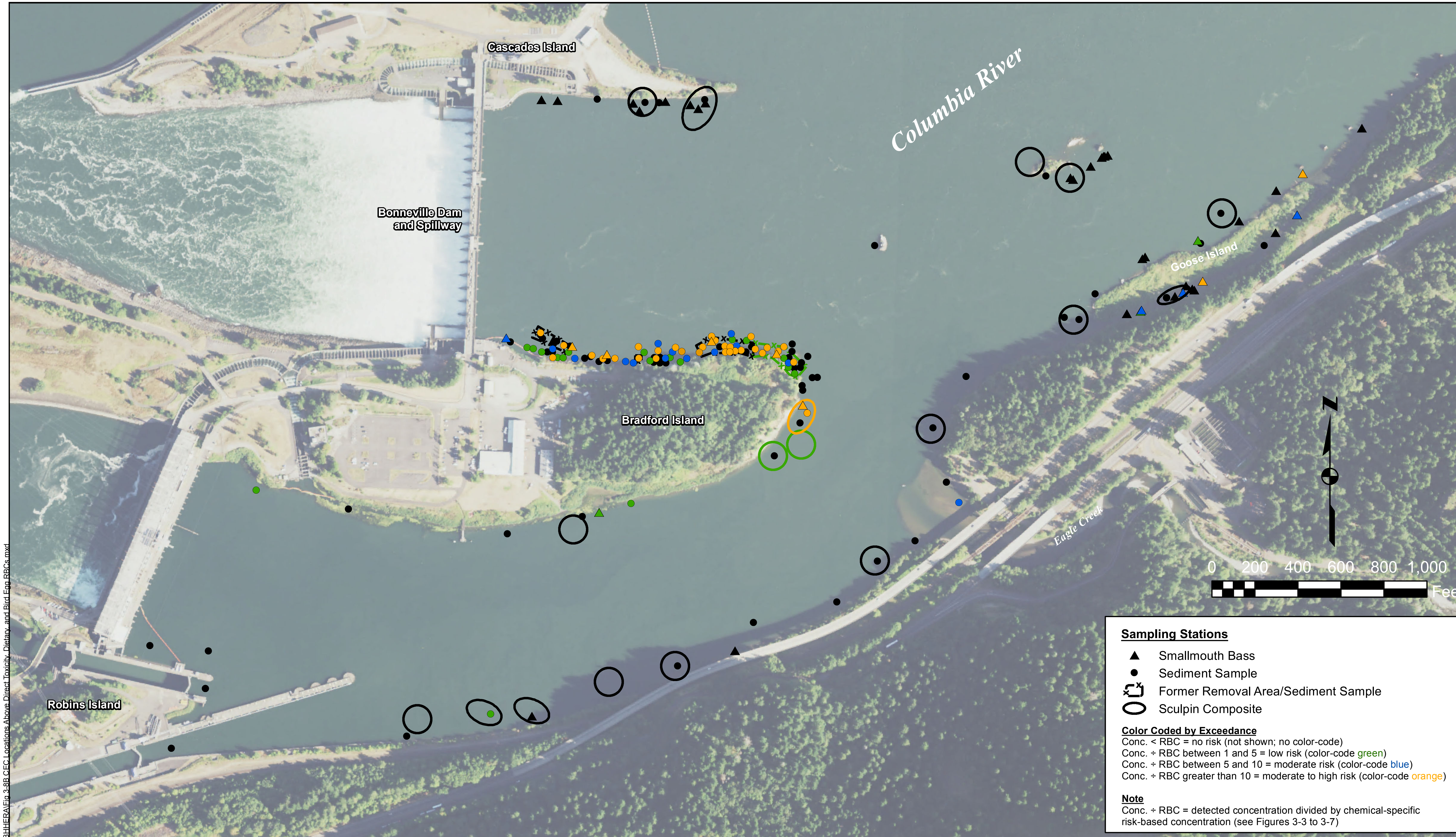
RIVER OPERABLE UNIT

CEC LOCATIONS ABOVE DIRECT TOXICITY AND DIETARY RBCs

DRAWING NUMBER: FIGURE 3-8A

GIS FILE NUMBER: FIG 3-8A

SHEET: REV.



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RIVER OPERABLE UNIT

CEC LOCATIONS ABOVE DIRECT TOXICITY, DIETARY, AND BIRD EGG RBCs

DRAWING NUMBER: FIGURE 3-8B

GIS FILE NUMBER: FIG 3-8B

SHEET: REV.

K:\bradford_island\GIS\2015\BHERA\Fig 3-8B CEC Locations Above Direct Toxicity, Dietary, and Bird Egg RBCs.mxd

APPENDIX A

Data Sensitivity Analysis

Appendix A
Data Sensitivity

In data sensitivity analysis, the goal is to evaluate the level of confidence at the low end of the reported range of concentrations regarding data usability in the baseline human health risk assessment (BHHERA). As discussed in Section 7.4 and shown in Figure 7-1 of the Final Remedial Investigation (RI; URS 2012), there are three categories in which individual data points may fall within a data set as they range from high to low concentrations: unqualified detections, detections at estimated concentrations ("J-flagged") and estimated maximum possible concentrations (EMPC-flagged), or non-detects ("U-flagged"). Less uncertainty is associated with the upper end of the range of reported concentrations that are well above the method detection limit (MDL) or reported detection limit (RDL), i.e., well above the lowest initial calibration standard of the laboratory instrument.

For unqualified detections, there is a high degree of confidence associated with both the identity of the analyte and its reported concentration. There is less confidence in J-flagged and EMPC-flagged detections because, although the analyte has been positively identified, the reported J- and EMPC-flagged values are estimated values, and the true concentration may actually be as low as the MDL/RDL. The U-flagged non-detect value is understood to represent a reliable concentration limit, above which an analyte is not present.

For the RI data set, a data sensitivity analysis was already performed for analytes with a detection frequency of less than 100% (i.e., those with at least one non-detect result), see Section 7.4, Table 7-3, and Table 7-4 of the Final RI (URS 2012). This appendix evaluates the data sensitivity of the non-RI data (representative historical "Pre-RI" sediment and 2011 "Pre-Feasibility Study [FS]" data) for analytes with a detection frequency less than 100%. The combined sediment data set is represented by all potentially relevant sediment data (i.e., historical "Pre-RI" sediment, RI sediment, and "Pre-FS" sediment) and the 2011 "Pre-FS" bass and clam tissue. Similar to the RI, the MDLs/RDLs of these non-detect analytes were compared to the lowest relevant human health and ecological screening level values (SLVs).

The evaluation process is intentionally conservative, using the lowest human health and ecological SLVs. In reality, multiple pathways and receptors are evaluated in the BHHERA, some of which may have higher SLVs. Therefore, exceedance of the lowest SLV by the MDL does not mean that the non-detect values have the potential to overestimate or underestimate risks for all receptors and pathways, only the receptor-pathway combination with the lowest SLV.

If the SLV is lower than the MDL, then there may be a limited ability to determine whether analytes that were reported as undetected can be eliminated from further consideration, particularly those analytes with 100% non-detect results. U-flagged data are commonly interpreted as signifying the absence of an analyte at the MDL. If the MDL is higher than the SLV, then it is more difficult to assume that the analyte is not present at a concentration of concern, and the level of confidence in eliminating the analyte is lower, particularly in the absence of detected data. Since the MDL is primarily influenced by the analytical and methodological technology, this type of uncertainty is not easily remedied unless more sensitive analytical methods are available and feasible for use.

A.1 Human Health Data Sensitivity

Table A-1 presents the analytes in sediment that had at least one non-detect result compared to the lowest fisher SLV (i.e., subsistence fisher). The following presents the analytes in sediment that had at least one non-detect result above the SLV: all nine individual polychlorinated biphenyls (PCBs) Aroclors, total PCB Aroclors, PCB Congeners 77, 81, 123, 126, 169, cadmium, thallium, all the dioxin/furans (except octachlorodibenzofuran [OCDF]), all pesticides with established SLVs, hexachlorobenzene, and pentachlorophenol.

Table A-2 presents the analytes in the 2011 “Pre-FS” smallmouth bass tissue (clams are not evaluated for human ingestion) with at least one non-detect result compared to the lowest fisher SLV. The following summarizes those analytes in tissue that had at least one non-detect result above the SLV for smallmouth bass: all individual PCB Aroclors, total PCB Aroclors, PCB Congeners 81, 126, and 169, some individual carcinogenic polycyclic aromatic hydrocarbons (cPAHs; benzo[a]anthracene, benzo[a]pyrene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene), cPAHs as benzo(a)pyrene equivalents (BaPEQ), and bis(2-ethyhexyl) phthalate.

There is a level of uncertainty due to these MDL/RDL exceedances of the SLVs; however, since all of the non-detected analytes with detection limits above the SLV also had detected values evaluated in the risk assessment, the likelihood that risk is underestimated is reduced. There is less potential for underestimation of risk related to the analytes that were sometimes detected because the estimation of the exposure point concentration (EPC) for these analytes by Pro-UCL and the Kaplan-Meyer method takes the absolute value of the MDL/RDL into consideration by including these detection limits in the concentration ranking for that analyte when the upper confidence limit (UCL) uses the MDL/RDL as the censoring limit.

In addition to the MDL/RDL exceedances of SLVs described above, the following non-detect analytes lacked SLVs:

- In sediment, selenium, silver, diesel range organics, residual range organics, six butyltins, all herbicides, seven pesticides, most SVOCs (50), and 2-methylnaphthalene (Table A-1)
- In smallmouth bass, antimony, beryllium, chromium, all pesticides, carbazole, and p-cresol (4-methyphenol) (Table A-2)

The lack of SLVs indicates an absence of reliable toxicological information for the evaluation of these chemicals. The uncertainty due to the lack of SLVs for several of these analytes was already discussed in the Final RI Uncertainty Section (Appendix O; URS 2012). The individual PAH components of diesel range and residual range organics were evaluated, which reduces the level of uncertainty for these particular analytes. The pesticides, SVOCs, and PAHs that lack SLVs are likely to be less toxic than their counterparts for which SLVs have been developed and risk has been evaluated, reducing the possibility that risks are underestimated. Due to the lack of SLVs for herbicides, risk may be underestimated; however, it is important to note that this entire class of analytes has never been detected (i.e., never positively identified as a site COI) and that the MDLs/RDLs are reflective of laboratory methodology limitations.

Screening-level fish tissue Regional Screening Levels (RSLs) were generated for the non-detect analytes without SLVs using the U.S. Environmental Protection Agency's on-line RSL calculator (USEPA 2015), assuming the subsistence fish consumption rate used in this BHHRA (45 grams/day). The tissue RSLs for the non-detect analytes were as follows:

- Calculated tissue RSLs greater than 1000 milligrams per kilogram (mg/kg): beryllium, chromium, selenium, silver, p-cresol
- Calculated tissue RSLs greater than 100 mg/kg: antimony, tributyltins
- Calculated tissue RSLs greater than 1 mg/kg: benzene hexachlorides (BHCs), toxaphene
- Calculated tissue RSLs between 0.1-1 mg/kg: aldrin, heptachlor, alpha-BHC

All these tissue RSLs are well above the maximum MDLs and MRLs, which are typically 0.1 mg/kg or less. Therefore, there is minimal potential for underestimation of risk related to these non-detected chemicals without SLVs. Tissue RSLs for some of these chemicals could not be calculated. However, this does not represent a significant uncertainty since these are considered to be of low toxicity to human health (e.g., monobutyltins, dibutyltins, a few SVOCs, and pesticide isomers or variants).

Overall, the level of uncertainty related to MDLs and MRLs is considered acceptable, and the potential for underestimation of human health risks related to data quality issues is considered low.

A.2 Ecological Data Sensitivity

Table A-3 presents the analytes in sediment that had at least one non-detect result compared to Group 1: the lowest of the benthic SLV, fish bioaccumulative SLV, and wildlife individual bioaccumulative SLV; and Group 2: the lowest of the benthic SLV, fish bioaccumulative SLV, and wildlife population bioaccumulative SLV. The difference between Group 1 and Group 2 was the consideration of bioaccumulative SLVs at the individual and population levels, respectively. The following presents the analytes in sediment that had at least one non-detect result above the two SLV categories:

1) Group 1: All nine individual PCBs Aroclors, Total PCB Aroclors, PCB Congeners 77, 81, 126, 169, cadmium, thallium, four butyltins, two dioxin/furans (2,3,4,7,8-PeCDF and 2,3,7,8-TCDD), and all pesticides with established SLVs except aldrin
2) Group 2: All nine individual PCBs Aroclors, PCB Congeners 77, 81, 126, and 169, cadmium, thallium, four butyltins, and all pesticides with established SLVs except aldrin

Table A-4 presents the analytes in the 2011 "Pre-FS" clam and smallmouth bass tissue with at least one non-detect result compared to Group 1: the lowest of the fish critical tissue level (CTL) and wildlife individual acceptable tissue level (ATL); and Group 2: the lowest of the fish CTL and wildlife population ATL. As with sediment, the difference between Group 1 and Group 2 was the consideration of bioaccumulative SLVs at the individual and population levels, respectively. The following summarizes those analytes in tissue that had at least one non-detect result above these two SLV categories for smallmouth bass and clam:

<u>Smallmouth Bass Tissue</u>

1) Group 1: All individual PCB Aroclors, Total PCB Aroclors, PCB Congeners 81, 126, and 169, chlordane (alpha), 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, bis(2-ethyl hexyl) phthalate, p-cresol
2) Group 2: PCB Congener 169, chlordane (alpha), 4,4'-DDT, 4,4'-DDE, bis(2-ethyl hexyl) phthalate, p-cresol

<u>Clam Tissue</u>

1) Group 1: Aroclors 1232, 1242, and 1254, Total PCBs as Aroclors, and p-cresol
2) Group 2: p-Cresol

There is a level of uncertainty due to these MDL/RDL exceedances of the SLVs; however, since all of the non-detected analytes with detection limits above the lowest of the fish CTL and wildlife population ATL also had detected values evaluated in the risk assessment, the likelihood that risk is underestimated is reduced. There is less potential for underestimation of risk related to the analytes that were sometimes detected because the estimation of the EPC for these analytes by Pro-UCL and the Kaplan-Meyer method takes the absolute value of the MDL/RDL into consideration by including these detection limits in the concentration ranking for that analyte when the UCL uses the MDL/RDL as the censoring limit.

In addition to the MDL/RDL exceedances of SLVs described above, the following non-detect analytes lacked SLVs:

- In sediment, diesel range organics, residual range organics, all herbicides, most pesticides, most SVOCs, and 2-methylnaphthalene (Table A-3)
- In smallmouth bass and clam, most pesticides, and carbazole (Table A-4)

The lack of SLVs indicates an absence of reliable toxicological information for the evaluation of these chemicals. The uncertainty due to the lack of SLVs for several of these analytes was already discussed in the Final RI Uncertainty Section (Appendix O; URS 2012). The individual PAH components of diesel range and residual range organics were evaluated, which reduces the level of uncertainty for these particular analytes. The pesticides, SVOCs, and PAHs that lack SLVs are likely to be less toxic than their counterparts for which SLVs have been developed and risk has been evaluated, reducing the possibility that risks are underestimated. Due to the lack of SLVs for herbicides, risk may be underestimated; however, it is important to note that this entire class of analytes has never been detected (i.e., never positively identified as a site contaminant of interest [COI]) and that the MDLs are reflective of laboratory methodology limitations.

A.3 Summary

Table A-5 summarizes the analytes that were never detected (100% non-detect) or sometimes detected (<100% non-detect) above the lowest relevant human health and/or ecological SLVs. Those analytes in grey font match those analytes previously identified in the RI data sensitivity analysis (see Table 7-5 of the Final RI; URS 2012), while those analytes in black font are newly identified analytes with MDLs/RDLs greater than the lowest SLVs. The elimination of the 100% non-detect analytes with elevated MDLs/RDLs as chemicals of potential concern (COPCs) and contaminants of potential ecological concern (CPECs) is subject to an unavoidable potential for underestimation of risk since they cannot be conclusively shown to be absent at concentrations of concern. However, there is less potential for underestimation of risk related to the analytes that were sometimes detected because the estimation of the EPC for these analytes by Pro-UCL and the Kaplan-Meyer method takes the absolute value of the MDL/RDL into consideration by including these detection limits in the concentration ranking for that analyte when the UCL uses the MDL/RDL as the censoring limit.

Table A-6 summarizes the analytes that were never detected (100% non-detect) or sometimes detected (<100% non-detect) for which either human health or ecological SLVs were not available. Those analytes in grey font match those analytes previously identified in the RI data sensitivity analysis (see Table 7-6 of the Final RI; URS 2012), while those analytes in black font are newly identified non-detect analytes that lack screening criteria. This represents a different type of uncertainty that is not related to analytical data quality but is relevant to the risk assessment process. The lack of SLVs indicates an absence of reliable or suitable toxicological information for the evaluation of the chemicals. Analytes that were never detected, including those with no SLVs available, may result in a potential for underestimation of risk. However, this uncertainty is unlikely to impact risk management decisions because the most studied chemicals with refined data quality procedures in the laboratory are often the most toxic. In addition, if these COIs are site-related, it is presumed that they would be co-located with risk-driving chemicals for which risk management decisions will be developed.

A.4 References

URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

U.S. Environmental Protection Agency. 2015. Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. RSL Table Update. June.

Table A-1
Sensitivity Analysis for River OU Sediment Samples - Human Health

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest HH SLV[1]	Number of NDs > HH SLV
PCB Aroclors		Aroclor 1016	ug/kg	109	109	0.020	21	0.048	108
PCB Aroclors		Aroclor 1221	ug/kg	109	109	0.020	29	0.048	108
PCB Aroclors		Aroclor 1232	ug/kg	109	109	0.050	37	0.048	109
PCB Aroclors		Aroclor 1242	ug/kg	109	109	0.060	21	0.048	109
PCB Aroclors		Aroclor 1248	ug/kg	109	107	0.39	39	0.048	107
PCB Aroclors		Aroclor 1254	ug/kg	109	36	0.49	8.9	0.048	36
PCB Aroclors		Aroclor 1260	ug/kg	109	106	0.28	379	0.048	106
PCB Aroclors		Aroclor 1262	ug/kg	31	31	0.39	21	0.048	31
PCB Aroclors		Aroclor 1268	ug/kg	31	31	0.39	21	0.048	31
PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	109	34	0.62	12	0.048	34
PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	29	1	0.19	0.19	0.0000064	1
PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	29	21	4.9E-05	0.14	0.0021	4
PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	29	3	1.6E-04	0.29	0.026	1
PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	29	16	4.8E-05	0.21	0.0000062	16
PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	29	1	9.4E-04	9.4E-04	0.026	0
PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	2	6.4E-04	7.1E-04	0.026	0
PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	28	4.5E-05	0.036	0.000021	28
PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	29	2	4.8E-05	8.1E-04	0.14	0
Metals		Antimony[2]	mg/kg	33	1	0.040	0.040	0.427	0
Metals		Beryllium[2]	mg/kg	108	15	0.10	0.70	0.847	0
Metals		Cadmium[2]	mg/kg	108	44	0.075	1.0	0.674	7
Metals		Mercury[2]	mg/kg	46	6	0.020	0.040	0.214	0
Metals		Selenium	mg/kg	98	95	0.20	1.0	--	No SLV
Metals		Silver	mg/kg	24	23	0.40	1.0	--	No SLV
Metals		Thallium[2]	mg/kg	108	34	0.056	0.40	0.354	1
NWTPH-Dx		Diesel Range Organics	mg/kg	46	7	1.8	2.8	--	No SLV
NWTPH-Dx		Residual Range Organics	mg/kg	46	12	5.0	180	--	No SLV
Butyltins		Dibutyltin Cation	ug/kg	7	7	0.21	0.27	--	No SLV
Butyltins		Dibutyltin dichloride	ug/kg	24	23	5.8	14	--	No SLV
Butyltins		Monobutyltin trichloride	ug/kg	24	24	5.8	14	--	No SLV
Butyltins		Monobutyltin	ug/Kg	7	7	0.29	0.37	--	No SLV
Butyltins		Tetrabutyltin	ug/Kg	21	21	0.49	5.9	--	No SLV
Butyltins		Tributyltin chloride	ug/kg	24	23	5.8	14	--	No SLV
Butyltins		Tri-n-butyltin	ug/Kg	7	7	0.48	0.60	10	0
Dioxins/Furans		1,2,3,4,6,7,8-HpCDD	ug/kg	2	2	7.7E-04	0.0017	1.1E-04	2
Dioxins/Furans		1,2,3,4,6,7,8-HpCDF	ug/kg	2	2	5.5E-04	7.0E-04	1.1E-04	2
Dioxins/Furans		1,2,3,4,7,8,9-HpCDF	ug/kg	2	2	5.4E-04	6.1E-04	1.1E-04	2
Dioxins/Furans		1,2,3,4,7,8-HxCDD	ug/kg	2	2	6.3E-04	6.7E-04	1.1E-05	2
Dioxins/Furans		1,2,3,4,7,8-HxCDF	ug/kg	2	2	4.9E-04	6.3E-04	1.1E-05	2
Dioxins/Furans		1,2,3,6,7,8-HxCDD	ug/kg	2	2	6.5E-04	6.9E-04	1.1E-05	2
Dioxins/Furans		1,2,3,6,7,8-HxCDF	ug/kg	2	2	4.3E-04	5.3E-04	1.1E-05	2
Dioxins/Furans		1,2,3,7,8,9-HxCDD	ug/kg	2	2	6.0E-04	6.4E-04	1.1E-05	2
Dioxins/Furans		1,2,3,7,8,9-HxCDF	ug/kg	2	2	4.0E-04	4.4E-04	1.1E-05	2
Dioxins/Furans		1,2,3,7,8-PeCDD	ug/kg	2	2	0.0010	0.0013	1.1E-06	2
Dioxins/Furans		1,2,3,7,8-PeCDF	ug/kg	2	2	6.0E-04	6.9E-04	3.7E-05	2
Dioxins/Furans		2,3,4,6,7,8-HxCDF	ug/kg	2	2	3.8E-04	4.3E-04	1.1E-05	2
Dioxins/Furans		2,3,4,7,8-PeCDF	ug/kg	2	2	5.8E-04	6.9E-04	3.7E-06	2
Dioxins/Furans		2,3,7,8-TCDD	ug/kg	2	2	4.5E-04	5.4E-04	1.1E-06	2
Dioxins/Furans		2,3,7,8-TCDF	ug/kg	2	2	4.4E-04	5.7E-04	1.1E-05	2
Dioxins/Furans		OCDD	ug/kg	2	1	0.0044	0.0044	3.7E-03	1
Dioxins/Furans		OCDF	ug/kg	2	2	9.8E-04	0.0010	3.7E-03	0
Herbicides		2,4,5-T	ug/kg	7	7	4.0	4.6	--	No SLV
Herbicides		2,4,5-TP (Silvex)	ug/kg	7	7	4.5	5.2	--	No SLV
Herbicides		2,4-D	ug/kg	7	7	4.0	4.6	--	No SLV
Herbicides		2,4-DB	ug/kg	7	7	3.7	4.3	--	No SLV
Herbicides		Dalapon	ug/kg	7	7	6.1	7.0	--	No SLV
Herbicides		Dicamba	ug/kg	7	7	4.4	5.1	--	No SLV
Herbicides		Dichloroprop	ug/kg	7	7	9.1	11	--	No SLV
Herbicides		Dinoseb	ug/kg	7	7	2.7	3.1	--	No SLV
Herbicides		MCPA	ug/kg	7	7	2600	3000	--	No SLV
Herbicides		MCPP	ug/kg	7	7	2600	3000	--	No SLV
Pesticides		Aldrin	ug/kg	21	21	0.034	17	--	No SLV
Pesticides		BHC (alpha)	ug/kg	21	21	0.047	26	2.3	1
Pesticides		BHC (beta)	ug/kg	21	21	0.043	29	2.3	1
Pesticides		BHC (delta)	ug/kg	21	21	0.042	21	2.3	1
Pesticides		BHC (gamma) Lindane	ug/kg	21	19	0.04	20	2.3	2
Pesticides		Chlordane (alpha)	ug/kg	21	21	0.029	740	0.046	16
Pesticides		Chlordane (gamma)	ug/kg	21	14	0.036	18	0.046	7
Pesticides		Dieldrin	ug/kg	21	21	0.058	5800	0.001	21
Pesticides		Endosulfan I	ug/kg	21	21	0.047	26	0.001	21
Pesticides		Endosulfan II	ug/kg	21	21	0.12	60	0.001	21
Pesticides		Endosulfan Sulfate	ug/kg	21	21	0.097	2300	0.001	21
Pesticides		Endrin Aldehyde	ug/kg	21	17	0.11	4000	--	No SLV
Pesticides		Endrin Ketone	ug/kg	21	20	0.093	99	--	No SLV
Pesticides		Endrin	ug/kg	21	17	0.057	29	--	No SLV
Pesticides		Heptachlor Epoxide	ug/kg	21	20	0.042	21	--	No SLV
Pesticides		Heptachlor	ug/kg	21	21	0.042	21	0.001	21
Pesticides		Methoxychlor	ug/kg	21	21	0.19	291	--	No SLV
Pesticides		Toxaphene	ug/kg	21	21	4.3	2180	--	No SLV
Pesticides		4,4'-DDD	ug/kg	21	20	0.086	44	0.04	20
Pesticides		4,4'-DDE	ug/kg	21	18	0.075	7100	0.04	18
Pesticides		4,4'-DDT	ug/kg	21	17	0.13	67	0.04	17
SVOCs		1,2,4-Trichlorobenzene	ug/kg	24	24	4.8	11	--	No SLV
SVOCs		1,2-Dichlorobenzene	ug/kg	24	24	5.0	12	--	No SLV
SVOCs		1,3-Dichlorobenzene	ug/kg	24	24	4.6	11	--	No SLV
SVOCs		1,4-Dichlorobenzene	ug/kg	24	24	5.0	12	--	No SLV
SVOCs		1-Methylnaphthalene	ug/kg	2	2	1.7	1.7	--	No SLV
SVOCs		2,4,5-Trichlorophenol	ug/kg	24	24	7.6	18	--	No SLV
SVOCs		2,4,6-Trichlorophenol	ug/kg	24	24	6.5	15	--	No SLV
SVOCs		2,4-Dichlorophenol	ug/kg	24	24	9.5	23	--	No SLV

Table A-1
Sensitivity Analysis for River OU Sediment Samples - Human Health

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest HH SLV[1]	Number of NDs > HH SLV
SVOCs		2,4-Dimethylphenol	ug/kg	24	24	9.2	22	--	No SLV
SVOCs		2,4-Dinitrophenol	ug/kg	24	24	97	230	--	No SLV
SVOCs		2,4-Dinitrotoluene	ug/kg	24	24	5.2	12	--	No SLV
SVOCs		2,6-Dinitrotoluene	ug/kg	24	24	4.8	11	--	No SLV
SVOCs		2-Chloronaphthalene	ug/kg	24	24	5.5	13	--	No SLV
SVOCs		2-Chlorophenol	ug/kg	24	24	6.3	15	--	No SLV
SVOCs		2-Methylphenol	ug/kg	24	24	6.5	15	--	No SLV
SVOCs		2-Nitroaniline	ug/kg	24	24	13	31	--	No SLV
SVOCs		2-Nitrophenol	ug/kg	24	24	9.4	22	--	No SLV
SVOCs		3,3'-Dichlorobenzidine	ug/kg	24	24	33	78	--	No SLV
SVOCs		3-Nitroaniline	ug/kg	24	24	10	25	--	No SLV
SVOCs		4,6-Dinitro-2-methylphenol	ug/kg	24	24	160	380	--	No SLV
SVOCs		4-Bromophenyl Phenyl Ether	ug/kg	24	24	6.1	14	--	No SLV
SVOCs		4-Chloro-3-methylphenol	ug/kg	24	24	9.0	21	--	No SLV
SVOCs		4-Chloroaniline	ug/kg	24	24	14	32	--	No SLV
SVOCs		4-Chlorophenyl Phenyl Ether	ug/kg	24	24	9.5	23	--	No SLV
SVOCs		4-Nitroaniline	ug/kg	24	24	12	29	--	No SLV
SVOCs		4-Nitrophenol	ug/kg	24	24	17	41	--	No SLV
SVOCs		Aniline	ug/kg	24	24	5.9	20	--	No SLV
SVOCs		Benzoic Acid	ug/kg	24	23	160	370	--	No SLV
SVOCs		Benzyl Alcohol	ug/kg	24	23	19	45	--	No SLV
SVOCs		Bis(2-chloroethoxy)methane	ug/kg	24	24	4.6	11	--	No SLV
SVOCs		Bis(2-chloroethyl) Ether	ug/kg	24	24	6.5	15	--	No SLV
SVOCs		Bis(2-chloroisopropyl) Ether	ug/kg	24	24	5.5	13	--	No SLV
SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	73	48	7.0	200	--	No SLV
SVOCs		Butyl Benzyl Phthalate	ug/kg	46	45	1.5	10	--	No SLV
SVOCs		Carbazole	ug/kg	52	46	1.3	4.7	--	No SLV
SVOCs		Dibenzofuran	ug/kg	100	99	1.8	11	--	No SLV
SVOCs		Diethyl Phthalate	ug/kg	24	23	8.4	20	--	No SLV
SVOCs		Dimethyl Phthalate	ug/kg	24	24	5.0	12	--	No SLV
SVOCs		Di-n-butyl Phthalate	ug/kg	46	37	5.5	19	--	No SLV
SVOCs		Di-n-octyl Phthalate	ug/kg	46	46	1.2	8.1	--	No SLV
SVOCs		Hexachlorobenzene	ug/kg	24	24	5.3	13	2.3	24
SVOCs		Hexachlorobutadiene	ug/kg	24	24	6.5	15	--	No SLV
SVOCs		Hexachlorocyclopentadiene	ug/kg	24	24	28	67	--	No SLV
SVOCs		Hexachloroethane	ug/kg	24	24	7.3	17	--	No SLV
SVOCs		Isophorone	ug/kg	24	24	6.1	14	--	No SLV
SVOCs		Nitrobenzene	ug/kg	24	24	5.7	14	--	No SLV
SVOCs		N-Nitrosodimethylamine	ug/kg	24	24	39	97	--	No SLV
SVOCs		N-Nitrosodi-n-propylamine	ug/kg	24	24	6.9	16	--	No SLV
SVOCs		N-Nitrosodiphenylamine	ug/kg	24	24	6.7	16	--	No SLV
SVOCs		p-cresol (4-Methylphenol)	ug/kg	46	37	1.5	6.7	--	No SLV
SVOCs		Pentachlorophenol	ug/kg	24	24	42	99	30	24
SVOCs		Phenol	ug/kg	24	23	6.3	15	--	No SLV
LPAH		2-Methylnaphthalene	ug/kg	100	100	1.3	11	--	No SLV
LPAH		Acenaphthene	ug/kg	126	122	1.0	5.1	62000	0
LPAH		Acenaphthylene	ug/kg	100	100	1.4	10	62000	0
LPAH		Anthracene	ug/kg	126	114	0.90	14	62000	0
LPAH		Fluorene	ug/kg	126	124	1.1	6.7	62000	0
LPAH		Naphthalene	ug/kg	100	100	1.4	12	62000	0
LPAH		Phenanthrene	ug/kg	126	77	1.3	4.5	62000	0
HPAH		Benzo(a)anthracene	ug/kg	126	77	1.4	5.1	47000	0
HPAH		Benzo(a)pyrene	ug/kg	126	79	1.6	16	47000	0
HPAH		Benzo(b)fluoranthene	ug/kg	126	78	2.1	15	47000	0
HPAH		Benzo(g,h,i)perylene	ug/kg	126	87	1.6	5.3	47000	0
HPAH		Benzo(k)fluoranthene	ug/kg	126	84	2.3	11	47000	0
HPAH		Chrysene	ug/kg	126	67	1.4	6.1	47000	0
HPAH		Dibenz(a,h)anthracene	ug/kg	126	116	1.5	5.7	47000	0
HPAH		Fluoranthene	ug/kg	126	72	1.8	5.9	62000	0
HPAH		Indeno(1,2,3-cd)pyrene	ug/kg	126	87	1.8	5.9	47000	0
HPAH		Pyrene	ug/kg	126	68	1.3	10	47000	0
BaPEQ		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	126	65	4.4	12	47000	0

Notes

1) Lowest HH SLV = lowest of the subsistence and recreational fisher sediment SLVs (ODEQ 2007). Also see Appendix J of the Final Remedial Investigation Report (URS 2012).

2) When available, the Reference Area UPL is shown for metals (antimony, beryllium, cadmium, mercury, thallium) since there were no risk-based SLVs available.

-- = not applicable
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic PAH
HH = human health
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM, capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
MDL = method detection limit
mg/kg = milligrams per kilogram, in dry weight
ND = non-detect
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
SLV = screening level value
SVOC = semi-volatile organic carbon
TEQ = toxicity equivalence
ug/kg = micrograms per kilogram, in dry weight
UPL = upper prediction limit

Sources

Oregon Department of Environmental Quality. 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table A-2
Sensitivity Analysis for River OU Bass and Clam Tissue Samples - Human Health

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest HH SLV[1]	Number of NDs > HH SLV
SB	PCB Aroclors		Aroclor 1016	ug/kg	38	38	2.4	280	0.57	38
SB	PCB Aroclors		Aroclor 1221	ug/kg	38	38	2.6	280	0.57	38
SB	PCB Aroclors		Aroclor 1232	ug/kg	38	38	2.3	280	0.57	38
SB	PCB Aroclors		Aroclor 1242	ug/kg	38	37	2.2	280	0.57	37
SB	PCB Aroclors		Aroclor 1248	ug/kg	38	38	0.51	280	0.57	35
SB	PCB Aroclors		Aroclor 1254	ug/kg	38	17	5.0	420	0.57	17
SB	PCB Aroclors		Aroclor 1260	ug/kg	38	38	1.9	300	0.57	38
SB	PCB Aroclors		Aroclor 1262	ug/kg	38	38	2.5	280	0.57	38
SB	PCB Aroclors		Aroclor 1268	ug/kg	38	38	2.0	280	0.57	38
SB	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	38	17	5.0	424	0.57	17
SB	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	38	4	0.0062	0.19	0.025	2
SB	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	1	0.048	0.048	0.000076	1
SB	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	38	38	9.2E-04	0.95	0.00025	38
SB	Metals		Antimony	mg/kg	38	19	0.0050	0.0060	--	No SLV
SB	Metals		Beryllium	mg/kg	38	34	5.0E-04	9.0E-04	--	No SLV
SB	Metals		Chromium	mg/kg	38	17	0.020	0.15	--	No SLV
SB	Butyltins		Dibutyltin Cation	ug/kg	13	13	0.11	0.11	150	0
SB	Butyltins		Monobutyltin	ug/kg	13	12	0.18	0.18	150	0
SB	Butyltins		Tetrabutyltin	ug/kg	13	13	0.15	0.15	150	0
SB	Butyltins		Tri-n-butyltin	ug/kg	13	13	0.11	0.11	150	0
SB	Pesticides		4,4'-DDD	ug/kg	19	3	2.7	20	--	No SLV
SB	Pesticides		4,4'-DDE	ug/kg	19	4	23	200	--	No SLV
SB	Pesticides		4,4'-DDT	ug/kg	19	13	1.0	16000	--	No SLV
SB	Pesticides		Aldrin	ug/kg	19	19	0.74	0.74	--	No SLV
SB	Pesticides		BHC (alpha)	ug/kg	19	19	0.16	0.99	--	No SLV
SB	Pesticides		BHC (beta)	ug/kg	19	13	0.41	1.3	--	No SLV
SB	Pesticides		BHC (delta)	ug/kg	19	19	0.20	3.9	--	No SLV
SB	Pesticides		BHC (gamma) Lindane	ug/kg	19	15	0.21	0.97	--	No SLV
SB	Pesticides		Chlordane (alpha)	ug/kg	19	18	0.25	220	--	No SLV
SB	Pesticides		Chlordane (gamma)	ug/kg	19	4	0.26	0.55	--	No SLV
SB	Pesticides		Dieldrin	ug/kg	19	11	0.20	2.4	--	No SLV
SB	Pesticides		Endosulfan I	ug/kg	19	14	0.22	5.5	--	No SLV
SB	Pesticides		Endosulfan II	ug/kg	19	19	0.24	11	--	No SLV
SB	Pesticides		Endosulfan Sulfate	ug/kg	19	19	0.53	140	--	No SLV
SB	Pesticides		Endrin Aldehyde	ug/kg	19	13	0.62	0.62	--	No SLV
SB	Pesticides		Endrin Ketone	ug/kg	19	19	0.39	140	--	No SLV
SB	Pesticides		Endrin	ug/kg	19	8	0.28	0.94	--	No SLV
SB	Pesticides		Heptachlor Epoxide	ug/kg	19	19	0.18	94	--	No SLV
SB	Pesticides		Heptachlor	ug/kg	19	19	0.27	5.1	--	No SLV
SB	Pesticides		Methoxychlor	ug/kg	19	17	0.48	17	--	No SLV
SB	Pesticides		Toxaphene	ug/kg	19	19	17	220000	--	No SLV
SB	SVOCs		Acenaphthene	ug/kg	38	17	0.11	0.94	15,000	0
SB	SVOCs		Anthracene	ug/kg	38	3	0.065	0.98	15,000	0
SB	SVOCs		Benzo(a)anthracene	ug/kg	38	32	0.038	2.0	1.57	4
SB	SVOCs		Benzo(a)pyrene	ug/kg	38	30	0.073	1.5	0.157	18
SB	SVOCs		Benzo(b)fluoranthene	ug/kg	38	32	0.066	1.4	1.57	0
SB	SVOCs		Benzo(g,h,i)perylene	ug/kg	38	32	0.073	1.9	15.7	0
SB	SVOCs		Benzo(k)fluoranthene	ug/kg	38	29	0.056	1.2	15.7	0
SB	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	38	31	66	5000	81.9	20
SB	SVOCs		Butyl Benzyl Phthalate	ug/kg	38	36	7.3	12	604	0
SB	SVOCs		Carbazole	ug/kg	38	38	6.2	9.1	--	No SLV
SB	SVOCs		Chrysene	ug/kg	38	30	0.055	1.9	157	0
SB	SVOCs		cPAHs as BaPEQ (KM-capped, MDL-based)	ug/kg	38	28	0.16	8.4	0.157	28
SB	SVOCs		Dibenz(a,h)anthracene	ug/kg	38	32	0.059	6.5	0.157	18
SB	SVOCs		Di-n-butyl Phthalate	ug/kg	38	22	8.2	71	49,157	0
SB	SVOCs		Di-n-octyl Phthalate	ug/kg	38	23	5.4	11	49,157	0
SB	SVOCs		Fluoranthene	ug/kg	38	11	0.090	0.98	20,000	0
SB	SVOCs		Fluorene	ug/kg	38	2	0.15	0.15	15,000	0
SB	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	38	31	0.064	2.0	1.57	18
SB	SVOCs		p-cresol (4-Methylphenol)	ug/kg	38	20	7.6	7.7	--	No SLV
SB	SVOCs		Pyrene	ug/kg	38	28	0.098	1.0	15,000	0

Notes

1) Lowest HH SLV = lowest of the subsistence and recreational fisher sediment SLVs (ODEQ 2007). Also see Appendix J of the Final Remedial Investigation Report (URS 2012).

-- = not applicable
BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic polycyclic aromatic hydrocarbons
HH = human health
KM, capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
ND = non-detect
PCB = polychlorinated biphenyl
RDL = reported detection limit
SB = Smallmouthbass
SLV = screening level value
SVOC = semi-volatile organic carbon
ug/kg = micrograms per kilogram, in wet weight

Sources

Oregon Department of Environmental Quality (ODEQ). 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table A-3
Ecological Sensitivity Analysis for River OU Sediment Samples - Ecological

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest Benthic SLV/ Fish Bio-SLV/ Wildlife Indiv. Bio-SLV[1]	Number NDs > SLV	Lowest Benthic SLV/ Fish Bio-SLV/ Wildlife Pop. Bio-SLV[2]	Number NDs > SLV
PCB Aroclors		Aroclor 1016	ug/kg	109	109	0.020	21	1.8	14	7	5
PCB Aroclors		Aroclor 1221	ug/kg	109	109	0.020	29	1.8	19	7	9
PCB Aroclors		Aroclor 1232	ug/kg	109	109	0.050	37	1.8	27	7	9
PCB Aroclors		Aroclor 1242	ug/kg	109	109	0.060	21	1.8	25	7	3
PCB Aroclors		Aroclor 1248	ug/kg	109	107	0.39	39	1.8	23	21	1
PCB Aroclors		Aroclor 1254	ug/kg	109	36	0.49	8.9	1.8	8	7	1
PCB Aroclors		Aroclor 1260	ug/kg	109	106	0.28	379	1.8	19	7	7
PCB Aroclors		Aroclor 1262	ug/kg	31	31	0.39	21	1.8	9	7	2
PCB Aroclors		Aroclor 1268	ug/kg	31	31	0.39	21	1.8	9	7	2
PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	109	34	0.62	12	1.8	20	22	0
PCB Congeners	77	3,3',4,4'-Tetrachlorobiphenyl	ug/kg	29	1	0.19	0.19	0.008	1	0.04	1
PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	29	21	4.9E-05	0.14	0.004	3	0.02	1
PCB Congeners	123	2,3',4,4',5'-Pentachlorobiphenyl	ug/kg	29	3	1.6E-04	0.29	1.2	0	33	0
PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	29	16	4.8E-05	0.21	0.00028	10	0.0078	5
PCB Congeners	156+157	2,3,3',4,4',5- & 2,3,3',4,4',5'-Hexachlorobiphenyl	ug/kg	29	1	9.4E-04	9.4E-04	1.2	0	24	0
PCB Congeners	167	2,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	2	6.4E-04	7.1E-04	1.2	0	33	0
PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	29	28	4.5E-05	0.036	0.0012	7	0.033	1
PCB Congeners	189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	ug/kg	29	2	4.8E-05	8.1E-04	6.6	0	180	0
Metals		Antimony[3]	mg/kg	33	1	0.040	0.040	0.43	0	0.43	0
Metals		Beryllium[3]	mg/kg	108	15	0.10	0.70	0.85	0	0.85	0
Metals		Cadmium[3]	mg/kg	108	44	0.075	1.0	0.67	7	0.67	7
Metals		Mercury[3]	mg/kg	46	6	0.020	0.040	0.21	0	0.21	0
Metals		Selenium	mg/kg	98	95	0.20	1.0	2	0	2	0
Metals		Silver	mg/kg	24	23	0.40	1.0	4.5	0	4.5	0
Metals		Thallium[3]	mg/kg	108	34	0.056	0.40	0.35	1	0.35	1
NWTPH-Dx		Diesel Range Organics	mg/kg	46	7	1.8	2.8	NV	No SLV	NV	No SLV
NWTPH-Dx		Residual Range Organics	mg/kg	46	12	5.0	180	NV	No SLV	NV	No SLV
Butyltins		Dibutyltin Cation	ug/kg	7	7	0.21	0.27	2.3	0	2.3	0
Butyltins		Dibutyltin dichloride	ug/kg	24	23	5.8	14	2.3	23	2.3	23
Butyltins		Monobutyltin trichloride	ug/kg	24	24	5.8	14	2.3	24	2.3	24
Butyltins		Monobutyltin	ug/Kg	7	7	0.29	0.37	2.3	0	2.3	0
Butyltins		Tetrabutyltin	ug/Kg	21	21	0.49	5.9	2.3	14	2.3	14
Butyltins		Tributyltin chloride	ug/kg	24	23	5.8	14	2.3	23	2.3	23
Butyltins		Tri-n-butyltin	ug/Kg	7	7	0.48	0.60	2.3	0	2.3	0
Dioxins/Furans		1,2,3,4,6,7,8-HpCDD	ug/kg	2	2	7.7E-04	0.0017	3.9	0	110	0
Dioxins/Furans		1,2,3,4,6,7,8-HpCDF	ug/kg	2	2	5.5E-04	7.0E-04	3.9	0	43	0
Dioxins/Furans		1,2,3,4,7,8,9-HpCDF	ug/kg	2	2	5.4E-04	6.1E-04	3.9	0	43	0
Dioxins/Furans		1,2,3,4,7,8-HxCDD	ug/kg	2	2	6.3E-04	6.7E-04	0.015	0	0.034	0
Dioxins/Furans		1,2,3,4,7,8-HxCDF	ug/kg	2	2	4.9E-04	6.3E-04	0.015	0	0.17	0
Dioxins/Furans		1,2,3,6,7,8-HxCDD	ug/kg	2	2	6.5E-04	6.9E-04	0.015	0	0.42	0
Dioxins/Furans		1,2,3,6,7,8-HxCDF	ug/kg	2	2	4.3E-04	5.3E-04	0.015	0	0.17	0
Dioxins/Furans		1,2,3,7,8,9-HxCDD	ug/kg	2	2	6.0E-04	6.4E-04	0.015	0	0.42	0
Dioxins/Furans		1,2,3,7,8,9-HxCDF	ug/kg	2	2	4.0E-04	4.4E-04	0.015	0	0.17	0
Dioxins/Furans		1,2,3,7,8-PeCDD	ug/kg	2	2	0.0010	0.0013	0.0015	0	0.017	0
Dioxins/Furans		1,2,3,7,8-PeCDF	ug/kg	2	2	6.0E-04	6.9E-04	0.014	0	0.095	0
Dioxins/Furans		2,3,4,6,7,8-HxCDF	ug/kg	2	2	3.8E-04	4.3E-04	0.015	0	0.17	0
Dioxins/Furans		2,3,4,7,8-PeCDF	ug/kg	2	2	5.8E-04	6.9E-04	0.00017	2	0.0011	0
Dioxins/Furans		2,3,7,8-TCDD	ug/kg	2	2	4.5E-04	5.4E-04	5.20E-05	2	5.6E-04	0
Dioxins/Furans		2,3,7,8-TCDF	ug/kg	2	2	4.4E-04	5.7E-04	0.0043	0	0.095	0
Dioxins/Furans		OCDD	ug/kg	2	1	0.0044	0.0044	130	0	3600	0
Dioxins/Furans		OCDF	ug/kg	2	2	9.8E-04	0.0010	130	0	3600	0
Herbicides		2,4,5-T	ug/kg	7	7	4.0	4.6	NV	No SLV	NV	No SLV
Herbicides		2,4,5-TP (Silvex)	ug/kg	7	7	4.5	5.2	NV	No SLV	NV	No SLV
Herbicides		2,4-D	ug/kg	7	7	4.0	4.6	NV	No SLV	NV	No SLV
Herbicides		2,4-DB	ug/kg	7	7	3.7	4.3	NV	No SLV	NV	No SLV
Herbicides		Dalapon	ug/kg	7	7	6.1	7.0	NV	No SLV	NV	No SLV
Herbicides		Dicamba	ug/kg	7	7	4.4	5.1	NV	No SLV	NV	No SLV
Herbicides		Dichloroprop	ug/kg	7	7	9.1	11	NV	No SLV	NV	No SLV
Herbicides		Dinoseb	ug/kg	7	7	2.7	3.1	NV	No SLV	NV	No SLV
Herbicides		MCPA	ug/kg	7	7	2600	3000	NV	No SLV	NV	No SLV
Herbicides		MCPP	ug/kg	7	7	2600	3000	NV	No SLV	NV	No SLV
Pesticides		Aldrin	ug/kg	21	21	0.034	17	40	0	40	0
Pesticides		BHC (alpha)	ug/kg	21	21	0.047	26	0.9	1	0.9	1
Pesticides		BHC (beta)	ug/kg	21	21	0.043	29	0.9	1	0.9	1
Pesticides		BHC (delta)	ug/kg	21	21	0.042	21	0.9	1	0.9	1
Pesticides		BHC (gamma) Lindane	ug/kg	21	19	0.04	20	0.9	2	0.9	2
Pesticides		Chlordane (alpha)	ug/kg	21	21	0.029	740	0.5	9	0.5	9
Pesticides		Chlordane (gamma)	ug/kg	21	14	0.036	18	0.5	2	0.5	2
Pesticides		Dieldrin	ug/kg	21	21	0.058	5800	0.37	10	1.8	8
Pesticides		Endosulfan I	ug/kg	21	21	0.047	26	NV	No SLV	NV	No SLV
Pesticides		Endosulfan II	ug/kg	21	21	0.12	60	NV	No SLV	NV	No SLV
Pesticides		Endosulfan Sulfate	ug/kg	21	21	0.097	2300	NV	No SLV	NV	No SLV
Pesticides		Endrin Aldehyde	ug/kg	21	17	0.11	4000	3	4	3	4
Pesticides		Endrin Ketone	ug/kg	21	20	0.093	99	3	1	3	1
Pesticides		Endrin	ug/kg	21	17	0.057	29	3	2	3	2
Pesticides		Heptachlor Epoxide	ug/kg	21	20	0.042	21	0.6	4	0.6	4
Pesticides		Heptachlor	ug/kg	21	21	0.042	21	10	1	10	1
Pesticides		Methoxychlor	ug/kg	21	21	0.19	291	NV	No SLV	NV	No SLV
Pesticides		Toxaphene	ug/kg	21	21	4.3	2180	NV	No SLV	NV	No SLV
Pesticides		4,4'-DDD	ug/kg	21	20	0.086	44	0.095	13	0.34	4
Pesticides		4,4'-DDE	ug/kg	21	18	0.075	7100	0.095	14	0.34	9
Pesticides		4,4'-DDT	ug/kg	21	17	0.13	67	0.095	17	0.34	6
SVOCs		1,2,4-Trichlorobenzene	ug/kg	24	24	4.8	11	NV	No SLV	NV	No SLV
SVOCs		1,2-Dichlorobenzene	ug/kg	24	24	5.0	12	NV	No SLV	NV	No SLV
SVOCs		1,3-Dichlorobenzene	ug/kg	24	24	4.6	11	NV	No SLV	NV	No SLV
SVOCs		1,4-Dichlorobenzene	ug/kg	24	24	5.0	12	NV	No SLV	NV	No SLV
SVOCs		1-Methylnaphthalene	ug/kg	2	2	1.7	1.7	NV	No SLV	NV	No SLV
SVOCs		2,4,5-Trichlorophenol	ug/kg	24	24	7.6	18	NV	No SLV	NV	No SLV
SVOCs		2,4,6-Trichlorophenol	ug/kg	24	24	6.5	15	NV	No SLV	NV	No SLV
SVOCs		2,4-Dichlorophenol	ug/kg	24	24	9.5	23	NV	No SLV	NV	No SLV
SVOCs		2,4-Dimethylphenol	ug/kg	24	24	9.2	22	NV	No SLV	NV	No SLV
SVOCs		2,4-Dinitrophenol	ug/kg	24	24	97	230	NV	No SLV	NV	No SLV
SVOCs		2,4-Dinitrotoluene	ug/kg	24	24	5.2	12	NV	No SLV	NV	No SLV
SVOCs		2,6-Dinitrotoluene	ug/kg	24	24	4.8	11	NV	No SLV	NV	No SLV
SVOCs		2-Chloronaphthalene	ug/kg	24	24	5.5	13	NV	No SLV	NV	No SLV
SVOCs		2-Chlorophenol	ug/kg	24	24	6.3	15	NV	No SLV	NV	No SLV
SVOCs		2-Methylphenol	ug/kg	24	24	6.5	15	NV	No SLV	NV	No SLV
SVOCs		2-Nitroaniline	ug/kg	24	24	13	31	NV	No SLV	NV	No SLV
SVOCs		2-Nitrophenol	ug/kg	24	24	9.4	22	NV	No SLV	NV	No SLV
SVOCs		3,3'-Dichlorobenzidine	ug/kg	24	24	33	78	NV	No SLV	NV	No SLV
SVOCs		3-Nitroaniline	ug/kg	24	24	10	25	NV	No SLV	NV	No SLV
SVOCs		4,6-Dinitro-2-methylphenol	ug/kg	24	24	160	380	NV	No SLV	NV	No SLV
SVOCs		4-Bromophenyl Phenyl Ether	ug/kg	24	24	6.1	14	NV	No SLV	NV	No SLV
SVOCs		4-Chloro-3-methylphenol	ug/kg	24	24	9.0	21	NV	No SLV	NV	No SLV
SVOCs		4-Chloroaniline	ug/kg	24	24	14	32	NV	No SLV	NV	No SLV
SVOCs		4-Chlorophenyl Phenyl Ether	ug/kg	24	24	9.5	23	NV	No SLV	NV	No SLV

Table A-3
Ecological Sensitivity Analysis for River OU Sediment Samples - Ecological

Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest Benthic SLV/ Fish Bio-SLV/ Wildlife Indiv. Bio-SLV[1]	Number NDs > SLV	Lowest Benthic SLV/ Fish Bio-SLV/ Wildlife Pop. Bio-SLV[2]	Number NDs > SLV
SVOCs		4-Nitroaniline	ug/kg	24	24	12	29	NV	No SLV	NV	No SLV
SVOCs		4-Nitrophenol	ug/kg	24	24	17	41	NV	No SLV	NV	No SLV
SVOCs		Aniline	ug/kg	24	24	5.9	20	NV	No SLV	NV	No SLV
SVOCs		Benzoic Acid	ug/kg	24	23	160	370	NV	No SLV	NV	No SLV
SVOCs		Benzyl Alcohol	ug/kg	24	23	19	45	NV	No SLV	NV	No SLV
SVOCs		Bis(2-chloroethoxy)methane	ug/kg	24	24	4.6	11	NV	No SLV	NV	No SLV
SVOCs		Bis(2-chloroethyl) Ether	ug/kg	24	24	6.5	15	NV	No SLV	NV	No SLV
SVOCs		Bis(2-chloroisopropyl) Ether	ug/kg	24	24	5.5	13	NV	No SLV	NV	No SLV
SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	73	48	7.0	200	750	0	750	0
SVOCs		Butyl Benzyl Phthalate	ug/kg	46	45	1.5	10	NV	No SLV	NV	No SLV
SVOCs		Carbazole	ug/kg	52	46	1.3	4.7	140	0	140	0
SVOCs		Dibenzofuran	ug/kg	100	99	1.8	11	5100	0	5100	0
SVOCs		Diethyl Phthalate	ug/kg	24	23	8.4	20	NV	No SLV	NV	No SLV
SVOCs		Dimethyl Phthalate	ug/kg	24	24	5.0	12	NV	No SLV	NV	No SLV
SVOCs		Di-n-butyl Phthalate	ug/kg	46	37	5.5	19	110	0	110	0
SVOCs		Di-n-octyl Phthalate	ug/kg	46	46	1.2	8.1	110	0	110	0
SVOCs		Hexachlorobenzene	ug/kg	24	24	5.3	13	110	0	100	0
SVOCs		Hexachlorobutadiene	ug/kg	24	24	6.5	15	NV	No SLV	NV	No SLV
SVOCs		Hexachlorocyclopentadiene	ug/kg	24	24	28	67	NV	No SLV	NV	No SLV
SVOCs		Hexachloroethane	ug/kg	24	24	7.3	17	NV	No SLV	NV	No SLV
SVOCs		Isophorone	ug/kg	24	24	6.1	14	NV	No SLV	NV	No SLV
SVOCs		Nitrobenzene	ug/kg	24	24	5.7	14	NV	No SLV	NV	No SLV
SVOCs		N-Nitrosodimethylamine	ug/kg	24	24	39	97	NV	No SLV	NV	No SLV
SVOCs		N-Nitrosodi-n-propylamine	ug/kg	24	24	6.9	16	NV	No SLV	NV	No SLV
SVOCs		N-Nitrosodiphenylamine	ug/kg	24	24	6.7	16	NV	No SLV	NV	No SLV
SVOCs		p-cresol (4-Methylphenol)	ug/kg	46	37	1.5	6.7	NV	No SLV	NV	No SLV
SVOCs		Pentachlorophenol	ug/kg	24	24	42	99	NV	No SLV	NV	No SLV
SVOCs		Phenol	ug/kg	24	23	6.3	15	NV	No SLV	NV	No SLV
LPAH		2-Methylnaphthalene	ug/kg	100	100	1.3	11	NV	No SLV	NV	No SLV
LPAH		Acenaphthene	ug/kg	126	122	1.0	5.1	290	0	290	0
LPAH		Acenaphthylene	ug/kg	100	100	1.4	10	160	0	160	0
LPAH		Anthracene	ug/kg	126	114	0.90	14	57	0	57	0
LPAH		Fluorene	ug/kg	126	124	1.1	6.7	77	0	77	0
LPAH		Naphthalene	ug/kg	100	100	1.4	12	176	0	176	0
LPAH		Phenanthrene	ug/kg	126	77	1.3	4.5	42	0	42	0
HPAH		Benzo(a)anthracene	ug/kg	126	77	1.4	5.1	32	0	32	0
HPAH		Benzo(a)pyrene	ug/kg	126	79	1.6	16	32	0	32	0
HPAH		Benzo(b)fluoranthene	ug/kg	126	78	2.1	15	27	0	27	0
HPAH		Benzo(g,h,i)perylene	ug/kg	126	87	1.6	5.3	300	0	300	0
HPAH		Benzo(k)fluoranthene	ug/kg	126	84	2.3	11	27	0	27	0
HPAH		Chrysene	ug/kg	126	67	1.4	6.1	57	0	57	0
HPAH		Dibenz(a,h)anthracene	ug/kg	126	116	1.5	5.7	33	0	33	0
HPAH		Fluoranthene	ug/kg	126	72	1.8	5.9	111	0	111	0
HPAH		Indeno(1,2,3-cd)pyrene	ug/kg	126	87	1.8	5.9	17	0	17	0
HPAH		Pyrene	ug/kg	126	68	1.3	10	53	0	53	0
TLPAH		Total LPAHs (KM, capped, MDL-based)	ug/kg	126	77	5.4	36	76	0	76	0
THPAH		Total HPAHs (KM-capped, MDL-based)	ug/kg	126	62	19	67	193	0	193	0
TPAH		Total PAHs (KM-capped, MDL-based)	ug/kg	126	62	25	103	1610	0	1610	0

Notes
1) Selected SLV = lower of benthic SLV (ODEQ 2001), freshwater fish Bio-SLV, and mammal/bird individual Bio-SLV (ODEQ 2007). Also see Table J-5 of the Final RI (URS 2012).
2) Selected SLV = lower of benthic SLV (DEQ 2001), freshwater fish Bio-SLV, and mammal/bird population Bio-SLV (DEQ 2007). Also see Table J-5 of the Final RI (URS 2012).
3) The Reference Area upper prediction limit is shown for metals, if greater than selected SLV.

-- = not applicable
BaPEQ = benzo(a)pyrene equivalents
Bio-SLV = bioaccumulative SLV
Eco = Ecological
HH = human health
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM, capped = Kaplan–Meier-based with Efron's bias correction, capped
LPAH = low molecular weight PAH
MDL = method detection limit
mg/kg = milligrams per kilogram, in dry weight
NV = Not available
ND = non-detect
NWTPH-Dx = northwest total petroleum hydrocarbon-diesel-extended
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
RI = remedial investigation
SLV = screening level value
SVOC = semi-volatile organic carbon
TEQ = toxicity equivalence
ug/kg = micrograms per kilogram, in dry weight

Sources

Oregon Department of Environmental Quality (ODEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management and Cleanup Division. Final. April 1998. Updated December 2001.
ODEQ. 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table A-4
Ecological Sensitivity Analysis for River OU Bass and Clam Tissue Samples - Ecological

Tissue	Analyte Group	IUPAC Number	Analyte	Units	Number of Samples	Number of ND	Minimum ND at MDL/RDL	Maximum ND at MDL/RDL	Lowest Fish CTL/ Wildlife Indiv. ATL[1]	Number NDs > SLV	Lowest Fish CTL/ Wildlife Pop. ATL[2]	Number NDs > SLV
SB	PCB Aroclors		Aroclor 1016	ug/kg	38	38	2.4	280	35	7	430	0
SB	PCB Aroclors		Aroclor 1221	ug/kg	38	38	2.6	280	35	6	430	0
SB	PCB Aroclors		Aroclor 1232	ug/kg	38	38	2.3	280	35	6	430	0
SB	PCB Aroclors		Aroclor 1242	ug/kg	38	37	2.2	280	35	6	430	0
SB	PCB Aroclors		Aroclor 1248	ug/kg	38	38	0.51	280	35	7	430	0
SB	PCB Aroclors		Aroclor 1254	ug/kg	38	17	5.0	420	35	7	430	0
SB	PCB Aroclors		Aroclor 1260	ug/kg	38	38	1.9	300	35	15	430	0
SB	PCB Aroclors		Aroclor 1262	ug/kg	38	38	2.5	280	35	10	430	0
SB	PCB Aroclors		Aroclor 1268	ug/kg	38	38	2.0	280	35	6	430	0
SB	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	38	17	5.0	424	35	7	430	0
SB	PCB Congeners	81	3,4,4',5-Tetrachlorobiphenyl	ug/kg	38	4	0.0062	0.19	0.08	2	0.4	0
SB	PCB Congeners	126	3,3',4,4',5-Pentachlorobiphenyl	ug/kg	38	1	0.048	0.048	0.0058	1	0.16	0
SB	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	38	38	9.2E-04	0.95	0.02	7	0.54	3
SB	Metals		Antimony	mg/kg	38	19	0.0050	0.0060	160	0	160	0
SB	Metals		Beryllium	mg/kg	38	34	5.0E-04	9.0E-04	0.53	0	0.53	0
SB	Metals		Chromium	mg/kg	38	17	0.020	0.15	15	0	15	0
SB	Butyltins		Dibutyltin Cation	ug/kg	13	13	0.11	0.11	55	0	55	0
SB	Butyltins		Monobutyltin	ug/kg	13	12	0.18	0.18	55	0	55	0
SB	Butyltins		Tetrabutyltin	ug/kg	13	13	0.15	0.15	55	0	55	0
SB	Butyltins		Tri-n-butyltin	ug/kg	13	13	0.11	0.11	55	0	55	0
SB	Pesticides		4,4'-DDD	ug/kg	19	3	2.7	20	13	1	48	0
SB	Pesticides		4,4'-DDE	ug/kg	19	4	23	200	13	4	48	1
SB	Pesticides		4,4'-DDT	ug/kg	19	13	1.0	16000	13	4	48	4
SB	Pesticides		Aldrin	ug/kg	19	19	0.74	0.74	NV	No SLV	NV	No SLV
SB	Pesticides		BHC (alpha)	ug/kg	19	19	0.16	0.99	NV	No SLV	NV	No SLV
SB	Pesticides		BHC (beta)	ug/kg	19	13	0.41	1.3	NV	No SLV	NV	No SLV
SB	Pesticides		BHC (delta)	ug/kg	19	19	0.20	3.9	NV	No SLV	NV	No SLV
SB	Pesticides		BHC (gamma) Lindane	ug/kg	19	15	0.21	0.97	NV	No SLV	NV	No SLV
SB	Pesticides		Chlordane (alpha)	ug/kg	19	18	0.25	220	60	2	60	2
SB	Pesticides		Chlordane (gamma)	ug/kg	19	4	0.26	0.55	60	0	60	0
SB	Pesticides		Dieldrin	ug/kg	19	11	0.20	2.4	44	0	220	0
SB	Pesticides		Endosulfan I	ug/kg	19	14	0.22	5.5	NV	No SLV	NV	No SLV
SB	Pesticides		Endosulfan II	ug/kg	19	19	0.24	11	NV	No SLV	NV	No SLV
SB	Pesticides		Endosulfan Sulfate	ug/kg	19	19	0.53	140	NV	No SLV	NV	No SLV
SB	Pesticides		Endrin Aldehyde	ug/kg	19	13	0.62	0.62	NV	No SLV	NV	No SLV
SB	Pesticides		Endrin Ketone	ug/kg	19	19	0.39	140	NV	No SLV	NV	No SLV
SB	Pesticides		Endrin	ug/kg	19	8	0.28	0.94	NV	No SLV	NV	No SLV
SB	Pesticides		Heptachlor Epoxide	ug/kg	19	19	0.18	94	NV	No SLV	NV	No SLV
SB	Pesticides		Heptachlor	ug/kg	19	19	0.27	5.1	NV	No SLV	NV	No SLV
SB	Pesticides		Methoxychlor	ug/kg	19	17	0.48	17	NV	No SLV	NV	No SLV
SB	Pesticides		Toxaphene	ug/kg	19	19	17	220000	NV	No SLV	NV	No SLV
SB	SVOCs		Acenaphthene	ug/kg	38	17	0.11	0.94	19000	0	19000	0
SB	SVOCs		Anthracene	ug/kg	38	3	0.065	0.98	19000	0	19000	0
SB	SVOCs		Benzo(a)anthracene	ug/kg	38	32	0.038	2.0	1000	0	1000	0
SB	SVOCs		Benzo(a)pyrene	ug/kg	38	30	0.073	1.5	1000	0	1000	0
SB	SVOCs		Benzo(b)fluoranthene	ug/kg	38	32	0.066	1.4	1000	0	1000	0
SB	SVOCs		Benzo(g,h,i)perylene	ug/kg	38	32	0.073	1.9	1000	0	1000	0
SB	SVOCs		Benzo(k)fluoranthene	ug/kg	38	29	0.056	1.2	1000	0	1000	0
SB	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	38	31	66	5000	1764	1	1764	1
SB	SVOCs		Butyl Benzyl Phthalate	ug/kg	38	36	7.3	12	310	0	310	0
SB	SVOCs		Carbazole	ug/kg	38	38	6.2	9.1	NV	No SLV	NV	No SLV
SB	SVOCs		Chrysene	ug/kg	38	30	0.055	1.9	1000	0	1000	0
SB	SVOCs		Dibenz(a,h)anthracene	ug/kg	38	32	0.059	6.5	1000	0	1000	0
SB	SVOCs		Di-n-butyl Phthalate	ug/kg	38	22	8.2	71	626	0	3115	0
SB	SVOCs		Di-n-octyl Phthalate	ug/kg	38	23	5.4	11	626	0	6260	0
SB	SVOCs		Fluoranthene	ug/kg	38	11	0.090	0.98	19000	0	19000	0
SB	SVOCs		Fluorene	ug/kg	38	2	0.15	0.15	19000	0	19000	0
SB	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	38	31	0.064	2.0	1000	0	1000	0
SB	SVOCs		p-cresol (4-Methylphenol)	ug/kg	38	20	7.6	7.7	0.12	20	0.12	20
SB	SVOCs		Pyrene	ug/kg	38	28	0.098	1.0	1000	0	1000	0
TC	PCB Aroclors		Aroclor 1016	ug/kg	28	28	2.4	28	35	0	430	0
TC	PCB Aroclors		Aroclor 1221	ug/kg	28	28	2.6	28	35	0	430	0
TC	PCB Aroclors		Aroclor 1232	ug/kg	28	28	2.3	40	35	2	430	0
TC	PCB Aroclors		Aroclor 1242	ug/kg	28	28	2.2	48	35	1	430	0
TC	PCB Aroclors		Aroclor 1248	ug/kg	28	28	0.51	28	35	0	430	0
TC	PCB Aroclors		Aroclor 1254	ug/kg	28	11	14	74	35	4	430	0
TC	PCB Aroclors		Aroclor 1260	ug/kg	28	28	1.9	28	35	0	430	0
TC	PCB Aroclors		Aroclor 1262	ug/kg	24	24	2.5	28	35	0	430	0
TC	PCB Aroclors		Aroclor 1268	ug/kg	28	28	2.0	28	35	0	430	0
TC	PCB Aroclors		Total PCBs as Aroclors (MDL-based)	ug/kg	28	11	14	74	35	4	430	0
TC	PCB Congeners	169	3,3',4,4',5,5'-Hexachlorobiphenyl	ug/kg	24	24	9.0E-04	0.017	0.02	0	0.54	0
TC	Metals		Antimony	mg/kg	29	19	0.0010	0.0050	160	0	160	0
TC	Butyltins		Dibutyltin Cation	ug/kg	1	1	0.11	0.11	55	0	55	0
TC	Butyltins		Monobutyltin	ug/kg	1	1	0.18	0.18	55	0	55	0
TC	Butyltins		Tetrabutyltin	ug/kg	1	1	0.15	0.15	55	0	55	0
TC	Butyltins		Tri-n-butyltin	ug/kg	1	1	0.11	0.11	55	0	55	0
TC	Pesticides		Aldrin	ug/kg	4	4	0.74	0.89	NV	No SLV	NV	No SLV
TC	Pesticides		BHC (beta)	ug/kg	4	3	1.3	2.1	NV	No SLV	NV	No SLV
TC	Pesticides		BHC (delta)	ug/kg	4	3	0.50	1.2	NV	No SLV	NV	No SLV
TC	Pesticides		BHC (gamma) Lindane	ug/kg	4	3	0.21	0.26	NV	No SLV	NV	No SLV
TC	Pesticides		Chlordane (alpha)	ug/kg	4	4	0.3	1.6	60	0	60	0
TC	Pesticides		Dieldrin	ug/kg	4	4	3.1	9.3	44	0	220	0
TC	Pesticides		Endosulfan I	ug/kg	4	1	5.3	5.3	NV	No SLV	NV	No SLV
TC	Pesticides		Endosulfan II	ug/kg	4	4	0.29	1.0	NV	No SLV	NV	No SLV
TC	Pesticides		Endosulfan Sulfate	ug/kg	4	4	0.53	0.64	NV	No SLV	NV	No SLV
TC	Pesticides		Endrin Ketone	ug/kg	4	4	0.39	0.47	NV	No SLV	NV	No SLV
TC	Pesticides		Heptachlor Epoxide	ug/kg	4	4	1.5	4.4	NV	No SLV	NV	No SLV
TC	Pesticides		Heptachlor	ug/kg	4	4	0.36	0.57	NV	No SLV	NV	No SLV
TC	Pesticides		Methoxychlor	ug/kg	4	4	0.58	1.2	NV	No SLV	NV	No SLV
TC	Pesticides		Toxaphene	ug/kg	4	4	150	170	NV	No SLV	NV	No SLV
TC	SVOCs		Acenaphthene	ug/kg	24	1	0.11	0.11	19000	0	19000	0
TC	SVOCs		Anthracene	ug/kg	24	4	0.065	0.33	19000	0	19000	0
TC	SVOCs		Benzo(a)anthracene	ug/kg	24	11	0.066	22	1000	0	1000	0
TC	SVOCs		Benzo(a)pyrene	ug/kg	24	19	0.081	0.86	1000	0	1000	0
TC	SVOCs		Benzo(b)fluoranthene	ug/kg	24	13	0.07	0.80	1000	0	1000	0
TC	SVOCs		Benzo(g,h,i)perylene	ug/kg	24	14	0.073	2.5	1000	0	1000	0
TC	SVOCs		Benzo(k)fluoranthene	ug/kg	24	20	0.056	0.58	1000	0	1000	0
TC	SVOCs		Bis(2-ethylhexyl) Phthalate	ug/kg	24	5	66	390	1764	0	1764	0
TC	SVOCs		Butyl Benzyl Phthalate	ug/kg	24	21	7.3	12	310	0	310	0
TC	SVOCs		Carbazole	ug/kg	24	24	6.2	13	NV	No SLV	NV	No SLV
TC	SVOCs		Chrysene	ug/kg	24	11	0.076	7.8	1000	0	1000	0
TC	SVOCs		Dibenz(a,h)anthracene	ug/kg	24	22	0.059	0.50	1000	0	1000	0
TC	SVOCs		Di-n-butyl Phthalate	ug/kg	24	22	8.2	170	626	0	3115	0
TC	SVOCs		Di-n-octyl Phthalate	ug/kg	24	23	5.4	16	626	0	6260	0
TC	SVOCs		Fluoranthene	ug/kg	24	5	8.6	16	19000	0	19000	0
TC	SVOCs		Indeno(1,2,3-cd)pyrene	ug/kg	24	16	0.064	0.50	1000	0	1000	0
TC	SVOCs		p-cresol (4-Methylphenol)	ug/kg	24	13	7.6	11	0.12	13	0.12	13
TC	SVOCs		Pyrene	ug/kg	24	12	0.098	7.2	1000	0	1000	0

Notes

1) Selected SLV = lower of the freshwater fish CTL and lowest mammal/bird individual ATL (ODEQ 2007). See Table 3-13 of BHHERA and Table J-5 of the Final RI (URS 2012).
2) Selected SLV = lower of the freshwater fish CTL and lowest mammal/bird population ATL (ODEQ 2007). See Table 3-13 of BHHERA and Table J-5 of the Final RI (URS 2012).

-- = not applicable
ATL = acceptable tissue level
BaPEQ = benzo(a)pyrene equivalence
CTL = critical tissue level
Eco = Ecological
HH = human health
HPAH = high molecular weight PAH
KM = Kaplan-Meier
KM, capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
mg/kg = milligrams per kilogram, in wet weight
ND = non-detect
NV = not available
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RDL = reported detection limit
RI = remedial investigation
SB = Smallmouth bass
SLV = screening level value
SVOC = semi-volatile organic carbon
TC = Clam
ug/kg = micrograms per kilogram, in wet weight

Sources

Oregon Department of Environmental Quality (ODEQ). 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table A-5
Summary of Non-Detects Above SLVs

	100% NDs with MDLs > HH SLV	< 100% NDs with MDLs > HH SLV	100% NDs with MDLs > Eco SLV	< 100% NDs with MDLs > Eco SLV
River OU				
Sediment	Aroclors 1016, 1221, 1232, 1242, 1262, and 1268; all dioxin/furan congeners except OCDD and OCDF; BHC (alpha), BHC (beta), BHC (delta), chlordane (alpha), dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, heptachlor; hexachlorobenzene, pentachlorophenol	Aroclors 1248, 1254, and 1260 and Total PCBs as Aroclors; PCB Congeners 77, 81, 123, 126, and 169; cadmium, thallium; OCDD; 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, BHC (gamma), chlordane (gamma)	Aroclors 1016, 1221, 1232, 1242, 1262, and 1268; monobutyltin trichloride, tetrabutyltin; 2,3,4,7,8-PeCDF, 2,3,7,8-TCDD; BHC (alpha), BHC (beta), BHC (delta), chlordane (alpha), dieldrin, heptachlor	Aroclors 1248, 1254, and 1260, and Total PCBs as Aroclors; PCB Congeners 77, 81, 126, and 169; cadmium, thallium, dibutyltin dichloride, tributyltin chloride; 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, BHC (gamma), chlordane (gamma), endrin aldehyde, endrin ketone, endrin, heptachlor epoxide
Clam	NA	NA	Aroclors 1232 and 1242	Aroclor 1254 and Total PCBs as Aroclors, p-cresol
Smallmouth Bass	Aroclors 1016, 1221, 1232, 1248, 1260, 1262, and 1268; PCB Congener 169	Aroclors 1242 and 1254, Total PCBs as Aroclors; PCB Congeners 81 and 126; bis(2-ethylhexyl) phthalate; benzo(a)anthracene, benzo(a)pyrene, dibenz(a.h)anthracene, indeno(1,2,3-cd)pyrene, and cPAHs as BaPEQ	Aroclors 1016, 1221, 1232, 1248, 1260, 1262, and 1268; PCB Congener 169	Aroclors 1242 and 1254, Total PCBs as Aroclors; PCB Congeners 81 and 126; 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane (alpha); p-cresol, and bis(2-ethylhexyl) phthalate

Notes
Grey = Previously identified in the screening level risk assessments in the Final Remedial Investigation Report (URS 2012).
Black = New; discussed in the data sensitivity evaluation in the BHHERA.

BaPEQ = benzo(a)pyrene equivalents
cPAH = carcinogenic polycyclic aromatic hydrocarbons
Eco = Ecological
HH = Human health
NA = not applicable
PCB = polychlorinated biphenyl
SLV = screening level value

Source
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

Table A-6
Summary of Non-Detects Without SLVs

Medium	100% NDs without HH SLV	< 100% NDs without HH SLV	100% NDs without Eco SLV	< 100% NDs without Eco SLV
River OU				
Sediment	Monobutyltin trichloride, monobutyltin; all herbicides; aldrin, methoxychlor, toxaphene; 40 SVOCs (including butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate); 2-methylnaphthalene	Selenium, silver; DRO, RRO; dibutyltin dichloride, tributyltin chloride; endrin aldehyde, endrin ketone, endrin, heptachlor epoxide; 10 SVOCs (including bis(2-ethylhexyl) phthalate, carbazole, and p-cresol	All herbicides, endosulfan I, endosulfan II, endosulfan sulfate, methoxychlor, toxaphene, 40 SVOCs, 2-methylnaphthalene	DRO, RRO, benzoic acid, benzyl alcohol, butyl benzyl phthalate, diethyl phthalate, p-cresol, phenol
Clam	NA	NA	Aldrin, endosulfan II, endosulfan sulfate, endrin ketone, hetpaclor epoxide, heptachlor, methoxychlor, toxaphene, carbazole	BHC (beta), BHC (delta), BHC (gamma), endosulfan I, total HPAHs
Smallmouth Bass	Nine pesticides; carbazole, and p-cresol	Antimony, beryllium and chromium; remaining 11 pesticides	Aldrin, BHC (alpha), BHC (delta), endosulfan II, endosulfan sulfate, endrin ketone, heptachlor epoxide, heptachlor, toxaphene, carbazole	BHC (beta), BHC (gamma), endosulfan I, endrin aldehyde, endrin, methoxyclor, total HPAHs

Notes
Grey = Previously identified in the screening level risk assessments in the Final Remedial Investigation Report (URS 2012).
Black = New; discussed in the data sensitivity evaluation in the BHHERA.

BHC = benzene hexachloride
DRO = diesel range organic
Eco = Ecological
HH = Human health
HPAH = high molecular weight polycyclic aromatic hydrocarbon
NA = not applicable
RRO = residual range organic
SLV = screening level value
SVOC = semi-volatile organic compound

Source
URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

APPENDIX B

HHRA Calculation Spreadsheets

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NOTES

EPCs from Tables 1-4 through 1-6.
Toxicity values from Table 2-5.
Exposure Factors from Tables 2-4.1 through Tables 2-4.5.
Bolded values indicate a risk estimate > 1E-06 or a hazard estimate >1.

ABBREVIATIONS

% = percent
"--" = data not available or not calculated
µg/L = microgram per liter
µg/m3 = micrograms per meter cubed
ABS_{d} = Dermal Soil Absorption Fraction
AT = averaging time

B = relative contribution of permeability coefficients in stratum corneum and viable epidermis
BaPEQ = benzo(a)pyrene equivalent(s)
BHC = benzene hexachloride
BW = body weight
CF_d = Conversion Factor
C_{fish} = concentration in fish
cm/hr = centimeter per hour
COC = constituent of concern
COPC = chemical of potential concern
cPAH = carcinogenic polycyclic aromatic hydrocarbon
C_{soil} = concentration in soil
CTE = central tendency exposure
C_w = concentration of chemical in water
DA_{event} = dose absorbed per unit area per event
days/yr – days per year
DDD = dichloro-diphenyl-dichloroethane
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane
ED = exposure duration
EF = exposure frequency
EPC = exposure point concentration
Fa_w = Fraction Absorbed
HQ = hazard quotient
g/mol = grams per mole
hr/event = hour per event
IRAF = Infant Risk Adjustment Factor
IRW = water ingestion rate
kg/mg = kilogram per milligram
KM - capped = Kaplan–Meier-based with Efron's bias correction, capped
KM = Kaplan-Meier
Kow = octanol-water partition coefficient
Kp = Permeability coefficient from water
MDL = method detection limit
mg/kg = milligrams per kilogram
mg/kg dry wt = milligrams per kilogram of dry sediment weight
mg/kg-day = milligrams per kilogram per day
mg/L = milligrams per liter
NA = not applicable
NRP = not reliably predicted
OAF = oral absorption factor
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RAIS = Risk Assessment Information System

RBC = Risk Based Concentration
RDL = reported detection limit
Ref. = reference
Rf_c = reference concentration
RfD_d = reference dose (dermal)
RfD_o = oral reference dose
RME = reasonable maximum exposure
SA = exposed surface area
$SF_{d =}$ oral slope factor adjusted for GI absorption
Sf_o = oral slope factor
SVOC = semivolatile organic compound
t* = time it takes to reach steady state
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalence
t_{event} = duration of event
TPH = total petroleum hydrocarbons

SOURCE:

U.S. Environmental Protection Agency (USEPA). 2004. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual. Part E: Supplemental Guidance for Dermal Evaluation. Final. PB99-963312. July.

Table B-1.1
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass Fisher - RME Summary (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc,c} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	1.8E+04	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	6.5E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	3.2E-02
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	1.6E-02
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	1.6E-04
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	2.8E-02
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	**3.0E+00**
Zinc	1.42E+01	No Toxicity Value	--	3.00E-01	5.8E-02
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**5E-03**	2.00E-05	**1.5E+03**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-base	4.63E-04	1.30E+05	**6E-03**	7.00E-10	**8.1E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**1E-02**	2.00E-05	**2.9E+03**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	1E-07	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	1E-06	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	2E-07	5.00E-04	1.3E-02
BHC (beta)	7.89E-04	1.80E+00	1E-07	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	8E-08	3.00E-04	2.7E-03

Table B-1.1
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass Fisher - RME Summary (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc,c} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	1.8E+04	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Chlordane (alpha)	3.00E-04	3.50E-01	1E-08	5.00E-04	7.3E-04
Chlordane (gamma)	3.19E+00	3.50E-01	**1E-04**	5.00E-04	**7.8E+00**
Dieldrin	5.49E-01	1.60E+01	**9E-04**	5.00E-05	**1.3E+01**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	1.1E-02
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	**3.4E+00**
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	1.5E-04
SVOCs and PAHs					
bis(2-ethylhexyl) phthalate	2.10E-01	1.40E-02	3E-07	2.00E-02	1.3E-02
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**1E-05**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	4.5E-04

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**1E-03**	**2.8E+01**
Pathway Sum with Total PCBs as Aroclors:	**6E-03**	**1.5E+03**
Pathway Sum with PCBs as TEQ:	**7E-03**	**8.3E+02**
Pathway Sum with Total PCBs as Congeners:	**1E-02**	**2.9E+03**

Table B-1.2
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass Fisher - RME Summary (Adult)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs	
Body Weight	BW_a	80	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, adult	ED_a	20	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	
Fish Ingestion Rate (adult)	IRF_a	4.4E+04	mg/day	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	2.93E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	1.42E-02
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	7.19E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	7.01E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	1.28E-02
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	**1.3E+00**
Zinc	1.42E+01	No Toxicity Value	--	3.00E-01	2.59E-02
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**8E-03**	2.00E-05	**6.8E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	4.63E-04	1.30E+05	**9E-03**	7.00E-10	**3.6E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**1E-02**	2.00E-05	**1.3E+03**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	2E-07	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	**2E-06**	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	3E-07	5.00E-04	5.68E-03
BHC (beta)	7.89E-04	1.80E+00	2E-07	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	1E-07	3.00E-04	1.21E-03

Table B-1.2
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass Fisher - RME Summary (Adult)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Body Weight	BW_a	80	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, adult	ED_a	20	yrs
Exposure Frequency	EF	365	days/yr
Fish Ingestion Rate (adult)	IRF_a	4.4E+04	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Chlordane (alpha)	3.00E-04	3.50E-01	2E-08	5.00E-04	3.29E-04
Chlordane (gamma)	3.19E+00	3.50E-01	**2E-04**	5.00E-04	**3.5E+00**
Dieldrin	5.49E-01	1.60E+01	**1E-03**	5.00E-05	**6.0E+00**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	4.97E-03
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	**1.5E+00**
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	6.72E-05
SVOCs and PAHs					
bis(2-ethylhexyl) phthalate	2.10E-01	1.40E-02	5E-07	2.00E-02	5.74E-03
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**6E-06**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	2.01E-04

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**2E-03**	**1.2E+01**
Pathway Sum with Total PCBs as Aroclors:	**9E-03**	**6.9E+02**
Pathway Sum with PCBs as TEQ:	**1E-02**	**3.7E+02**
Pathway Sum with Total PCBs as Congeners:	**2E-02**	**1.3E+03**

Table B-2.1
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc,c} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	4.9E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	1.7E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	8.5E-03
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	4.3E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	4.2E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	7.6E-03
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	8.0E-01
Zinc	1.42E+01	No Toxicity Value	--	3.00E-01	1.5E-02
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**1E-03**	2.00E-05	**4.1E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-basec	4.63E-04	1.30E+05	**2E-03**	7.00E-10	**2.2E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**3E-03**	2.00E-05	**7.7E+02**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	3E-08	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	4E-07	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	5E-08	5.00E-04	3.4E-03
BHC (beta)	7.89E-04	1.80E+00	4E-08	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	2E-08	3.00E-04	7.2E-04
Chlordane (alpha)	3.00E-04	3.50E-01	3E-09	5.00E-04	2.0E-04

Table B-2.1
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc,c} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	4.9E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Chlordane (gamma)	3.19E+00	3.50E-01	**3E-05**	5.00E-04	**2.1E+00**
Dieldrin	5.49E-01	1.60E+01	**2E-04**	5.00E-05	**3.6E+00**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	3.0E-03
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	9.0E-01
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	4.0E-05
SVOCs and PAHs					
bis(2-ethylhexyl) phthalate	2.10E-01	1.40E-02	8E-08	2.00E-02	3.4E-03
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**3E-06**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	1.2E-04

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**3E-04**	**7.4E+00**
Pathway Sum with Total PCBs as Aroclors:	**2E-03**	**4.1E+02**
Pathway Sum with PCBs as TEQ:	**2E-03**	**2.2E+02**
Pathway Sum with Total PCBs as Congeners:	**3E-03**	**7.8E+02**

Table B-2.2
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary (Adult)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$
Body Weight	BW_a	80	kg	
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, adult	ED_a	3	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (adult)	IRF_a	1.6E+04	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	1.1E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	5.1E-03
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	2.6E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	2.5E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	4.6E-03
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	4.9E-01
Zinc	1.42E+01	No Toxicity Value	--	3.00E-01	9.3E-03
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**4E-04**	2.00E-05	**2.5E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	4.63E-04	1.30E+05	**5E-04**	7.00E-10	**1.3E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**8E-04**	2.00E-05	**4.7E+02**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	9E-09	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	1E-07	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	1E-08	5.00E-04	2.0E-03
BHC (beta)	7.89E-04	1.80E+00	1E-08	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	6E-09	3.00E-04	4.4E-04

Table B-2.2
Risk and Hazard Estimates: Tribal Subsistence Smallmouth Bass (Child and Adult): CTE Summary (Adult)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs	
Body Weight	BW_a	80	kg	
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, adult	ED_a	3	yrs	Noncancer Hazard:
Exposure Frequency	EF	365	days/yr	
Fish Ingestion Rate (adult)	IRF_a	1.6E+04	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Chlordane (alpha)	3.00E-04	3.50E-01	9E-10	5.00E-04	1.2E-04
Chlordane (gamma)	3.19E+00	3.50E-01	**9E-06**	5.00E-04	**1.3E+00**
Dieldrin	5.49E-01	1.60E+01	**7E-05**	5.00E-05	**2.2E+00**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	1.8E-03
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	5.4E-01
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	2.4E-05
SVOCs and PAHs					
bis(2-ethylhexyl) phthalate	2.10E-01	1.40E-02	2E-08	2.00E-02	2.1E-03
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**2E-06**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	7.3E-05

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**9E-05**	**4.5E+00**
Pathway Sum with Total PCBs as Aroclors:	**5E-04**	**2.5E+02**
Pathway Sum with PCBs as TEQ:	**6E-04**	**1.4E+02**
Pathway Sum with Total PCBs as Congeners:	**9E-04**	**4.7E+02**

Table B-3.1
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - RME (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	ATc	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	7.4E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	2.5E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	1.2E-02
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	6.2E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	6.1E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	1.1E-02
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	**1.2E+00**
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**2E-03**	2.00E-05	**5.9E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	4.63E-04	1.30E+05	**2E-03**	7.00E-10	**3.1E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**4E-03**	2.00E-05	**1.1E+03**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	4E-08	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	5E-07	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	7E-08	5.00E-04	4.9E-03
BHC (beta)	7.89E-04	1.80E+00	6E-08	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	3E-08	3.00E-04	1.0E-03
Chlordane (alpha)	3.00E-04	3.50E-01	4E-09	5.00E-04	2.8E-04
Chlordane (gamma)	3.19E+00	3.50E-01	**5E-05**	5.00E-04	**3.0E+00**

Table B-3.1
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - RME (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	ATc	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	7.4E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Dieldrin	5.49E-01	1.60E+01	**4E-04**	5.00E-05	**5.2E+00**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	4.3E-03
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	**1.3E+00**
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	5.8E-05
SVOCs and PAHs					
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**4E-06**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	1.7E-04

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**4E-04**	**1.1E+01**
Pathway Sum with Total PCBs as Aroclors:	**2E-03**	**6.0E+02**
Pathway Sum with PCBs as TEQ:	**3E-03**	**3.2E+02**
Pathway Sum with Total PCBs as Congeners:	**4E-03**	**1.1E+03**

Table B-3.2
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - RME (Adult)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Body Weight	BW_a	80	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, adult	ED_a	20	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (adult)	IRF_a	2.3E+04	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	1.5E-03
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	7.3E-03
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	3.7E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	3.6E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	6.5E-03
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	6.9E-01
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**4E-03**	2.00E-05	**3.5E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	4.63E-04	1.30E+05	**5E-03**	7.00E-10	**1.8E+02**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**8E-03**	2.00E-05	**6.6E+02**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	9E-08	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	1E-06	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	1E-07	5.00E-04	2.9E-03
BHC (beta)	7.89E-04	1.80E+00	1E-07	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	6E-08	3.00E-04	6.2E-04
Chlordane (alpha)	3.00E-04	3.50E-01	8E-09	5.00E-04	1.7E-04
Chlordane (gamma)	3.19E+00	3.50E-01	**9E-05**	5.00E-04	**1.8E+00**

Table B-3.2
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - RME (Adult)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Body Weight	BW_a	80	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, adult	ED_a	20	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (adult)	IRF_a	2.3E+04	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Dieldrin	5.49E-01	1.60E+01	**7E-04**	5.00E-05	**3.1E+00**
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	2.5E-03
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	7.7E-01
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	3.4E-05
SVOCs and PAHs					
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	**3E-06**	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	1.0E-04

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**8E-04**	**6.3E+00**
Pathway Sum with Total PCBs as Aroclors:	**5E-03**	**3.5E+02**
Pathway Sum with PCBs as TEQ:	**6E-03**	**1.9E+02**
Pathway Sum with Total PCBs as Congeners:	**8E-03**	**6.6E+02**

Table B-4.1
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - CTE (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	1.5E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	5.0E-04
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	2.4E-03
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	1.2E-03
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	1.2E-05
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	2.2E-03
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	2.3E-01
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	4E-04	2.00E-05	**1.2E+02**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-basec	4.63E-04	1.30E+05	5E-04	7.00E-10	**6.2E+01**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	8E-04	2.00E-05	**2.2E+02**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	9E-09	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	1E-07	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	1E-08	5.00E-04	9.7E-04
BHC (beta)	7.89E-04	1.80E+00	1E-08	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	6E-09	3.00E-04	2.1E-04
Chlordane (alpha)	3.00E-04	3.50E-01	8E-10	5.00E-04	5.6E-05

Table B-4.1
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - CTE (Child)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight	BW_c	15	kg	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, child	ED_c	6	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (child)	IRF_c	1.5E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Chlordane (gamma)	3.19E+00	3.50E-01	**9E-06**	5.00E-04	6.0E-01
Dieldrin	5.49E-01	1.60E+01	**7E-05**	5.00E-05	1.0E+00
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	8.5E-04
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	2.6E-01
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	1.1E-05
SVOCs and PAHs					
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	9E-07	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	3.4E-05

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**8E-05**	**2.1E+00**
Pathway Sum with Total PCBs as Aroclors:	**5E-04**	**1.2E+02**
Pathway Sum with PCBs as TEQ:	**6E-04**	**6.4E+01**
Pathway Sum with Total PCBs as Congeners:	**8E-04**	**2.2E+02**

Table B-4.2
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - CTE (Adult)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs
Body Weight	BW_a	80	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, adult	ED_a	3	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (adult)	IRF_a	4.2E+03	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Metals					
Aluminum	5.35E+00	No Toxicity Value	--	1.00E+00	2.7E-04
Antimony	1.04E-02	No Toxicity Value	--	4.00E-04	1.3E-03
Barium	2.63E+00	No Toxicity Value	--	2.00E-01	6.6E-04
Chromium (III)	1.92E-01	No Toxicity Value	--	1.50E+00	6.4E-06
Copper	9.33E-01	No Toxicity Value	--	4.00E-02	1.2E-03
Mercury	2.46E-01	No Toxicity Value	--	1.00E-04	1.2E-01
PCB Aroclors					
Total PCBs as Aroclors (MDL-based)	2.48E+01	2.00E+00	**1E-04**	2.00E-05	**6.2E+01**
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	4.63E-04	1.30E+05	**1E-04**	7.00E-10	**3.3E+01**
Total PCBs as Congeners (KM-based, capped)	4.71E+01	2.00E+00	**2E-04**	2.00E-05	**1.2E+02**
Pesticides					
4,4'-DDD	4.54E-03	2.40E-01	2E-09	No Toxicity Value	--
4,4'-DDE	3.91E-02	3.40E-01	3E-08	No Toxicity Value	--
4,4'-DDT	5.19E-03	3.40E-01	4E-09	5.00E-04	5.2E-04
BHC (beta)	7.89E-04	1.80E+00	3E-09	No Toxicity Value	--
BHC (gamma) Lindane	6.65E-04	1.10E+00	2E-09	3.00E-04	1.1E-04
Chlordane (alpha)	3.00E-04	3.50E-01	2E-10	5.00E-04	3.0E-05

Table B-4.2
Risk and Hazard Estimates: Non-Tribal Recreational Smallmouth Bass Fisher - CTE (Adult)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$
Body Weight	BW_a	80	kg	
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, adult	ED_a	3	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (adult)	IRF_a	4.2E+03	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Chlordane (gamma)	3.19E+00	3.50E-01	**2E-06**	5.00E-04	3.2E-01
Dieldrin	5.49E-01	1.60E+01	**2E-05**	5.00E-05	5.5E-01
Endosulfan I	5.45E-02	No Toxicity Value	--	6.00E-03	4.6E-04
Endrin	8.27E-01	No Toxicity Value	--	3.00E-04	1.4E-01
Endrin Aldehyde	2.61E-01	No Toxicity Value	--	No Toxicity Value	--
Methoxychlor	6.14E-04	No Toxicity Value	--	5.00E-03	6.2E-06
SVOCs and PAHs					
cPAHs as BaPEQ (KM-capped, MDL-based)	2.84E-03	7.30E+00	6E-07	No Toxicity Value	--
p-cresol (4-Methylphenol)	3.68E-02	No Toxicity Value	--	1.00E-01	1.9E-05

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**2E-05**	**1.1E+00**
Pathway Sum with Total PCBs as Aroclors:	**1E-04**	**6.4E+01**
Pathway Sum with PCBs as TEQ:	**2E-04**	**3.4E+01**
Pathway Sum with Total PCBs as Congeners:	**2E-04**	**1.2E+02**

Table B-5.1
Risk and Hazard Estimates: Non-Tribal Recreational Crayfish Fisher - RME (Child)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (child)	IRF_c	5.7E+03	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Arsenic	5.19E-01	1.50E+00	**2E-05**	3.00E-04	6.3E-01
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	1.10E-06	1.30E+05	**4E-06**	7.00E-10	5.7E-01
Total PCBs as Congeners (KM-based, capped)	1.87E-02	2.00E+00	**1E-06**	2.00E-05	3.4E-01

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**2E-05**	6.3E-01
Pathway Sum with PCBs as TEQ:	**3E-05**	**1.2E+00**
Pathway Sum with Total PCBs as Congeners:	**3E-05**	9.7E-01

Table B-5.2
Risk and Hazard Estimates: Non-Tribal Recreational Crayfish Fisher - RME (Adult)

Definition	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs	$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$
Body Weight	BW_a	80	kg	
Conversion Factor	CF_o	1E-06	kg/mg	
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg	
Exposure Duration, adult	ED_a	20	yrs	Noncancer Hazard:
Exposure Frequency	EF	350	days/yr	$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$
Fish Ingestion Rate (adult)	IRF_a	1.8E+04	mg/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Arsenic	5.19E-01	1.50E+00	**5E-05**	3.00E-04	3.7E-01
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based	1.10E-06	1.30E+05	**9E-06**	7.00E-10	3.4E-01
Total PCBs as Congeners (KM-based, capped)	1.87E-02	2.00E+00	**2E-06**	2.00E-05	2.0E-01

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**5E-05**	3.7E-01
Pathway Sum with PCBs as TEQ:	**6E-05**	7.1E-01
Pathway Sum with Total PCBs as Congeners:	**5E-05**	5.7E-01

Table B-6.1
Risk and Hazard Estimates: Non-Tribal Recreational Crayfish Bass Fisher - CTE (Child)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (child)	IRF_c	1.1E+03	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_c \times ED_c \times EF \times CF_O}{BW_c \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	C_{fish} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (dimensionless)
Metals					
Arsenic	5.19E-01	1.50E+00	**5E-06**	3.00E-04	1.3E-01
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.10E-06	1.30E+05	**9E-07**	7.00E-10	1.1E-01
Total PCBs as Congeners (KM-based, capped)	1.87E-02	2.00E+00	**2E-07**	2.00E-05	6.8E-02

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	**5E-06**	1.3E-01
Pathway Sum with PCBs as TEQ:	**6E-06**	2.4E-01
Pathway Sum with Total PCBs as Congeners:	**5E-06**	1.9E-01

Table B-6.2
Risk and Hazard Estimates: Non-Tribal Recreational Crayfish Bass Fisher - CTE (Adult)

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs
Body Weight	BW_a	80	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in fish	C_{fish}	chemical-specific	mg/kg
Exposure Duration, adult	ED_a	3	yrs
Exposure Frequency	EF	350	days/yr
Fish Ingestion Rate (adult)	IRF_a	3.3E+03	mg/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

$$Risk = SF_O \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_O} \times \left[C_{fish} \times \left(\frac{IRF_a \times ED_a \times EF \times CF_O}{BW_a \times AT_{nc} \times 365\ days/year}\right)\right]$$

Analyte	**C_{fish}** (mg/kg)	**SF_o** $(mg/kg\text{-}day)^{-1}$	**Cancer Risk** (dimensionless)	**RfD_o** (mg/kg-day)	**Noncancer Hazard** (dimensionless)
Metals					
Arsenic	5.19E-01	1.50E+00	1E-06	3.00E-04	6.8E-02
PCB Congeners					
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.10E-06	1.30E+05	2E-07	7.00E-10	6.2E-02
Total PCBs as Congeners (KM-based, capped)	1.87E-02	2.00E+00	6E-08	2.00E-05	3.7E-02

	Cancer Risk	Hazard Index
Pathway Sum Excluding PCBs:	1E-06	6.8E-02
Pathway Sum with PCBs as TEQ:	**2E-06**	1.3E-01
Pathway Sum with Total PCBs as Congeners:	1E-06	1.1E-01

Table B-7.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - RME

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	100	mg/day
Soil Ingestion Rate (child)	IRS_c	200	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Inorganic Constituents							
Antimony	0.00E+00	4.17E-01	No Toxicity Value	--	4.00E-04	5.7E-03	5.4E-04
Arsenic	0.00E+00	7.68E+00	1.50E+00	**7E-06**	3.00E-04	1.4E-01	1.3E-02
Cadmium	0.00E+00	5.40E-01	No Toxicity Value	--	1.00E-03	3.0E-03	2.8E-04
Chromium	0.00E+00	1.45E+02	No Toxicity Value	--	No Toxicity Value	--	--
Cobalt	0.00E+00	1.12E+01	No Toxicity Value	--	3.00E-04	2.0E-01	1.9E-02
Copper	0.00E+00	3.32E+01	No Toxicity Value	--	4.00E-02	4.5E-03	4.3E-04
Lead	0.00E+00	--	No Toxicity Value	--	No Toxicity Value	--	--
Manganese	0.00E+00	5.11E+02	No Toxicity Value	--	2.40E-02	1.2E-01	1.1E-02
Mercury	0.00E+00	1.13E-01	No Toxicity Value	--	1.60E-04	3.9E-03	3.6E-04
Nickel	0.00E+00	1.19E+02	No Toxicity Value	--	2.00E-02	3.3E-02	3.1E-03
Silver	0.00E+00	2.00E+00	No Toxicity Value	--	5.00E-03	2.2E-03	2.1E-04
Thallium	0.00E+00	2.44E-01	No Toxicity Value	--	1.00E-05	1.3E-01	1.3E-02
Vanadium	0.00E+00	5.55E+01	No Toxicity Value	--	5.00E-03	6.1E-02	5.7E-03

Table B-7.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - RME

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	100	mg/day
Soil Ingestion Rate (child)	IRS_c	200	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Zinc	0.00E+00	1.24E+02	No Toxicity Value	--	3.00E-01	2.3E-03	2.1E-04
PCBs							
Total PCBs as Aroclors (MDL-based)	0.00E+00	1.72E-01	2.00E+00	2E-07	2.00E-05	4.7E-02	4.4E-03
Total PCBs as Congeners (KM-based, capped)	0.00E+00	8.08E-01	2.00E+00	1E-06	2.00E-05	2.2E-01	2.1E-02
PCBs as Mammal TEQ (KM-capped, RDL-based)	0.00E+00	2.97E-06	1.30E+05	2E-07	7.00E-10	2.3E-02	2.2E-03
Butyltins							
Dibutyltin dichloride	0.00E+00	4.60E-03	No Toxicity Value	--	3.00E-04	8.4E-05	7.9E-06
Tributyltin chloride	0.00E+00	1.30E-02	No Toxicity Value	--	3.00E-04	2.4E-04	2.2E-05
Pesticides							
4,4'-DDE	0.00E+00	1.20E-03	3.40E-01	3E-10	No Toxicity Value	--	--
4,4'-DDT	0.00E+00	4.10E-02	3.40E-01	9E-09	5.00E-04	4.5E-04	4.2E-05
BHC (gamma) Lindane	0.00E+00	8.00E-05	1.10E+00	5E-11	3.00E-04	1.5E-06	1.4E-07
Chlordane (gamma)	0.00E+00	1.00E-02	3.50E-01	2E-09	5.00E-04	1.1E-04	1.0E-05
Endrin Aldehyde	0.00E+00	3.20E-03	No Toxicity Value	--	No Toxicity Value	--	--

Table B-7.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - RME

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	100	mg/day
Soil Ingestion Rate (child)	IRS_c	200	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Endrin	0.00E+00	2.70E-03	No Toxicity Value	--	3.00E-04	4.9E-05	4.6E-06
TPH							
Diesel Range Organics	0.00E+00	2.56E+01	No Toxicity Value	--	2.00E-02	7.0E-03	6.6E-04
SVOCs and PAHs							
cPAHs as BaPEQ (KM-capped, MDL-based)	M	1.73E-01	7.30E+00	**4E-06**	No Toxicity Value	--	--
Anthracene	0.00E+00	1.69E-02	No Toxicity Value	--	3.00E-01	3.1E-07	2.9E-08
Fluoranthene	0.00E+00	6.53E-01	No Toxicity Value	--	4.00E-02	8.9E-05	8.4E-06
Phenanthrene	0.00E+00	7.51E-02	No Toxicity Value	--	3.00E-01	1.4E-06	1.3E-07
pyrene	0.00E+00	7.55E-01	No Toxicity Value	--	3.00E-02	1.4E-04	1.3E-05
Acenaphthene	0.00E+00	5.89E-03	No Toxicity Value	--	6.00E-02	5.4E-07	5.0E-08
Fluorene	0.00E+00	1.40E-02	No Toxicity Value	--	4.00E-02	1.9E-06	1.8E-07
Bis(2-ethylhexyl) Phthalate	0.00E+00	2.77E+00	1.40E-02	2E-08	2.00E-02	7.6E-04	7.1E-05
Butyl Benzyl Phthalate	0.00E+00	1.00E-02	1.90E-03	1E-11	2.00E-01	2.7E-07	2.6E-08
Carbazole	0.00E+00	2.08E-02	2.00E-02	3E-10	No Toxicity Value	--	--

Table B-7.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - RME

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0\text{-}2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2\text{-}6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6\text{-}16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16\text{-}30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	$ED_{0\text{-}2}$	2	yrs
Exposure Duration, child 2-6	$ED_{2\text{-}6}$	4	yrs
Exposure Duration, child 6-16	$ED_{6\text{-}16}$	10	yrs
Exposure Duration, adult 16-26	$ED_{16\text{-}30}$	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	100	mg/day
Soil Ingestion Rate (child)	IRS_c	200	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_O}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Di-n-butyl Phthalate	0.00E+00	2.22E-02	No Toxicity Value	--	1.00E-01	1.2E-06	1.1E-07
p-cresol (4-Methylphenol)	0.00E+00	3.62E-02	No Toxicity Value	--	1.00E-01	2.0E-06	1.9E-07
Phenol	0.00E+00	2.40E-02	No Toxicity Value	--	3.00E-01	4.4E-07	4.1E-08

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	**1E-05**	7.2E-01	6.7E-02
Pathway Sum with Total PCBs as Aroclors:	**1E-05**	7.7E-01	7.2E-02
Pathway Sum with Total PCBs as Congeners:	**1E-05**	9.4E-01	8.8E-02
Pathway Sum with PCBs as TEQ:	**1E-05**	7.4E-01	7.0E-02

Table B-7.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - RME

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-26}	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Refererence Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	(mg/kg-day)$^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times \left[C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)\right]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right.\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	ABS_d (unitless)	SF_d (mg/kg-day)$^{-1}$	Cancer Risk (dimensionless)	RfD_d (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Inorganic Constituents								
Antimony	0.00E+00	4.17E-01	1.00E-02	--	--	6.00E-05	2.6E-03	3.9E-04
Arsenic	0.00E+00	7.68E+00	3.00E-02	1.50E+00	**2E-06**	3.00E-04	2.9E-02	4.3E-03
Cadmium	0.00E+00	5.40E-01	1.00E-03	--	--	2.50E-05	8.1E-04	1.2E-04
Chromium	0.00E+00	1.45E+02	1.00E-02	--	--	--	--	--
Cobalt	0.00E+00	1.12E+01	1.00E-02	--	--	3.00E-04	1.4E-02	2.1E-03
Copper	0.00E+00	3.32E+01	1.00E-02	--	--	4.00E-02	3.1E-04	4.6E-05
Lead	0.00E+00	--	1.00E-02	--	--	--	--	--
Manganese	0.00E+00	5.11E+02	1.00E-02	--	--	9.60E-04	2.0E-01	3.0E-02
Mercury	0.00E+00	1.13E-01	1.00E-02	--	--	1.60E-04	2.6E-04	4.0E-05
Nickel	0.00E+00	1.19E+02	1.00E-02	--	--	8.00E-04	5.6E-02	8.3E-03
Silver	0.00E+00	2.00E+00	1.00E-02	--	--	2.00E-04	3.7E-03	5.6E-04
Thallium	0.00E+00	2.44E-01	1.00E-02	--	--	1.00E-05	9.1E-03	1.4E-03
Vanadium	0.00E+00	5.55E+01	1.00E-02	--	--	1.30E-04	1.6E-01	2.4E-02

Table B-7.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - RME

Description	Variable	Value		Equations:
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless	Cancer Risk:
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs	Nonmutagens:
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs	
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs	
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-26}$	1	yrs	
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day	
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day	
Averaging Time, Carcinogens	AT_c	70	yrs	Mutagens:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs	
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight, adult	BW_a	80	kg	
Body Weight, child	BW_c	15	kg	
Conversion Factor	CF_d	1E-06	kg/mg	
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg	
Fraction of EV in Contact with Soil	EC	1	unitless	
Exposure Duration, child 0-2	ED_{0-2}	2	yrs	
Exposure Duration, child 2-6	ED_{2-6}	4	yrs	
Exposure Duration, child 6-16	ED_{6-16}	10	yrs	
Exposure Duration, adult 16-26	ED_{16-26}	10	yrs	
Exposure Duration, adult	ED_a	20	yrs	Noncancer Hazard:
Exposure Duration, child	ED_c	6	yrs	
Exposure Frequency, resident	EF_r	150	days/yr	
Refererence Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day	
Exposed Body Surface Area, adult	SA_a	6820	cm^2	
Exposed Body Surface Area, child	SA_c	1950	cm^2	
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	(mg/kg-day)$^{-1}$	

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times \left[C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)\right]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right]\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

					Cancer		Noncancer	Noncancer
Zinc	0.00E+00	1.24E+02	1.00E-02	--	--	3.00E-01	1.5E-04	2.3E-05
PCBs								
Total PCBs as Aroclors (MDL-based)	0.00E+00	1.72E-01	1.40E-01	2.00E+00	2E-07	2.00E-05	4.5E-02	6.7E-03
Total PCBs as Congeners (KM-based, capped)	0.00E+00	8.08E-01	1.40E-01	2.00E+00	1E-06	2.00E-05	2.1E-01	3.2E-02
PCBs as Mammal TEQ (KM-capped, RDL-based)	0.00E+00	2.97E-06	3.00E-02	1.30E+05	6E-08	7.00E-10	4.8E-03	7.1E-04
Butyltins								
Dibutyltin dichloride	0.00E+00	4.60E-03	1.00E-01	--	--	3.00E-04	5.7E-05	8.6E-06
Tributyltin chloride	0.00E+00	1.30E-02	1.00E-01	--	--	3.00E-04	1.6E-04	2.4E-05
Pesticides								
4,4'-DDE	0.00E+00	1.20E-03	1.00E-01	3.40E-01	2E-10	--	--	--
4,4'-DDT	0.00E+00	4.10E-02	3.00E-02	3.40E-01	2E-09	5.00E-04	9.2E-05	1.4E-05
BHC (gamma) Lindane	0.00E+00	8.00E-05	4.00E-02	1.10E+00	2E-11	3.00E-04	4.0E-07	6.0E-08
Chlordane (gamma)	0.00E+00	1.00E-02	4.00E-02	3.50E-01	7E-10	5.00E-04	3.0E-05	4.5E-06
Endrin Aldehyde	0.00E+00	3.20E-03	1.00E-02	--	--	--	--	--
Endrin	0.00E+00	2.70E-03	1.00E-01	--	--	3.00E-04	3.4E-05	5.0E-06
TPH								

Table B-7.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - RME

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0\text{-}2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2\text{-}6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6\text{-}16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16\text{-}26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	$ED_{0\text{-}2}$	2	yrs
Exposure Duration, child 2-6	$ED_{2\text{-}6}$	4	yrs
Exposure Duration, child 6-16	$ED_{6\text{-}16}$	10	yrs
Exposure Duration, adult 16-26	$ED_{16\text{-}26}$	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Refererence Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times \left[C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)\right]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right.\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

					Cancer		Noncancer	Noncancer
Diesel Range Organics	0.00E+00	2.56E+01	0.00E+00	--	--	2.00E-02	0.0E+00	0.0E+00
SVOCs and PAHs								
cPAHs as BaPEQ (KM-capped, MDL-based)	M	1.73E-01	1.30E-01	7.30E+00	**3E-06**	--	--	--
Anthracene	0.00E+00	1.69E-02	1.30E-01	--	--	3.00E-01	2.7E-07	4.1E-08
Fluoranthene	0.00E+00	6.53E-01	1.30E-01	--	--	4.00E-02	7.9E-05	1.2E-05
Phenanthrene	0.00E+00	7.51E-02	1.30E-01	--	--	3.00E-01	1.2E-06	1.8E-07
pyrene	0.00E+00	7.55E-01	1.30E-01	--	--	3.00E-02	1.2E-04	1.8E-05
Acenaphthene	0.00E+00	5.89E-03	1.30E-01	--	--	6.00E-02	4.8E-07	7.2E-08
Fluorene	0.00E+00	1.40E-02	1.30E-01	--	--	4.00E-02	1.7E-06	2.6E-07
Bis(2-ethylhexyl) Phthalate	0.00E+00	2.77E+00	1.00E-01	1.40E-02	2E-08	2.00E-02	5.2E-04	7.8E-05
Butyl Benzyl Phthalate	0.00E+00	1.00E-02	1.00E-01	1.90E-03	9E-12	2.00E-01	1.9E-07	2.8E-08
Carbazole	0.00E+00	2.08E-02	1.00E-01	2.00E-02	2E-10	--	--	--
Di-n-butyl Phthalate	0.00E+00	2.22E-02	1.00E-01	--	--	1.00E-01	8.3E-07	1.2E-07
p-cresol (4-Methylphenol)	0.00E+00	3.62E-02	1.00E-01	--	--	1.00E-01	1.4E-06	2.0E-07

Table B-7.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - RME

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0\text{-}2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2\text{-}6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6\text{-}16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16\text{-}26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	$ED_{0\text{-}2}$	2	yrs
Exposure Duration, child 2-6	$ED_{2\text{-}6}$	4	yrs
Exposure Duration, child 6-16	$ED_{6\text{-}16}$	10	yrs
Exposure Duration, adult 16-26	$ED_{16\text{-}26}$	10	yrs
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	150	days/yr
Refererence Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times \left[C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)\right]$$

Mutagens:

$$Risk = SF_d \times \Bigg\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

					Cancer		Noncancer	Noncancer
Phenol	0.00E+00	2.40E-02	1.00E-01	--	--	3.00E-01	3.0E-07	4.5E-08

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	**5E-06**	4.7E-01	7.1E-02
Pathway Sum with Total PCBs as Aroclors:	**5E-06**	5.2E-01	7.8E-02
Pathway Sum with Total PCBs as Congeners:	**6E-06**	6.9E-01	1.0E-01
Pathway Sum with PCBs as TEQ:	**5E-06**	4.8E-01	7.2E-02

Table B-8.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - CTE

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	50	mg/day
Soil Ingestion Rate (child)	IRS_c	100	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Inorganic Constituents							
Antimony	0	4.17E-01	No Toxicity Value	--	4.00E-04	9.5E-05	1.3E-06
Arsenic	0	7.68E+00	1.50E+00	**9E-08**	3.00E-04	2.3E-03	3.3E-05
Cadmium	0	5.40E-01	No Toxicity Value	--	1.00E-03	4.9E-05	6.9E-07
Chromium	0	1.45E+02	No Toxicity Value	--	No Toxicity Value	--	--
Cobalt	0	1.12E+01	No Toxicity Value	--	3.00E-04	3.4E-03	4.8E-05
Copper	0	3.32E+01	No Toxicity Value	--	4.00E-02	7.6E-05	1.1E-06
Lead	0	--	No Toxicity Value	--	No Toxicity Value	--	--
Manganese	0	5.11E+02	No Toxicity Value	--	2.40E-02	1.9E-03	2.7E-05
Mercury	0	1.13E-01	No Toxicity Value	--	1.60E-04	6.4E-05	9.1E-07
Nickel	0	1.19E+02	No Toxicity Value	--	2.00E-02	5.4E-04	7.6E-06
Silver	0	2.00E+00	No Toxicity Value	--	5.00E-03	3.7E-05	5.1E-07
Thallium	0	2.44E-01	No Toxicity Value	--	1.00E-05	2.2E-03	3.1E-05
Vanadium	0	5.55E+01	No Toxicity Value	--	5.00E-03	1.0E-03	1.4E-05

Table B-8.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - CTE

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	50	mg/day
Soil Ingestion Rate (child)	IRS_c	100	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Zinc	0	1.24E+02	No Toxicity Value	--	3.00E-01	3.8E-05	5.3E-07
PCBs							
Total PCBs as Aroclors (MDL-based)	0	1.72E-01	2.00E+00	3E-09	2.00E-05	7.8E-04	1.1E-05
Total PCBs as Congeners (KM-based, capped)	0	8.08E-01	2.00E+00	1E-08	2.00E-05	3.7E-03	5.2E-05
PCBs as Mammal TEQ (KM-capped, RDL-based)	0	2.97E-06	1.30E+05	3E-09	7.00E-10	3.9E-04	5.4E-06
Butyltins							
Dibutyltin dichloride	0	4.60E-03	No Toxicity Value	--	3.00E-04	1.4E-06	2.0E-08
Tributyltin chloride	0	1.30E-02	No Toxicity Value	--	3.00E-04	4.0E-06	5.6E-08
Pesticides							
4,4'-DDE	0	1.20E-03	3.40E-01	3E-12	No Toxicity Value	--	--
4,4'-DDT	0	4.10E-02	3.40E-01	1E-10	5.00E-04	7.5E-06	1.1E-07
BHC (gamma) Lindane	0	8.00E-05	1.10E+00	7E-13	3.00E-04	2.4E-08	3.4E-10
Chlordane (gamma)	0	1.00E-02	3.50E-01	3E-11	5.00E-04	1.8E-06	2.6E-08
Endrin Aldehyde	0	3.20E-03	No Toxicity Value	--	No Toxicity Value	--	--

Table B-8.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - CTE

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	50	mg/day
Soil Ingestion Rate (child)	IRS_c	100	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\,\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\,\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Endrin	0	2.70E-03	No Toxicity Value	--	3.00E-04	8.2E-07	1.2E-08
TPH							
Diesel Range Organics	0	2.56E+01	No Toxicity Value	--	2.00E-02	1.2E-04	1.6E-06
SVOCs and PAHs							
cPAHs as BaPEQ (KM-capped, MDL-based)	M	1.73E-01	7.30E+00	**6E-08**	No Toxicity Value	--	--
Anthracene	0	1.69E-02	No Toxicity Value	--	3.00E-01	5.2E-09	7.2E-11
Fluoranthene	0	6.53E-01	No Toxicity Value	--	4.00E-02	1.5E-06	2.1E-08
Phenanthrene	0	7.51E-02	No Toxicity Value	--	3.00E-01	2.3E-08	3.2E-10
pyrene	0	7.55E-01	No Toxicity Value	--	3.00E-02	2.3E-06	3.2E-08
Acenaphthene	0	5.89E-03	No Toxicity Value	--	6.00E-02	9.0E-09	1.3E-10
Fluorene	0	1.40E-02	No Toxicity Value	--	4.00E-02	3.2E-08	4.5E-10
Bis(2-ethylhexyl) Phthalate	0	2.77E+00	1.40E-02	3E-10	2.00E-02	1.3E-05	1.8E-07
Butyl Benzyl Phthalate	0	1.00E-02	1.90E-03	2E-13	2.00E-01	4.6E-09	6.4E-11
Carbazole	0	2.08E-02	2.00E-02	3E-12	No Toxicity Value	--	--

Table B-8.1
Risk and Hazard Estimates: Incidental Ingestion of Soil, Wader - CTE

Definition	Variable	Value	
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-30}$	1	yrs
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight	BW_a	80	kg
Body Weight	BW_c	15	kg
Conversion Factor	CF_o	1E-06	kg/mg
COPC Concentration in soil	C_{soil}	chemical-specific	mg/kg
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-30}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Fraction Contaminated Soil Ingested	FI	1.0	unitless
Soil Ingestion Rate (adult)	IRS_a	50	mg/day
Soil Ingestion Rate (child)	IRS_c	100	mg/day
Oral Reference Dose	RfD_O	chemical-specific	(mg/kg-day)
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations ıe

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}} + \frac{IRS_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Mutagens:

$$Risk = SF_O \times \left[C_{soil} \times EF_r \times FI \times CF_O \times \left(\frac{IRS_c \times ED_{0-2} \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_c \times ED_{2-6} \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{6-16} \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year} + \frac{IRS_a \times ED_{16-30} \times ADAF_{16-30}}{BW_a \times AT_c \times 365\ days/year}\right)\right]$$

Noncancer Hazaard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{soil} \times \left(\frac{IRS_c \times ED_c \times EF_r \times FI \times CF_o}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Di-n-butyl Phthalate	0	2.22E-02	No Toxicity Value	--	1.00E-01	2.0E-08	2.8E-10
p-cresol (4-Methylphenol)	0	3.62E-02	No Toxicity Value	--	1.00E-01	3.3E-08	4.6E-10
Phenol	0	2.40E-02	No Toxicity Value	--	3.00E-01	7.3E-09	1.0E-10

	Cancer Risk		Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	**2E-07**		1.2E-02	1.7E-04
Pathway Sum with Total PCBs as Aroclors:	**2E-07**		1.3E-02	1.8E-04
Pathway Sum with Total PCBs as Congeners:	**2E-07**		1.6E-02	2.2E-04
Pathway Sum with PCBs as TEQ:	**2E-07**		1.2E-02	1.7E-04

Table B-8.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - CTE

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0\text{-}2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2\text{-}6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6\text{-}16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16\text{-}26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	$ED_{0\text{-}2}$	2	yrs
Exposure Duration, child 2-6	$ED_{2\text{-}6}$	4	yrs
Exposure Duration, child 6-16	$ED_{6\text{-}16}$	10	yrs
Exposure Duration, adult 16-26	$ED_{16\text{-}26}$	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Refererenc Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	(mg/kg-day)$^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times [C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right.\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

Analyte	Mutagen?	C_{soil} (mg/kg)	ABS_d (unitless)	SF_d (mg/kg-day)$^{-1}$	Cancer Risk (dimensionless)	RfD_d (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
Inorganic Constituents								
Antimony	0.00E+00	4.17E-01	1.00E-02	--	--	6.00E-05	8.7E-05	1.9E-06
Arsenic	0.00E+00	7.68E+00	3.00E-02	1.50E+00	**4E-08**	3.00E-04	9.6E-04	2.2E-05
Cadmium	0.00E+00	5.40E-01	1.00E-03	--	--	2.50E-05	2.7E-05	6.1E-07
Chromium	0.00E+00	1.45E+02	1.00E-02	--	--	--	--	--
Cobalt	0.00E+00	1.12E+01	1.00E-02	--	--	3.00E-04	4.7E-04	1.0E-05
Copper	0.00E+00	3.32E+01	1.00E-02	--	--	4.00E-02	1.0E-05	2.3E-07
Lead	0.00E+00	--	1.00E-02	--	--	--	--	--
Manganese	0.00E+00	5.11E+02	1.00E-02	--	--	9.60E-04	6.6E-03	1.5E-04
Mercury	0.00E+00	1.13E-01	1.00E-02	--	--	1.60E-04	8.8E-06	2.0E-07
Nickel	0.00E+00	1.19E+02	1.00E-02	--	--	8.00E-04	1.9E-03	4.2E-05
Silver	0.00E+00	2.00E+00	1.00E-02	--	--	2.00E-04	1.2E-04	2.8E-06
Thallium	0.00E+00	2.44E-01	1.00E-02	--	--	1.00E-05	3.0E-04	6.8E-06
Vanadium	0.00E+00	5.55E+01	1.00E-02	--	--	1.30E-04	5.3E-03	1.2E-04
Zinc	0.00E+00	1.24E+02	1.00E-02	--	--	3.00E-01	5.1E-06	1.2E-07
PCBs								
Total PCBs as Aroclors (MDL-based)	0.00E+00	1.72E-01	1.40E-01	2.00E+00	6E-09	2.00E-05	1.5E-03	3.4E-05
Total PCBs as Congeners (KM-based, capped)	0.00E+00	8.08E-01	1.40E-01	2.00E+00	3E-08	2.00E-05	7.0E-03	1.6E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	0.00E+00	2.97E-06	3.00E-02	1.30E+05	1E-09	7.00E-10	1.6E-04	3.6E-06
Butyltins								
Dibutyltin dichloride	0.00E+00	4.60E-03	1.00E-01	--	--	3.00E-04	1.9E-06	4.3E-08
Tributyltin chloride	0.00E+00	1.30E-02	1.00E-01	--	--	3.00E-04	5.4E-06	1.2E-07

Table B-8.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - CTE

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-26}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Refererenc Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	(mg/kg-day)$^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times [C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right]\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

					Cancer		Noncancer	Noncancer
Pesticides								
4,4'-DDE	0.00E+00	1.20E-03	1.00E-01	3.40E-01	5E-12	--	--	--
4,4'-DDT	0.00E+00	4.10E-02	3.00E-02	3.40E-01	5E-11	5.00E-04	3.1E-06	6.9E-08
BHC (gamma) Lindane	0.00E+00	8.00E-05	4.00E-02	1.10E+00	4E-13	3.00E-04	1.3E-08	3.0E-10
Chlordane (gamma)	0.00E+00	1.00E-02	4.00E-02	3.50E-01	2E-11	5.00E-04	1.0E-06	2.2E-08
Endrin Aldehyde	0.00E+00	3.20E-03	1.00E-02	--	--	--	--	--
Endrin	0.00E+00	2.70E-03	1.00E-01	--	--	3.00E-04	1.1E-06	2.5E-08
TPH								
Diesel Range Organics	0.00E+00	2.56E+01	0.00E+00	--	--	2.00E-02	0.0E+00	0.0E+00
SVOCs and PAHs								
cPAHs as BaPEQ (KM-capped, MDL-based)	M	1.73E-01	1.30E-01	7.30E+00	**1E-07**	--	--	--
Anthracene	0.00E+00	1.69E-02	1.30E-01	--	--	3.00E-01	9.1E-09	2.1E-10
Fluoranthene	0.00E+00	6.53E-01	1.30E-01	--	--	4.00E-02	2.6E-06	5.9E-08
Phenanthrene	0.00E+00	7.51E-02	1.30E-01	--	--	3.00E-01	4.1E-08	9.1E-10
pyrene	0.00E+00	7.55E-01	1.30E-01	--	--	3.00E-02	4.1E-06	9.2E-08
Acenaphthene	0.00E+00	5.89E-03	1.30E-01	--	--	6.00E-02	1.6E-08	3.6E-10
Fluorene	0.00E+00	1.40E-02	1.30E-01	--	--	4.00E-02	5.7E-08	1.3E-09
Bis(2-ethylhexyl) Phthalate	0.00E+00	2.77E+00	1.00E-01	1.40E-02	4E-10	2.00E-02	1.7E-05	3.9E-07
Butyl Benzyl Phthalate	0.00E+00	1.00E-02	1.00E-01	1.90E-03	2E-13	2.00E-01	6.2E-09	1.4E-10
Carbazole	0.00E+00	2.08E-02	1.00E-01	2.00E-02	5E-12	--	--	--
Di-n-butyl Phthalate	0.00E+00	2.22E-02	1.00E-01	--	--	1.00E-01	2.8E-08	6.2E-10
p-cresol (4-Methylphenol)	0.00E+00	3.62E-02	1.00E-01	--	--	1.00E-01	4.5E-08	1.0E-09

Table B-8.2
Risk and Hazard Estimates: Dermal Contact with Soil, Wader - CTE

Description	Variable	Value	
Dermal Soil Absorption Fraction	ABS_d	chemical-specific	unitless
Age-dependent Adjustment Factor, 0-2	$ADAF_{0-2}$	10	yrs
Age-dependent Adjustment Factor, 2-6	$ADAF_{2-6}$	3	yrs
Age-dependent Adjustment Factor, 6-16	$ADAF_{6-16}$	3	yrs
Age-dependent Adjustment Factor, 16-26	$ADAF_{16-26}$	1	yrs
Soil-to-Skin Adherence Fraction	AF_a	0.16	mg/cm^2-day
Soil-to-Skin Adherence Fraction	AF_c	0.7	mg/cm^2-day
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	20	yrs
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor	CF_d	1E-06	kg/mg
COPC Concentration in Soil	C_{soil}	chemical-specific	mg/kg
Fraction of EV in Contact with Soil	EC	1	unitless
Exposure Duration, child 0-2	ED_{0-2}	2	yrs
Exposure Duration, child 2-6	ED_{2-6}	4	yrs
Exposure Duration, child 6-16	ED_{6-16}	10	yrs
Exposure Duration, adult 16-26	ED_{16-26}	10	yrs
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	5	days/yr
Refererenc Dose Adjusted for GI Absorption	RfD_d	chemical-specific	mg/kg-day
Exposed Body Surface Area, adult	SA_a	6820	cm^2
Exposed Body Surface Area, child	SA_c	1950	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations:

Cancer Risk:

Nonmutagens:

$$Risk = SF_d \times [C_{soil} \times ED_a \times EF \times EV \times EC \times ABS_d \times CF_d \times \left(\frac{AF_a \times SA_a}{BW_a \times AT_c \times 365\ day/year} + \frac{AF_c \times ED_c \times SA_c}{BW_c \times AT_c \times 365\ day/year}\right)]$$

Mutagens:

$$Risk = SF_d \times \left\{C_{soil} \times EF_r \times EV \times EC \times ABS_d \times CF_d \times \left[\frac{ED_{0-2} \times AF_c \times SA_c \times ADAF_{0-2}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{2-6} \times AF_c \times SA_c \times ADAF_{2-6}}{BW_c \times AT_c \times 365\ days/year} + \frac{ED_{6-16} \times AF_a \times SA_a \times ADAF_{6-16}}{BW_a \times AT_c \times 365\ days/year}\right.\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_d} \times \left[C_{soil} \times \left(\frac{AF_c \times ABS_d \times ED_{nc,c} \times EF_r \times EV \times EC \times SA_c \times CF_d}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}}\right)\right]$$

					Cancer		Noncancer	Noncancer
Phenol	0.00E+00	2.40E-02	1.00E-01	--	--	3.00E-01	1.0E-08	2.2E-10

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	**2E-07**	1.6E-02	3.6E-04
Pathway Sum with Total PCBs as Aroclors:	**2E-07**	1.7E-02	3.9E-04
Pathway Sum with Total PCBs as Congeners:	**2E-07**	2.3E-02	5.1E-04
Pathway Sum with PCBs as TEQ:	**2E-07**	1.6E-02	3.6E-04

Table B-9.1
Risk and Hazard Estimates: Ingestion of Water, Swimmer - RME

Definitions	Variable	Value		Equations
Averaging Time, carcinogens	AT_c	70	yrs	Carcinogenic:
Averaging Time, noncarcinogens, worker	$AT_{nc,a}$	20	yrs	
Body Weight, adult	BW_a	80	kg	$$Risk = SF_o \times \left[C_{water} \times \left(\frac{IRs \times EFs \times EDa \times FIs \times CFo}{BW_a \times AT_c \times 365 day/year} \right) \right]$$
Conversion Factor, ingestion	CF_o	1.0E-03	mg/µg	
COPC Concentration in Water	C_{water}	chemical-specific	µg/L	
Exposure Duration, adult	EDa	20	yrs	
Exposure Frequency, swimmer	EFs	150	days/yr	Noncarcinogenic:
Fraction Contaminated Water Ingested, swimmer	FIs	1.0	unitless	
Water Ingestion Rate, swimmer	IRWs	0.05	L/day	$$Hazard = \frac{1}{RfD_o} \times \left[C_{water} \times \left(\frac{IRs \times EFs \times EDa \times FIs \times CFo}{BW_a \times ATnca \times 365 day/year} \right) \right]$$
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Compound	Exposure Point Concentration (*µg/L*)	SF_o (*mg/kg-day*)$^{-1}$	Cancer Risk (*dimensionless*)	RfD_o (*mg/kg-day*)	Noncancer Hazard (Child) (*dimensionless*)	Noncancer Hazard (Adult) (*dimensionless*)
COPCs						
Arsenic	1.01E+00	1.50E+00	3E-07	3.00E-04	4.6E-03	8.6E-04
Total PCBs as Congeners (KM-based, capped)	2.09E-04	2.00E+00	8E-11	2.00E-05	1.4E-05	2.7E-06
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.09E-10	1.30E+05	3E-12	7.00E-10	2.1E-07	4.0E-08

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	3E-07	4.6E-03	8.6E-04
Pathway Sum with Total PCBs as Congeners:	3E-07	4.6E-03	8.6E-04
Pathway Sum with PCBs as TEQ:	3E-07	4.6E-03	8.6E-04

Table B-9.2
Risk and Hazard Estimates: Dermal Contact with Water, Swimmer - RME, River OU, Bradford Island

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,w}$	20	yrs
Body Weight, adult	BW_a	80	kg
COPC Absorbed Dose per Event	DA_{event}	chemical-specific	mg/cm^2-event
Exposure Duration, adult	ED_w	20	yrs
Exposure Frequency, swimmer	EF_w	150	days/yr
Event Frequency, swimmer	EV_w	1	events/day
Oral Reference Dose Adjusted for GI Absorption	RfD_d	chemical-specific	(mg/kg-day)
Exposed Body Surface Area, adult	SA_a	20900	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Carcinogenic:

$$Risk = SF_d \times \left[DA_{event} \times \left(\frac{EFs \times EDa \times EVs \times SAa}{BW_a \times AT_c \times 365 day/year} \right) \right]$$

Noncarcinogenic:

$$Hazard = \frac{1}{RfD_d} \times \left[DA_{event} \times \left(\frac{EFs \times EDa \times EVs \times SAa}{BW_a \times ATnca \times 365 day/year} \right) \right]$$

Compound	DA_{event} (*mg/cm^2-event*)	SF_D (*mg/kg-day*)$^{-1}$	Cancer Risk (*dimensionless*)	RfD_D (mg/kg-day)	Noncancer Hazard (Child) (*dimensionless*)	Noncancer Hazard (Adult) (*dimensionless*)
COPCs						
Arsenic	1.65E-09	1.50E+00	1E-07	3.00E-04	9.6E-04	5.9E-04
Total PCBs as Congeners (KM-based, capped)	2.19E-09	2.00E+00	2E-07	2.00E-05	1.9E-02	1.2E-02
PCBs as Mammal TEQ (KM-capped, RDL-based)	5.98E-16	1.30E+05	4E-09	7.00E-10	1.5E-04	9.2E-05

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	1E-07	9.6E-04	5.9E-04
Pathway Sum with Total PCBs as Congeners:	3E-07	2.0E-02	1.2E-02
Pathway Sum with PCBs as TEQ:	1E-07	1.1E-03	6.8E-04

Table B-9.3
Estimation of Kp, Tau(event), B, and t* for Organic Compounds, Swimmer - RME

Definition	Variable	Value		Equations
Permeability coefficient from water	K_p	Calculated (Equation 1	cm/hr	1) $K_p = 10^{(-2.8+0.66\,LogK_{OW} - 0.0056\,MW)}$
Octanol:water partition coefficient	K_{ow}	Chemical-specific	dimensionless	
Molecular weight	MW	Chemical-specific	g/mole	2) $\tau_{event} = \frac{(l_{sc})^2}{6D_{sc}}$
Lag time per event	t_{event}	Calculated (Equation 2	hr/event	
Thickness of the strateum corneum	l_{sc}	0.001	cm	
Effective diffusion coefficient, through the stratum corne	D_{sc}	Calculated (Equation 2	cm^2/hr	where: $D_{sc} = l_{sc} \times 10^{(-2.8-0.0056\,MW)}$
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Calculated (Equation 3	dimensionless	
Time it takes to reach steady state	t*	Calculated (Equation 4	hr	3) $B = K_p \frac{\sqrt{MW}}{2.6}$ (as an approximation)
Correlation coefficient	b	Calculated (Equation 4	dimensionless	
Correlation coefficient	c	Calculated (Equation 4	dimensionless	

4) $$If\ \ B \le 0.6: \quad t^* = 2.4\tau_{event}$$

$$If\ \ B > 0.6: \quad t^* = 6\tau_{event}\left(b - \sqrt{b^2 - c^2}\right)$$

where: $$c = \frac{1 + 3B + 3B^2}{3 \times (1 + B)}$$

$$b = \frac{2 \times (1 + B)^2}{\pi} - c$$

Compound	MW (*g/mole*)	$LogK_{OW}$ (*dimensionless*)	Kp (*cm/hr*)	t_{event} (*hr/event*)	B (*dimensionless*)	c (*dimensionless*)	b (*dimensionless*)	t* (*hr*)
COPCs								
Arsenic	77.95	6.80E-01	1.63E-03	2.87E-01	5.54E-03	3.37E-01	3.07E-01	6.90E-01
Total PCBs as Congeners (KM-based, capped)	291.99	7.10E+00	1.78E+00	4.54E+00	1.17E+01	1.17E+01	9.11E+01	2.07E+01
PCBs as Mammal TEQ (KM-capped, RDL-based)	321.98	6.80E+00	7.67E-01	6.68E+00	5.29E+00	5.35E+00	1.99E+01	2.94E+01

Table B-9.4
Calculation of Dose Absorbed Per Unit Area Per Event (DAevent), Swimmer - RME, River OU, Bradford Island

Definition	Variable	Value		Equations
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Chemical-specific	dimensionless	*Organics:*
				If $t_{event} \leq t^*$, then:
Concentration of chemical in water	C_w	Measured	mg/cm^3	$DA_{event} = 2FA_w \times K_p \times (C_w \times CF_d) \times \left(\sqrt{\frac{6\tau_{event} t_{event}}{\pi}}\right)$
Conversion Factor	CF_d	1.0E-06	(mg L) / (µg cm^3)	
Dose absorbed per unit area per event	DA_{event}	Calculated	mg/cm^2-event	
Fraction Absorbed	FA_w	1	dimensionless	If $t_{event} > t^*$, then:
Permeability coefficient from water	K_p	Chemical-specific	cm/hr	$DA_{event} = FA_w \times K_p \times (C_w \times CF_d) \times \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$
Lag time per event	t_{event}	Chemical-specific	hr/event	
Duration of event	t_{event}	1	hr/event	
Time it takes to reach steady state	t*	Chemical-specific	hr	*Inorganics:*
				$DA_{event} = K_p \times (C_w \times CF_d) \times t_{event}$

Compound	K_p [a] (*cm/hr*)	C_w [b] (*µg/L*)	t_{event} [c] (*hr/event*)	t* [c] (*hr*)	B [c] (*dimensionless*)	DA_{event} (*mg/cm^2-event*)
COPCs						
Arsenic	1.63E-03	1.01E+00	2.87E-01	6.90E-01	5.54E-03	1.65E-09
Total PCBs as Congeners (KM-based, capped	1.78E+00	2.09E-04	4.54E+00	2.07E+01	1.17E+01	2.19E-09
PCBs as Mammal TEQ (KM-capped, RDL-bas	7.67E-01	1.09E-10	6.68E+00	2.94E+01	5.29E+00	5.98E-16

[a] Table B-9.3.
[b] from Table 1-4.
[c] from Table B-9.2.

Table B-10.1
Risk and Hazard Estimates -- Ingestion of Water, Swimmer - CTE

Definitions	Variable	Value		Equations
Exposure Duration, child	Edc	6	yrs	
Averaging Time, noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Averaging Time, carcinogens	AT_c	70	yrs	Carcinogenic:
Averaging Time, noncarcinogens, adult	$AT_{nc,a}$	3	yrs	
Body Weight, adult	BW_a	80	kg	
Conversion Factor, ingestion	CF_o	1.0E-03	mg/µg	
COPC Concentration in Water	C_{water}	chemical-specific	µg/L	
Exposure Duration, adult	EDa	3	yrs	
Exposure Frequency, swimmer	EFs	5	days/yr	Noncarcinogenic:
Fraction Contaminated Water Ingested, swimmer	FIs	1.0	unitless	
Water Ingestion Rate, swimmer	IRWs	0.05	L/day	
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day	
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Carcinogenic:

$$Risk = SF_o \times \left[C_{water} \times \left(\frac{IRs \times EFs \times EDa \times FIs \times CFo}{BW_a \times AT_c \times 365 day/year} \right) \right]$$

Noncarcinogenic:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{water} \times \left(\frac{IRs \times EFs \times EDa \times FIs \times CFo}{BW_a \times ATnca \times 365 day/year} \right) \right]$$

Compound	Exposure Point Concentration (*µg/L*)	SF_o (*mg/kg-day*)$^{-1}$	Cancer Risk (*dimensionless*)	RfD_o (*mg/kg-day*)	Noncancer Hazard (Child) (*dimensionless*)	Noncancer Hazard (Adult) (*dimensionless*)
COPCs						
Arsenic	1.01E+00	1.50E+00	6E-09	3.00E-04	1.5E-04	2.9E-05
Total PCBs as Congeners (KM-based, capped)	2.09E-04	2.00E+00	2E-12	2.00E-05	4.8E-07	9.0E-08
PCBs as Mammal TEQ (KM-capped, RDL-based)	1.09E-10	1.30E+05	6E-14	7.00E-10	7.1E-09	1.3E-09

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	6E-09	1.5E-04	2.9E-05
Pathway Sum with Total PCBs as Congeners:	6E-09	1.5E-04	2.9E-05
Pathway Sum with PCBs as TEQ:	6E-09	1.5E-04	2.9E-05

Table B-10.2
Risk and Hazard Estimates: Dermal Contact with Water, Swimmer - CTE, River OU, Bradford Island

Definition	Variable	Value	
Averaging Time, carcinogens	AT_c	70	yrs
Averaging Time, noncarcinogens, adult	$AT_{nc,w}$	3	yrs
Body Weight, adult	BW_a	80	kg
COPC Absorbed Dose per Event	DA_{event}	chemical-specific	mg/cm^2-event
Exposure Duration, adult	ED_w	3	yrs
Exposure Frequency, swimmer	EF_w	5	days/yr
Event Frequency, swimmer	EV_w	1	events/day
Oral Reference Dose Adjusted for GI Absorption	RfD_d	chemical-specific	(mg/kg-day)
Exposed Body Surface Area, adult	SA_a	20000	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_d	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Carcinogenic:

$$Risk = SF_d \times \left[DA_{event} \times \left(\frac{EFs \times EDa \times EVs \times SAa}{BW_a \times AT_c \times 365\, day/year} \right) \right]$$

Noncarcinogenic:

$$Hazard = \frac{1}{RfD_d} \times \left[DA_{event} \times \left(\frac{EFs \times EDa \times EVs \times SAa}{BW_a \times ATnc \times 365\, day/year} \right) \right]$$

Compound	**DA_{event}** (*mg/cm^2-event*)	**SF_D** (*$(mg/kg\text{-}day)^{-1}$*)	**Cancer Risk** (*dimensionless*)	**RfD_D** (mg/kg-day)	**Noncancer Hazard (Child)** (*dimensionless*)	**Noncancer Hazard (Adult)** (*dimensionless*)
COPCs						
Arsenic	8.23E-10	1.50E+00	8E-10	3.00E-04	1.6E-05	9.4E-06
Total PCBs as Congeners (KM-based, capped)	1.55E-09	2.00E+00	2E-09	2.00E-05	4.5E-04	2.7E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	4.23E-16	1.30E+05	4E-11	7.00E-10	3.5E-06	2.1E-06

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	8E-10	1.6E-05	9.4E-06
Pathway Sum with Total PCBs as Congeners:	3E-09	4.7E-04	2.8E-04
Pathway Sum with PCBs as TEQ:	8E-10	2.0E-05	1.1E-05

Table B-10.3
Estimation of Kp, Tau(event), B, and t* for Organic Compounds, Swimmer - CTE

Definition	Variable	Value		Equations
Permeability coefficient from water	K_p	Calculated (Equation 1)	cm/hr	1) $K_p = 10^{(-2.8+0.66\,LogK_{OW} - 0.0056\,MW)}$
Octanol:water partition coefficient	K_{ow}	Chemical-specific	dimensionless	
Molecular weight	MW	Chemical-specific	g/mole	2) $\tau_{event} = \frac{(l_{sc})^2}{6D_{sc}}$
Lag time per event	t_{event}	Calculated (Equation 2)	hr/event	
Thickness of the strateum corneum	l_{sc}	0.001	cm	
Effective diffusion coefficient, through the stratum corne	D_{sc}	Calculated (Equation 2)	cm^2/hr	where: $D_{sc} = l_{sc} \times 10^{(-2.8-0.0056\,MW)}$
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Calculated (Equation 3)	dimensionless	
Time it takes to reach steady state	t*	Calculated (Equation 4)	hr	3) $B = K_p \frac{\sqrt{MW}}{2.6}$ (as an approximation)
Correlation coefficient	b	Calculated (Equation 4)	dimensionless	
Correlation coefficient	c	Calculated (Equation 4)	dimensionless	

4) $If \;\; B \le 0.6: \quad t^* = 2.4\tau_{event}$

$$If \;\; B > 0.6: \quad t^* = 6\tau_{event}\left(b - \sqrt{b^2 - c^2}\right)$$

where: $c = \frac{1 + 3B + 3B^2}{3 \times (1 + B)}$

$$b = \frac{2 \times (1 + B)^2}{\pi} - c$$

Compound	MW (*g/mole*)	$LogK_{OW}$ (*dimensionless*)	Kp (*cm/hr*)	t_{event} (*hr/event*)	B (*dimensionless*)	c (*dimensionless*)	b (*dimensionless*)	t* (*hr*)
COPCs								
Arsenic	77.95	6.80E-01	1.63E-03	2.87E-01	5.54E-03	3.37E-01	3.07E-01	6.90E-01
Total PCBs as Congeners (KM-based, capped)	291.99	7.10E+00	1.78E+00	4.54E+00	1.17E+01	1.17E+01	9.11E+01	2.07E+01
PCBs as Mammal TEQ (KM-capped, RDL-based)	321.98	6.80E+00	7.67E-01	6.68E+00	5.29E+00	5.35E+00	1.99E+01	2.94E+01

Table B-10.4
Calculation of Dose Absorbed Per Unit Area Per Event (DAevent), Swimmer - CTE, River OU, Bradford Island

Definition	Variable	Value		Equations
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Chemical-specific	dimensionless	*Organics:*
				If $t_{event} \le t^*$, then:
Concentration of chemical in water	C_w	Measured	mg/cm^3	$DA_{event} = 2FA_w \times K_p \times (C_w \times CF_d) \times \left(\sqrt{\frac{6\tau_{event} t_{event}}{\pi}}\right)$
Conversion Factor	CF_d	1.0E-06	$(mg\ L) / (\mu g\ cm^3)$	
Dose absorbed per unit area per event	DA_{event}	Calculated	mg/cm^2-event	
Fraction Absorbed	FA_w	1	dimensionless	If $t_{event} > t^*$, then:
Permeability coefficient from water	K_p	Chemical-specific	cm/hr	$DA_{event} = FA_w \times K_p \times (C_w \times CF_d) \times \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$
Lag time per event	t_{event}	Chemical-specific	hr/event	
Duration of event	t_{event}	0.5	hr/event	
Time it takes to reach steady state	t*	Chemical-specific	hr	*Inorganics:*
				$DA_{event} = K_p \times (C_w \times CF_d) \times t_{event}$

Compound	K_p [a] (*cm/hr*)	C_w [b] (*µg/L*)	t_{event} [c] (*hr/event*)	t* [c] (*hr*)	B [c] (*dimensionless*)	DA_{event} (*mg/cm^2-event*)
COPCs						
Arsenic	1.63E-03	1.01E+00	2.87E-01	6.90E-01	5.54E-03	8.23E-10
Total PCBs as Congeners (KM-based, capped	1.78E+00	2.09E-04	4.54E+00	2.07E+01	1.17E+01	1.55E-09
PCBs as Mammal TEQ (KM-capped, RDL-bas	7.67E-01	1.09E-10	6.68E+00	2.94E+01	5.29E+00	4.23E-16

[a] Table B-9.3.
[b] from Table 1-4.
[c] from Table B-10.3.

Table B-11.1
Risk and Hazard Estimates: Ingestion of Water, Hypothetical Downstream Potable Water User - RME

Definitions	Variable	Value	
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, Noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor, ingestion exposure	CF_o	1.0E-03	mg/µg
COPC Concentration in Water	C_{water}	chemical-specific	µg/L
Exposure Duration, adult	ED_a	20	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	350	days/yr
Fraction Contaminated Water Ingested, resident	FI_r	1.0	unitless
Water Ingestion Rate, adult	IRW_a	2.5	L/day
Water Ingestion Rate, child	IRW_c	0.78	L/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{water} \times EF_r \times FI_r \times CF_O \times \left(\frac{IRW_c \times ED_c}{BW_c \times AT_c \times 365\frac{day}{year}} + \frac{IRW_a \times ED_a}{BW_a \times AT_c \times 365\frac{day}{year}}\right)\right]$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{water} \times \left(\frac{IRW_c \times ED_c \times EF_r \times FI_r \times CF_O}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{water} (*µg/L*)	SF_o (*mg/kg-day*)$^{-1}$	Cancer Risk (*dimensionless*)	RfD_o (*mg/kg-day*)	Noncancer Hazard (Child) (*dimensionless*)	Noncancer Hazard (Adult) (*dimensionless*)
COPCs							
Arsenic	0	1.01E+00	1.50E+00	2E-05	3.00E-04	1.7E-01	1.0E-01
Total PCBs as Congeners (KM-based, capped)	0	2.09E-04	2.00E+00	5E-09	2.00E-05	5.2E-04	3.1E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	0	1.09E-10	1.30E+05	2E-10	7.00E-10	7.8E-06	4.7E-06

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	2E-05	1.7E-01	1.0E-01
Pathway Sum with PCBs as TEQ:	2E-05	1.7E-01	1.0E-01
Pathway Sum with Total PCBs as Congeners:	2E-05	1.7E-01	1.0E-01

Table B-11.2
Risk and Hazard Estimates: Dermal Contact with Water, Hypothetical Downstream Potable Water User - RME

Definition	Variable	Value		Equations
Averaging Time, Carcinogens	AT_c	70	yrs	Cancer Risk:
Averaging Time, Noncarcinogens, adult	$AT_{nc,a}$	20	yrs	Nonmutagenic:
Averaging Time, Noncarcinogens, child	$AT_{nc,c}$	6	yrs	
Body Weight, adult	BW_a	80	kg	
Body Weight, child	BW_c	15	kg	
COPC Absorbed Dose per Event	DA_{event}	chemical-specific	mg/cm^2-event	
Exposure Duration, adult	ED_a	20	yrs	
Exposure Duration, child	ED_c	6	yrs	
Exposure Frequency, resident	EF_r	350	days/yr	
Event Frequency, resident	EV_r	1	events/day	
Oral Reference Dose Adjusted for GI Absorption	RfD_d	chemical-specific	(mg/kg-day)	
Exposed Body Surface Area, adult	SA_a	20900	cm^2	Noncancer:
Exposed Body Surface Area, child	SA_c	6378	cm^2	
Oral Slope Factor Adjusted for GI Absorption	SF_D	chemical-specific	$(mg/kg\text{-}day)^{-1}$	

Nonmutagenic:

$$Risk = SF_D \times [EF_r \times EV_r \times \left(\frac{DA_{event,child} \times ED_c \times SA_c}{BW_c \times AT_c \times 365 \frac{day}{year}} + \frac{DA_{event,adult} \times ED_a \times SA_a}{BW_a \times AT_c \times 365 \frac{day}{year}} \right)]$$

Noncancer:

$$Hazard = \frac{1}{RfD_d} \times \left[EV_r \times \left(\frac{DA_{event,child} \times ED_c \times SA_c \times EF_r}{BW_c \times AT_{nc,c} \times 365 \frac{day}{year}} \right) \right]$$

Analyte	Mutagen?	$DA_{event,child}$ [a] (mg/cm²-event)	$DA_{event,adult}$ [a] (mg/cm²-event)	SF_D [b] $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	% of Total	RfD_D [b] (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
COPCs									
Arsenic	0	5.45E-10	7.17E-10	1.50E+00	1E-07	100%	3.00E-04	7.4E-04	6.0E-04
Total PCBs as Congeners (KM-based, capped)	0	--	--	2.00E+00	--	--	2.00E-05	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	0	--	--	1.30E+05	--	--	7.00E-10	--	--
					Cancer Risk			Hazard Index (Child)	Hazard Index (Adult)
				Pathway Sums:	1E-07			7.4E-04	6.0E-04

[a] from Table B-11.4

-- = No value

Table B-11.3

Estimation of Kp, Tau(event), B, and t* for Organic Compounds, Hypothetical Downstream Potable Water User - RME

Definition	Variable	Value		Equations
Permeability coefficient from water	K_p	Calculated (Equation 1)	cm/hr	1) $K_p = 10^{(-2.8+0.66 LogK_{OW} - 0.0056MW)}$
Octanol:water partition coefficient	K_{ow}	Chemical-specific	dimensionless	
Molecular weight	MW	Chemical-specific	g/mole	2) $\tau_{event} = \frac{(l_{sc})^2}{6D_{sc}}$
Lag time per event	t_{event}	Calculated (Equation 2)	hr/event	
Thickness of the strateum corneum	l_{sc}	0.001	cm	
Effective diffusion coefficient, through the stratum corne	D_{sc}	Calculated (Equation 2)	cm^2/hr	where: $D_{sc} = l_{sc} \times 10^{(-2.8-0.0056MW)}$
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Calculated (Equation 3)	dimensionless	3) $B = K_p \frac{\sqrt{MW}}{2.6}$ (as an approximation)
Time it takes to reach steady state	t*	Calculated (Equation 4)	hr	
Correlation coefficient	b	Calculated (Equation 4)	dimensionless	
Correlation coefficient	c	Calculated (Equation 4)	dimensionless	4) If $B \leq 0.6$: $t^* = 2.4\tau_{event}$

If $B > 0.6$: $t^* = 6\tau_{event}\left(b - \sqrt{b^2 - c^2}\right)$

where: $c = \frac{1 + 3B + 3B^2}{3 \times (1 + B)}$

$$b = \frac{2 \times (1+B)^2}{\pi} - c$$

Analyte	MW (*g/mole*)	$LogK_{OW}$ (*dimensionless*)	Kp[a] (*cm/hr*)	t_{event} (*hr/event*)	B (*dimensionless*)	c (*dimensionless*)	b (*dimensionless*)	t* (*hr*)
COPCs								
Arsenic	77.95	6.80E-01	1.00E-03	2.87E-01	3.40E-03	3.36E-01	3.05E-01	6.90E-01
Total PCBs as Congeners (KM-based, capped)	291.99	7.10E+00	NRP	4.54E+00	--	--	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	321.98	6.80E+00	NRP	6.68E+00	--	--	--	--

[a] NRP = Not reliably predicted; the compound's chemical properties fall outside the Effective Prediction Domain for Kp (Equations 3.9 and 3.10; USEPA 2004).

-- = No value

Table B-11.4
Calculation of Dose Absorbed Per Unit Area Per Event (DAevent), Hypothetical Downstream Potable Water User - RME

Definition	Variable	Value		Equations
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Chemical-specific	dimensionless	*Organics:*
Concentration of chemical in water	C_{water}	Measured	µg/L	If $t_{event,[receptor]} \le t^*$, then: $DA_{event,[receptor]} = 2FA_r \times K_p \times (C_{water} \times CF_d) \times \left(\sqrt{\frac{6\tau_{event} \times t_{event,[receptor]}}{\pi}}\right)$
Conversion Factor	CF_d	1.0E-06	(mg·L) / (µg·cm³)	
Dose absorbed per unit area per event	DA_{event}	Calculated	mg/cm²-event	If $t_{event,[receptor]} > t^*$, then:
Fraction Absorbed, resident	FA_r	Chemical-specific	dimensionless	$DA_{event,[receptor]} = FA_r \times K_p \times (C_{water} \times CF_d) \times \left\{\frac{t_{event,[receptor]}}{1+B} + 2\tau_{event} \times \left[\frac{1+3B+3B^2}{(1+B)^2}\right]\right\}$
Permeability coefficient from water	K_p	Chemical-specific	cm/hr	
Lag time per event	t_{event}	Chemical-specific	hr/event	*Inorganics:*
Duration of event, child	$t_{event,child}$	0.54	hr/event	$DA_{event,[receptor]} = K_p \times (C_{water} \times CF_d) \times t_{event,[receptor]}$
Duration of event, adult	$t_{event,adult}$	0.71	hr/event	
Time it takes to reach steady state	t*	Chemical-specific	hr	

Analyte	FA_r[a] (*dimensionless*)	K_p[b] (*cm/hr*)	C_{water}[c] (*µg/L*)	t_{event}[d] (*hr/event*)	t*[d] (*hr*)	B[d] (*dimensionless*)	$DA_{event,child}$ (*mg/cm² -event*)	$DA_{event,adult}$ (*mg/cm² -event*)
COPCs								
Arsenic	--	1.00E-03	1.01E+00	2.87E-01	6.90E-01	3.40E-03	5.45E-10	7.17E-10
Total PCBs as Congeners (KM-based, capped)	1	NRP	2.09E-04	4.54E+00	--	--	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	1	NRP	1.09E-10	6.68E+00	--	--	--	--

[b] FA_r for organic chemicals is from Exhibit B-3, USEPA (2004. RAGS Part E. EPA/540/R/99/005); for chemicals not listed in Exhibit B-3, a default value of 1.0 was used.
[b] K_p for inorganics is from USEPA (2004. RAGS Part E. EPA/540/R/99/005);
NRP = Not Reliably Predicted
[c] from Table 1-4.
[d] from Table B-11.5.

-- = No value

Table B-12.1
Risk and Hazard Estimates -- Ingestion of Water, Hypothetical Downstream Potable Water User - CTE

Definitions	Variable	Value	
Averaging Time, Noncarcinogens, adult	$AT_{nc,c}$	3	yrs
Averaging Time, Carcinogens	Ata	70	yrs
Averaging Time, Noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
Conversion Factor, ingestion exposure	CF_o	1.0E-03	mg/µg
COPC Concentration in Water	C_{water}	chemical-specific	µg/L
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	350	days/yr
Fraction Contaminated Water Ingested, resident	FI_r	1.0	unitless
Water Ingestion Rate, adult	IRW_a	1.4	L/day
Water Ingestion Rate, child	IRW_c	0.78	L/day
Oral Reference Dose	RfD_O	chemical-specific	mg/kg-day
Oral Slope Factor	SF_O	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

Nonmutagens:

$$Risk = SF_o \times \left[C_{water} \times EF_r \times FI_r \times CF_O \times \left(\frac{IRW_c \times ED_c}{BW_c \times AT_c \times 365\,\frac{day}{year}} + \frac{IRW_a \times ED_a}{BW_a \times AT_c \times 365\,\frac{dc}{ye}}\right.\right.$$

Noncancer Hazard:

$$Hazard = \frac{1}{RfD_o} \times \left[C_{water} \times \left(\frac{IRW_c \times ED_c \times EF_r \times FI_r \times CF_O}{BW_c \times AT_{nc,c} \times 365\ day/year}\right)\right]$$

Analyte	Mutagen?	C_{water} (µg/L)	SF_o $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	RfD_o (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
COPCs							
Arsenic	0	1.01E+00	1.50E+00	8E-06	3.00E-04	1.7E-01	5.6E-02
Total PCBs as Congeners (KM-based, capped)	0	2.09E-04	2.00E+00	2E-09	2.00E-05	5.2E-04	1.8E-04
PCBs as Mammal TEQ (KM-capped, RDL-based)	0	1.09E-10	1.30E+05	7E-11	7.00E-10	7.8E-06	2.6E-06

	Cancer Risk	Hazard Index (Child)	Hazard Index (Adult)
Pathway Sum Excluding PCBs:	8E-06	1.7E-01	5.6E-02
Pathway Sum with PCBs as TEQ:	8E-06	1.7E-01	5.6E-02
Pathway Sum with Total PCBs as Congeners:	8E-06	1.7E-01	5.7E-02

Table B-12.2

Risk and Hazard Estimates: Dermal Contact with Water, Hypothetical Downstream Potable Water User - CTE

Definition	Variable	Value	
Averaging Time, Carcinogens	AT_c	70	yrs
Averaging Time, Noncarcinogens, adult	$AT_{nc,a}$	3	yrs
Averaging Time, Noncarcinogens, child	$AT_{nc,c}$	6	yrs
Body Weight, adult	BW_a	80	kg
Body Weight, child	BW_c	15	kg
COPC Absorbed Dose per Event	DA_{event}	chemical-specific	mg/cm^2-event
Exposure Duration, adult	ED_a	3	yrs
Exposure Duration, child	ED_c	6	yrs
Exposure Frequency, resident	EF_r	350	days/yr
Event Frequency, resident	EV_r	1	events/day
Oral Reference Dose Adjusted for GI Absorption	RfD_d	chemical-specific	(mg/kg-day)
Exposed Body Surface Area, adult	SA_a	20000	cm^2
Exposed Body Surface Area, child	SA_c	6378	cm^2
Oral Slope Factor Adjusted for GI Absorption	SF_D	chemical-specific	$(mg/kg\text{-}day)^{-1}$

Equations

Cancer Risk:

Nonmutagenic:

$$Risk = SF_D \times [EF_r \times EV_r \times \left(\frac{DA_{event,child} \times ED_c \times SA_c}{BW_c \times AT_c \times 365\frac{day}{year}} + \frac{DA_{event,adult} \times ED_a \times SA_a}{BW_a \times AT_c \times 365\frac{day}{year}}\right)$$

Noncancer:

$$Hazard = \frac{1}{RfD_d} \times \left[EV_r \times \left(\frac{DA_{event,child} \times ED_c \times SA_c \times EF_r}{BW_c \times AT_{nc,c} \times 365\frac{day}{year}}\right)\right]$$

Analyte	Mutagen?	$DA_{event,child}$ [a] (mg/cm^2-event)	$DA_{event,adult}$ [a] (mg/cm^2-event)	SF_D [b] $(mg/kg\text{-}day)^{-1}$	Cancer Risk (dimensionless)	% of Total	RfD_D [b] (mg/kg-day)	Noncancer Hazard (Child) (dimensionless)	Noncancer Hazard (Adult) (dimensionless)
COPCs									
Arsenic	0	1.62E-10	1.62E-10	1.50E+00	1E-08	100%	3.00E-04	2.2E-04	1.3E-04
Total PCBs as Congeners (KM-based, capped)	0	--	--	2.00E+00	--	--	2.00E-05	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	0	--	--	1.30E+05	--	--	7.00E-10	--	--
				Pathway Sums:	Cancer Risk 1E-08			Hazard Index (Child) 2.2E-04	Hazard Index (Adult) 1.3E-04

[a] from Table B-11.4

-- = No value

Table B-12.3
Estimation of Kp, Tau(event), B, and t* for Organic Compounds, Hypothetical Downstream Potable Water User - CTE

Definition	Variable	Value	
Permeability coefficient from water	K_p	Calculated (Equation 1)	cm/hr
Octanol:water partition coefficient	K_{ow}	Chemical-specific	dimensionless
Molecular weight	MW	Chemical-specific	g/mole
Lag time per event	t_{event}	Calculated (Equation 2)	hr/event
Thickness of the strateum corneum	l_{sc}	0.001	cm
Effective diffusion coefficient, through the stratum corneum	D_{sc}	Calculated (Equation 2)	cm^2/hr
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Calculated (Equation 3)	dimensionless
Time it takes to reach steady state	t*	Calculated (Equation 4)	hr
Correlation coefficient	b	Calculated (Equation 4)	dimensionless
Correlation coefficient	c	Calculated (Equation 4)	dimensionless

Equations

1) $$K_p = 10^{(-2.8+0.66LogK_{OW}-0.0056MW)}$$

2) $$\tau_{event} = \frac{(l_{sc})^2}{6D_{sc}}$$

where: $$D_{sc} = l_{sc} \times 10^{(-2.8-0.0056MW)}$$

3) $$B = K_p \frac{\sqrt{MW}}{2.6}$$ (as an approximation)

4) If $B \le 0.6$: $t^* = 2.4\tau_{event}$

If $B > 0.6$: $t^* = 6\tau_{event}\left(b - \sqrt{b^2 - c^2}\right)$

where: $$c = \frac{1 + 3B + 3B^2}{3 \times (1 + B)}$$

$$b = \frac{2 \times (1 + B)^2}{\pi} - c$$

Analyte	MW (*g/mole*)	$LogK_{OW}$ (*dimensionless*)	Kp[a] (*cm/hr*)	t_{event} (*hr/event*)	B (*dimensionless*)	c (*dimensionless*)	b (*dimensionless*)	t* (*hr*)
COPCs								
Arsenic	77.95	6.80E-01	1.00E-03	2.87E-01	3.40E-03	3.36E-01	3.05E-01	6.90E-01
Total PCBs as Congeners (KM-based, capped)	291.99	7.10E+00	NRP	4.54E+00	--	--	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	321.98	6.80E+00	NRP	6.68E+00	--	--	--	--

[a] NRP = Not reliably predicted; the compound's chemical properties fall outside the Effective Prediction Domain for Kp (Equations 3.9 and 3.10; USEPA 2004).

-- = No value

Table B-12.4

Calculation of Dose Absorbed Per Unit Area Per Event (DAevent), Hypothetical Downstream Potable Water User - CTE

Definition	Variable	Value		Equations
Relative contribution of permeability coefficients in stratum corneum and viable epidermis	B	Chemical-specific	dimensionless	*Organics:*
Concentration of chemical in water	C_{water}	Measured	µg/L	If $t_{event,[receptor]} \leq t^*$, then: $DA_{event,[receptor]} = 2FA_r \times K_p \times (C_{water} \times CF_d) \times \left(\sqrt{\frac{6\tau_{event} \times t_{event,[receptor]}}{\pi}}\right)$
Conversion Factor	CF_d	1.0E-06	(mg·L) / (µg·cm^3)	
Dose absorbed per unit area per event	DA_{event}	Calculated	mg/cm^2-event	If $t_{event,[receptor]} > t^*$, then:
Fraction Absorbed, resident	FA_r	Chemical-specific	dimensionless	$DA_{event,[receptor]} = FA_r \times K_p \times (C_{water} \times CF_d) \times \left\{\frac{t_{event,[receptor]}}{1+B} + 2\tau_{event} \times \left[\frac{1+3B+3B^2}{(1+B)^2}\right]\right\}$
Permeability coefficient from water	K_p	Chemical-specific	cm/hr	
Lag time per event	t_{event}	Chemical-specific	hr/event	*Inorganics:*
Duration of event, child	$t_{event,child}$	0.16	hr/event	$DA_{event,[receptor]} = K_p \times (C_{water} \times CF_d) \times t_{event,[receptor]}$
Duration of event, adult	$t_{event,adult}$	0.16	hr/event	
Time it takes to reach steady state	t*	Chemical-specific	hr	

Analyte	FA_r [a] (*dimensionless*)	K_p [b] (*cm/hr*)	C_{water} [c] (*µg/L*)	t_{event} [d] (*hr/event*)	t* [d] (*hr*)	B [d] (*dimensionless*)	$DA_{event,child}$ (*mg/cm^2-event*)	$DA_{event,adult}$ (*mg/cm^2-event*)
COPCs								
Arsenic	--	1.00E-03	1.01E+00	2.87E-01	6.90E-01	3.40E-03	1.62E-10	1.62E-10
Total PCBs as Congeners (KM-based, capped)	1	NRP	2.09E-04	4.54E+00	--	--	--	--
PCBs as Mammal TEQ (KM-capped, RDL-based)	1	NRP	1.09E-10	6.68E+00	--	--	--	--

[b] FA_r for organic chemicals is from Exhibit B-3, USEPA (2004. RAGS Part E. EPA/540/R/99/005); for chemicals not listed in Exhibit B-3, a default value of 1.0 was used.

[b] K_p for inorganics is from USEPA (2004. RAGS Part E. EPA/540/R/99/005);
NRP = Not Reliably Predicted

[c] from Table 1-4.

[d] from Table B-12.3.

-- = No value

APPENDIX C

Assessment and Measurement Endpoints for River OU BERA

Table C-1. Assessment and Measurement Endpoints for Ecological Risk Assessment

Assessment Endpoints	Measurement Endpoints: Measures of Exposure	Measurement Endpoints: Measures of Effect
River OU		
Protection of the trophic level 1 infaunal community with no unacceptable effects on reproduction, growth, or development on a population level due to contaminants of interest (COIs) in sediment and porewater.	Measured concentrations in sediment from 0 to 1 foot below ground surface (bgs) and surface water that reduce reproduction, health, and/or survival of populations in the trophic level 1 infaunal community.	Potential toxicity due to exceedances of screening values protective of the benthic community or observed toxicity in toxicity tests (ODEQ 2001; LWG 2007; MacDonald et al. 2000).
Protection of the trophic level 1 epibenthic community with no unacceptable effects on reproduction, growth, or development on a population level due to COIs in sediment and surface water.	Measured concentrations in sediment from 0 to 1 foot bgs and surface water (or groundwater discharging to the river) that reduce reproduction, health, and/or survival of populations in the epibenthic community.	Potential toxicity due to exceedances of screening values protective of the benthic and aquatic communities or observed toxicity in toxicity tests (ODEQ 2001; LWG 2007; MacDonald et al. 2000; Suter et al. 1996; ODEQ Water Quality Criteria [WQC] OAR 340-041; USEPA 2006).
Protection of the trophic level 1 epibenthic and infaunal community, represented by the **Asian clam**, with no unacceptable effects on reproduction, growth, or development on a population level due to COIs in sediment, porewater, and surface water.	Measured concentrations in sediment from 0 to 1 foot bgs, surface water (or groundwater discharging to the river), and clam tissue that reduce reproduction, health, and/or survival of populations of trophic level 1 epibenthic community.	Potential toxicity due to exceedances of screening values protective of the benthic community or observed toxicity in toxicity and bioaccumulation tests based on survival, growth, and reproduction of resident populations of Corbicula clam (ODEQ 2001; LWG 2007; MacDonald et al 2000; Suter et al. 1996; ODEQ WQC OAR 340-041; USEPA 2006).
Protection of the trophic level 2-3 epibenthic community, represented by the **crayfish**, with no unacceptable effects on reproduction, growth, or development on a population level due to COIs in sediment and surface water.	Measured concentrations in sediment from 0 to 1 foot bgs, surface water (or groundwater discharging to the river) and tissue that reduce reproduction, health, and/or survival of populations of the trophic level 2-3 epibenthic community.	Potential toxicity due to exceedances of screening values protective of the benthic community or observed toxicity in toxicity and bioaccumulation tests based on survival, growth, and reproduction of resident populations of crayfish (ODEQ 2001; LWG 2007; MacDonald et al 2000; Suter et al. 1996; ODEQ WQC OAR 340-041; USEPA 2006).

Table C-1. Assessment and Measurement Endpoints for Ecological Risk Assessment

Assessment Endpoints	Measurement Endpoints	
	Measures of Exposure	**Measures of Effect**
Protection of herbivorous or invertivorous fish (trophic level 2), represented by the largescale sucker, with no unacceptable effects on reproduction, growth, or development on the population level due to COIs in sediment, surface water, and prey.	Measured concentrations in sediment from 0 to 1 foot bgs, surface water (or groundwater discharging to the river), and fish tissues that reduce reproduction, health, and/or survival of populations of trophic level 2 fish.	Potential toxicity due to exceedances of screening values protective of the aquatic community or observed toxicity in bioaccumulation and toxicity tests based on survival, growth, and reproduction of resident populations of trophic level 2 fish (ODEQ 2001; LWG 2007; MacDonald et al 2000; Suter et al. 1996; USEPA 2006; USACE/USEPA 2005).
Protection of invertivorous and piscivorous fish (trophic level 3), represented by the **sculpin**, with no unacceptable effects on reproduction, growth, or development on the population level due to COIs in sediment, surface water, and prey.	Measured concentrations in sediment from 0 to 1 foot bgs, surface water (or groundwater discharging to the river), and fish tissues that reduce reproduction, health, and/or survival of populations of trophic level 3 fish.	Potential toxicity due to exceedances of screening values protective of the aquatic community or observed toxicity in bioaccumulation and toxicity tests based on survival, growth, and reproduction of resident populations of trophic level 3 fish (ODEQ 2007; LWG 2007; USACE/USEPA 2005; ODEQ WQC OAR 340-041; USEPA 2006).
Protection of top level predator fish (trophic level 4), represented by the **smallmouth bass**, walleye pike and northern pikeminnow, with no unacceptable effects on reproduction, growth, or development on the population level due to COIs in sediment, surface water, and prey.	Measured concentrations in sediment from 0 to 1 foot bgs, surface water (or groundwater discharging to the river), and fish tissues that reduce reproduction, health, and/or survival of populations of top-level predatory fish.	Potential toxicity due to exceedances of screening values protective of the aquatic community or observed toxicity in bioaccumulation and toxicity tests based on survival, growth, and reproduction of resident populations of top-level predatory fish (ODEQ 2007; LWG 2007; USACE/USEPA 2005; ODEQ WQC OAR 340-041; USEPA 2006).
Protection of large carnivorous mammals (trophic level 3-4), represented by the **mink**, with no unacceptable effects on reproduction, growth, or development on a population level due to COIs in sediment, aquatic invertebrates, and fish.	Measured or estimated concentrations in sediment from 0 to 1 foot bgs, surface water, and fish and shellfish tissues that reduce reproduction, health, and/or survival of populations of large carnivorous mammals.	Potential or observed toxicity due to exceedances of screening values and/or acceptable hazard quotients related to survival, growth, and reproduction of resident populations of mink (ODEQ 2001; ODEQ 2007; LWG 2007; USEPA 2005; Sample et al. 1996).

Table C-1. Assessment and Measurement Endpoints for Ecological Risk Assessment

Assessment Endpoints	Measurement Endpoints	
	Measures of Exposure	Measures of Effect
Protection of top-level piscivorous threatened or endangered birds (trophic level 3-4), represented by the **bald eagle**, with no unacceptable effects on reproduction, growth, or development on an individual level due to COIs in sediment and fish.	Measured or estimated concentrations in surface water and fish tissues, and predicted concentrations in eggs that reduce reproduction, health, and/or survival of populations of top-level piscivorous birds.	Potential or observed toxicity due to exceedances of screening values and/or acceptable hazard quotients related to survival, growth, and reproduction of individual bald eagles (ODEQ 2001; ODEQ 2007; LWG 2007; USEPA 2005; Sample et al. 1996).
Protection of top-level piscivorous birds (trophic level 4), represented by the **osprey**, with no unacceptable effects on reproduction, growth, or development on a population level due to COIs in sediment and fish.	Measured concentrations in or estimated concentrations in surface water and fish tissues, and predicted concentrations in eggs that reduce reproduction, health, and/or survival of populations of top-level piscivorous birds.	Potential or observed toxicity due to exceedances of screening values and/or acceptable hazard quotients related to survival, growth, and reproduction of resident populations of osprey (ODEQ 2001; ODEQ 2007; LWG 2007; USEPA 2005; Sample et al. 1996).

Bold = receptors evaluated in the Baseline Ecological Risk Assessment

Sources:

Lower Willamette Group (LWG). 2007. Portland Harbor RI/FS Comprehensive Round 2 Report, Appendix G.

MacDonald et al. 2000. Probable Effect Concentrations. Arch ET&C 39(1):20.

Oregon Department of Environmental Quality (ODEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Managementand Cleanup Division. Final. April 1998. Updated December 2001.

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United States Army Corps of Engineers (USACE)/United States Environmental Protection Agency (USEPA). 2005. Environmental Residue and Effects Database (ERED), last updated October 2005. On-line database. http://el.erdc.usace.army.mil/ered/.

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United States Environmental Protection Agency (USEPA). 2006. National Ambient Water Quality Criteria (WQC). Office of Water and Office of Science and Technology. (http://epa.gov/waterscience/criteria/nrwqc-2006.pdf)

APPENDIX D

Site-Specific Bioaccumulation Factors

Appendix D
Site-Specific Bioaccumulation Factors

Risk-based concentrations (RBCs) in sediment were generated as a tool for identifying the general areas of the River Operable Unit (OU) that may be contributing to food web-related risks. These sediment RBCs were back-calculated from the tissue RBCs developed for human and ecological receptors using Oregon Department of Environmental Quality's (ODEQ's) methodology (ODEQ 2007).

Sections 2.7 and 3.5.3 of the main River OU baseline human health and ecological risk assessment (BHHERA) text present the equations and input parameters used to develop the tissue and sediment RBCs for the human and ecological receptors potentially exposed to site-related chemicals of concern (COCs) through fish and shellfish consumption. First, receptor-specific tissue RBCs were generated. Then, sediment RBCs were back-calculated from the tissue RBCs using the site-specific bioaccumulation factors (BAFs) described in this appendix. Given the high level of uncertainty associated with establishing BAFs for inorganics and in accordance with ODEQ's 2007 guidance, BAFs were not calculated for inorganic COCs. BAFs were only calculated for organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs).

As described in more detail below, the general methodology in the U.S. Environmental Protection Agency's (USEPA's) guidance *Estimation of Biota Sediment Accumulation Factor (BSAF) from Paired Observations of Chemical Concentrations in Biota and Sediment* (2009) was followed during development of the sediment-tissue BSAFs. The site-specific BAFs were developed by first using sediment and invertebrate paired datasets from the River OU to estimate BSAFs. To account for biomagnification in the food web that ultimately reflects accumulation in fish tissue, River OU invertebrate and fish median concentrations were used to estimate invertebrate-fish biomagnification factors (BMFs). To estimate final site-specific BAFs, the selected sediment-invertebrate BSAFs were multiplied by the invertebrate-fish BMFs.

The inherent uncertainty in the sediment-to-tissue link estimated through the BAF development process is reflected in the sediment RBCs and makes the sediment RBCs less reliable than the tissue RBCs for actual predictions of risk to humans, fish, and wildlife. However, comparison of the sediment RBCs to site sediment data allowed for: 1) a visual tool for representation of potential site-related impacts to the aquatic food web of the River OU, and 2) development of general areas of potential concern for consideration in the upcoming River OU Feasibility Study.

D.1 Methodology

For the first step in the development of BSAFs, co-located sediment-clam and sediment-crayfish COC concentrations that were organic carbon and lipid normalized were displayed on plots, and a visual analysis of potential trends and outliers was conducted. Based on the outcome of the initial review of the paired data, in which clear trends were not observed, and due to the limited datasets for a rigorous statistical analysis, the averaging approach presented by USEPA (2009) was selected over a regression-based approach for deriving BSAFs. As stated in Appendix D of USEPA (2009): "While the USEPA recommends use of the average BSAF, the median BSAF for each chemical and sediment-organism pair was selected as a more likely estimate of the central tendency because is it less affected by outliers and skewed data (Bechtel Jacobs Company, LLC 1998; USEPA 2007)." Because the RBCs will be considered as target cleanup levels for sediment in the FS, the median value was selected as the appropriate more realistic statistic for the BSAFs.

BSAFs were calculated for co-located pairs of sediment-clam samples (26 pairs of Aroclors, 24 pairs of congeners, four pairs of OCPs) and sediment-crayfish samples (13 pairs of Aroclors and congeners) using the following calculation:

$$BSAF = \frac{C_o/f_l}{C_s/f_{soc}}$$

Where:

BSAF = biota-sediment accumulation factor

C_o = chemical concentration in the organism (microgram per kilogram [ug/kg] wet weight)

f_l = lipid fraction of the organism (gram [g] lipid/g wet weight)

C_s = chemical concentration in the sediment (ug/kg dry weight)

f_{soc} = fraction of organic carbon in sediment (g organic carbon/g dry weight)

While the USEPA recommends use of the average BSAF, the median BSAF for each chemical and sediment-organism pair was selected as a more likely estimate of the central tendency because is it less affected by outliers and skewed data (Bechtel Jacobs Company, LLC 1998; USEPA 2007). In addition to calculating median BSAFs for the individual paired sediment-invertebrate datasets, River OU median BSAFs were estimated with these same datasets for comparative purposes.

To account for biomagnification in the food web for COCs with the potential to increase in concentration with increasing trophic level (i.e., OCPs and PCBs), BMFs were calculated in a two-step process. Due to the lack of co-location between invertebrate and fish tissue samples (e.g., one smallmouth bass could forage on invertebrates over the entire River OU depending on resource availability), River OU median BMFs were estimated. The first step was to lipid normalize the benthic invertebrate (clam or crayfish) tissue and the fish (sculpin or smallmouth bass) tissue using the following equation:

$$C_l = C_o/f_l$$

Where:

C_l = lipid normalized chemical concentration in the organism (ug/kg wet weight - lipid)
C_o = chemical concentration in the organism (ug/kg wet weight)
f_l = lipid fraction of the organism (g lipid/g wet weight)

The second step was to calculate the chemical specific BMFs using the River OU median lipid normalized chemical concentrations in benthic invertebrate (clams or crayfish) and in fish (sculpin or bass) through the following equation:

$$BMF = \frac{median\ C_{fl}}{median\ C_{bl}}$$

Where:

BMF = biota magnification factor
C_{fl} = chemical concentration in the fish lipid normalized (ug/kg wet weight - lipid)
C_{bl} = chemical concentration in the benthic invertebrate lipid normalized (ug/kg wet weight - lipid)

The final BAFs that were calculated by multiplying the selected paired sediment-invertebrate BSAFs and the selected River OU invertebrate-fish BMFs are discussed in the following section.

D.2 Findings and Selected Bioaccumulation Factor

Table D-1 presents the site-specific sediment-clam and sediment-crayfish BSAFs; clam-sculpin, clam-bass, and crayfish-bass BMFs; and the final selected BAFs. The sediment-clam BSAFs were selected as the final BSAFs, rather than the sediment-crayfish BSAFs, for the following reasons:

- Lack of OCP data for crayfish
- Larger and more current PCB dataset for clams
- Crayfish are highly opportunistic feeders that are much more mobile than clams (i.e., crayfish tissue concentrations are more difficult to associate with a specific sediment location); therefore, more confidence is placed in the sediment-clam paired BSAFs.

The paired median BSAFs and River OU median BSAFs for sediment and clams were very similar (Table D-1) and, given the higher level of confidence in using paired datasets (USEPA 2009), the paired median sediment-clam BSAFs were selected as the final BSAFs.

The clam-bass BMFs were selected as the final BMFs, rather than clam-sculpin or crayfish-bass BMFs, for the following reasons:

- Lack of OCP data for sculpin
- Larger and more current PCB dataset for bass

- Based on their trophic level in the aquatic food web, bass would be expected to accumulate higher concentrations of OCP and PCBs and are also more representative of species consumed by humans and wildlife.

The final sediment-clam-bass BAFs for each organic contaminant of ecological concern (CEC) are presented in the final column of Table D-1.

D.3 References

Bechtel Jacobs Company, LLC. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Bechtel Jacobs Company LLC, Oak Ridge, TN. BJC/OR-112.

Oregon Department of Environmental Quality (ODEQ). 2007. Guidance for Assessing Bioaccumlative Chemicals of Concern in Sediment. Final. April.

U.S. Environmental Protection Agency (USEPA). 2007. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). Office of Solid Waste and Emergency Response, Washington D.C. November 2003, Most Recent Revision 2007 (Attachment 4-1).

USEPA. 2009. Estimation of Biota Sediment Accumulation Factor (BSAF) from Paired Observations of Chemical Concentrations in Biota and Sediment. EPA/600/R-06/047. ERASC-013F. February.

Table D-1

Summary of Site-Specific Biota-Sediment Accumulation Factors (BSAFs), Biomagnification Factors (BMFs), and Final Selected Bioaccumulation Factors (BAFs)

	Location-Specific Pairs Median BSAF (kg OC / kg lipid)		River OU Median BSAF or BMF (kg OC / kg lipid or kg lipid / kg lipid)										Final BAF = paired $BSAF_{sed-clam}$ X River OU $BMF_{clam-bass}$
Chemical	**$BSAF_{sed-clam}$**	**$BSAF_{sed-crayfish}$**	**Sed_{oc}**	**$Clam_{lipid}$**	**$Crayfish_{lipid}$**	**$Sculpin_{lipid}$**	**$Bass_{lipid}$**	**$BSAF_{sed-clam}$**	**$BSAF_{sed-cray}$**	**$BMF_{clam-sculpin}$**	**$BMF_{clam-bass}$**	**$BMF_{cray-bass}$**	
4,4'-DDE	**3.4**	--	82	557	--	--	793	6.8	--	--	**1.4**	--	**4.9**
Chlordane (gamma)	**0.16**	--	39	915	--	--	29	23	--	--	**0.032**	--	**0.0052**
Dieldrin	**0.14**	--	101	466	--	--	28	4.6	--	--	**0.060**	--	**0.0082**
Endosulfan I	**0.21**	--	19	133	--	--	10	7.0	--	--	**0.079**	--	**0.017**
Endrin	**0.14**	--	25	213	--	--	16	8.6	--	--	**0.077**	--	**0.011**
PCBs as Bird TEQ (KM-capped, RDL-based)	**8.5**	3.2	0.013	0.10	0.029	0.042	0.16	7.7	2.2	0.42	**1.6**	5.6	**14**
PCBs as Mammal TEQ (KM-capped, RDL-based)	**12**	3.4	0.0020	0.024	0.0056	0.020	0.066	12	2.7	0.84	**2.7**	12	**31**
Total PCBs as Aroclors (MDL-based)	**2.2**	0.87	2,625	1,289	364	786	1,969	0.49	0.14	0.61	**1.5**	5.4	**3.3**
Total PCBs as Congeners (KM-based, capped)	**14**	2.5	92	1,380	133	930	3,111	15	1.4	0.67	**2.3**	23	**32**

Notes

PCBs = polychlorinated biphenyls
BAF = bioaccumulation factor
BMF = biomagnification factor
BSAF = Biota Sediment Accumulation Factor
kg = kilogram
KM, capped = Kaplan–Meier-based with Efron's bias correction, capped
MDL = method detection limit
OC = organic carbon
RDL = reported detection limit
TEQ = toxicity equivalence

APPENDIX E

USACE Responses to ODEQ Comments on Draft River OU BHHERA

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
Specific Human Health Comments		
1.	**ES-2, top paragraph**. Site-specific RBCs might better be called preliminary remediation goals (PRGs), following EPA terminology. The term "RBC" is used in DEQ's Risk-Based Decision Making guidance. However, it is not incorrect to refer to the site-specific values as RBCs.	Comment noted. It is the U.S. Army Corps of Engineer's (USACE's) preference to refer to them as site-specific risk based concentrations (RBCs) in the River Operable Unit (OU) Baseline Human Health and Ecological Risk Assessment (BHHERA) report. No revisions to the Baseline Human Health Risk Assessment (BHHRA) are necessary.
2.	**ES-2, third paragraph**. There is a statement that "overall concentrations of PCBs in bass tissue may be decreasing" This may be true, but has not been convincingly shown.	The statement that "overall concentrations of PCBs in bass tissue may be decreasing" will be deleted in the Executive Summary (ES).
3.	**ES-3, second paragraph**. Exposure values are selected as a combination of means and upper bounds such that the final result represents reasonable maximum exposure. This does not mean that all exposure factor values were "intentionally biased towards overestimation of exposure." Please revise the statement.	Sentence will be revised to say *"Exposure factor values were selected to represent the mean or the upper bounds of the range of exposures"*
4.	**ES-3, second to last paragraph**. DEQ's acceptable risk level for multiple carcinogens of 1 x 10^{-5} applies to all carcinogens, not just those that act with similar modes of action. This is similar to EPA's definition of cumulative risk applied to an acceptable risk range of 1 x 10^{-6} to 1 x 10^{-4}.	The report text, as written, is consistent with current published Oregon Department of Environmental Quality (ODEQ) guidance regarding acceptable risk levels (ODEQ 2010). USACE cannot make revisions based on unpublished guidance or policy. However, the current presentation of results is consistent with both U.S. Environmental Protection Agency's (USEPA's) Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) preferences regarding "point-of-departure" and Oregon Department of Environmental Quality's (ODEQ's) new internal preference for "acceptable risk levels" for individual and grouped chemicals. Consistent with CERCLA guidance, the BHHERA currently identifies all chemicals that exceed $1x10^{-6}$ risk level, which is applied both to individual and grouped chemicals such as carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and polychlorinated biphenyls (PCBs). Chemicals exceeding $1x10^{-6}$ risk are bolded in the tables. RBCs (as shown in Table 2-16) are calculated for $1x10^{-6}$ risk level. The figures show exceedances above the RBCs. Therefore no revisions to BHHRA tables and figures are necessary. No additional text changes to the BHHRA are necessary.

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
5.	**ES-4**. RME does not "significantly overestimate exposure". This is discussed further in Section 2.3.	Sentence will be revised to say *"The estimated risks for the fish consumption scenario are based on exposures that are intended to be highly conservative in order to evaluate whether additional evaluation or action is warranted."*
6.	**Page 2-11, Section 2.5, end of second paragraph**. Chemical groups with a common mode of action should not be considered in the context of the risk level for multiple carcinogens of 1 x 10^{-5}. DEQ's new approach (not specified at the time the risk assessment was being developed) is that chemical classes with a common mode of action should be evaluated as a single substance, and compared with the acceptable risk level of 1 x 10^{-6}. DEQ's acceptable risk level for multiple carcinogens of 1 x 10^{-5} applies to all carcinogens, not just those that act with similar modes of action.	See response to Comment 4.
7.	**Page 2-12, top paragraph**. It is best not to assign a meaning to DEQ's acceptable excess cancer risk level that is not specified. It is true that an increased cancer risk of 1 x 10^{-6} cannot be distinguished in a population because of much higher background rates. Still, the rule definition is for acceptable risk; Oregon rules do not explicitly discuss *de minimis* risk. The presentation of background rates of cancer should be either 0.5, or 0.5 x 10^{0}, or 5 x 10^{-1} for men (not 0.5 x 10^{1}), and either 0.3, or 0.3 x 10^{0}, or 3 x 10^{-1} for women (not 0.3 x 10^{1}).	USACE's goal in the use of the term "*de minimis* risk" was to not confuse risk estimates below ODEQ's acceptable risk level with risk estimates within USEPA's acceptable risk range. USACE will revise text to state that *"the "de minimis" risk level corresponding to the "point of departure", as defined by USEPA is equivalent to ODEQ's acceptable risk level for individual carcinogens. USEPA notes that any potential actions to reduce risks at or below de minimis levels are generally not warranted because the associated risks to public health are very low."* Agreed. Background rates of cancer will be presented as 0.5 for men and 0.3 for women.
8.	**Page 2-12, bottom paragraph.** The discussion of confidence placed on TEQ estimates of PCB risk should be limited to cancer risk. Noncancer risk is primarily evaluated using one of the measures of total PCB concentration. The RfD for noncancer risk for PCB TEQ is based on different toxic endpoints than the RfD for PCB Aroclors, so it is appropriate to look at TEQ risk separately from risk attributed to PCB-Aroclors or PCB-congeners. TEQ risk, however, is not a more precise measure of PCB noncancer risk. For total PCB (non-TEQ) risk, the exposure point concentration based on congeners is expected to be more accurate than the EPC based on Aroclors.	USACE agrees that the non-cancer toxicity endpoints are different among the two methods. Cancer and non-cancer effects based on PCB toxicity equivalence quotient (TEQ) are evaluated using the toxicity equivalence factor (TEF) approach relative to 2,3,7,8-TCDD. Cancer and non-cancer effects for Total PCBs Aroclor and Total PCBs congeners are evaluated using the Aroclor oral slope factor (SFo) and oral reference dose (RfDo). The discussion on Page 2-2, bottom paragraph, and the discussion in Sections 2.6.9, third paragraph, will be revised as follows: "*the highest level of confidence is placed in the TEQ estimates of PCBs for cancer risk*".

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
9.	**Page 2-13, Section 2.5.1 and page 2-15, Section 2.5.2.** Although ELCRs are calculated probabilities, noncancer hazards are not probabilities.	Agreed. The discussions in Sections 2.5.1 and 2.5.2 will be revised as follows: *"ELCRs are calculated probabilities, and noncancer hazard quotients are calculated ratios of the estimated dose to a reference dose, based on conservative exposure factors… "*
10.	**Page 2-19, Section 2.5.5**. Risks may be within EPA range, but should also be characterized as above DEQ limits.	See responses to Comments 4 and 7.
11.	**Page 2-20, Section 2.6.2**. Dibenzofuran has toxicity information available in EPA 2015b (under "furan"). There may not be quantitative toxicity information for endrin ketone, but values are available for endrin (as noted). Heptachlor epoxide is a carcinogen with available toxicity values.	The purpose of Section 2.6.2 is to explain why three chemicals (dibenzofuran, endrin ketone, and heptachlor epoxide) detected in sediment, but without bioaccumulation-based SLVs, were not selected for quantitative evaluation for bioaccumulation-based exposures. Dibenzofuran, endrin ketone and heptachlor epoxide were reported at very low detection frequencies in sediment (1%, 5% and 5% respectively) and were not detected in any of the tissue samples. Therefore, these three chemicals were not included as COPCs for the bioaccumulation-based pathway in the BHHRA. No revisions to the BHHRA are necessary.
12.	**Page 2-21, top paragraph.** With such large differences in fish concentrations, it is also possible that fish consumption risks could be underestimated.	Text on page 2-21 will be revised to state "*with such large differences in fish tissue concentrations, the UCL could be overestimated or underestimated. However, other parameters related to fish consumption are conservatively selected and would tend to overestimate exposure and risk.*"
13.	**Page 2-22, Section 2.6.8.** The evaluation of potential risk to infants presented in this report can be considered an attempt to calculate doses of COPCs to nursing infants, although by using the IRAF approach, dose differences were combined with toxicity differences. A separate infant exposure adjustment factor (IEAF) of 38 for PCBs could have been specified, as presented in DEQ guidance. More recent studies, including human epidemiology studies, indicate that IEAF values well above 100 are possible. The IRAF approach in DEQ guidance may underestimate risk.	The infant risk methodology and the default Infant Risk Adjustment Factors (IRAFs) were selected and applied after a telephone discussion between AECOM and Mike Poulsen (ODEQ) on August 5, 2015 to finalize the approach. The verbal discussion was then documented in an e-mail (see River USACE Attachment 1_Infant IRAF Email). No revisions to the BHHRA are necessary.
14.	**Page 2-23, second paragraph**. Congeners that are not typical of Aroclor 1254 may be more toxic than the congener mix associated with Aroclor 1254. Potential risks may therefore be underestimated. However, as noted, the potential for overestimation (and underestimation) of Aroclor risk is expected to be low since Aroclor 1254 was the dominant Aroclor reported in site data.	Comment noted. No revision to the BHHRA is necessary.

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
15.	**Page 2-23, end of third paragraph**. Noncancer risks from exposure to PCBs are primarily based on total PCB concentrations, not TEQ concentrations. The PCB TEQ toxicity factor is based on a different toxic endpoint than the total PCB toxicity factor. The more protective RfD value (based on total PCBs) should be used in the noncancer risk evaluation, although it is acceptable to also evaluate additional endpoints.	See the response to Question 8. The existing calculations are consistent with the comment. Non-cancer hazards were evaluated in three ways: (i) by applying the Aroclor 1254 RfDo to Total PCBs as Aroclors, (ii) by applying the Aroclor 1254 RfDo to Total PCBs as Congeners and (iii) by applying the 2,3,7.8-TCDD RfDo to PCB TEQ. No revisions to the BHHRA are necessary.
16.	**Page 2-23, Section 2.6.10**. Nursing infants were included so that risks from bioaccumulating chemicals passed from mothers to infants were considered. We do not expect that infants will consume fish or be directly exposed to sediments; the evaluation is based on adult females being exposed to sediment.	Agreed. In Section 2.6.10, the "Nursing Infant" text will be revised as follows: "*…infants are not expected to directly consume fish or be exposed to sediments. These estimated risks to infants are based on ingestion to maternal milk from adult females being exposed to sediments and consuming fish*".
17.	**Page 2-24, Table (unnumbered).** The critical effects used as the basis for the RfDo values are shown. What are not shown in the table are the other organ systems that may be affected by the chemicals. For example, PCBs can have adverse effects on the liver, but this was not the basis for the RfDo. Quantifying effects on the same organ can be difficult because RfDs may not be available. We acknowledge that summing all HQs to get an HI is expected to be health protective because not all chemicals may be acting on the same organ. However, the degree of health protectiveness may not be great. Also, synergistic (or antagonistic) effects are not considered.	Agreed. The purpose of the unnumbered table on page 2-24 was to provide a perspective on the critical effects associated with the different COCs. Quantification and segregation of hazard quotients by target organs or effects was not performed in the BHHRA and no risk management recommendations were developed based on the concept. No revisions to the BHHRA are necessary.
18.	**Page 2-24, Section 2.6.12**. Uncertainty regarding whether swimming or consumption of water is occurring is different than uncertainty regarding risk associated with these activities were they to occur. The level of uncertainty is not insignificant.	The last sentence in Section 2.6.12 will be revised to state *"Additionally, since swimming is prohibited in the entire River OU, and potable use of untreated river water is also not known to occur, the level of uncertainty related to characterization of these hypothetical surface water exposure pathways is high."*
19.	**Page 2-25, Section 2.6.15**. High calculated risks are not "a reflection of the multiple layers of conservatism that are intentionally built into the risk assessment methodology"; they are a reflection of the high concentrations of PCBs measured in fish tissue.	Section 2.6.15 was written because the BHHERA is a public document and showing risk levels of the order of 1x10-2 might be alarming without understanding the underlying assumptions. USACE will revise the text in Section 2.6.15 to say "… *these calculated values are the result of a combination of conservative exposure assumptions and the concentrations in exposure media. Accordingly, these estimated risk values are in part due to the multiple layers of conservatism that are intentionally built into the risk assessment methodology, from the selection of RME/CTE exposure factor values and*

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		toxicity values to assumptions such as whole-body, uncooked fish consumption without any cooking losses and the assumption that the consumer's entire resident finfish consumption is derived only from fish caught in the River OU. For chemicals…"
20.	**Page 2-27, top paragraph**. In the statement, "The Nursing Infant pathway further increases the magnitude by the 25-fold modification of the mother's noncancer hazard", if "increases the magnitude" refers to the larger dose to the infant compared with the dose to the mother, this is correct. If instead "increases the magnitude" refers to the statement that the fish ingestion pathway is evaluated with multiple layers of conservatism, then it is not necessarily correct. Risks to infants may be underestimated.	The last sentence in the second paragraph of Section 2.8 will be revised to "*The Nursing Infant pathway further increases the magnitude of the dose to the infant, relative to the mother's dose, by 25-fold. The infant exposure was used to derive the PCB RBCs, which resulted in the RBC being over two orders of magnitude below the Reference UPL for PCBs.*".
21.	**Page 2-27, DDE**. For smallmouth bass, DDE was not retained as a COC because risk is within EPA's acceptable range, and because concentrations were not localized. However, calculated risks are above DEQ's acceptable risk level, so DDE should be retained.	Comment noted. DDE was highlighted as a chemical with risks exceeding $1x10^{-6}$. The final selection for contaminants of concern (COCs) that were recommended for further evaluation in the River OU Feasibility Study (FS) is based on considerations of risk, spatial patterns of exceedance and site-related contribution. While DDE fell within USEPA's acceptable risk range, it did not appear to be an in-water, site-related concern and there is only one location with a slight exceedance in Bradford Island sediments. The detections of DDE may also be analytical artifacts associated with PCB analyses. Overall, there appears to be no valid reason to retain DDE as an in-water chemical recommended for further evaluation in the River OU FS. Uncertainty text will be added to Section 2.6.4 (also see response to Comment #32), as follows: "*Due to the data gaps in the RI sampling (no pesticide or butyltin analysis and limited SVOC analysis), the 2011 Pre-FS tissue and sediment sampling was conducted to address these data gaps. The 2011 Pre-FS sampling was statistically robust for risk evaluation (not limited) and served its purpose by targeting the analytical data gaps in the former source areas, including the analytes with potential Upland contributions to the River. The maximum concentrations of OCPs occur in the former source area in the 2011 Pre-FS samples with the highest concentrations of PCBs, collected within the former source areas. OCP compounds can be confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of*

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
		Bradford Island. Their presence in localized areas of the Upland OU Landfill AOPC has been documented. Co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU creates an uncertainty as to whether OCPs are site-related from in-water disposal activities. The potential for the OCPs to be related to the upland-to-river pathway will be further evaluated in the FS." No revision to the BHHRA is necessary.
22.	**Page 2-28 Crayfish Tissue**. PCB risk was compared with an acceptable limit of 1 x 10^{-5}. DEQ considers PCBs a single substance, so the appropriate acceptable risk limit is 1 x 10^{-6}. Also, this evaluation is based only on cancer results. There should also be a discussion of noncancer risk.	Please see response to Comment #4. PCBs are retained as COCs based on exceeding USEPA's "*de minimis*" risk level. The non-cancer hazards associated with crayfish tissue are discussed in Section 2.6.2.2.2. The purpose of the discussion on Page 2-28 is to interpret risks and hazards in the light of exceedances of RBCs and spatial trends of distribution. Discussion of the noncancer hazards for crayfish tissue will be added for those locations where there is an exceedance of the noncancer based RBC for PCB-Cong, as opposed to the cancer-based RBC for PCB-TEQ.
23.	**Page 2-28, Sediment - Direct Contact**. Background levels are characterized by UPLs, which is why a dataset is considered above background if one sample exceeds the background UPL. Therefore, the statement that "it is unlikely a wader would remain in one location" is not relevant.	The last sentence on page 2-28, Sediment – Direct Contact will be revised to state *"Arsenic exceeded background at only one of 45 sediment locations (S-1-43; Figure 2-5B); therefore, risks related to arsenic are considered insignificant, and arsenic is not recommended for retention as a COC."*
24.	**Page 2-29.** Similar to PCBs, cPAH risk was compared with an acceptable limit of 1 x 10-5. DEQ considers cPAHs a single substance, so the appropriate acceptable risk limit is 1 x 10-6. Regardless, individual cPAHs exceed 1 x 10-6. PCB HQs are greater than 1, and there is no extra conservatism built into the screening level evaluation of the nursing infant scenario. cPAHs and PCBs should be COCs for sediment. Background levels are characterized by UPLs, which is why a dataset is considered above background if at least one sample exceeds the background UPL. It is difficult to evaluate the bioaccumulation of arsenic and mercury. cPAHs in sediment exceed a risk of 1 x 10^{-6}, and may need to be evaluated for bioaccumulation.	Please see response to Comment #4. Since the comparisons are also made to USEPA's "*de minimis*" risk level, no revisions are needed. It is also noted that the RME and CTE risks for cPAHs are in the range of less than 1x10-5 to less than 1x10^{-6}, indicating that cPAHs overall are of relatively low risk for direct contact with sediment. PCBs were retained as COCs for sediment. cPAHs were eliminated as COCs based on the low number of exceedances of the RBCs, with only a single larger exceedance in the vicinity of Bradford Island. As noted in the response to Comment #21, the spatial distribution and relatively low risk associated with cPAHs does not warrant inclusion among the in-water chemicals recommended for further evaluation in the River OU FS. Comment noted. USACE agrees that it is difficult to evaluate the bioaccumulation of arsenic and mercury beyond what has already been

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		presented in the BHHERA. The significance of risk associated with a single or a few minor exceedances of the river Reference Area upper prediction limit (UPL) is considered to be low and therefore, arsenic and mercury were not selected as COCs. The bioaccumulation potential for cPAHs was assessed by evaluating fish consumption risks using the fish tissue data for cPAHs and other contaminants of potential concern (COPCs) for human health. The approach was based on ODEQ's position that food-web modeling would not be considered reliable or acceptable to evaluate bioaccumulation from sediments. cPAHs were included in the fish consumption pathway and the reasons for their elimination as COCs in fish tissue are discussed on page 2-28 of the BHHERA. No revisions to the BHHRA are necessary.
25.	**Page 2-30, top paragraph.** Using background concentrations as cleanup levels (similar to RBCs) is challenging. UPLs may not be appropriately protective.	Comment noted. Appropriate cleanup levels will be further assessed in the River OU FS. No revisions to the BHHRA are necessary.
26.	**Table 1-6, Tissue Samples.** Please provide a summary of all data used for each evaluation. Tables should clearly show the data that was used to calculate the EPC. This comment also applies to the ERA.	Table 1-6 provides the summary statistics of all data used in the BHHERA per tissue (the exposure point concentration [EPC] used for each evaluation is shown in the tables for each evaluation, e.g., maximum detected value or 95% upper confidence level [UCL]). Data tables used for calculation of the EPCs was previously provided in the Remedial Investigation (RI) Report (URS 2012), the 2011 Pre-FS Data Report (URS 2013), and the Data Evaluation Technical Memorandum (DETM) for the expanded sediment dataset (URS 2014). In addition, the database supplied to the Technical Advisory Group (TAG) includes data identifiers indicating what specific data was evaluated for the BHHERA (see the "ResultUsedInFS" field the "RI_Results_Processed" table).
27.	**Table 2-4.1.** DEQ 2007 guidance is to use 142 g/day for subsistence and tribal consumption rates. A slightly higher rate of 175 g/day has been used on other sites in Oregon, and DEQ's Water Quality Program used a fish consumption rate of 175 g/day to establish state ambient water quality criteria. A fish consumption rate of 44 g/day is inadequate to characterize tribal ingestion rates for a known major fishing location. The appropriate rate for tribal consumption is 175 g/day because it was derived from Columbia River basin data (A Fish	It is important to remember that the 142 g/day and the 175 g/day rates refer to total fish consumption (resident and anadromous species). The COPC selection process for the fish consumption scenario used ODEQ's 2007 screening level values (SLVs) based on 142 g/day consumption rate. Therefore, the screening-level HHRA has already incorporated very conservative fish ingestion rates.

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	Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin, Technical Report 94-3, Columbia River Inter-Tribal Fish Commission, Portland, Oregon, October 1994).	The purpose of the BHHRA is to estimate risks based on more realistic, site-specific conditions and exposures. The rates used in the BHHRA are still conservative in that they assume that 100% of resident finfish consumption is derived solely from forebay smallmouth bass. The fish ingestion rate was extensively discussed during the development of the RI/FS Management Plan (MP) (URS 2007). Appendix B of the RI/FS MP (HHRA Work Plan) provides extensive documentation for the selected fish ingestion rate (Section B.4.2.1.3.2). It was reviewed by all TAG members and the proposed rates were accepted without comment. The rates were again presented during the more recent TAG meetings (June 4, 2014) and no comments were received. No revisions to the BHHRA are necessary.
28.	**Table 2-16**. According to Table 2-15, the calculated RBC for sediment bioaccumulation of PCB-conger should be 0.013 ug/kg, not 0.000013 ug/kg. However, the almost order of magnitude difference in RBCs for PCB-Aroclor and PCB-congener is troubling. See comments on Appendix D.	The bioaccumulation RBC for PCB-congener will be corrected to 0.013 ug/kg in Table 2-16. See response to comments on Appendix D.
29.	**Figure 2-6B**. An HQ greater than 100 is not moderate risk, it is ten times the DEQ hot spot level.	The word “moderate” will be removed from the legend for Hazard Quotient (HQ)>100 in Figures 2-3, 2-6A, 2-6B and 2-7.
General ERA Comments		
30.	**RI Data Presentation:** The data presentation in the risk assessment is limited to statistical summaries and maps depicting locations exceeding site specific risk based concentrations (RBCs). Comprehensive maps and tables compiling information from all sampling events should also be provided to show the distribution in site media (e.g. sediment, surface water, groundwater seeps). A larger discussion of extent of contamination should be presented as a compliment / appendix to the risk assessment in order to augment the final RI. Additionally, data tables should be provided showing all the site data with media analyzed, collection dates and associated analyte list. The tables should show the data that was included in the risk assessment, and, if excluded, the reasons for the exclusion. An uncertainty analysis should be provided that shows any changes in the results if the complete dataset of historical tissue and sediment data is included.	Since the River OU BHHERA builds upon the findings of the Final RI Report (URS 2012) and DETM (URS 2014), only the COPCs and contaminants of potential ecological concern (CPECs) and media that warranted further evaluation were provided in the baseline report. Comprehensive info, maps, tables of surface water and groundwater seeps were presented in the RI Report. Comprehensive info, maps, and tables of all sediment sampling events were presented in the DETM. Additionally, the sediment inclusion/exclusion evaluation was presented in the DETM. The single 2006 large-scale sucker composite tissue sample was excluded from the BHHERA based on the qualitative evaluation presented in the RI Report. The uncertainty regarding the inclusion/exclusion of the large-scale sucker tissue was previously addressed in Appendix O of the RI. As noted in the RI, a quantitative evaluation of large-scale sucker is not likely to add either precision or accuracy to the risk estimates, and its

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		exclusion does not result in underestimation of risk due to the quantitative evaluation of the smallmouth bass in the risk assessments. No revisions to the BHHERA are necessary.
31.	**Unresolved Comments on 2010 Risk Assessment:** DEQ's Sept. 2011 comments on the 2010 risk assessment were not completely resolved. These comments span some of the topics described on page 1-2 of this document, including the conceptual site model, data quality, and data management, processing and screening. Many of these comments are relevant to the resolution of this 2015 risk assessment document. Where possible, applicable DEQ's 2011 comments are repeated in the following specific comments.	Comment noted. See USACE responses to specific Baseline Ecological Risk Assessment (BERA) comments.
32.	**Data Gaps for Key COCs:** Data gaps in previous analytical program should be discussed for COCs in order to augment the conceptual site model and upland / in water connections. For tissue, this includes the 2008 bass tissue data. This is particularly important for interpreting the latest round of tissue data that showed significant levels of pesticides in fish tissue. For example, sediment and tissue data for pesticides are limited since they were not included in previous rounds of forebay sampling. While analyzed in the 2002 data, these were not included in this risk evaluation. The pre-2003 data are included in Appendix G of the 2010 RI/RA. These data include additional pesticide data that shows links to Site sources; examples are shown below: a. DDT and isomers at IW-01 (Eastern hot spot), IW16 (Former Pile #2) and PW1-01. b. Significant concentrations of DDX at TP1-01 – test pit upland (3,060 ppb, 1,830 ppb and 9,520 ppb of 4,4'-DDD, DDE and DDT respectively) c. Dinoseb at TP4-01 (upland test pit) at 51.2 pbb d. Sandblast catch basin filter sock sample CB1-FS with DDX, Aldrin, BHC, gamma Chlordane, Dieldrin, Endosulfan 1, Endosulfan Sulfate, Endrin e. Butyltins in sandblast grit – SBDS-24, 19, 18	USACE will add the following text to the BHHERA Section 2.6.4 and Section 3.5.2.10: *"Due to the data gaps in the RI sampling (no pesticide or butyltin analysis and limited SVOC analysis), the 2011 Pre-FS tissue and sediment sampling was conducted to address these data gaps. The 2011 Pre-FS sampling was statistically robust for risk evaluation (not limited) and served its purpose by targeting the analytical data gaps in the former source areas, including the analytes with potential Upland contributions to the River. The maximum concentrations of OCPs occur in the former source area in the 2011 Pre-FS samples with the highest concentrations of PCBs, collected within the former source areas. OCP compounds can be confounded with PCB congeners during laboratory analyses due to similarity of structure and overlapping mass ratios. There is no supporting site evidence to suggest that OCPs were disposed at the former debris piles in the north shore of Bradford Island. Their presence in localized areas of the Upland OU Landfill AOPC has been documented. Co-location with elevated PCBs and lack of uniform levels of OCPs throughout the River OU creates an uncertainty as to whether OCPs are site-related from in-water disposal activities. The potential for the OCPs to be related to the upland-to-river pathway will be further evaluated in the FS."* Other data gaps from previous analytical programs were previously addressed in the RI Report (URS 2012). As described in the DETM (URS 2014), the pre-2003 data were not included in the BHHERA dataset because the equipment and associated

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		sediment were removed in 2000 and 2002, and these data are not representative of current conditions. The 2011 pre-FS sediment sampling targeted areas along the north shore, including the equipment/sediment removal areas.
33.	**Source Control:** Some of the data sets that represent catch basins or sediments near the sandblast and landfill AOPCs should be considered in assessing the need for the control of sources from upland in in-water. This evaluation also completes the CSM and aids in the interpretation of COIs detected in sediment, water and fish tissue data. This evaluation should be included in the risk assessment. If completed in a separate document, the results should be summarized here.	Comment noted. The upland-to-river pathway evaluation has not yet been completed and will not be part of the BHHERA. It will be completed in the Upland FS or River FS. No revisions to the BERA are necessary.
34.	**Updated Sediment Debris Observations:** Exposure to site equipment, oil and debris is a part of the CSM. Information relevant to the current (post removal) debris conditions at the site should be included, including areas suspected of containing NAPL. For example, during the most recent sampling the following notes were made: "Samples collected in 2011 showed evidence of debris in the samples P 112 (tip of island, former removal area). 8-8oz jars of brown to black medium to coarse sand with gravel + little silt. Lot of glass debris removed from sediment before placing into containers. 37 clams collected. And wire. Diver stated observing a lot of debris (glass, bulbs, etc.) during". "Sample contained debris (glass + wire (filament?)"	USACE will revise the Section 2.6.3 uncertainty section as follows: *"Post-removal field data logs that indicate debris (e.g., glass, bulbs, wire, etc.) is still located along the north shore. The potential for NAPL sources of PCBs that may be present in rocky crevices in the river bottom cannot be ruled out. If present, NAPL is likely limited to the north shore and eastern tip of Bradford Island. Therefore, the impact of these potential releases would be expected to be localized in distribution. Remaining debris and suspected NAPL will be further addressed in the River OU FS."* The ecological conceptual exposure model (CEM) text in Section 3.3 will refer the reader to Section 2.6.3 as by adding the following sentence to the end of the second paragraph: *"Also see the NAPL discussion presented in Section 2.6.3."*

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35.	**Section 3.2, Surface Water:** Surface water exposure to benthic and aquatic organisms was not evaluated in the River OU or Upland OU risk assessments. The risk assessment should provide a summary of water data including storm water, groundwater, groundwater seep, pore water and surface water data collected. Figure 3-1 should be revised to reflect that surface water exposure to benthic and aquatic organisms is complete and potentially significant. These pathways were included in Figure 12-19 of the 2010 RI/RA, and are included in Appendix C measurement endpoints. Screening level values presented in the 2010 risk assessment were reviewed in DEQ's Sept. 30, 2011 comments and should be used in this risk assessment. With limited sediment present at the site, direct screening of surface water with ambient water criteria and other benchmarks provides an important line of evidence on effects to aquatic life. It is also important to establish surface water criteria applicable to monitoring of remedial actions. Updated screening should be provided along with a summary of COCs / pathways.	Comment noted. The upland-to-river evaluation has not yet been completed and will not be part of the BHHERA. It will be completed in the Upland FS or River FS. Surface water exposure to ecological receptors was evaluated in the Screening Level Ecological Risk Assessment (SLERA), including incorporation of site-specific water hardness per ODEQ recommendations (see Appendix P of URS 2012); surface water was not recommended for further evaluation (URS 2012). Therefore, Figure 3-1 accurately reflects that surface water exposure to benthic and aquatic organisms is complete but a minor pathway. As described in Section 3.1, because surface water was not identified as an ecological medium of concern in the RI, it was only included in the drinking water ingestion pathway for wildlife receptors. Applicable surface water criteria for monitoring of remedial actions will be established in the River OU FS, if necessary. No revisions to the BERA are necessary.
36.	**Section 3.2, Exposure Pathways, Figure 3-1:** Sediment exposure to aquatic organisms should also be complete and potentially significant.	Figure 3-1 will be revised to indicate that exposure to sediment to aquatic organisms is complete and potentially significant.
37.	**Section 3.3.1, Exposure Factors and Exposure Units:** The text states "for the predatory fish (smallmouth bass), the size of their foraging range is similar to the size of the River OU, and so the entire River OU from the Bonneville Dam to the northern tip of Goose Island was considered one EU for the bass." The primary exposure to Site related contaminants (locality of the facility) is directly surrounding Bradford Island where releases occurred and migrated, as well as Goose Island where material from Bradford Island was placed. Therefore, summary statistics should be presented separately in a Bradford Island exposure area. Since concentrations are significantly higher around Bradford Island, this also helps with the statistical analysis of the forebay data, where there are different populations of concentration data.	Comment noted. A Bradford Island exposure unit (EU) for smallmouth bass is not supported based on their larger foraging range and the locations where smallmouth bass collection was possible. No revisions to the BERA are necessary.
38.	**Figure 3.3.2, Exposure Point Concentrations, Surface Water:** Each seep or surface water sampling location should be screened separately (point by point) against ambient water quality criteria (and other secondary sources) for the protection of aquatic life (See DEQ's Sept. 2011 General Comment #9, Bullet #2). Exceedances of screening criteria should be presented by each location in a table along with maps similar to the tissue and sediment exceedances of risk based criteria.	Comment noted. The upland-to-river evaluation has not yet been completed and will not be part of the BHHERA. It will be completed in the Upland FS or River FS. No revisions to the BERA are necessary.

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39.	**Section 3.3.3, Dose Estimation, Area Use Factor:** Given that an exposure data area from the entire forebay was used to estimate exposure point concentrations, an area use factor is unnecessary. Risk estimates should be provided using an area use factor of 1. For the osprey, eagle, and mink, receptor-specific area use factors were calculated as the River OU site size divided by the size of the home range, resulting in site use estimates of 71%, 86%, and 65%, respectively.	USACE will continue to use the species-specific area use factors (AUFs) applied in the BERA. As stated in Section C.4.2.5 of Appendix C in the RI/FS MP (URS 2007), exposure doses calculated for piscivorous wildlife receptors in the BERA will be estimated using exposure algorithms that calculate the average daily dose (ADD) for the selected receptors. The ADD equations provided in Section D.3 of Appendix D in the RI/FS MP include application of AUFs; accordingly, home-ranges from Table D-1 were used to develop the AUFs. AUFs are developed specifically to address exposure units that are smaller than the receptors home range. No revisions to the BERA are necessary.
40.	**Section 3.4.1, Direct Toxicity Benchmarks:** Benthic Invertebrate and Fish Toxicity Benchmarks, Table 3-13: Benthic invertebrate sediment screening levels represent a probability of toxicity and are not dose response based. The reference to "NOAEC" and LOAEC" in these cases should be removed. Risk based criteria should be used for all COI and not 95% reference sediment UPLs. COIs can be screened out if it is established that Site concentrations are at natural background concentrations for metals only. This evaluation should be presented separately for review. Please refer to DEQ General Comment #8 from the Sept. 2011 comment set, which detail the statistical considerations for the background evaluation. Mercury in particular is noted as one COC that should be considered above background due to site related sources.	As described in the second paragraph of Section 3.5, USACE agrees that in sediments there generally are no no-observable-adverse-effect concentrations (NOAEC) or lowest-observable-adverse-effect concentrations (LOAEC) *per se*, but there are other endpoints that provide bounding concentrations representing low likelihood of effects and concentrations at which effects are likely to occur. It further describes that for simplicity, the NOAEC/LOAEC terminology for sediment benchmarks was used with the understanding that they are equivalent to lower-bound and upper-bound toxicity benchmarks. No revisions to the BERA are necessary.
41.	**Section 3.4, Direct Toxicity COCs, TPH:** DRO and RRO should be identified as COCs for benthic invertebrates and aquatic organisms.	As stated in the response to ODEQ comments on the Final RI (see Appendix P of the RI, URS 2012), "due to the low confidence in SLVs for TPH for purposes of blanket application to sites with petroleum hydrocarbons, the chemical indicator approach whereby the most toxic components of TPH mixtures (e.g., VOCs and PAHs) are used to assess risk will be maintained. The potential for risk was only demonstrated for PAHs based on direct exposure to the benthic community. Therefore, an evaluation of TPH results along with results for the indicator chemicals will be performed in the River FS to confirm co-location." No revisions to the BERA are necessary.

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42.	**Section 3.4.2, Benthic Invertebrate and Fish Tissue Benchmarks:** See attached table (Attachment 2) for an example spreadsheet with fish and invertebrate tissue CTLs developed using DEQ methodology. Please provide a similar spreadsheet for review that is inclusive of all detected COIs. Fish and shellfish CTLs for PAHs should be evaluated / developed. DEQ's bioaccumulation guidance (2007) reports CTLs for pyrene and fluoranthene. Additional PAH CTLs can be developed using the same methodology. a. The BCFs (L/kg) and water quality criteria (WQC) were reviewed relative to DEQ methodology. Using this methodology, BCFs should be taken from the Washington State Department of Ecology's CLARC on-line database. CTLs should be updated with new water quality criteria according to the hierarchy provided in DEQ's comments on Dec. 2010: i. National ambient water quality criteria ii. Tier II chronic values from Suter and Tsao, 1996 iii. EPA, 2003. Chronic Values (FCV) for PAHs. Outdated values for acenaphthene and naphthalene should not be used. iv. EPA Region III BTAG, Freshwater Screening Criteria b. CTLs for aluminum and antimony should be updated as follows: : Aluminum: BCF = 50 L/kg, CTL = 44 mg/kg Antimony: WQC = 0.03 mg/L, CTL = 0.03 mg/kg	a. The CTL development work is shown in Table 3-13. USACE identifies all critical tissue levels (CTLs) and shows the calculation of CTLs via ODEQ's method of multiplying the water quality criteria (WQC) by the bioconcentration factor (BCF) in a subtable in Table 3-13. Use of the WQC in the BERA is consistent with the WQC hierarchy used in the RI Report (see Appendix J). Instead of the Cleanup Levels and Risk Calculation (CLARC) database, USACE used Oak Ridge National Laboratory (ORNL) as the source of BCFs. Both ORNL and CLARC databases are scientifically supported, and use of ORNL is consistent with the sources used in the RI Report for the SLV hierarchy (see Appendix J, URS 2012). Smallmouth bass tissue RBCs for endrin were developed (Table 3-20) but were inadvertently not listed in the text summary bullets for CECs to be further evaluated in the River OU FS. USACE will add endrin to the list of OCPs to be further assessed in the River OU FS by revising the bullets in Sections 3.6, 4.2, and the ES (page ES-6) as follows: • *"Fish community – PCBs (PCB-Aro, PCB-Cong, and PCB-TEQs for fish) and OCPs (gamma-chlordane, dieldrin, endrins, and endosulfan I)"* The use of the CLARC BCFs would lower the risk estimates for three organics while increasing risk estimates for six metals and six organics. However, the use of CLARC BCFs would not substantively impact the findings of the BERA: all affected CPEC LOAECs would remain at or less than 1 for clam, crayfish, and sculpin; and the affected CPEC NOAECs for smallmouth bass would remain at or less than 1 with the exception of endosulfan I (HQ slightly lower from 6.2 to 3.6) and endrins (endrin HQ slightly higher from 3.1 to 5.8 and endrin aldehyde HQ would change from 0.97 to 1.8). Since endosulfan I RBCs are still the lowest tissue OCP RBC for small mouth bass, the lowest RBC would increase from 0.0087 (Table 3-20) to 0.015 mg/kg wet weight. In Section 3.5.3.2.1 of the BHHERA, it is noted that endrin and endosulfan I have NOAECs above 1 and discussion of the bass with the highest concentrations is also evaluated. As stated at the end of that

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		section (Section 3.5.3.2.1), OCPs were "considered to have the potential to pose an unacceptable risk to large predatory fish ingesting bass as prey." No additional revisions to the BERA are necessary. b. See response to Comment 4a. Please note that the aluminum CTL that was used in the BERA is the same as the one ODEQ is suggesting (the BERA used a CTL for aluminum of 44 mg/kg). No revisions to the BERA are necessary.
43.	**Section 3.4.3, Toxicity Reference Values for Birds and Mammals and Wildlife TRVs, Table 3-14:** a. 4,4'-DDD, 4,4'-DDE and 4,4'-DDT should all have the same screening level value of 0.032 mg/kg bw-day. The Total DDx values are correct. b. Aluminum: The aluminum TRVs should be taken from Oak Ridge as follows: Bird NOAEL: 4.45 mg/kg bw-day Bird LOAEL: 44.5 mg/kg bw-day Mammal NOAEL: 0.803 mg/kg bw-day Mammal LOAEL: 8.03 mg/kg bw-day	a. The BERA is using 0.032 mg/kg-bw/day for DDD and DDE and an even more conservative toxicity reference value (TRV) for DDT (0.009 mg/kg-bw/day). b. The use of aluminum TRVs from the Portland Harbor is consistent with the established TRVs for wildlife (see Section C.3.2.7 in the RI/FS MP, URS 2007). The Portland Harbor TRVs used in the BERA are scientifically sound and conservative because they are based on aluminum lactate, an ionic form of aluminum that is not directly comparable to the form present in the environment but one that has a higher bioavailbility than aluminum compounds typically found in diet and drinking water (LWG 2013; ATSDR 2008). No revisions to the BERA are necessary.
44.	**Section 3.4.2, PAH ATLs:** DEQ's comments from Sept. 2011, Specific Comment 32, applies as follows: "If mammalian EPA Eco SSLs for high molecular weight polycyclic aromatic hydrocarbons (HPAHs) and low molecular weight polycyclic aromatic hydrocarbons (LPAHs) are not used to evaluate acceptable tissue levels in aquatic biota (for mammals) use either a PAH chemical specific toxicity reference value (e.g. benzo(a)pyrene) or an appropriate surrogate for each detected PAH. The EPA Eco SSL TRVs for LAPH and LPAH are 65.6 mg/kg bw/day and 0.615 mg/kg bw/day dry weight."	Comment noted. Since the detected concentrations of polycyclic aromatic hydrocarbons (PAHs) in fish and shellfish are so low, utilizing USEPA's Ecological Soil Screening Level (Eco SSL) mammalian TRVs for development of acceptable tissue levels (ATLs) rather than those used in the BERA would not result in different conclusions in the BERA. For further details, see response to ODEQ specific comment 32 in Appendix P of the RI Report (URS 2012). And since PAHs were not retained as CPECs for further evaluation for birds and mammals in the RI Report, they were not evaluated further for birds and mammals in the BERA. No revision to the BERA is necessary.

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45.	**Section 3.5.2, Data Quality Evaluation:** COCs identified on the basis of inadequate MDLs (here on page 3-11 and in Table A-5) should be carried forward into the analytical program for the FS. Of particular concern are COCs with 100% of the NDs > Eco SLVs. For sediment, these include Aroclors 1016, 1221, 1232, 1242, 1262 and 1268; monobutyltin, trichloride, tetrabutyltin, 2,3,4,7,8-PcCDF, 2,3,7, - TCDD, BHC (alpha), BHC (beta), chlordane (alpha), dieldrin, and heptachlor.	PCBs as a class were retained as contaminants of ecological concern (CECs) and COCs. The COCs/CECs identified in Table A-5 due to elevated MDLs in 100% of the samples will be considered in the FS. No revisions to the BERA are necessary.
46.	**Section 3.5.2.2, Bioaccumulative CPECs:** This section should show that appropriate tissue was collected near sediment exceedances of ATLs / CTL criteria for those CPECs that were dropped. It is unclear how sediment phthalates were dropped as sediment CPECs given the detected concentrations in tissue.	As presented in Table 3-1, bis(2-ethyl hexyl) phthalate and di-n-butyl phthalate were dropped as CPECs because all detected concentrations in tissue were below the fish CTLs and bird and mammal ATLs. Butyl benzyl phthalate was retained as a CPEC for the BERA because the maximum detected concentration (MDC) in bass collected in 2008 exceeded the CTL for fish; in 2011 bass samples it was non-detect. The two remaining phthalates detected in 2011 tissue had MDCs below the CTLs and ATLs and were also not retained as CPECs. No revisions to the BERA are necessary.
47.	**Section 3.5.2.3, Dioxins and Furans:** Given the detections of pesticides and that dioxins and furans are a presence as a contaminant in PCB mixtures, and the presence of pesticide sources at the Site, dioxins and furans should be included as COIs. While we don't require considerable additional testing for dioxins, we will ask you include those analytes in future fish tissue sampling.	Comment noted. ODEQ's request that dioxins and furans be considered COIs and analyzed in future fish tissue sampling will be considered in the River OU FS, during which time the USACE will evaluate the potential inclusion of dioxins and furans for long term monitoring in fish tissue . No revisions to the BERA are necessary,
48.	**Section 3.5.2.4, Age of Tissue Data:** Comparison of the two datasets for smallmouth bass does not support the statement that tissue concentrations are decreasing. The two datasets were not collected using a study design that would allow for the identification of trends. Additionally, as noted, the younger fish in the 2011 sampling had the most significant concentrations of PCBs. It would be unlikely that these fish were exposed to pre-removal conditions.	The text in Section 3.5.2.4 will be revised to state the following *"…While there was a wider spread in PCB concentrations reported in the 2011 bass dataset, only a few fish were found to have elevated detections. Generally low levels of PCBs were noted in the remaining 2011 bass samples as compared to the 2006 PCB concentrations in bass, which had a larger number of elevated PCB detections. Although the 2006 and 2011 bass data may appear to be decreasing, these two datasets are not necessarily comparable and more data would be needed to make any strong inferences about data trends. Younger fish may have a lower PCB body burden than older fish, and given the elevated concentrations were detected in young 2011 fish that were unlikely to have been exposed to pre-removal conditions, there remains uncertainty as to whether the smallmouth bass data used in the BERA may over- or underestimate River OU exposure by fish consumers."*

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49.	**Section 3.5.2.8, Dietary Item Assumptions:** The assumptions about the mink diet may significantly underestimate risk if the species is ingesting a higher proportion of higher trophic level fish. A range of risk estimates that include a higher proportion of fish should be presented in the risk assessment in order to quantitatively evaluate this assumption (from 33 % as presented to 100%).	Comment noted. For the mink, it was assumed in the BERA that 100% of its invertebrate and finfish consumption consisted of crayfish (33 percent), sculpin (33 percent), and smallmouth bass (33 percent) that reside exclusively in the River OU for their lifetime. The dietary composition described above is from the RI/FS MP (URS 2007). In fact, as discussed in Section C.4.2.5 of the RI/FS MP, it is likely that the choice of the smallmouth bass may overestimate exposure for the mink since they will likely consume larger amounts of other fish species that spend far less time in the River OU. In addition, although mink may also ingest upland receptors (which is why it was also evaluated in the Upland OU), the River OU BERA is already conservatively assuming exclusive (100%) ingestion of riverine prey. A diet of 100% smallmouth bass by mink is extremely unlikely and would add a huge overestimation of risk to the BERA. No revisions to the BERA are necessary.
50.	**Section 3.5.2.9, Estimated Concentrations:** Estimating surface water concentrations for contaminants of interest lacking surface water data using sediment partitioning methods is highly uncertain at this Site. This is due to the lack of traditional sediment matrix and the dominance of cobble and gravel. NAPL partitioning is also not considered in these equations. However, data used to support decision making related to measurements of compliance in the pore water or surface water for future analysis should be made by direct surface water measurements. While the focus of this evaluation appears to be wildlife ingestion of surface water, the emphasis in the evaluation of pore water / surface water should be direct effects to aquatic life, and determining the bioavailability of bioaccumulatives in the food chain.	See response to Question 35. Surface water data used to support decision making may be further assessed in the River OU FS, if necessary. No revisions to the BERA are necessary.
51.	**Section 3.5.2.10:** For the evaluation of larger home range fish tissue concentrations (e.g. bass), it is reasonable to assume Bradford Island as a separate exposure area. These species are not foraging throughout the river OU in an equal access, random manner. A Bradford Island fish exposure unit should be included in the risk assessment.	See response to Question 37. No revisions to the BERA are necessary.

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52.	**Section 3.5.3.1, Calculation of Site Specific Tissue Risk Based Concentrations and Table 3-20, Summary of Site Specific Risk Based Concentrations:** Site specific RBCs need to be revised using an AUF of 1 given that data from the forebay is used in the development of exposure point concentrations. Please consider the DEQ prepared attached table of fish acceptable tissue levels (ATLs) as comments on the tissue RBCs (Attachment 1). These additional ATLs were developed using DEQ guidance methodology for bioaccumulative chemicals in sediment. These should be used to screen data presented in Table 1-6, Statistical Summary for River OU Tissue Samples. These tissue samples should also be screened using the attached table of critical tissue levels for the protection of fish and shellfish (Attachment 2). For example, crayfish and sculpin tissue concentrations should be screened against bird ATLs.	USACE will continue to use the species-specific AUFs applied in the BERA. See response to Question 39 regarding use of AUFs in the River OU BHHERA. See response to Comment 42. USACE developed ATLs and CTLs according to ODEQ methodology. The BERA followed established hierarchies and AUFs. No revisions to the BERA are necessary.
53.	**Section 3.5.3.1: See also comments on Appendix D, Calculation of Risk Based Concentrations**. a. UPLs from the reference Site should not be used in place of risk based screening concentrations b. Sediment was not screened for tissue against ATLs (ingestion by birds, mammals) and CTLs (fish and shellfish) using DEQ Guidance for Bioaccumulative Chemicals in Sediment. Screening of sediment using these criteria should be completed before site specific RBCs are developed. All exceedances should be shown in Figure 3-8 A-B.	a. See response to Comment 25. b. In the DETM (URS 2014), sediment was screened for tissue against ATLs and CTLs using ODEQ Guidance for Bioaccumulative Chemicals in Sediment, as noted in the introduction (Section 1) of the BHHERA. No revisions to the BERA are necessary.
54.	**Section 3.5.3.2.1, Risk Description, Fish Community, Mercury:** Exceedances of sculpin fish concentrations around the "small unnamed island in the middle of the river across from the southern tip of Goose Island" are dismissed as being too far from the original source. However, this area is within the scope of upriver backflow influence. Based on the detected concentrations of mercury in fish and sediment, and the known sources in the uplands of Bradford Island, it cannot be concluded that these concentrations are at background levels. See also DEQ's 2011 comments (General Comment #10) that stated "mercury has an association with the bulb slope and landfill, detection in groundwater seeps, occurrence in bass over risk-based levels and relatively greater variability than reference variability in sediment. Therefore, regardless of comparison of the central tendency in sediment, mercury should be retained as a significant COPC warranting focus at these upland AOPCs and the in- water OU". In sediment, mercury appears most significant in the river area off drainage outfalls from the sandblast area (e.g. P116).	The following text in Section 3.5.3.2.1 will be revised as follows: *"Samples SF-15 and SF-16 are located in a small unnamed island in the middle of the river across from the southern tip of Goose Island."* The upland-to-river evaluation has not yet been completed and will not be part of the BHHERA. It will be completed in the Upland FS or River FS.

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55.	**Section 3.5.3.2, Fish Community:** Large scale sucker and carp were collected and analyzed at the Site, but only bass were included in the risk assessment. These fish should be included in the risk analysis and screening and discussed in this section. This was also included in DEQ's 2011 as Specific Comment 30: "The largescale sucker should be included as a receptor of concern, just as bass and sculpin, and screened in the risk assessment. Since this species is a separate receptor of concern, it should be included in the main document and not considered only in the uncertainty section. Largescale sucker tissue concentrations should be compared to both DEQ critical tissue levels (CTLs) and acceptable tissue levels (ATLs)."	The single 2006 large-scale sucker composite tissue sample was excluded from the BHHERA based on the qualitative evaluation presented in the RI (URS 2012). The uncertainty regarding the inclusion/exclusion of the large-scale sucker tissue was addressed in Appendix O of the RI. As noted in the RI, a quantitative evaluation of large-scale sucker is not likely to add either precision or accuracy to the risk estimates, and its exclusion does not result in underestimation of risk due to the quantitative evaluation of the smallmouth bass in the RAs. As stated in Table B-9 in the in the 2007 RI/FS MP (URS 2007), the common carp "Has not been observed or collected from the Forebay to date. Not selected for HHRA." The ecological tables in the RI/FS MP state the same. No revisions to the BERA are necessary.
56.	**Section 3.5.3.2.4 and 3.5.3.2.5, Sediment COCs, OCPs:** OCPs were not analyzed in the forebay sediment and tissue samples. The only data that exists is pre 2002 sediment data that appears to not have been included in the risk assessment. An examination of these data and the recent sampling in sediment and tissue show the highest exceedances in the former western hot spot area and the sandblast area. Therefore, there is uncertainty in assuming that they are only found co-located with former debris piles in former removal areas.	The 2011 pre-FS sediment and tissue samples collected in the River OU include analysis of organochlorine pesticides (OCPs) (URS 2013) and were included in the BHHERA. See Figures 2 and 3 of the 2011 Data Report (URS 2013) and Figures 1-5A and 1-5B of the BHHERA. The upland-to-river evaluation has not yet been completed and will not be part of the BHHERA. It will be completed in the Upland FS or River FS.
57.	**Table 3-15:** Please add total PAHs to the criteria table with hazard quotients.	USACE will add Total PAHs to Table 3-15.
58.	**Table 3-16 and Table 3-17:** The UPL (footnote D) does not represent background conditions. This issue was described in DEQ's Sept. 2011 comments (See DEQ 2011 Specific Comment #11 and 34, Pages 5 and 9). DEQ's definition of background (DEQ Rule, 340-122-0115) "means the concentration of hazardous substance, if any, existing in the environment in the location of the facility before the occurrence of any past or present release or releases". While EPA's definition may include anthropogenic in the definition of background, EPA also does not screen out these COCs and the full risk is calculated in the risk assessment. The approach taken here by the Corps appears to use EPA's definition to then screen out chemicals using the UPL from the reference Site. The UPL should not replace the NOAEL. This applies to aluminum, barium and cadmium for clams and lead for crayfish.	As stated in Section 6.2.3 of the RI Report (URS 2012), one of the objectives of the river Reference Area characterization was to complete a statistically-based program of collection/analysis of sediment and tissue data from an upstream Reference Area and establish site-specific background concentrations of inorganic contaminants of interest (COIs), as well as evaluate the contribution of ambient concentrations of organic COIs to the site-wide risk estimate. USACE will continue to use the site-specific background UPLs established for the river Reference Area. Screening out of COIs below background was done in the RI Report and was based on a statistical population-to-population evaluation (see Section 8 of the RI). The BERA evaluated the risk to all CPECs recommended for further evaluation (from the RI and DETM) and did

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
		not screen any out any CPECs based on a comparison to Reference Area background UPLs prior to the Level III assessment. The replacement of lower SLVs with higher UPLs for metals (as was done in Tables 3-16 and 3-17) is consistent with the methodology used in the RI Report (URS 2012). However, the following text will be added to Section 3.4.1, *"Due to the anticipated outcome of the baseline RAs that will document the need for further evaluation of PCBs in an FS, the BERA goes beyond the traditional assessment of the presence/absence and magnitude of baseline risk. To assist with development of future site management strategy, in the cases where SLVs are lower than UPLs, the UPLs were used in the risk evaluation in place of the lower SLVs for metals only."*
59.	**Table 3-18 and 3-19:** Excluding COIs that are found in reference tissue above risk based values is inappropriate**.** A statistical comparison between background concentrations for metals and site tissue concentrations should be completed instead for metals only. Reference area UPLs should not be used, and COIs dropped on this basis should be identified as COCs. COCs dropped on this basis include mercury in sculpin and bass tissue, and barium in bass tissue.	See response to Question 58.
Appendix D Comments		
60.	**Appendix D** provides a general description of the development of site-specific bioaccumulation factors and summarizes the BSAFs and BMFs. The supporting information needs to be provided, including the analytical data in the evaluation, the calculations of organic carbon and lipid normalized values (by location), and the plots of organic carbon and lipid normalized data used to determine that a BSAF rather than regression approach was more appropriate. All location-specific pairs should be provided, such that the reader can review each location specific BSAF and the associated variation and range (expand Appendix D Table D-1). Once the data is provided, DEQ can provide specific comments on the BSAF approach. Variation in the calculated relationship between lipid normalized tissue and organic carbon normalized sediment (BSAF) are to be expected given the presence of exposure to fourth phase contamination at the Site. The use of median BSAFs instead of means does not accurately incorporate this exposure of fish, shellfish and invertebrates to these "outlier" points when the median BSAF is used.	USACE is supplying the sediment and tissue data and associated calculations used for biota-sediment accumulation factor (BSAF) development (see River USACE Attachment 2_App D River OU BSAF BMF database.xlsx, provided separately). Most of the scatter plots did not show a clear trend due to the limited datasets, and possibly other factors (e.g., time of sampling). The text in Section D.1 will be modified as follows to provide clarification: *"Based on the outcome of the initial review of the paired data, in which clear trends were not observed, and due to the limited datasets for a rigorous statistical analysis, the averaging approach presented by USEPA (2009) was selected over a regression-based approach for deriving BSAFs. As stated in Appendix D: "While the USEPA recommends use of the average BSAF, the median BSAF for each chemical and sediment-organism pair was selected as a more likely estimate of the central tendency because is it less affected by outliers and skewed data (Bechtel Jacobs Company, LLC 1998; USEPA 2007). " Because the RBCs will be considered as target cleanup levels for*

Comment Number	Comments by Jennifer Peterson, Mike Poulsen and Bob Schwarz, DEQ Cleanup Program March 2, 2016	US Army Corps of Engineers Response/Action Taken
		sediment in the FS, the median value was selected as the appropriate more realistic statistic for the BSAFs." The uncertainties inherent in the sediment RBCs due to the BSAFs and biomagnification factor (BMFs) are highlighted in the fourth paragraph of Appendix D (first page). As stated, the sediment RBCs are less reliable than the tissue RBCs due to the uncertainty in the sediment to tissue link. Therefore, the tissue RBCs will be emphasized in the FS as the main line of evidence to measure COC/CEC presence/absence and concentration in fish and benthic invertebrate tissues. The sediment RBCs will be used as a secondary line of evidence in the pursuit to identify specific source areas that may be contributing to tissue concentrations.
61.	**Page 1-1** discusses "potential oil in rock crevices may currently be sources of contamination". Therefore, sediment based RBCs may not a viable approach as a single line of evidence. For these reasons, sediment RBCs may be of limited use in identifying areas of river media above risk levels. Methods that would capture exposure concentrations resulting from this additional phase, such as field collected clam or crayfish tissue, or a surrogate such as lipid bags placed on the river bottom, are recommended instead.	Comment noted. The RBCs developed in the BHHERA will be used in support of the FS, but not as a single line of evidence. As stated in the BHHERA, suspected non-aqueous phase liquids (NAPL) will be addressed further in the River OU FS. USACE will take ODEQ's recommendations under advisement. No revisions to the BERA are necessary.
62.	**Table D-1.** There is considerable difference in the BSAFsed-clam and BSAFsed-cray values for PCB-Aroclors and PCB-congeners, which is unexpected. Some of the difference may be due to differential uptake of congeners such that it is difficult to get an accurate Aroclor analysis in tissue. There also may be differences in where the samples were collected for the different types of analysis. The Sed_{oc} values are substantially different. These large differences in results indicate large uncertainty in the BSAF/BMF evaluation and calculation of RBCs.	See the response to Question 60. BSAF uncertainty is recognized and is addressed in the following paragraph provided in the first section of Appendix D: "The inherent uncertainty in the sediment-to-tissue link estimated through the BAF development process is reflected in the sediment RBCs and makes the sediment RBCs less reliable than the tissue RBCs for actual predictions of risk to humans, fish, and wildlife. However, comparison of the sediment RBCs to site sediment data allowed for: 1) a visual tool for representation of potential site-related impacts to the aquatic food web of the River OU, and 2) development of general areas of potential concern for consideration in the upcoming River OU Feasibility Study." No revisions to the BERA are necessary.

References:

ATSDR. 2008. Toxicological profile for aluminum. September 2008. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

LWG. 2013. Portland Harbor RI/FS, Final Remedial Investigation Report, Appendix G: Baseline Ecological Risk Assessment, Final. December.

ODEQ. 2010. Human Health Risk Assessment Guidance. Final. October.

URS. 2007. Remedial Investigation/Feasibility Study (RI/FS) Management Plan (MP), Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon. September.

URS. 2012. Upland and River Operable Units Remedial Investigation Report. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. June.

URS. 2013. Final Analytical Results for Sediment, Clams and Bass collected from Forebay September/October 2011 and Bass collected from Reference Area August 2011, Bradford Island Pre-Feasibility Study. Bonneville Dam Forebay, Cascade Locks, Oregon.

URS. 2014. Data Evaluation Technical Memorandum, River Operable Unit. Bradford Island, Bonneville Dam Forebay, Cascade Locks, Oregon. July 3.

APPENDIX E - Attachment 1

Infant IRAF Emails

From:	Vedagiri, Usha
To:	Patterson, Heather
Subject:	FW: Question about Nursing Infant IRAFs
Date:	Monday, March 14, 2016 6:54:06 PM

Usha Vedagiri, Ph.D.
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From: POULSEN Mike [POULSEN.Mike@deq.state.or.us]
Sent: Wednesday, August 05, 2015 4:19 PM
To: Vedagiri, Usha
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Sorry, I was trying to be helpful, and may have caused more confusion instead. We are revising our RBCs to incorporate EPA's new exposure values (such as 80 kg BW instead of 70 kg). We are taking the RME values from EPA's new regional screening level default assumptions, so you can use those if you want. We need to dig deeper into the Exposure Factors Handbook to decide on appropriate CTE values (EPA doesn't bother with CTE). I thought we were done with that, but we need to check a few values. Once we are done, we will put out a revised RBC table, perhaps in the next month.

- Mike

From: Vedagiri, Usha [mailto:usha.vedagiri@aecom.com]
Sent: Wednesday, August 05, 2015 4:08 PM
To: POULSEN Mike
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Hi Mike,

1) Thanks for the clarification. Yes, I understand the time-integrated aspect of the Adult+Child risk that you mean, so we're on the same page with you on that.

2) When you say you had questions on the CTE values, do you mean CTE assumptions as presented in the DEQ 2010 guidance?

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From: POULSEN Mike [POULSEN.Mike@deq.state.or.us]
Sent: Wednesday, August 05, 2015 3:57 PM
To: Vedagiri, Usha
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Usha –

I think you accurately summarized what we discussed yesterday. We were a little rushed at the end because I had to run to another meeting, so I may not have been clear about the wader ELCR. You express it as using either the mother's adult ELCR or the mother's (child + adult) ELCR. To elaborate, you shouldn't need to do any additional work characterizing the mother's risk. Most likely it will be based on child + adult exposure, so use the 0.6 IRAF. The point is that ELCR risk to the infant will be no worse than risk to the mother.

If you have any other questions, let me know.

- Mike

p.s. On a separate topic, I forgot to mention CTE exposure assumptions. I looked over these when we had our previous discussion last month, and found that I had some questions for the DEQ toxicologists. We are still trying to make time to resolve them. Once we settle on the CTE values, I will send you a summary. If this issue is holding up the Bradford risk assessment, let me know and we'll make a project decision.

From: Vedagiri, Usha [mailto:usha.vedagiri@aecom.com]
Sent: Tuesday, August 04, 2015 3:54 PM
To: POULSEN Mike
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Hi Mike,

Thank you for the discussion earlier today.

So your final recommendations were as follows, using Total PCBs as an example from Table D-3 of ODEQ 2010. The Total PCBs IRAFs are shown in Red Font below.

1) For Fish Ingestion (for the River OU HHRA)

Infant ELCR = Mother's Adulthood-based ELCR X 1
Infant HQ = Mother's adulthood-based HQ X 25

2) For Wader in direct contact with sediment (for the River OU HHRA, using residential soil/sediment assumptions for exposure duration and soil/sediment ingestion)

Infant ELCR = Mother's Adulthood-based ELCR X 1

OR

Infant ELCR = Child+Mother's ELCR X 0.6

Infant HQ = Child-based HQ X 4

3) For Fishing Platform User in Upland OU Soils (For the Upland OU HHRA, using residential soil assumptions)

Same as Sediment Wader

We will select similarly for the other COPCs. Please let us know if we misunderstood anything. Also, I know the call took longer than expected this morning, I appreciate your taking the time to explain the details to us.

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From: POULSEN Mike [mailto:POULSEN.Mike@deq.state.or.us]
Sent: Tuesday, August 04, 2015 9:52 AM
To: Vedagiri, Usha
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

OK, I'll be around.

- Mike

From: Vedagiri, Usha [mailto:usha.vedagiri@aecom.com]
Sent: Tuesday, August 04, 2015 9:51 AM
To: POULSEN Mike
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Thanks, Mike.

Can I call you in about 10 minutes (10 am) to clarify the last point about the correct IRAFs to use for the fish ingestion pathway? I need to make sure that I understand it correctly.

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From: POULSEN Mike [mailto:POULSEN.Mike@deq.state.or.us]
Sent: Tuesday, August 04, 2015 9:34 AM
To: Vedagiri, Usha
Cc: Kim, Dan; SCHWARZ Bob
Subject: RE: Question about Nursing Infant IRAFs

Usha –

I realize our footnotes to Table D-3 are not crystal clear. Things got complicated when we tried to apply a simple IRAF to a scenario that either combined child and adult exposure, or considered child-only exposure for a relatively short time (6 years) relative to the chemical's half-life (such that the steady-state assumption is not valid).

Your interpretation of 1) sounds correct. I think your interpretation of 2) is correct, but note that this applies only to the residential soil exposure pathway. "Adult exposure pathway" basically applies to every long-term scenario other than residential soil exposure. I use the term "long-term" because we decided that for construction worker and excavation worker, the exposure duration was too short relative to steady-state for us to apply any IRAF. Our RBCs for construction and excavation workers do not include infant exposure.

For fish consumption at Bradford, long-term fish consumption for an adult should be evaluated. This will allow you to calculate the risk to an infant using IRAF = 25 for PCBs. Attempting to determine an infant risk based on fish consumption for a child will not be appropriately protective.

I'm around this week if you want to discuss, which is probably a good idea. I have a meeting today from 11 am to 1 pm, and one at 4 pm, but otherwise I should be at my desk.

- Mike

From: Vedagiri, Usha [mailto:usha.vedagiri@aecom.com]
Sent: Monday, August 03, 2015 10:39 PM
To: POULSEN Mike
Cc: Kim, Dan
Subject: RE: Question about Nursing Infant IRAFs

Hi Mike,

We are working away on our HHRA and I have a question about the correct usage of the Infant Risk Adjustment Factors in Table D-3 of your HHRA Guidance.

There are 2 sets of IRAFs given for the each of the Cancer and Non-Cancer conversions. The first set is for Adult Exposure Pathways, the second set is for Residential Soil Exposure Pathways.

This is how I'm interpreting the recommended usage of these factors:

1) If the mother's exposure and risk is based on exposure during adulthood only (e.g., occupational settings) or any scenario where the mother is exposed only during adulthood, then we would use the IRAFs corresponding to "Adult Exposure Pathways" for both cancer and non-cancer.

2) If the mother's exposure includes exposure during the mother's childhood and adulthood (e.g., residential exposure of 0-6 yrs plus continuing to 7-26 years age), then, we would use "Residential Soil Exposure Pathway" IRAFs for the cancer; Also, in any residential-type scenario where non-cancer effects are based on childhood exposure, we would use the Residential Soil Exposure Pathway IRAFs.

Is my interpretation correct?

For the Bradford Island River OU, we are evaluating fish consumption for childhood onwards for both subsistence and recreational fishers. Therefore, the mother's exposures for cancer assume exposure from her childhood onwards. For non-cancer, we have childhood exposure-based estimates (0-6 years duration).

So to evaluate the infant risks for the fish consumption pathways, I would do the following:

a) Take the mother's cancer risk, (based on exposure from 0-26 years of age) and multiply by IRAF = 1 for total PCBs as Aroclors and for PCB TEQ and IRAF = 0.004 for DDTs.

3) Take the child non-cancer hazard (based on exposure from 0-6 years of age) and multiply by IRAF = 4 for Total PCBs, IRAF = 0.3 for PCB TEQ and DDTs.

I will call you tomorrow to verify that my understanding is correct.

Thank you.

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From: POULSEN Mike [POULSEN.Mike@deq.state.or.us]
Sent: Friday, May 22, 2015 4:09 PM
To: Vedagiri, Usha
Cc: SCHWARZ Bob
Subject: RE: Question about DEQ RBCs for Human Health

Usha –

The June 2012 RBC table is the current one. We are in the process of revising the table, but the toxicologist who was working on the revisions recently left the agency. I hope to check over the revisions and publish a revised table in June. The main changes are updated toxicity values and incorporation of EPA's new exposure parameter values. I will check with Bob with regard to the use of RBCs on the Bradford Island project. I doubt that the revisions will have a significant impact on remediation decisions. For chemicals without DEQ RBCs, we will look at EPA's regional screening levels.

- Mike

From: Vedagiri, Usha [mailto:usha.vedagiri@aecom.com]
Sent: Friday, May 22, 2015 2:06 PM
To: POULSEN Mike
Subject: Question about DEQ RBCs for Human Health

Hi Mike,

How are you? I have a question about DEQ's updates to the RBCs for human health. As far as I can tell, the last update was in June 2012. I realize that there is an Excel version of the RBCs table available on-line.

However, what is the status of the RBCs? Does DEQ now use the US EPA RSLs as the primary source of screening values for HH? Are the DEQ RBCs being discontinued and are they now obsolete?

Or are we supposed to update the RCBs ourselves by using the Excel version to calculate updated RBCs (including updating the toxicity values) and is only the pdf version that is out of date?

I want to make sure that I understand DEQ's current thinking on the use of RBCs and RSLs.

Have a wonderful weekend!

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APPENDIX E - Attachment 2

OU BSAF BMF Database

Database RESorMDLConv	Database D_RESorMDLconv	Database UNITSconv	Database MATRIX	Database SITE_ID	Database SAMP_ID	Database SAMP_DATE	Database Chem_Name	Database BASIS	Database PF_CODE	Database OC	Calculated ResultOC_Norm	Calculated Median	Calculated	Calculated Clam	Calculated $Clam_{lipid}$	Calculated D_Clam	Calculated Crayfish	Calculated $Crayfish_{lipid}$	Calculated D_Crayfish	Calculated $BSAF_{sed-clam}$	Calculated $BSAF_{sed-cray}$
0.36	1	ug/Kg	SD	P116	111018P116SD	10/18/2011	4,4'-DDE	D	T	0.468	77	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.66	0	ug/Kg	SD	P117	111018P117SD	10/18/2011	4,4'-DDE	D	T	0.203	325	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.29	1	ug/Kg	SD	P118	111018P118SD	10/18/2011	4,4'-DDE	D	T	0.379	77	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.215	0	ug/kg	SD	S1-32	030321S132SD	3/21/2003	4,4'-DDE	D	T	1.4	15	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.214	0	ug/kg	SD	S1-38	030320S138SD	3/20/2003	4,4'-DDE	D	T	1.4	15	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.212	0	ug/kg	SD	S1-43	030321S143SD	3/21/2003	4,4'-DDE	D	T	0.4	53	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.076	0	ug/kg	SD	S1-52	030324S152SD	3/24/2003	4,4'-DDE	D	T	2.3	3	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.13	0	ug/Kg	SD	P115	111018P115SD	10/18/2011	4,4'-DDE	D	T	0.186	70	82.08955224		10	555.5555556	1	#N/A	#N/A	#N/A	7.948717949	#N/A
1.2	1	ug/kg	SD	S1-35	030313S135SD	3/13/2003	4,4'-DDE	D	T	0.22	545	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.076	0	ug/kg	SD	S1-40	030314S140SD	3/14/2003	4,4'-DDE	D	T	0.5	15	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	0	ug/Kg	SD	P112	111019P112SD	10/19/2011	4,4'-DDE	D	T	0.132	11364	82.08955224		8.4	700	1	#N/A	#N/A	#N/A	0.0616	#N/A
58	0	ug/Kg	SD	P113	111019P113SD	10/19/2011	4,4'-DDE	D	T	0.089	65169	82.08955224		8	500	1	#N/A	#N/A	#N/A	0.007672414	#N/A
0.11	0	ug/Kg	SD	P114	111019P114SD	10/19/2011	4,4'-DDE	D	T	0.134	82	82.08955224		9.5	558.8235294	1	#N/A	#N/A	#N/A	6.807486631	#N/A
14	0	ug/kg	SD	S1-29	030325S129SD	3/25/2003	4,4'-DDE	D	T	0.24	5833	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.05	0	ug/kg	SD	S1-31	030319S131SD	3/19/2003	4,4'-DDE	D	T	0.4	263	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.076	0	ug/kg	SD	S1-37	030326S137SD	3/26/2003	4,4'-DDE	D	T	0.094	81	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.075	0	ug/kg	SD	S1-45	030325S145SD	3/25/2003	4,4'-DDE	D	T	0.28	27	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
7100	0	ug/kg	SD	S1-46	030325S146SD	3/25/2003	4,4'-DDE	D	T	1.5	473333	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.9	0	ug/kg	SD	S1-47	030319S147SD	3/19/2003	4,4'-DDE	D	T	1.3	146	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
7.9	0	ug/kg	SD	S1-48	030319S148SD	3/19/2003	4,4'-DDE	D	T	1	790	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
16	0	ug/kg	SD	S1-49	030328S149SD	3/28/2003	4,4'-DDE	D	T	0.3	5333	82.08955224		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.23	1	ug/Kg	SD	P116	111018P116SD	10/18/2011	Chlordane (gamma)	D	T	0.468	49	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.9	1	ug/Kg	SD	P117	111018P117SD	10/18/2011	Chlordane (gamma)	D	T	0.203	936	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.16	1	ug/Kg	SD	P118	111018P118SD	10/18/2011	Chlordane (gamma)	D	T	0.379	42	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.112	0	ug/kg	SD	S1-32	030321S132SD	3/21/2003	Chlordane (gamma)	D	T	1.4	8	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.112	0	ug/kg	SD	S1-38	030320S138SD	3/20/2003	Chlordane (gamma)	D	T	1.4	8	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.111	0	ug/kg	SD	S1-43	030321S143SD	3/21/2003	Chlordane (gamma)	D	T	0.4	28	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.037	0	ug/kg	SD	S1-52	030324S152SD	3/24/2003	Chlordane (gamma)	D	T	2.3	2	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.25	1	ug/Kg	SD	P115	111018P115SD	10/18/2011	Chlordane (gamma)	D	T	0.186	134	39.36170213		5.9	327.7777778	1	#N/A	#N/A	#N/A	2.438666667	#N/A
0.037	0	ug/kg	SD	S1-35	030313S135SD	3/13/2003	Chlordane (gamma)	D	T	0.22	17	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.037	0	ug/kg	SD	S1-40	030314S140SD	3/14/2003	Chlordane (gamma)	D	T	0.5	7	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	1	ug/Kg	SD	P112	111019P112SD	10/19/2011	Chlordane (gamma)	D	T	0.132	7576	39.36170213		16	1333.333333	1	#N/A	#N/A	#N/A	0.176	#N/A
44	1	ug/Kg	SD	P113	111019P113SD	10/19/2011	Chlordane (gamma)	D	T	0.089	49438	39.36170213		18	1125	1	#N/A	#N/A	#N/A	0.022755682	#N/A
6.5	1	ug/Kg	SD	P114	111019P114SD	10/19/2011	Chlordane (gamma)	D	T	0.134	4851	39.36170213		12	705.8823529	1	#N/A	#N/A	#N/A	0.145520362	#N/A
0.036	0	ug/kg	SD	S1-29	030325S129SD	3/25/2003	Chlordane (gamma)	D	T	0.24	15	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.548	0	ug/kg	SD	S1-31	030319S131SD	3/19/2003	Chlordane (gamma)	D	T	0.4	137	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.037	0	ug/kg	SD	S1-37	030326S137SD	3/26/2003	Chlordane (gamma)	D	T	0.094	39	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.037	0	ug/kg	SD	S1-45	030325S145SD	3/25/2003	Chlordane (gamma)	D	T	0.28	13	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18.4	0	ug/kg	SD	S1-46	030325S146SD	3/25/2003	Chlordane (gamma)	D	T	1.5	1227	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.11	0	ug/kg	SD	S1-47	030319S147SD	3/19/2003	Chlordane (gamma)	D	T	1.3	8	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.449	0	ug/kg	SD	S1-48	030319S148SD	3/19/2003	Chlordane (gamma)	D	T	1	45	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.037	0	ug/kg	SD	S1-49	030328S149SD	3/28/2003	Chlordane (gamma)	D	T	0.3	12	39.36170213		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.14	0	ug/Kg	SD	P116	111018P116SD	10/18/2011	Dieldrin	D	T	0.468	30	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.3	0	ug/Kg	SD	P117	111018P117SD	10/18/2011	Dieldrin	D	T	0.203	640	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.14	0	ug/Kg	SD	P118	111018P118SD	10/18/2011	Dieldrin	D	T	0.379	37	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.083	0	ug/kg	SD	S1-32	030321S132SD	3/21/2003	Dieldrin	D	T	1.4	6	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.082	0	ug/kg	SD	S1-38	030320S138SD	3/20/2003	Dieldrin	D	T	1.4	6	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.082	0	ug/kg	SD	S1-43	030321S143SD	3/21/2003	Dieldrin	D	T	0.4	21	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-52	030324S152SD	3/24/2003	Dieldrin	D	T	2.3	3	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.19	0	ug/Kg	SD	P115	111018P115SD	10/18/2011	Dieldrin	D	T	0.186	102	101		3.1	172.2222222	0	#N/A	#N/A	#N/A	1.685964912	#N/A
0.058	0	ug/kg	SD	S1-35	030313S135SD	3/13/2003	Dieldrin	D	T	0.22	26	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-40	030314S140SD	3/14/2003	Dieldrin	D	T	0.5	12	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
6.9	0	ug/Kg	SD	P112	111019P112SD	10/19/2011	Dieldrin	D	T	0.132	5227	101		9.3	775	0	#N/A	#N/A	#N/A	0.14826087	#N/A
29	0	ug/Kg	SD	P113	111019P113SD	10/19/2011	Dieldrin	D	T	0.089	32584	101		8.6	537.5	0	#N/A	#N/A	#N/A	0.01649569	#N/A
4.3	0	ug/Kg	SD	P114	111019P114SD	10/19/2011	Dieldrin	D	T	0.134	3209	101		6.7	394.1176471	0	#N/A	#N/A	#N/A	0.122818057	#N/A
11	0	ug/kg	SD	S1-29	030325S129SD	3/25/2003	Dieldrin	D	T	0.24	4583	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.404	0	ug/kg	SD	S1-31	030319S131SD	3/19/2003	Dieldrin	D	T	0.4	101	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-37	030326S137SD	3/26/2003	Dieldrin	D	T	0.094	62	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-45	030325S145SD	3/25/2003	Dieldrin	D	T	0.28	21	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5800	0	ug/kg	SD	S1-46	030325S146SD	3/25/2003	Dieldrin	D	T	1.5	386667	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.9	0	ug/kg	SD	S1-47	030319S147SD	3/19/2003	Dieldrin	D	T	1.3	146	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
7.9	0	ug/kg	SD	S1-48	030319S148SD	3/19/2003	Dieldrin	D	T	1	790	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
13	0	ug/kg	SD	S1-49	030328S149SD	3/28/2003	Dieldrin	D	T	0.3	4333	101		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.063	0	ug/Kg	SD	P116	111018P116SD	10/18/2011	Endosulfan I	D	T	0.468	13	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.66	0	ug/Kg	SD	P117	111018P117SD	10/18/2011	Endosulfan I	D	T	0.203	325	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

0.063	0	ug/Kg	SD	P118	111018P118SD	10/18/2011	Endosulfan I	D	T	0.379	17	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.047	0	ug/kg	SD	S1-32	030321S132SD	3/21/2003	Endosulfan I	D	T	1.4	3	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.047	0	ug/kg	SD	S1-38	030320S138SD	3/20/2003	Endosulfan I	D	T	1.4	3	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.047	0	ug/kg	SD	S1-43	030321S143SD	3/21/2003	Endosulfan I	D	T	0.4	12	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.052	0	ug/kg	SD	S1-52	030324S152SD	3/24/2003	Endosulfan I	D	T	2.3	2	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.063	0	ug/Kg	SD	P115	111018P115SD	10/18/2011	Endosulfan I	D	T	0.186	34	18.9		0.85	47.22222222	1	#N/A	#N/A	#N/A	1.394179894	#N/A
0.053	0	ug/kg	SD	S1-35	030313S135SD	3/13/2003	Endosulfan I	D	T	0.22	24	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.053	0	ug/kg	SD	S1-40	030314S140SD	3/14/2003	Endosulfan I	D	T	0.5	11	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.1	0	ug/Kg	SD	P112	111019P112SD	10/19/2011	Endosulfan I	D	T	0.132	1591	18.9		5.3	441.6666667	0	#N/A	#N/A	#N/A	0.277619048	#N/A
5.4	0	ug/Kg	SD	P113	111019P113SD	10/19/2011	Endosulfan I	D	T	0.089	6067	18.9		1.7	106.25	1	#N/A	#N/A	#N/A	0.017511574	#N/A
1.4	0	ug/Kg	SD	P114	111019P114SD	10/19/2011	Endosulfan I	D	T	0.134	1045	18.9		2.7	158.8235294	1	#N/A	#N/A	#N/A	0.152016807	#N/A
0.052	0	ug/kg	SD	S1-29	030325S129SD	3/25/2003	Endosulfan I	D	T	0.24	22	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.231	0	ug/kg	SD	S1-31	030319S131SD	3/19/2003	Endosulfan I	D	T	0.4	58	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.052	0	ug/kg	SD	S1-37	030326S137SD	3/26/2003	Endosulfan I	D	T	0.094	55	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.052	0	ug/kg	SD	S1-45	030325S145SD	3/25/2003	Endosulfan I	D	T	0.28	19	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
26.2	0	ug/kg	SD	S1-46	030325S146SD	3/25/2003	Endosulfan I	D	T	1.5	1747	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.047	0	ug/kg	SD	S1-47	030319S147SD	3/19/2003	Endosulfan I	D	T	1.3	4	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.189	0	ug/kg	SD	S1-48	030319S148SD	3/19/2003	Endosulfan I	D	T	1	19	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.052	0	ug/kg	SD	S1-49	030328S149SD	3/28/2003	Endosulfan I	D	T	0.3	17	18.9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.094	0	ug/Kg	SD	P116	111018P116SD	10/18/2011	Endrin	D	T	0.468	20	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.54	1	ug/Kg	SD	P117	111018P117SD	10/18/2011	Endrin	D	T	0.203	266	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.094	0	ug/Kg	SD	P118	111018P118SD	10/18/2011	Endrin	D	T	0.379	25	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.091	0	ug/kg	SD	S1-32	030321S132SD	3/21/2003	Endrin	D	T	1.4	7	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.09	0	ug/kg	SD	S1-38	030320S138SD	3/20/2003	Endrin	D	T	1.4	6	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.089	0	ug/kg	SD	S1-43	030321S143SD	3/21/2003	Endrin	D	T	0.4	22	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-52	030324S152SD	3/24/2003	Endrin	D	T	2.3	3	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.094	0	ug/Kg	SD	P115	111018P115SD	10/18/2011	Endrin	D	T	0.186	51	24.80211082		1.4	77.77777778	1	#N/A	#N/A	#N/A	1.539007092	#N/A
0.058	0	ug/kg	SD	S1-35	030313S135SD	3/13/2003	Endrin	D	T	0.22	26	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-40	030314S140SD	3/14/2003	Endrin	D	T	0.5	12	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.7	1	ug/Kg	SD	P112	111019P112SD	10/19/2011	Endrin	D	T	0.132	2045	24.80211082		3.8	316.6666667	1	#N/A	#N/A	#N/A	0.154814815	#N/A
7.4	1	ug/Kg	SD	P113	111019P113SD	10/19/2011	Endrin	D	T	0.089	8315	24.80211082		4.1	256.25	1	#N/A	#N/A	#N/A	0.030819257	#N/A
1.9	1	ug/Kg	SD	P114	111019P114SD	10/19/2011	Endrin	D	T	0.134	1418	24.80211082		2.9	170.5882353	1	#N/A	#N/A	#N/A	0.120309598	#N/A
0.057	0	ug/kg	SD	S1-29	030325S129SD	3/25/2003	Endrin	D	T	0.24	24	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.442	0	ug/kg	SD	S1-31	030319S131SD	3/19/2003	Endrin	D	T	0.4	111	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-37	030326S137SD	3/26/2003	Endrin	D	T	0.094	62	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-45	030325S145SD	3/25/2003	Endrin	D	T	0.28	21	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
29.1	0	ug/kg	SD	S1-46	030325S146SD	3/25/2003	Endrin	D	T	1.5	1940	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.089	0	ug/kg	SD	S1-47	030319S147SD	3/19/2003	Endrin	D	T	1.3	7	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
9.9	0	ug/kg	SD	S1-48	030319S148SD	3/19/2003	Endrin	D	T	1	990	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.058	0	ug/kg	SD	S1-49	030328S149SD	3/28/2003	Endrin	D	T	0.3	19	24.80211082		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.0005181	1	ug/kg	SD	P116	111018P116SD	10/18/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.468	0	0.013		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.0006094	1	ug/kg	SD	P117	111018P117SD	10/18/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.203	0	0.013		0.00513491	0.197496538	1	#N/A	#N/A	#N/A	0.657889683	#N/A
0.00517	1	ug/kg	SD	P118	111018P118SD	10/18/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.379	1	0.013		0.00640398	0.246306923	1	#N/A	#N/A	#N/A	0.180561555	#N/A
0.0008976	1	ug/kg	SD	P04	08022604SD	2/26/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.01	0	0.013		0.00660792	0.220264	1	0.000765314	0.139148	1	2.478460784	1.565725045
0.001848	1	ug/kg	SD	P115	111018P115SD	10/18/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.186	1	0.013		0.01058618	0.588121111	1	#N/A	#N/A	#N/A	0.591940079	#N/A
0.0000209	1	ug/kg	SD	P88	08031788SD	3/17/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.3	0	0.013		0.00279851	0.099946786	1	#N/A	#N/A	#N/A	14.34642857	#N/A
0.00001749	1	ug/kg	SD	P89	08031789SD	3/17/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.21	0	0.013		0.00259743	0.099901154	1	#N/A	#N/A	#N/A	11.99499274	#N/A
0.00282	1	ug/kg	SD	Debris Pile 02	060405-SED-1	4/5/2006	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.5365	1	0.013		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.010857	1	ug/kg	SD	P112	111019P112SD	10/19/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.132	8	0.013		0.032312351	2.692695917	1	#N/A	#N/A	#N/A	0.327379443	#N/A
0.049555	1	ug/kg	SD	P113	111019P113SD	10/19/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.089	56	0.013		0.03553	2.220625	1	#N/A	#N/A	#N/A	0.039882075	#N/A
0.004895	1	ug/kg	SD	P114	111019P114SD	10/19/2011	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.134	4	0.013		0.0242	1.423529412	1	#N/A	#N/A	#N/A	0.389689359	#N/A
0.0000121	1	ug/kg	SD	P05	08031905SD	3/19/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.54	0	0.013		0.00313313	0.104437667	1	0.00145805	0.104146429	1	132.9206667	132.55
0.00003751	1	ug/kg	SD	P06	08031806SD	3/18/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.24	0	0.013		0.00382965	0.132056897	1	0.0025916	0.2356	1	8.449388209	15.07438017
0.00009482	1	ug/kg	SD	P17	08022117SD	2/21/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.62	0	0.013		0.00210298	0.09559	1	8.25396E-05	0.01719575	1	16.33155452	2.937894432
0.00008019	1	ug/kg	SD	P18	08021118SD	2/11/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.86	0	0.013		0.00227645	0.094852083	1	0.000290169	0.039749178	1	10.17243941	4.262912227
0.00006666	1	ug/kg	SD	P65	08022965SD	2/29/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.61	0	0.013		0.00296989	0.089996667	1	#N/A	#N/A	#N/A	8.235518552	#N/A
0.0000143	1	ug/kg	SD	P67	08030367SD	3/3/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.11	0	0.013	TC not analyzed fc	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.0001848	1	ug/kg	SD	P110	090427110SD	4/27/2009	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	2.56	0	0.013		0.0022737	0.076957184	1	0.000142758	0.023137439	1	10.66073544	3.205186386
0.00009394	1	ug/kg	SD	P21	08021221SD	2/12/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.16	0	0.013		0.00221243	0.092184583	1	0.000216766	0.030106389	1	11.38323575	3.717629456
0.000237448	1	ug/kg	SD	P111	090429111SD	4/29/2009	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.1	0	0.013	Goose Island sed (	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.000143	1	ug/kg	SD	P10	08021410SD	2/14/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.5	0	0.013		0.0018689	0.093445	1	#N/A	#N/A	#N/A	9.801923077	#N/A
0.0001408	1	ug/kg	SD	P11	08021411SD	2/14/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.42	0	0.013		0.00231726	0.089125385	1	#N/A	#N/A	#N/A	8.988497596	#N/A
0.0001309	1	ug/kg	SD	P09	08021409SD	2/14/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.25	0	0.013	TC not analyzed fc	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.00010296	1	ug/kg	SD	P13	08031713SD	3/17/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.19	0	0.013		0.00266717	0.098784074	1	0.000139876	0.017058049	1	11.41735122	1.971549927
0.00002112	1	ug/kg	SD	P14	08031814SD	3/18/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.54	0	0.013		0.00277695	0.099176786	1	0.000116523	0.020090172	1	72.31640625	14.64908405
0.00009306	1	ug/kg	SD	P08	08021508SD	2/15/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.56	0	0.013		0.00250657	0.096406538	1	0.000265738	0.035910541	1	5.801382069	2.160960961
0.00008459	1	ug/kg	SD	P07	08021507SD	2/15/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	0.51	0	0.013		0.00269929	0.103818846	1	0.000684255	0.112172951	1	6.259322797	6.762998572

0.0001529	1	ug/kg	SD	P15	08022115SD	2/21/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.06	0	0.013		0.00226347	0.087056538	1	0.000270622	0.031105977	1	6.035312673	2.15646407
0.0001353	1	ug/kg	SD	P16	08022116SD	2/21/2008	PCBs as Bird TEQ (KM-capped, RDL-based)	D	T	1.25	0	0.013		0.00213664	0.092897391	1	0.000266574	0.024234	1	8.582537999	2.238913525
0.00006006	1	ug/kg	SD	P116	111018P116SD	10/18/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.468	0	0.0020416		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.0001441	1	ug/kg	SD	P117	111018P117SD	10/18/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.203	0	0.0020416		0.00192027	0.073856538	1	#N/A	#N/A	#N/A	1.040449501	#N/A
0.001452	1	ug/kg	SD	P118	111018P118SD	10/18/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.379	0	0.0020416		0.00284438	0.109399231	1	#N/A	#N/A	#N/A	0.285553089	#N/A
0.0001474	1	ug/kg	SD	P04	08022604SD	2/26/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.01	0	0.0020416		0.00356334	0.118778	1	0.000273779	0.049778	1	8.138791045	3.410839891
0.0004895	1	ug/kg	SD	P115	111018P115SD	10/18/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.186	0	0.0020416		0.00413402	0.229667778	1	#N/A	#N/A	#N/A	0.872690637	#N/A
7.39563E-07	1	ug/kg	SD	P88	08031788SD	3/17/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.3	0	0.0020416		0.000628727	0.022454536	1	#N/A	#N/A	#N/A	91.08569134	#N/A
5.46084E-07	1	ug/kg	SD	P89	08031789SD	3/17/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.21	0	0.0020416		0.000586861	0.022571577	1	#N/A	#N/A	#N/A	86.80040349	#N/A
0.001668	1	ug/kg	SD	Debris Pile 02	060405-SED-1	4/5/2006	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.5365	0	0.0020416		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.00297	1	ug/kg	SD	P112	111019P112SD	10/19/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.132	2	0.0020416		0.01408	1.173333333	1	#N/A	#N/A	#N/A	0.521481481	#N/A
0.013255	1	ug/kg	SD	P113	111019P113SD	10/19/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.089	15	0.0020416		0.01507	0.941875	1	#N/A	#N/A	#N/A	0.063241701	#N/A
0.0010879	1	ug/kg	SD	P114	111019P114SD	10/19/2011	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.134	1	0.0020416		0.00893717	0.525715882	1	#N/A	#N/A	#N/A	0.647540475	#N/A
1.70478E-06	1	ug/kg	SD	P05	08031905SD	3/19/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.54	0	0.0020416		0.000939708	0.0313236	1	0.000650287	0.046449071	1	282.9593496	419.5941412
3.75045E-06	1	ug/kg	SD	P06	08031806SD	3/18/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.24	0	0.0020416		0.00119801	0.04131069	1	0.00141922	0.12902	1	26.4356691	82.56289245
0.00001881	1	ug/kg	SD	P17	08022117SD	2/21/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.62	0	0.0020416		0.000434907	0.0197685	1	4.60152E-06	0.00095865	1	17.02550239	0.825631579
0.00001375	1	ug/kg	SD	P18	08021118SD	2/11/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.86	0	0.0020416		0.000461494	0.019228917	1	5.53454E-05	0.007581562	1	12.02681333	4.741922192
0.0000143	1	ug/kg	SD	P65	08022965SD	2/29/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.61	0	0.0020416		0.000640882	0.019420667	1	#N/A	#N/A	#N/A	8.284340326	#N/A
2.12498E-07	1	ug/kg	SD	P67	08030367SD	3/3/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.11	0	0.0020416	TC not analyzed fo	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.00002893	1	ug/kg	SD	P110	090427110SD	4/27/2009	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	2.56	0	0.0020416		0.000379258	0.012836622	1	3.04832E-05	0.004940551	1	11.35905723	4.371866815
0.00001991	1	ug/kg	SD	P21	08021221SD	2/12/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.16	0	0.0020416		0.000495	0.020625	1	8.2874E-06	0.001151028	1	12.01657459	0.670613874
0.00004521	1	ug/kg	SD	P111	090429111SD	4/29/2009	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.1	0	0.0020416	Goose Island sed (	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.00002959	1	ug/kg	SD	P10	08021410SD	2/14/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.5	0	0.0020416		0.000500027	0.02500135	1	#N/A	#N/A	#N/A	12.67388476	#N/A
0.0000242	1	ug/kg	SD	P11	08021411SD	2/14/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.42	0	0.0020416		0.000517902	0.019919308	1	#N/A	#N/A	#N/A	11.68818881	#N/A
0.0000286	1	ug/kg	SD	P09	08021409SD	2/14/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.25	0	0.0020416	TC not analyzed fo	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.00002123	1	ug/kg	SD	P13	08031713SD	3/17/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.19	0	0.0020416		0.000622534	0.023056815	1	3.52066E-05	0.004293488	1	12.92398004	2.406618223
4.91942E-07	1	ug/kg	SD	P14	08031814SD	3/18/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.54	0	0.0020416		0.000653785	0.023349464	1	2.99651E-05	0.005166397	1	730.9433836	161.7314783
0.00002167	1	ug/kg	SD	P08	08021508SD	2/15/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.56	0	0.0020416		0.000725252	0.027894308	1	4.44191E-05	0.006002581	1	7.208496681	1.551197695
7.09313E-06	1	ug/kg	SD	P07	08021507SD	2/15/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	0.51	0	0.0020416		0.000917334	0.035282077	1	0.000191818	0.031445574	1	25.36800993	22.60954279
0.00003652	1	ug/kg	SD	P15	08022115SD	2/21/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.06	0	0.0020416		0.000492096	0.018926769	1	5.29012E-05	0.006080598	1	5.493531047	1.764905138
0.00002552	1	ug/kg	SD	P16	08022116SD	2/21/2008	PCBs as Mammal TEQ (KM-capped, RDL-based)	D	T	1.25	0	0.0020416		0.000501611	0.021809174	1	1.26269E-05	0.0011479	1	10.68239318	0.562255094
3.35	1	ug/kg	SD	DP-129	030321DP129SD	3/21/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.1	305	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
11	1	ug/Kg	SD	P116	111018P116SD	10/18/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.468	2350	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
86	1	ug/Kg	SD	P117	111018P117SD	10/18/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.203	42365	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	1	ug/Kg	SD	P118	111018P118SD	10/18/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.379	2639	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
56.27	1	ug/kg	SD	S1-32	030321S132SD	3/21/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.4	4019	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25.12	1	ug/kg	SD	S1-38	030320S138SD	3/20/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.4	1794	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
145.86	1	ug/kg	SD	S1-43	030321S143SD	3/21/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.4	36465	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
21.075	1	ug/kg	SD	S1-52	030324S152SD	3/24/2003	Total PCBs as Aroclors (MDL-based)	D	T	2.3	916	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
16.45	1	ug/kg	SD	S2-58	030324S258SD	3/24/2003	Total PCBs as Aroclors (MDL-based)	D	T	2.2	748	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
77.45	1	ug/kg	SD	S2-65	030306S265SD	3/6/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.9	4076	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
17.45	1	ug/kg	SD	TR-15	030320TR15SD	3/20/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.84	2077	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18.45	1	ug/kg	SD	TR-16	030320TR16SD	3/20/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.8	1025	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1300.445	1	ug/kg	SD	TR-21	030306TR21SD	3/6/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.58	224215	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
14.445	1	ug/kg	SD	TR-22	030306TR22SD	3/6/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.6	903	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	0	ug/kg	SD	P110	090427110SD	4/27/2009	Total PCBs as Aroclors (MDL-based)	D	T	2.56	195	2625		14	473.8534439	0	2.6	421.3938412	0	2.426129633	2.157536467
0.63	0	ug/kg	SD	DP-120	030402DP120SD	4/3/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.71	89	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.945	1	ug/kg	SD	DP-121	030403DP121SD	4/3/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.4	139	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.4	0	ug/kg	SD	P67	08030367SD	3/3/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.11	3091	2625		21	567.5675676	1	#N/A	#N/A	#N/A	0.183624801	#N/A
3.4	0	ug/kg	SD	P65	08022965SD	2/29/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.61	557	2625		21	636.3636364	1	#N/A	#N/A	#N/A	1.14171123	#N/A
3.4	0	ug/kg	SD	P05	08031905SD	3/19/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.54	221	2625		23	766.6666667	1	9.8	700	0	3.47254902	3.170588235
3.4	0	ug/kg	SD	P14	08031814SD	3/18/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.54	221	2625		22	785.7142857	1	2.6	448.2758621	0	3.558823529	2.030425963
2.19	1	ug/kg	SD	S1-35	030313S135SD	3/13/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.22	995	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
95.995	1	ug/kg	SD	S1-40	030314S140SD	3/14/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.5	19199	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1502.29	1	ug/kg	SD	S2-53	030318S253SD	3/18/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.92	163292	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
380.45	1	ug/kg	SD	S2-59	030314S259SD	3/14/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.67	56784	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
240.45	1	ug/kg	SD	S2-60	030318S260SD	3/18/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.85	28288	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
99.45	1	ug/kg	SD	S2-68	030305S268SD	3/5/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.97	10253	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5800.445	1	ug/kg	SD	S2-69	030317S269SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.86	674470	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75.445	1	ug/kg	SD	S2-70	030314S270SD	3/14/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.42	17963	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
110.45	1	ug/kg	SD	S2-71	030314S271SD	3/14/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.84	13149	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
230.45	1	ug/kg	SD	S2-74	030305S274SD	3/5/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.91	25324	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
100.445	1	ug/kg	SD	S2-75	030325S275SD	3/25/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.8	5580	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
41.46	1	ug/kg	SD	S2-76	030313S276SD	3/13/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.34	12194	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50.45	1	ug/kg	SD	S2-77	030314S277SD	3/14/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.94	5367	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
56.445	1	ug/kg	SD	TR-1	030317TR1SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	1	5645	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
410.445	1	ug/kg	SD	TR-2	030317TR2SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.72	57006	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

120.445	1	ug/kg	SD	TR-3	030317TR3SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.56	21508	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
160.45	1	ug/kg	SD	TR-4	030317TR4SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.8	8914	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
150.45	1	ug/kg	SD	TR-5	030317TR5SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.09	13803	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
120.45	1	ug/kg	SD	TR-6	030317TR6SD	3/17/2003	Total PCBs as Aroclors (MDL-based)	D	T	2.1	5736	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.4	0	ug/kg	SD	P89	08031789SD	3/17/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.21	1619	2625		21	807.6923077	1	#N/A	#N/A	#N/A	0.498868778	#N/A
1130.39	1	ug/kg	SD	Debris Pile 02	060405-SED-1	4/5/2006	Total PCBs as Aroclors (MDL-based)	D	T	0.5365	210697	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.4	0	ug/kg	SD	P13	08031713SD	3/17/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.19	286	2625		22	814.8148148	1	2.6	317.0731707	0	2.851851852	1.109756098
3.4	0	ug/kg	SD	P88	08031788SD	3/17/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.3	1133	2625		23	821.4285714	1	#N/A	#N/A	#N/A	0.724789916	#N/A
6.3	1	ug/kg	SD	P06	08031806SD	3/18/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.24	2625	2625		32	1103.448276	1	19	1727.272727	0	0.420361248	0.658008658
110.445	1	ug/kg	SD	S1-29	030325S129SD	3/25/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.24	46019	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
289.5	1	ug/kg	SD	S1-31	030319S131SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.4	72375	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
31.45	1	ug/kg	SD	S1-37	030326S137SD	3/26/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.094	33457	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
150.445	1	ug/kg	SD	S1-45	030325S145SD	3/25/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.28	53730	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
22190.91	1	ug/kg	SD	S1-46	030325S146SD	3/25/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.5	1479394	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2434.135	1	ug/kg	SD	S1-47	030319S147SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.3	187241	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2932.41	1	ug/kg	SD	S1-48	030319S148SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	1	293241	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
27.205	1	ug/kg	SD	S1-49	030328S149SD	3/28/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.3	9068	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
14531.71	1	ug/kg	SD	S2-56	030401S256SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.305	4764495	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
150.44	1	ug/kg	SD	S2-57	030401S257SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.47	32009	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
120.45	1	ug/kg	SD	S2-61	030318S261SD	3/18/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.44	27375	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.65	1	ug/kg	SD	S2-62	030319S262SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	1	265	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3502.29	1	ug/kg	SD	S2-63	030403S263SD	4/3/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.1	318390	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3000.445	1	ug/kg	SD	S2-64	030401S264SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.32	937639	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
7.25	1	ug/kg	SD	TR-12	030404TR12SD	4/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.36	2014	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
660.45	1	ug/kg	SD	TR-23	030318TR23SD	3/18/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.2	330225	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
160.45	1	ug/kg	SD	TR-24	030318TR24SD	3/18/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.29	55328	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
34.45	1	ug/kg	SD	TR-25	030326TR25SD	3/26/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.16	21531	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
120.45	1	ug/kg	SD	TR-26	030326TR26SD	3/26/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.53	22726	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
39.445	1	ug/kg	SD	TR-27	030319TR27SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.24	16435	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
180.445	1	ug/kg	SD	TR-28	030319TR28SD	3/19/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.42	42963	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.745	1	ug/kg	SD	TR-7	030401TR7SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.37	742	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.445	1	ug/kg	SD	TR-8	030401TR8SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.52	278	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.63	0	ug/kg	SD	DP-118	030402DP118SD	4/3/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.83	76	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.63	0	ug/kg	SD	DP-123	030304DP123SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.96	66	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
4.6	0	ug/kg	SD	P18	08021118SD	2/11/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.86	535	2625		28	1166.666667	0	2.6	356.1643836	0	2.18115942	0.665872543
3.4	0	ug/kg	SD	P11	08021411SD	2/14/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.42	239	2625		32	1230.769231	0	#N/A	#N/A	#N/A	5.140271493	#N/A
3.4	0	ug/kg	SD	P15	08022115SD	2/21/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.06	321	2625		32	1230.769231	0	2.6	298.8505747	0	3.837104072	0.931710615
8.1	0	ug/kg	SD	P21	08021221SD	2/12/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.16	698	2625		30	1250	0	2.6	361.1111111	0	1.790123457	0.517146776
540.445	1	ug/kg	SD	SE-117	030305SE117SD	3/5/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.2	45037	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.545	1	ug/kg	SD	TR-10	030331TR10SD	3/31/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.16	2216	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.25	1	ug/kg	SD	TR-13	030331TR13SD	3/31/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.145	1552	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2.25	1	ug/kg	SD	TR-14	030331TR14SD	3/31/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.13	1731	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
12.45	1	ug/kg	SD	TR-9	030331TR9SD	3/31/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.1	12450	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
77.7	1	ug/kg	SD	P43	08032043SD	3/20/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.23	33783	2625	Eagle Creek sed o	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.4	0	ug/kg	SD	P44	08032044SD	3/20/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.57	596	2625	Goose Island sed (	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.9	0	ug/kg	SD	P17	08022117SD	2/21/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.62	241	2625		28	1272.727273	0	2.6	541.6666667	0	5.286713287	2.25
3.4	0	ug/kg	SD	P16	08022116SD	2/21/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.25	272	2625		30	1304.347826	0	2.6	236.3636364	0	4.795396419	0.868983957
0.64	0	ug/kg	SD	GI-115	030304GI115SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.4	46	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.64	0	ug/kg	SD	DP-125	030401DP125SD	4/1/2003	Total PCBs as Aroclors (MDL-based)	D	T	1	64	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.62	0	ug/kg	SD	GI-112	030402GI112SD	4/3/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.84	74	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
3.9	0	ug/kg	SD	P10	08021410SD	2/14/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.5	260	2625		36	1800	0	#N/A	#N/A	#N/A	6.923076923	#N/A
7.6	0	ug/kg	SD	P08	08021508SD	2/15/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.56	1357	2625		55	2115.384615	0	2.6	351.3513514	0	1.558704453	0.258890469
1.45	1	ug/kg	SD	GI-111	030304GI111SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.6	91	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.35	1	ug/kg	SD	GI-111	030304GI133SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.94	144	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
12.6	1	ug/kg	SD	P111	090429111SD	4/29/2009	Total PCBs as Aroclors (MDL-based)	D	T	1.1	1145	2625	Goose Island sed (	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.63	0	ug/kg	SD	DP-127	030304DP127SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.2	53	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.63	0	ug/kg	SD	DP-127	030304DP127SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.2	53	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.62	0	ug/kg	SD	DP-127	030304DP132SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.69	90	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.62	0	ug/kg	SD	DP-127	030304DP132SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.69	90	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.62	0	ug/kg	SD	DP-128	030304DP128SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	0.45	138	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.65	0	ug/kg	SD	DP-130	030305DP130SD	3/5/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.4	46	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.63	0	ug/kg	SD	DP-130	030305DP135SD	3/5/2003	Total PCBs as Aroclors (MDL-based)	D	T	2.1	30	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
4.3	0	ug/kg	SD	P09	08021409SD	2/14/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.25	344	2625		49	2130.434783	0	#N/A	#N/A	#N/A	6.193124368	#N/A
6.8	0	ug/kg	SD	P07	08021507SD	2/15/2008	Total PCBs as Aroclors (MDL-based)	D	T	0.51	1333	2625		74	2846.153846	0	4	655.7377049	0	2.134615385	0.491803279
28.7	1	ug/kg	SD	P04	08022604SD	2/26/2008	Total PCBs as Aroclors (MDL-based)	D	T	1.01	2842	2625		120	4000	1	8.6	1563.636364	0	1.407665505	0.550269243
11.6	0	ug/kg	SD	A3	070927A3 SD	9/27/2007	Total PCBs as Aroclors (MDL-based)	D	T	1.09	1064	2625		180	5454.545455	1	#N/A	#N/A	#N/A	5.12539185	#N/A
132.6	1	ug/kg	SD	A1	070926A1 SD	9/26/2007	Total PCBs as Aroclors (MDL-based)	D	T	1.02	13000	2625		355	10757.57576	1	#N/A	#N/A	#N/A	0.827505828	#N/A

11	1	ug/Kg	SD	P115	111018P115SD	10/18/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.186	5914	2625		370	20555.55556	1	#N/A	#N/A	#N/A	3.475757576	#N/A
7.75	1	ug/kg	SD	DP-124	030304DP124SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1.2	646	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
320	1	ug/Kg	SD	P114	111019P114SD	10/19/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.134	238806	2625		620	36470.58824	1	#N/A	#N/A	#N/A	0.152720588	#N/A
670	1	ug/Kg	SD	P112	111019P112SD	10/19/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.132	507576	2625		800	66666.66667	1	#N/A	#N/A	#N/A	0.131343284	#N/A
0.64	0	ug/kg	SD	DP-122	030304DP122SD	3/4/2003	Total PCBs as Aroclors (MDL-based)	D	T	1	64	2625		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1900	1	ug/Kg	SD	P113	111019P113SD	10/19/2011	Total PCBs as Aroclors (MDL-based)	D	T	0.089	2134831	2625		1200	75000	1	#N/A	#N/A	#N/A	0.035131579	#N/A
15.27354	1	ug/kg	SD	P116	111018P116SD	10/18/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.468	3264	91.8		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
28.8426	1	ug/kg	SD	P117	111018P117SD	10/18/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.203	14208	91.8		184.913716	7112.066	1	#N/A	#N/A	#N/A	0.50056146	#N/A
314.502	1	ug/kg	SD	P118	111018P118SD	10/18/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.379	82982	91.8		303.157483	11659.90319	1	#N/A	#N/A	#N/A	0.140511135	#N/A
29.733	1	ug/kg	SD	P04	08022604SD	2/26/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.01	2944	91.8		311.5993508	10386.64503	1	16.8404488	3061.899782	1	3.528238481	1.040096452
118.8048	1	ug/kg	SD	P115	111018P115SD	10/18/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.186	63874	91.8		449.143445	24952.41361	1	#N/A	#N/A	#N/A	0.390653318	#N/A
0.20352	1	ug/kg	SD	P88	08031788SD	3/17/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.3	68	91.8		33.3490919	1191.038996	1	#N/A	#N/A	#N/A	17.55658898	#N/A
0.15102615	1	ug/kg	SD	P89	08031789SD	3/17/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.21	72	91.8		31.641	1216.961538	1	#N/A	#N/A	#N/A	16.92170019	#N/A
480.238	1	ug/kg	SD	Debris Pile 02	060405-SED-1	4/5/2006	Total PCBs as Congeners (KM-based, capped)	D	T	0.5365	89513	91.8		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
807.879	1	ug/kg	SD	P112	111019P112SD	10/19/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.132	612030	91.8		2028.84	169070	1	#N/A	#N/A	#N/A	0.276244834	#N/A
4311.762	1	ug/kg	SD	P113	111019P113SD	10/19/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.089	4844676	91.8		1877.79	117361.875	1	#N/A	#N/A	#N/A	0.024224915	#N/A
258.057	1	ug/kg	SD	P114	111019P114SD	10/19/2011	Total PCBs as Congeners (KM-based, capped)	D	T	0.134	192580	91.8		1081.677	63628.05882	1	#N/A	#N/A	#N/A	0.330398318	#N/A
0.30051	1	ug/kg	SD	P05	08031905SD	3/19/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.54	20	91.8		65.8028064	2193.42688	1	16.854	1203.857143	1	112.404825	61.69312169
0.77751	1	ug/kg	SD	P06	08031806SD	3/18/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.24	324	91.8		95.0645114	3278.0866	1	42.7335491	3884.8681	1	10.11872238	11.99172157
0.5883	1	ug/kg	SD	P17	08022117SD	2/21/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.62	36	91.8		24.4615683	1111.889468	1	0.54537	113.61875	1	30.61806797	3.128716216
0.52311	1	ug/kg	SD	P18	08021118SD	2/11/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.86	61	91.8		25.9162374	1079.843225	1	1.12254	153.7726027	1	17.75277042	2.528042636
0.39909	1	ug/kg	SD	P65	08022965SD	2/29/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.61	65	91.8		33.072	1002.181818	1	#N/A	#N/A	#N/A	15.31812145	#N/A
0.06110052	1	ug/kg	SD	P67	08030367SD	3/3/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.11	56	91.8	TC not analyzed fo	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.20045	1	ug/kg	SD	P110	090427110SD	4/27/2009	Total PCBs as Congeners (KM-based, capped)	D	T	2.56	47	91.8		21.4492609	725.9861533	1	0.6042	97.92544571	1	15.48189889	2.088293065
0.57081	1	ug/kg	SD	P21	08021221SD	2/12/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.16	49	91.8		24.645	1026.875	1	0.97626	135.5916667	1	20.86815227	2.755493655
1.34037	1	ug/kg	SD	P111	090429111SD	4/29/2009	Total PCBs as Congeners (KM-based, capped)	D	T	1.1	122	91.8	Goose Island sed	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1.23702	1	ug/kg	SD	P10	08021410SD	2/14/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.5	82	91.8		30.6301631	1531.508155	1	#N/A	#N/A	#N/A	18.57093849	#N/A
1.12095	1	ug/kg	SD	P11	08021411SD	2/14/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.42	79	91.8		26.712	1027.384615	1	#N/A	#N/A	#N/A	13.01472995	#N/A
2.0978105	1	ug/kg	SD	P09	08021409SD	2/14/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.25	168	91.8	TC not analyzed fo	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
0.6837	1	ug/kg	SD	P13	08031713SD	3/17/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.19	57	91.8		33.1896816	1229.247467	1	0.60261	73.48902439	1	21.39541444	1.279098128
0.14345139	1	ug/kg	SD	P14	08031814SD	3/18/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.54	9	91.8		33.9961732	1214.149043	1	0.83475	143.9224138	1	130.3430748	15.45056602
1.08438	1	ug/kg	SD	P08	08021508SD	2/15/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.56	194	91.8		51.516	1981.384615	1	3.1323	423.2837838	1	10.2323483	2.185939605
1.6854	1	ug/kg	SD	P07	08021507SD	2/15/2008	Total PCBs as Congeners (KM-based, capped)	D	T	0.51	330	91.8		65.667	2525.653846	1	12.4338	2038.327869	1	7.642597968	6.167955459
0.97308	1	ug/kg	SD	P15	08022115SD	2/21/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.06	92	91.8		26.871	1033.5	1	0.82044	94.30344828	1	11.25816993	1.027270678
0.83634	1	ug/kg	SD	P16	08022116SD	2/21/2008	Total PCBs as Congeners (KM-based, capped)	D	T	1.25	67	91.8		25.5360274	1110.262061	1	1.34355	122.1409091	1	16.59405955	1.825527134

Database	Database	Database	Database	Database	Database	Database	Database	Database	Calculated	Calculated	Calculated
										Paired Location from Sediment	
RESorMDL	D_RESorM	UNITSconv	SITE_ID	SAMP_ID	Chem_Name	MATRIX	Lookup	LIPID	ResultLipidNorm	Tab	Median
0.0003	1	ug/kg	P01-CF	08021901CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP01PCBs as Bird TEQ (KM-capped, RDL-based)	1.2	0.025025917	No Sed Location	0.029008476
0.000765	1	ug/kg	P04-CF	08021904CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP04PCBs as Bird TEQ (KM-capped, RDL-based)	0.55	0.139148	P04	0.029008476
0.001458	1	ug/kg	P05-CF	08021505CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP05PCBs as Bird TEQ (KM-capped, RDL-based)	1.4	0.104146429	P05	0.029008476
0.002592	1	ug/kg	P06-CF	08021406CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP06PCBs as Bird TEQ (KM-capped, RDL-based)	1.1	0.2356	P06	0.029008476
0.000684	1	ug/kg	P07-CF	08021407CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP07PCBs as Bird TEQ (KM-capped, RDL-based)	0.61	0.112172951	P07	0.029008476
0.000266	1	ug/kg	P08-CF	08021408CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP08PCBs as Bird TEQ (KM-capped, RDL-based)	0.74	0.035910541	P08	0.029008476
0.00014	1	ug/kg	P13-CF	08021413CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP13PCBs as Bird TEQ (KM-capped, RDL-based)	0.82	0.017058049	P13	0.029008476
0.000117	1	ug/kg	P14-CF	08022014CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP14PCBs as Bird TEQ (KM-capped, RDL-based)	0.58	0.020090172	P14	0.029008476
0.000271	1	ug/kg	P15-CF	08021915CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP15PCBs as Bird TEQ (KM-capped, RDL-based)	0.87	0.031105977	P15	0.029008476
0.000267	1	ug/kg	P16-CF	08022216CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP16PCBs as Bird TEQ (KM-capped, RDL-based)	1.1	0.024234	P16	0.029008476
8.25E-05	1	ug/kg	P17-CF	08021917CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP17PCBs as Bird TEQ (KM-capped, RDL-based)	0.48	0.01719575	P17	0.029008476
0.00029	1	ug/kg	P18-CF	08021918CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP18PCBs as Bird TEQ (KM-capped, RDL-based)	0.73	0.039749178	P18	0.029008476
0.000139	1	ug/kg	P19-CF	08021919CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP19PCBs as Bird TEQ (KM-capped, RDL-based)	0.93	0.014904409	No Sed Location	0.029008476
0.000198	1	ug/kg	P20-CF	08021920CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP20PCBs as Bird TEQ (KM-capped, RDL-based)	0.71	0.027910563	No Sed Location	0.029008476
0.000217	1	ug/kg	P21-CF	08021921CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP21PCBs as Bird TEQ (KM-capped, RDL-based)	0.72	0.030106389	P21	0.029008476
0.000143	1	ug/kg	P110	090429110CF	PCBs as Bird TEQ (KM-capped, RDL-based)	CF	CFP110PCBs as Bird TEQ (KM-capped, RDL-based)	0.617	0.023137439	P11	0.029008476
9.04E-05	1	ug/kg	P01-CF	08021901CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP01PCBs as Mammal TEQ (KM-capped, RDL-based)	1.2	0.007529958	No Sed Location	0.005584489
0.000274	1	ug/kg	P04-CF	08021904CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP04PCBs as Mammal TEQ (KM-capped, RDL-based)	0.55	0.049778	P04	0.005584489
0.00065	1	ug/kg	P05-CF	08021505CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP05PCBs as Mammal TEQ (KM-capped, RDL-based)	1.4	0.046449071	P05	0.005584489
0.001419	1	ug/kg	P06-CF	08021406CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP06PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1	0.12902	P06	0.005584489
0.000192	1	ug/kg	P07-CF	08021407CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP07PCBs as Mammal TEQ (KM-capped, RDL-based)	0.61	0.031445574	P07	0.005584489
4.44E-05	1	ug/kg	P08-CF	08021408CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP08PCBs as Mammal TEQ (KM-capped, RDL-based)	0.74	0.006002581	P08	0.005584489
3.52E-05	1	ug/kg	P13-CF	08021413CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP13PCBs as Mammal TEQ (KM-capped, RDL-based)	0.82	0.004293488	P13	0.005584489
3E-05	1	ug/kg	P14-CF	08022014CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP14PCBs as Mammal TEQ (KM-capped, RDL-based)	0.58	0.005166397	P14	0.005584489
5.29E-05	1	ug/kg	P15-CF	08021915CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP15PCBs as Mammal TEQ (KM-capped, RDL-based)	0.87	0.006080598	P15	0.005584489
1.26E-05	1	ug/kg	P16-CF	08022216CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP16PCBs as Mammal TEQ (KM-capped, RDL-based)	1.1	0.0011479	P16	0.005584489
4.6E-06	1	ug/kg	P17-CF	08021917CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP17PCBs as Mammal TEQ (KM-capped, RDL-based)	0.48	0.00095865	P17	0.005584489
5.53E-05	1	ug/kg	P18-CF	08021918CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP18PCBs as Mammal TEQ (KM-capped, RDL-based)	0.73	0.007581562	P18	0.005584489
6.03E-06	1	ug/kg	P19-CF	08021919CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP19PCBs as Mammal TEQ (KM-capped, RDL-based)	0.93	0.000648432	No Sed Location	0.005584489
7.99E-06	1	ug/kg	P20-CF	08021920CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP20PCBs as Mammal TEQ (KM-capped, RDL-based)	0.71	0.001125811	No Sed Location	0.005584489
8.29E-06	1	ug/kg	P21-CF	08021921CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP21PCBs as Mammal TEQ (KM-capped, RDL-based)	0.72	0.001151028	P21	0.005584489
3.05E-05	1	ug/kg	P110	090429110CF	PCBs as Mammal TEQ (KM-capped, RDL-based)	CF	CFP110PCBs as Mammal TEQ (KM-capped, RDL-based)	0.617	0.004940551	P11	0.005584489
2.6	0	ug/kg	P01-CF	08021901CF	Total PCBs as Aroclors (MDL-based)	CF	CFP01Total PCBs as Aroclors (MDL-based)	1.2	216.6666667	No Sed Location	363.6541471
2.6	0	ug/kg	P02-CF	08021902CF	Total PCBs as Aroclors (MDL-based)	CF	CFP02Total PCBs as Aroclors (MDL-based)	1.7	152.9411765	No Sed Location	363.6541471
2.6	0	ug/kg	P03-CF	08022003CF	Total PCBs as Aroclors (MDL-based)	CF	CFP03Total PCBs as Aroclors (MDL-based)	0.62	419.3548387	No Sed Location	363.6541471
8.6	0	ug/kg	P04-CF	08021904CF	Total PCBs as Aroclors (MDL-based)	CF	CFP04Total PCBs as Aroclors (MDL-based)	0.55	1563.636364	P04	363.6541471
9.8	0	ug/kg	P05-CF	08021505CF	Total PCBs as Aroclors (MDL-based)	CF	CFP05Total PCBs as Aroclors (MDL-based)	1.4	700	P05	363.6541471
19	0	ug/kg	P06-CF	08021406CF	Total PCBs as Aroclors (MDL-based)	CF	CFP06Total PCBs as Aroclors (MDL-based)	1.1	1727.272727	P06	363.6541471
4	0	ug/kg	P07-CF	08021407CF	Total PCBs as Aroclors (MDL-based)	CF	CFP07Total PCBs as Aroclors (MDL-based)	0.61	655.7377049	P07	363.6541471
2.6	0	ug/kg	P08-CF	08021408CF	Total PCBs as Aroclors (MDL-based)	CF	CFP08Total PCBs as Aroclors (MDL-based)	0.74	351.3513514	P08	363.6541471
2.6	0	ug/kg	P13-CF	08021413CF	Total PCBs as Aroclors (MDL-based)	CF	CFP13Total PCBs as Aroclors (MDL-based)	0.82	317.0731707	P13	363.6541471
2.6	0	ug/kg	P14-CF	08022014CF	Total PCBs as Aroclors (MDL-based)	CF	CFP14Total PCBs as Aroclors (MDL-based)	0.58	448.2758621	P14	363.6541471
2.6	0	ug/kg	P15-CF	08021915CF	Total PCBs as Aroclors (MDL-based)	CF	CFP15Total PCBs as Aroclors (MDL-based)	0.87	298.8505747	P15	363.6541471
2.6	0	ug/kg	P16-CF	08022216CF	Total PCBs as Aroclors (MDL-based)	CF	CFP16Total PCBs as Aroclors (MDL-based)	1.1	236.3636364	P16	363.6541471
2.6	0	ug/kg	P17-CF	08021917CF	Total PCBs as Aroclors (MDL-based)	CF	CFP17Total PCBs as Aroclors (MDL-based)	0.48	541.6666667	P17	363.6541471
2.6	0	ug/kg	P18-CF	08021918CF	Total PCBs as Aroclors (MDL-based)	CF	CFP18Total PCBs as Aroclors (MDL-based)	0.73	356.1643836	P18	363.6541471
2.6	0	ug/kg	P19-CF	08021919CF	Total PCBs as Aroclors (MDL-based)	CF	CFP19Total PCBs as Aroclors (MDL-based)	0.93	279.5698925	No Sed Location	363.6541471
2.6	0	ug/kg	P20-CF	08021920CF	Total PCBs as Aroclors (MDL-based)	CF	CFP20Total PCBs as Aroclors (MDL-based)	0.71	366.1971831	No Sed Location	363.6541471
2.6	0	ug/kg	P21-CF	08021921CF	Total PCBs as Aroclors (MDL-based)	CF	CFP21Total PCBs as Aroclors (MDL-based)	0.72	361.1111111	P21	363.6541471

2.6	0	ug/kg	P110	090429110CF	Total PCBs as Aroclors (MDL-based)	CF	CFP110Total PCBs as Aroclors (MDL-based)	0.617	421.3938412	P11	363.6541471
1.45167	1	ug/kg	P01-CF	08021901CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP01Total PCBs as Congeners (KM-based, capped)	1.2	120.9725	No Sed Location	132.963439
16.84045	1	ug/kg	P04-CF	08021904CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP04Total PCBs as Congeners (KM-based, capped)	0.55	3061.899782	P04	132.963439
16.854	1	ug/kg	P05-CF	08021505CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP05Total PCBs as Congeners (KM-based, capped)	1.4	1203.857143	P05	132.963439
42.73355	1	ug/kg	P06-CF	08021406CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP06Total PCBs as Congeners (KM-based, capped)	1.1	3884.8681	P06	132.963439
12.4338	1	ug/kg	P07-CF	08021407CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP07Total PCBs as Congeners (KM-based, capped)	0.61	2038.327869	P07	132.963439
3.1323	1	ug/kg	P08-CF	08021408CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP08Total PCBs as Congeners (KM-based, capped)	0.74	423.2837838	P08	132.963439
0.60261	1	ug/kg	P13-CF	08021413CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP13Total PCBs as Congeners (KM-based, capped)	0.82	73.48902439	P13	132.963439
0.83475	1	ug/kg	P14-CF	08022014CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP14Total PCBs as Congeners (KM-based, capped)	0.58	143.9224138	P14	132.963439
0.82044	1	ug/kg	P15-CF	08021915CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP15Total PCBs as Congeners (KM-based, capped)	0.87	94.30344828	P15	132.963439
1.34355	1	ug/kg	P16-CF	08022216CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP16Total PCBs as Congeners (KM-based, capped)	1.1	122.1409091	P16	132.963439
0.54537	1	ug/kg	P17-CF	08021917CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP17Total PCBs as Congeners (KM-based, capped)	0.48	113.61875	P17	132.963439
1.12254	1	ug/kg	P18-CF	08021918CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP18Total PCBs as Congeners (KM-based, capped)	0.73	153.7726027	P18	132.963439
0.78069	1	ug/kg	P19-CF	08021919CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP19Total PCBs as Congeners (KM-based, capped)	0.93	83.94516129	No Sed Location	132.963439
0.92538	1	ug/kg	P20-CF	08021920CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP20Total PCBs as Congeners (KM-based, capped)	0.71	130.3352113	No Sed Location	132.963439
0.97626	1	ug/kg	P21-CF	08021921CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP21Total PCBs as Congeners (KM-based, capped)	0.72	135.5916667	P21	132.963439
0.6042	1	ug/kg	P110	090429110CF	Total PCBs as Congeners (KM-based, capped)	CF	CFP110Total PCBs as Congeners (KM-based, capped)	0.617	97.92544571	P11	132.963439
200	0	ug/Kg	62	R09032011SB62	4,4'-DDE	SB	SB624,4'-DDE	4.2	4761.904762	No Sed Location	793.1034483
34	0	ug/Kg	63	R09032011SB63	4,4'-DDE	SB	SB634,4'-DDE	3.4	1000	No Sed Location	793.1034483
29	1	ug/Kg	64	R09032011SB64	4,4'-DDE	SB	SB644,4'-DDE	1.9	1526.315789	No Sed Location	793.1034483
25	1	ug/Kg	65	R09032011SB65	4,4'-DDE	SB	SB654,4'-DDE	3.4	735.2941176	No Sed Location	793.1034483
20	1	ug/Kg	67	R09032011SB67	4,4'-DDE	SB	SB674,4'-DDE	3.6	555.5555556	No Sed Location	793.1034483
35	0	ug/Kg	68	R09032011SB68	4,4'-DDE	SB	SB684,4'-DDE	3.1	1129.032258	No Sed Location	793.1034483
13	1	ug/Kg	69	R09032011SB69	4,4'-DDE	SB	SB694,4'-DDE	2.5	520	No Sed Location	793.1034483
18	1	ug/Kg	70	R09032011SB70	4,4'-DDE	SB	SB704,4'-DDE	3.1	580.6451613	No Sed Location	793.1034483
23	1	ug/Kg	71	R09042011SB71	4,4'-DDE	SB	SB714,4'-DDE	3.4	676.4705882	No Sed Location	793.1034483
14	1	ug/Kg	72	R09042011SB72	4,4'-DDE	SB	SB724,4'-DDE	2.1	666.6666667	No Sed Location	793.1034483
16	1	ug/Kg	73	R09042011SB73	4,4'-DDE	SB	SB734,4'-DDE	2.6	615.3846154	No Sed Location	793.1034483
36	1	ug/Kg	74	R09042011SB74	4,4'-DDE	SB	SB744,4'-DDE	3.7	972.972973	No Sed Location	793.1034483
22	1	ug/Kg	76	R09042011SB76	4,4'-DDE	SB	SB764,4'-DDE	3.4	647.0588235	No Sed Location	793.1034483
23	0	ug/Kg	78	R09042011SB78	4,4'-DDE	SB	SB784,4'-DDE	2.9	793.1034483	No Sed Location	793.1034483
76	1	ug/Kg	79	R09042011SB79	4,4'-DDE	SB	SB794,4'-DDE	3.5	2171.428571	No Sed Location	793.1034483
72	1	ug/Kg	81	R09042011SB81	4,4'-DDE	SB	SB814,4'-DDE	3	2400	No Sed Location	793.1034483
38	1	ug/Kg	82	R09042011SB82	4,4'-DDE	SB	SB824,4'-DDE	0.71	5352.112676	No Sed Location	793.1034483
21	1	ug/Kg	83	R09042011SB83	4,4'-DDE	SB	SB834,4'-DDE	3	700	No Sed Location	793.1034483
68	1	ug/Kg	84	R09042011SB84	4,4'-DDE	SB	SB844,4'-DDE	6.4	1062.5	No Sed Location	793.1034483
660	1	ug/Kg	62	R09032011SB62	Chlordane (gamma)	SB	SB62Chlordane (gamma)	4.2	15714.28571	No Sed Location	29.41176471
1600	1	ug/Kg	63	R09032011SB63	Chlordane (gamma)	SB	SB63Chlordane (gamma)	3.4	47058.82353	No Sed Location	29.41176471
1.1	1	ug/Kg	64	R09032011SB64	Chlordane (gamma)	SB	SB64Chlordane (gamma)	1.9	57.89473684	No Sed Location	29.41176471
0.63	1	ug/Kg	65	R09032011SB65	Chlordane (gamma)	SB	SB65Chlordane (gamma)	3.4	18.52941176	No Sed Location	29.41176471
0.72	1	ug/Kg	67	R09032011SB67	Chlordane (gamma)	SB	SB67Chlordane (gamma)	3.6	20	No Sed Location	29.41176471
5000	1	ug/Kg	68	R09032011SB68	Chlordane (gamma)	SB	SB68Chlordane (gamma)	3.1	161290.3226	No Sed Location	29.41176471
1.3	1	ug/Kg	69	R09032011SB69	Chlordane (gamma)	SB	SB69Chlordane (gamma)	2.5	52	No Sed Location	29.41176471
0.4	1	ug/Kg	70	R09032011SB70	Chlordane (gamma)	SB	SB70Chlordane (gamma)	3.1	12.90322581	No Sed Location	29.41176471
1	1	ug/Kg	71	R09042011SB71	Chlordane (gamma)	SB	SB71Chlordane (gamma)	3.4	29.41176471	No Sed Location	29.41176471
0.26	0	ug/Kg	72	R09042011SB72	Chlordane (gamma)	SB	SB72Chlordane (gamma)	2.1	12.38095238	No Sed Location	29.41176471
0.26	0	ug/Kg	73	R09042011SB73	Chlordane (gamma)	SB	SB73Chlordane (gamma)	2.6	10	No Sed Location	29.41176471
2	1	ug/Kg	74	R09042011SB74	Chlordane (gamma)	SB	SB74Chlordane (gamma)	3.7	54.05405405	No Sed Location	29.41176471
0.46	1	ug/Kg	76	R09042011SB76	Chlordane (gamma)	SB	SB76Chlordane (gamma)	3.4	13.52941176	No Sed Location	29.41176471
1200	1	ug/Kg	78	R09042011SB78	Chlordane (gamma)	SB	SB78Chlordane (gamma)	2.9	41379.31034	No Sed Location	29.41176471
3.7	1	ug/Kg	79	R09042011SB79	Chlordane (gamma)	SB	SB79Chlordane (gamma)	3.5	105.7142857	No Sed Location	29.41176471
0.56	1	ug/Kg	81	R09042011SB81	Chlordane (gamma)	SB	SB81Chlordane (gamma)	3	18.66666667	No Sed Location	29.41176471
0.55	0	ug/Kg	82	R09042011SB82	Chlordane (gamma)	SB	SB82Chlordane (gamma)	0.71	77.46478873	No Sed Location	29.41176471

0.29	0	ug/Kg	83	R09042011SB83	Chlordane (gamma)	SB	SB83Chlordane (gamma)	3	9.666666667	No Sed Location	29.41176471
0.99	1	ug/Kg	84	R09042011SB84	Chlordane (gamma)	SB	SB84Chlordane (gamma)	6.4	15.46875	No Sed Location	29.41176471
370	1	ug/Kg	62	R09032011SB62	Dieldrin	SB	SB62Dieldrin	4.2	8809.52381	No Sed Location	28.16901408
950	1	ug/Kg	63	R09032011SB63	Dieldrin	SB	SB63Dieldrin	3.4	27941.17647	No Sed Location	28.16901408
0.72	1	ug/Kg	64	R09032011SB64	Dieldrin	SB	SB64Dieldrin	1.9	37.89473684	No Sed Location	28.16901408
0.2	0	ug/Kg	65	R09032011SB65	Dieldrin	SB	SB65Dieldrin	3.4	5.882352941	No Sed Location	28.16901408
0.26	0	ug/Kg	67	R09032011SB67	Dieldrin	SB	SB67Dieldrin	3.6	7.222222222	No Sed Location	28.16901408
2900	1	ug/Kg	68	R09032011SB68	Dieldrin	SB	SB68Dieldrin	3.1	93548.3871	No Sed Location	28.16901408
0.83	1	ug/Kg	69	R09032011SB69	Dieldrin	SB	SB69Dieldrin	2.5	33.2	No Sed Location	28.16901408
0.2	0	ug/Kg	70	R09032011SB70	Dieldrin	SB	SB70Dieldrin	3.1	6.451612903	No Sed Location	28.16901408
0.69	0	ug/Kg	71	R09042011SB71	Dieldrin	SB	SB71Dieldrin	3.4	20.29411765	No Sed Location	28.16901408
0.2	0	ug/Kg	72	R09042011SB72	Dieldrin	SB	SB72Dieldrin	2.1	9.523809524	No Sed Location	28.16901408
0.2	0	ug/Kg	73	R09042011SB73	Dieldrin	SB	SB73Dieldrin	2.6	7.692307692	No Sed Location	28.16901408
1.5	1	ug/Kg	74	R09042011SB74	Dieldrin	SB	SB74Dieldrin	3.7	40.54054054	No Sed Location	28.16901408
0.2	0	ug/Kg	76	R09042011SB76	Dieldrin	SB	SB76Dieldrin	3.4	5.882352941	No Sed Location	28.16901408
740	1	ug/Kg	78	R09042011SB78	Dieldrin	SB	SB78Dieldrin	2.9	25517.24138	No Sed Location	28.16901408
2.4	0	ug/Kg	79	R09042011SB79	Dieldrin	SB	SB79Dieldrin	3.5	68.57142857	No Sed Location	28.16901408
0.97	0	ug/Kg	81	R09042011SB81	Dieldrin	SB	SB81Dieldrin	3	32.33333333	No Sed Location	28.16901408
0.2	0	ug/Kg	82	R09042011SB82	Dieldrin	SB	SB82Dieldrin	0.71	28.16901408	No Sed Location	28.16901408
0.27	1	ug/Kg	83	R09042011SB83	Dieldrin	SB	SB83Dieldrin	3	9	No Sed Location	28.16901408
0.94	0	ug/Kg	84	R09042011SB84	Dieldrin	SB	SB84Dieldrin	6.4	14.6875	No Sed Location	28.16901408
95	1	ug/Kg	62	R09032011SB62	Endosulfan I	SB	SB62Endosulfan I	4.2	2261.904762	No Sed Location	10.47619048
210	1	ug/Kg	63	R09032011SB63	Endosulfan I	SB	SB63Endosulfan I	3.4	6176.470588	No Sed Location	10.47619048
0.22	0	ug/Kg	64	R09032011SB64	Endosulfan I	SB	SB64Endosulfan I	1.9	11.57894737	No Sed Location	10.47619048
0.22	0	ug/Kg	65	R09032011SB65	Endosulfan I	SB	SB65Endosulfan I	3.4	6.470588235	No Sed Location	10.47619048
0.22	0	ug/Kg	67	R09032011SB67	Endosulfan I	SB	SB67Endosulfan I	3.6	6.111111111	No Sed Location	10.47619048
5.5	0	ug/Kg	68	R09032011SB68	Endosulfan I	SB	SB68Endosulfan I	3.1	177.4193548	No Sed Location	10.47619048
0.39	1	ug/Kg	69	R09032011SB69	Endosulfan I	SB	SB69Endosulfan I	2.5	15.6	No Sed Location	10.47619048
0.22	0	ug/Kg	70	R09032011SB70	Endosulfan I	SB	SB70Endosulfan I	3.1	7.096774194	No Sed Location	10.47619048
0.22	0	ug/Kg	71	R09042011SB71	Endosulfan I	SB	SB71Endosulfan I	3.4	6.470588235	No Sed Location	10.47619048
0.22	0	ug/Kg	72	R09042011SB72	Endosulfan I	SB	SB72Endosulfan I	2.1	10.47619048	No Sed Location	10.47619048
0.22	0	ug/Kg	73	R09042011SB73	Endosulfan I	SB	SB73Endosulfan I	2.6	8.461538462	No Sed Location	10.47619048
0.22	0	ug/Kg	74	R09042011SB74	Endosulfan I	SB	SB74Endosulfan I	3.7	5.945945946	No Sed Location	10.47619048
0.22	0	ug/Kg	76	R09042011SB76	Endosulfan I	SB	SB76Endosulfan I	3.4	6.470588235	No Sed Location	10.47619048
190	1	ug/Kg	78	R09042011SB78	Endosulfan I	SB	SB78Endosulfan I	2.9	6551.724138	No Sed Location	10.47619048
1.5	1	ug/Kg	79	R09042011SB79	Endosulfan I	SB	SB79Endosulfan I	3.5	42.85714286	No Sed Location	10.47619048
0.53	0	ug/Kg	81	R09042011SB81	Endosulfan I	SB	SB81Endosulfan I	3	17.66666667	No Sed Location	10.47619048
0.22	0	ug/Kg	82	R09042011SB82	Endosulfan I	SB	SB82Endosulfan I	0.71	30.98591549	No Sed Location	10.47619048
0.22	0	ug/Kg	83	R09042011SB83	Endosulfan I	SB	SB83Endosulfan I	3	7.333333333	No Sed Location	10.47619048
0.44	0	ug/Kg	84	R09042011SB84	Endosulfan I	SB	SB84Endosulfan I	6.4	6.875	No Sed Location	10.47619048
220	1	ug/Kg	62	R09032011SB62	Endrin	SB	SB62Endrin	4.2	5238.095238	No Sed Location	16.47058824
540	1	ug/Kg	63	R09032011SB63	Endrin	SB	SB63Endrin	3.4	15882.35294	No Sed Location	16.47058824
0.5	1	ug/Kg	64	R09032011SB64	Endrin	SB	SB64Endrin	1.9	26.31578947	No Sed Location	16.47058824
0.28	0	ug/Kg	65	R09032011SB65	Endrin	SB	SB65Endrin	3.4	8.235294118	No Sed Location	16.47058824
0.28	1	ug/Kg	67	R09032011SB67	Endrin	SB	SB67Endrin	3.6	7.777777778	No Sed Location	16.47058824
1200	1	ug/Kg	68	R09032011SB68	Endrin	SB	SB68Endrin	3.1	38709.67742	No Sed Location	16.47058824
0.45	1	ug/Kg	69	R09032011SB69	Endrin	SB	SB69Endrin	2.5	18	No Sed Location	16.47058824
0.28	0	ug/Kg	70	R09032011SB70	Endrin	SB	SB70Endrin	3.1	9.032258065	No Sed Location	16.47058824
0.56	1	ug/Kg	71	R09042011SB71	Endrin	SB	SB71Endrin	3.4	16.47058824	No Sed Location	16.47058824
0.28	0	ug/Kg	72	R09042011SB72	Endrin	SB	SB72Endrin	2.1	13.33333333	No Sed Location	16.47058824
0.28	0	ug/Kg	73	R09042011SB73	Endrin	SB	SB73Endrin	2.6	10.76923077	No Sed Location	16.47058824
0.62	1	ug/Kg	74	R09042011SB74	Endrin	SB	SB74Endrin	3.7	16.75675676	No Sed Location	16.47058824
0.28	0	ug/Kg	76	R09042011SB76	Endrin	SB	SB76Endrin	3.4	8.235294118	No Sed Location	16.47058824

390	1	ug/Kg	78	R09042011SB78	Endrin	SB	SB78Endrin	2.9	13448.27586 No Sed Location	16.47058824
0.94	1	ug/Kg	79	R09042011SB79	Endrin	SB	SB79Endrin	3.5	26.85714286 No Sed Location	16.47058824
0.3	1	ug/Kg	81	R09042011SB81	Endrin	SB	SB81Endrin	3	10 No Sed Location	16.47058824
0.28	0	ug/Kg	82	R09042011SB82	Endrin	SB	SB82Endrin	0.71	39.43661972 No Sed Location	16.47058824
0.28	0	ug/Kg	83	R09042011SB83	Endrin	SB	SB83Endrin	3	9.333333333 No Sed Location	16.47058824
0.94	0	ug/Kg	84	R09042011SB84	Endrin	SB	SB84Endrin	6.4	14.6875 No Sed Location	16.47058824
0.002061	1	ug/kg	01	060605100SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB01PCBs as Bird TEQ (KM-capped, RDL-based)	2	0.103037 No Sed Location	0.162387916
0.02519	1	ug/kg	02	060605101SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB02PCBs as Bird TEQ (KM-capped, RDL-based)	3.2	0.7871875 No Sed Location	0.162387916
0.0297	1	ug/kg	03	060605200SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB03PCBs as Bird TEQ (KM-capped, RDL-based)	1.7	1.747058824 No Sed Location	0.162387916
0.004236	1	ug/kg	04	060605201SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB04PCBs as Bird TEQ (KM-capped, RDL-based)	1.7	0.249201765 No Sed Location	0.162387916
0.002834	1	ug/kg	05	060605202SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB05PCBs as Bird TEQ (KM-capped, RDL-based)	1.4	0.202423571 No Sed Location	0.162387916
0.006326	1	ug/kg	06	060605203SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB06PCBs as Bird TEQ (KM-capped, RDL-based)	2.8	0.225936071 No Sed Location	0.162387916
0.004847	1	ug/kg	07	060605204SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB07PCBs as Bird TEQ (KM-capped, RDL-based)	3.6	0.134636944 No Sed Location	0.162387916
0.03487	1	ug/kg	08	060605205SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB08PCBs as Bird TEQ (KM-capped, RDL-based)	2.8	1.245357143 No Sed Location	0.162387916
0.003391	1	ug/kg	09	060605207SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB09PCBs as Bird TEQ (KM-capped, RDL-based)	2.5	0.1356212 No Sed Location	0.162387916
0.006641	1	ug/kg	10	060605208SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB10PCBs as Bird TEQ (KM-capped, RDL-based)	2.4	0.276723333 No Sed Location	0.162387916
0.4499	1	ug/kg	11	060605209SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB11PCBs as Bird TEQ (KM-capped, RDL-based)	4.1	10.97317073 No Sed Location	0.162387916
0.01166	1	ug/kg	12	060606102SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB12PCBs as Bird TEQ (KM-capped, RDL-based)	2.1	0.555238095 No Sed Location	0.162387916
0.026839	1	ug/kg	13	060606103SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB13PCBs as Bird TEQ (KM-capped, RDL-based)	2.4	1.118279583 No Sed Location	0.162387916
0.002007	1	ug/kg	14	060606104SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB14PCBs as Bird TEQ (KM-capped, RDL-based)	2.4	0.083622917 No Sed Location	0.162387916
0.002412	1	ug/kg	15	060606210SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB15PCBs as Bird TEQ (KM-capped, RDL-based)	1.7	0.141874118 No Sed Location	0.162387916
0.02552	1	ug/kg	16	060815402SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB16PCBs as Bird TEQ (KM-capped, RDL-based)	5.3	0.481509434 No Sed Location	0.162387916
1.0923	1	ug/kg	17	060815403SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB17PCBs as Bird TEQ (KM-capped, RDL-based)	5.5	19.86 No Sed Location	0.162387916
0.06523	1	ug/kg	18	060815405SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB18PCBs as Bird TEQ (KM-capped, RDL-based)	4.7	1.38787234 No Sed Location	0.162387916
0.004637	1	ug/kg	19	060815406SB	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB19PCBs as Bird TEQ (KM-capped, RDL-based)	6.6	0.070256667 No Sed Location	0.162387916
0.4983	1	ug/kg	62	R09032011SB62	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB62PCBs as Bird TEQ (KM-capped, RDL-based)	4.2	11.86428571 No Sed Location	0.162387916
2.328661	1	ug/kg	63	R09032011SB63	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB63PCBs as Bird TEQ (KM-capped, RDL-based)	3.4	68.49002941 No Sed Location	0.162387916
0.001703	1	ug/kg	64	R09032011SB64	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB64PCBs as Bird TEQ (KM-capped, RDL-based)	1.9	0.089638421 No Sed Location	0.162387916
0.002626	1	ug/kg	65	R09032011SB65	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB65PCBs as Bird TEQ (KM-capped, RDL-based)	3.4	0.077245882 No Sed Location	0.162387916
0.001768	1	ug/kg	67	R09032011SB67	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB67PCBs as Bird TEQ (KM-capped, RDL-based)	3.6	0.049102778 No Sed Location	0.162387916
3.452253	1	ug/kg	68	R09032011SB68	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB68PCBs as Bird TEQ (KM-capped, RDL-based)	3.1	111.363 No Sed Location	0.162387916
0.002954	1	ug/kg	69	R09032011SB69	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB69PCBs as Bird TEQ (KM-capped, RDL-based)	2.5	0.1181796 No Sed Location	0.162387916
0.001716	1	ug/kg	70	R09032011SB70	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB70PCBs as Bird TEQ (KM-capped, RDL-based)	3.1	0.055340645 No Sed Location	0.162387916
0.002402	1	ug/kg	71	R09042011SB71	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB71PCBs as Bird TEQ (KM-capped, RDL-based)	3.4	0.070652353 No Sed Location	0.162387916
0.00116	1	ug/kg	72	R09042011SB72	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB72PCBs as Bird TEQ (KM-capped, RDL-based)	2.1	0.055230476 No Sed Location	0.162387916
0.001546	1	ug/kg	73	R09042011SB73	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB73PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.059480385 No Sed Location	0.162387916
0.004009	1	ug/kg	74	R09042011SB74	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB74PCBs as Bird TEQ (KM-capped, RDL-based)	3.7	0.108338108 No Sed Location	0.162387916
0.00224	1	ug/kg	76	R09042011SB76	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB76PCBs as Bird TEQ (KM-capped, RDL-based)	3.4	0.065880294 No Sed Location	0.162387916
1.298	1	ug/kg	78	R09042011SB78	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB78PCBs as Bird TEQ (KM-capped, RDL-based)	2.9	44.75862069 No Sed Location	0.162387916
0.006402	1	ug/kg	79	R09042011SB79	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB79PCBs as Bird TEQ (KM-capped, RDL-based)	3.5	0.182901714 No Sed Location	0.162387916
0.003594	1	ug/kg	81	R09042011SB81	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB81PCBs as Bird TEQ (KM-capped, RDL-based)	3	0.119804667 No Sed Location	0.162387916
0.002132	1	ug/kg	82	R09042011SB82	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB82PCBs as Bird TEQ (KM-capped, RDL-based)	0.71	0.300346479 No Sed Location	0.162387916
0.001653	1	ug/kg	83	R09042011SB83	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB83PCBs as Bird TEQ (KM-capped, RDL-based)	3	0.055088 No Sed Location	0.162387916
0.003183	1	ug/kg	84	R09042011SB84	PCBs as Bird TEQ (KM-capped, RDL-based)	SB	SB84PCBs as Bird TEQ (KM-capped, RDL-based)	6.4	0.049738906 No Sed Location	0.162387916
0.000676	1	ug/kg	01	060605100SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB01PCBs as Mammal TEQ (KM-capped, RDL-based)	2	0.0337766 No Sed Location	0.065679683
0.01243	1	ug/kg	02	060605101SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB02PCBs as Mammal TEQ (KM-capped, RDL-based)	3.2	0.3884375 No Sed Location	0.065679683
0.01441	1	ug/kg	03	060605200SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB03PCBs as Mammal TEQ (KM-capped, RDL-based)	1.7	0.847647059 No Sed Location	0.065679683
0.001426	1	ug/kg	04	060605201SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB04PCBs as Mammal TEQ (KM-capped, RDL-based)	1.7	0.083897647 No Sed Location	0.065679683
0.001	1	ug/kg	05	060605202SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB05PCBs as Mammal TEQ (KM-capped, RDL-based)	1.4	0.071463071 No Sed Location	0.065679683
0.002195	1	ug/kg	06	060605203SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB06PCBs as Mammal TEQ (KM-capped, RDL-based)	2.8	0.0784025 No Sed Location	0.065679683
0.001327	1	ug/kg	07	060605204SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB07PCBs as Mammal TEQ (KM-capped, RDL-based)	3.6	0.036868333 No Sed Location	0.065679683
0.01848	1	ug/kg	08	060605205SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB08PCBs as Mammal TEQ (KM-capped, RDL-based)	2.8	0.66 No Sed Location	0.065679683
0.001225	1	ug/kg	09	060605207SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB09PCBs as Mammal TEQ (KM-capped, RDL-based)	2.5	0.0489984 No Sed Location	0.065679683

0.002	1	ug/kg	10	060605208SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB10PCBs as Mammal TEQ (KM-capped, RDL-based)	2.4	0.0833525 No Sed Location	0.065679683
0.2343	1	ug/kg	11	060605209SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB11PCBs as Mammal TEQ (KM-capped, RDL-based)	4.1	5.714634146 No Sed Location	0.065679683
0.005158	1	ug/kg	12	060606102SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB12PCBs as Mammal TEQ (KM-capped, RDL-based)	2.1	0.245609048 No Sed Location	0.065679683
0.01287	1	ug/kg	13	060606103SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB13PCBs as Mammal TEQ (KM-capped, RDL-based)	2.4	0.53625 No Sed Location	0.065679683
0.000777	1	ug/kg	14	060606104SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB14PCBs as Mammal TEQ (KM-capped, RDL-based)	2.4	0.032369792 No Sed Location	0.065679683
0.001018	1	ug/kg	15	060606210SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB15PCBs as Mammal TEQ (KM-capped, RDL-based)	1.7	0.059896294 No Sed Location	0.065679683
0.004974	1	ug/kg	16	060815402SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB16PCBs as Mammal TEQ (KM-capped, RDL-based)	5.3	0.093840377 No Sed Location	0.065679683
0.4686	1	ug/kg	17	060815403SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB17PCBs as Mammal TEQ (KM-capped, RDL-based)	5.5	8.52 No Sed Location	0.065679683
0.02915	1	ug/kg	18	060815405SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB18PCBs as Mammal TEQ (KM-capped, RDL-based)	4.7	0.620212766 No Sed Location	0.065679683
0.001435	1	ug/kg	19	060815406SB	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB19PCBs as Mammal TEQ (KM-capped, RDL-based)	6.6	0.021748333 No Sed Location	0.065679683
0.2948	1	ug/kg	62	R09032011SB62	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB62PCBs as Mammal TEQ (KM-capped, RDL-based)	4.2	7.019047619 No Sed Location	0.065679683
1.122	1	ug/kg	63	R09032011SB63	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB63PCBs as Mammal TEQ (KM-capped, RDL-based)	3.4	33 No Sed Location	0.065679683
0.000678	1	ug/kg	64	R09032011SB64	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB64PCBs as Mammal TEQ (KM-capped, RDL-based)	1.9	0.035700211 No Sed Location	0.065679683
0.000807	1	ug/kg	65	R09032011SB65	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB65PCBs as Mammal TEQ (KM-capped, RDL-based)	3.4	0.023735088 No Sed Location	0.065679683
0.000591	1	ug/kg	67	R09032011SB67	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB67PCBs as Mammal TEQ (KM-capped, RDL-based)	3.6	0.016403444 No Sed Location	0.065679683
1.65	1	ug/kg	68	R09032011SB68	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB68PCBs as Mammal TEQ (KM-capped, RDL-based)	3.1	53.22580645 No Sed Location	0.065679683
0.000945	1	ug/kg	69	R09032011SB69	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB69PCBs as Mammal TEQ (KM-capped, RDL-based)	2.5	0.03778324 No Sed Location	0.065679683
0.000457	1	ug/kg	70	R09032011SB70	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB70PCBs as Mammal TEQ (KM-capped, RDL-based)	3.1	0.01474 No Sed Location	0.065679683
0.000868	1	ug/kg	71	R09042011SB71	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB71PCBs as Mammal TEQ (KM-capped, RDL-based)	3.4	0.025524853 No Sed Location	0.065679683
0.000364	1	ug/kg	72	R09042011SB72	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB72PCBs as Mammal TEQ (KM-capped, RDL-based)	2.1	0.017356952 No Sed Location	0.065679683
0.000533	1	ug/kg	73	R09042011SB73	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB73PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.020495962 No Sed Location	0.065679683
0.001705	1	ug/kg	74	R09042011SB74	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB74PCBs as Mammal TEQ (KM-capped, RDL-based)	3.7	0.046072162 No Sed Location	0.065679683
0.00073	1	ug/kg	76	R09042011SB76	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB76PCBs as Mammal TEQ (KM-capped, RDL-based)	3.4	0.021473618 No Sed Location	0.065679683
0.6688	1	ug/kg	78	R09042011SB78	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB78PCBs as Mammal TEQ (KM-capped, RDL-based)	2.9	23.06206897 No Sed Location	0.065679683
0.002801	1	ug/kg	79	R09042011SB79	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB79PCBs as Mammal TEQ (KM-capped, RDL-based)	3.5	0.080020286 No Sed Location	0.065679683
0.001228	1	ug/kg	81	R09042011SB81	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB81PCBs as Mammal TEQ (KM-capped, RDL-based)	3	0.040931 No Sed Location	0.065679683
0.000817	1	ug/kg	82	R09042011SB82	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB82PCBs as Mammal TEQ (KM-capped, RDL-based)	0.71	0.11512662 No Sed Location	0.065679683
0.00052	1	ug/kg	83	R09042011SB83	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB83PCBs as Mammal TEQ (KM-capped, RDL-based)	3	0.017331967 No Sed Location	0.065679683
0.001087	1	ug/kg	84	R09042011SB84	PCBs as Mammal TEQ (KM-capped, RDL-based)	SB	SB84PCBs as Mammal TEQ (KM-capped, RDL-based)	6.4	0.016991047 No Sed Location	0.065679683
30.2	0	ug/kg	01	060605100SB	Total PCBs as Aroclors (MDL-based)	SB	SB01Total PCBs as Aroclors (MDL-based)	2	1510 No Sed Location	1968.865827
1322	1	ug/kg	02	060605101SB	Total PCBs as Aroclors (MDL-based)	SB	SB02Total PCBs as Aroclors (MDL-based)	3.2	41312.5 No Sed Location	1968.865827
242.2	0	ug/kg	03	060605200SB	Total PCBs as Aroclors (MDL-based)	SB	SB03Total PCBs as Aroclors (MDL-based)	1.7	14247.05882 No Sed Location	1968.865827
69.2	0	ug/kg	04	060605201SB	Total PCBs as Aroclors (MDL-based)	SB	SB04Total PCBs as Aroclors (MDL-based)	1.7	4070.588235 No Sed Location	1968.865827
53.2	1	ug/kg	05	060605202SB	Total PCBs as Aroclors (MDL-based)	SB	SB05Total PCBs as Aroclors (MDL-based)	1.4	3800 No Sed Location	1968.865827
97.3	0	ug/kg	06	060605203SB	Total PCBs as Aroclors (MDL-based)	SB	SB06Total PCBs as Aroclors (MDL-based)	2.8	3475 No Sed Location	1968.865827
40.2	0	ug/kg	07	060605204SB	Total PCBs as Aroclors (MDL-based)	SB	SB07Total PCBs as Aroclors (MDL-based)	3.6	1116.666667 No Sed Location	1968.865827
1322	1	ug/kg	08	060605205SB	Total PCBs as Aroclors (MDL-based)	SB	SB08Total PCBs as Aroclors (MDL-based)	2.8	47214.28571 No Sed Location	1968.865827
29.4	0	ug/kg	09	060605207SB	Total PCBs as Aroclors (MDL-based)	SB	SB09Total PCBs as Aroclors (MDL-based)	2.5	1176 No Sed Location	1968.865827
98.2	0	ug/kg	10	060605208SB	Total PCBs as Aroclors (MDL-based)	SB	SB10Total PCBs as Aroclors (MDL-based)	2.4	4091.666667 No Sed Location	1968.865827
14220	1	ug/kg	11	060605209SB	Total PCBs as Aroclors (MDL-based)	SB	SB11Total PCBs as Aroclors (MDL-based)	4.1	346829.2683 No Sed Location	1968.865827
87.2	0	ug/kg	12	060606102SB	Total PCBs as Aroclors (MDL-based)	SB	SB12Total PCBs as Aroclors (MDL-based)	2.1	4152.380952 No Sed Location	1968.865827
423.8	0	ug/kg	13	060606103SB	Total PCBs as Aroclors (MDL-based)	SB	SB13Total PCBs as Aroclors (MDL-based)	2.4	17658.33333 No Sed Location	1968.865827
21	0	ug/kg	14	060606104SB	Total PCBs as Aroclors (MDL-based)	SB	SB14Total PCBs as Aroclors (MDL-based)	2.4	875 No Sed Location	1968.865827
24.5	0	ug/kg	15	060606210SB	Total PCBs as Aroclors (MDL-based)	SB	SB15Total PCBs as Aroclors (MDL-based)	1.7	1441.176471 No Sed Location	1968.865827
590	1	ug/kg	16	060815402SB	Total PCBs as Aroclors (MDL-based)	SB	SB16Total PCBs as Aroclors (MDL-based)	5.3	11132.07547 No Sed Location	1968.865827
18110	1	ug/kg	17	060815403SB	Total PCBs as Aroclors (MDL-based)	SB	SB17Total PCBs as Aroclors (MDL-based)	5.5	329272.7273 No Sed Location	1968.865827
1422	1	ug/kg	18	060815405SB	Total PCBs as Aroclors (MDL-based)	SB	SB18Total PCBs as Aroclors (MDL-based)	4.7	30255.31915 No Sed Location	1968.865827
17.7	0	ug/kg	19	060815406SB	Total PCBs as Aroclors (MDL-based)	SB	SB19Total PCBs as Aroclors (MDL-based)	6.6	268.1818182 No Sed Location	1968.865827
13000	1	ug/Kg	62	R09032011SB62	Total PCBs as Aroclors (MDL-based)	SB	SB62Total PCBs as Aroclors (MDL-based)	4.2	309523.8095 No Sed Location	1968.865827
29000	1	ug/Kg	63	R09032011SB63	Total PCBs as Aroclors (MDL-based)	SB	SB63Total PCBs as Aroclors (MDL-based)	3.4	852941.1765 No Sed Location	1968.865827
32	1	ug/Kg	64	R09032011SB64	Total PCBs as Aroclors (MDL-based)	SB	SB64Total PCBs as Aroclors (MDL-based)	1.9	1684.210526 No Sed Location	1968.865827
20	1	ug/Kg	65	R09032011SB65	Total PCBs as Aroclors (MDL-based)	SB	SB65Total PCBs as Aroclors (MDL-based)	3.4	588.2352941 No Sed Location	1968.865827
21	1	ug/Kg	67	R09032011SB67	Total PCBs as Aroclors (MDL-based)	SB	SB67Total PCBs as Aroclors (MDL-based)	3.6	583.3333333 No Sed Location	1968.865827

65000	1	ug/Kg	68	R09032011SB68	Total PCBs as Aroclors (MDL-based)	SB	SB68Total PCBs as Aroclors (MDL-based)	3.1	2096774.194	No Sed Location	1968.865827
37	1	ug/Kg	69	R09032011SB69	Total PCBs as Aroclors (MDL-based)	SB	SB69Total PCBs as Aroclors (MDL-based)	2.5	1480	No Sed Location	1968.865827
17	1	ug/Kg	70	R09032011SB70	Total PCBs as Aroclors (MDL-based)	SB	SB70Total PCBs as Aroclors (MDL-based)	3.1	548.3870968	No Sed Location	1968.865827
26	1	ug/Kg	71	R09042011SB71	Total PCBs as Aroclors (MDL-based)	SB	SB71Total PCBs as Aroclors (MDL-based)	3.4	764.7058824	No Sed Location	1968.865827
5.8	0	ug/Kg	72	R09042011SB72	Total PCBs as Aroclors (MDL-based)	SB	SB72Total PCBs as Aroclors (MDL-based)	2.1	276.1904762	No Sed Location	1968.865827
5	0	ug/Kg	73	R09042011SB73	Total PCBs as Aroclors (MDL-based)	SB	SB73Total PCBs as Aroclors (MDL-based)	2.6	192.3076923	No Sed Location	1968.865827
38	1	ug/Kg	74	R09042011SB74	Total PCBs as Aroclors (MDL-based)	SB	SB74Total PCBs as Aroclors (MDL-based)	3.7	1027.027027	No Sed Location	1968.865827
12	1	ug/Kg	76	R09042011SB76	Total PCBs as Aroclors (MDL-based)	SB	SB76Total PCBs as Aroclors (MDL-based)	3.4	352.9411765	No Sed Location	1968.865827
27000	1	ug/Kg	78	R09042011SB78	Total PCBs as Aroclors (MDL-based)	SB	SB78Total PCBs as Aroclors (MDL-based)	2.9	931034.4828	No Sed Location	1968.865827
190	1	ug/Kg	79	R09042011SB79	Total PCBs as Aroclors (MDL-based)	SB	SB79Total PCBs as Aroclors (MDL-based)	3.5	5428.571429	No Sed Location	1968.865827
23	0	ug/Kg	81	R09042011SB81	Total PCBs as Aroclors (MDL-based)	SB	SB81Total PCBs as Aroclors (MDL-based)	3	766.6666667	No Sed Location	1968.865827
16	0	ug/Kg	82	R09042011SB82	Total PCBs as Aroclors (MDL-based)	SB	SB82Total PCBs as Aroclors (MDL-based)	0.71	2253.521127	No Sed Location	1968.865827
9.2	0	ug/Kg	83	R09042011SB83	Total PCBs as Aroclors (MDL-based)	SB	SB83Total PCBs as Aroclors (MDL-based)	3	306.6666667	No Sed Location	1968.865827
50	1	ug/Kg	84	R09042011SB84	Total PCBs as Aroclors (MDL-based)	SB	SB84Total PCBs as Aroclors (MDL-based)	6.4	781.25	No Sed Location	1968.865827
33.708	1	ug/kg	01	060605100SB	Total PCBs as Congeners (KM-based, capped)	SB	SB01Total PCBs as Congeners (KM-based, capped)	2	1685.4	No Sed Location	3111.467928
1440.063	1	ug/kg	02	060605101SB	Total PCBs as Congeners (KM-based, capped)	SB	SB02Total PCBs as Congeners (KM-based, capped)	3.2	45001.96875	No Sed Location	3111.467928
879.111	1	ug/kg	03	060605200SB	Total PCBs as Congeners (KM-based, capped)	SB	SB03Total PCBs as Congeners (KM-based, capped)	1.7	51712.41176	No Sed Location	3111.467928
96.672	1	ug/kg	04	060605201SB	Total PCBs as Congeners (KM-based, capped)	SB	SB04Total PCBs as Congeners (KM-based, capped)	1.7	5686.588235	No Sed Location	3111.467928
41.976	1	ug/kg	05	060605202SB	Total PCBs as Congeners (KM-based, capped)	SB	SB05Total PCBs as Congeners (KM-based, capped)	1.4	2998.285714	No Sed Location	3111.467928
137.058	1	ug/kg	06	060605203SB	Total PCBs as Congeners (KM-based, capped)	SB	SB06Total PCBs as Congeners (KM-based, capped)	2.8	4894.928571	No Sed Location	3111.467928
59.307	1	ug/kg	07	060605204SB	Total PCBs as Congeners (KM-based, capped)	SB	SB07Total PCBs as Congeners (KM-based, capped)	3.6	1647.416667	No Sed Location	3111.467928
1733.1	1	ug/kg	08	060605205SB	Total PCBs as Congeners (KM-based, capped)	SB	SB08Total PCBs as Congeners (KM-based, capped)	2.8	61896.42857	No Sed Location	3111.467928
69.642	1	ug/kg	09	060605207SB	Total PCBs as Congeners (KM-based, capped)	SB	SB09Total PCBs as Congeners (KM-based, capped)	2.5	2785.68	No Sed Location	3111.467928
148.824	1	ug/kg	10	060605208SB	Total PCBs as Congeners (KM-based, capped)	SB	SB10Total PCBs as Congeners (KM-based, capped)	2.4	6201	No Sed Location	3111.467928
19302.6	1	ug/kg	11	060605209SB	Total PCBs as Congeners (KM-based, capped)	SB	SB11Total PCBs as Congeners (KM-based, capped)	4.1	470795.122	No Sed Location	3111.467928
325.155	1	ug/kg	12	060606102SB	Total PCBs as Congeners (KM-based, capped)	SB	SB12Total PCBs as Congeners (KM-based, capped)	2.1	15483.57143	No Sed Location	3111.467928
1305.512	1	ug/kg	13	060606103SB	Total PCBs as Congeners (KM-based, capped)	SB	SB13Total PCBs as Congeners (KM-based, capped)	2.4	54396.343	No Sed Location	3111.467928
32.118	1	ug/kg	14	060606104SB	Total PCBs as Congeners (KM-based, capped)	SB	SB14Total PCBs as Congeners (KM-based, capped)	2.4	1338.25	No Sed Location	3111.467928
54.81905	1	ug/kg	15	060606210SB	Total PCBs as Congeners (KM-based, capped)	SB	SB15Total PCBs as Congeners (KM-based, capped)	1.7	3224.650141	No Sed Location	3111.467928
1192.818	1	ug/kg	16	060815402SB	Total PCBs as Congeners (KM-based, capped)	SB	SB16Total PCBs as Congeners (KM-based, capped)	5.3	22506	No Sed Location	3111.467928
26505.3	1	ug/kg	17	060815403SB	Total PCBs as Congeners (KM-based, capped)	SB	SB17Total PCBs as Congeners (KM-based, capped)	5.5	481914.5455	No Sed Location	3111.467928
2481.99	1	ug/kg	18	060815405SB	Total PCBs as Congeners (KM-based, capped)	SB	SB18Total PCBs as Congeners (KM-based, capped)	4.7	52808.29787	No Sed Location	3111.467928
40.704	1	ug/kg	19	060815406SB	Total PCBs as Congeners (KM-based, capped)	SB	SB19Total PCBs as Congeners (KM-based, capped)	6.6	616.7272727	No Sed Location	3111.467928
30495.46	1	ug/kg	62	R09032011SB62	Total PCBs as Congeners (KM-based, capped)	SB	SB62Total PCBs as Congeners (KM-based, capped)	4.2	726082.481	No Sed Location	3111.467928
101473.8	1	ug/kg	63	R09032011SB63	Total PCBs as Congeners (KM-based, capped)	SB	SB63Total PCBs as Congeners (KM-based, capped)	3.4	2984523.529	No Sed Location	3111.467928
43.884	1	ug/kg	64	R09032011SB64	Total PCBs as Congeners (KM-based, capped)	SB	SB64Total PCBs as Congeners (KM-based, capped)	1.9	2309.684211	No Sed Location	3111.467928
37.83988	1	ug/kg	65	R09032011SB65	Total PCBs as Congeners (KM-based, capped)	SB	SB65Total PCBs as Congeners (KM-based, capped)	3.4	1112.937706	No Sed Location	3111.467928
34.62075	1	ug/kg	67	R09032011SB67	Total PCBs as Congeners (KM-based, capped)	SB	SB67Total PCBs as Congeners (KM-based, capped)	3.6	961.6874028	No Sed Location	3111.467928
183147.6	1	ug/kg	68	R09032011SB68	Total PCBs as Congeners (KM-based, capped)	SB	SB68Total PCBs as Congeners (KM-based, capped)	3.1	5907987.135	No Sed Location	3111.467928
48.018	1	ug/kg	69	R09032011SB69	Total PCBs as Congeners (KM-based, capped)	SB	SB69Total PCBs as Congeners (KM-based, capped)	2.5	1920.72	No Sed Location	3111.467928
26.064	1	ug/kg	70	R09032011SB70	Total PCBs as Congeners (KM-based, capped)	SB	SB70Total PCBs as Congeners (KM-based, capped)	3.1	840.7742452	No Sed Location	3111.467928
49.70835	1	ug/kg	71	R09042011SB71	Total PCBs as Congeners (KM-based, capped)	SB	SB71Total PCBs as Congeners (KM-based, capped)	3.4	1462.01035	No Sed Location	3111.467928
13.22468	1	ug/kg	72	R09042011SB72	Total PCBs as Congeners (KM-based, capped)	SB	SB72Total PCBs as Congeners (KM-based, capped)	2.1	629.7465095	No Sed Location	3111.467928
14.64141	1	ug/kg	73	R09042011SB73	Total PCBs as Congeners (KM-based, capped)	SB	SB73Total PCBs as Congeners (KM-based, capped)	2.6	563.1311731	No Sed Location	3111.467928
106.3624	1	ug/kg	74	R09042011SB74	Total PCBs as Congeners (KM-based, capped)	SB	SB74Total PCBs as Congeners (KM-based, capped)	3.7	2874.660678	No Sed Location	3111.467928
35.457	1	ug/kg	76	R09042011SB76	Total PCBs as Congeners (KM-based, capped)	SB	SB76Total PCBs as Congeners (KM-based, capped)	3.4	1042.852941	No Sed Location	3111.467928
69276.3	1	ug/kg	78	R09042011SB78	Total PCBs as Congeners (KM-based, capped)	SB	SB78Total PCBs as Congeners (KM-based, capped)	2.9	2388837.931	No Sed Location	3111.467928
277.296	1	ug/kg	79	R09042011SB79	Total PCBs as Congeners (KM-based, capped)	SB	SB79Total PCBs as Congeners (KM-based, capped)	3.5	7922.742857	No Sed Location	3111.467928
51.516	1	ug/kg	81	R09042011SB81	Total PCBs as Congeners (KM-based, capped)	SB	SB81Total PCBs as Congeners (KM-based, capped)	3	1717.2	No Sed Location	3111.467928
37.206	1	ug/kg	82	R09042011SB82	Total PCBs as Congeners (KM-based, capped)	SB	SB82Total PCBs as Congeners (KM-based, capped)	0.71	5240.28169	No Sed Location	3111.467928
22.71068	1	ug/kg	83	R09042011SB83	Total PCBs as Congeners (KM-based, capped)	SB	SB83Total PCBs as Congeners (KM-based, capped)	3	757.02271	No Sed Location	3111.467928
41.14492	1	ug/kg	84	R09042011SB84	Total PCBs as Congeners (KM-based, capped)	SB	SB84Total PCBs as Congeners (KM-based, capped)	6.4	642.8894328	No Sed Location	3111.467928
0.000997	1	ug/kg	SF-01	F-1	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-01PCBs as Bird TEQ (KM-capped, RDL-based)	3.59	0.027781588	P88	0.04194952

0.002106	1	ug/kg	SF-02	F-2	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-02PCBs as Bird TEQ (KM-capped, RDL-based)	4.83	0.043608282 P89	0.04194952
0.1188	1	ug/kg	SF-03	F-3	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-03PCBs as Bird TEQ (KM-capped, RDL-based)	3.94	3.015228426 P5	0.04194952
0.01859	1	ug/kg	SF-04	F-4	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-04PCBs as Bird TEQ (KM-capped, RDL-based)	2.56	0.726171875 No Sed Location	0.04194952
0.010874	1	ug/kg	SF-05	F-5	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-05PCBs as Bird TEQ (KM-capped, RDL-based)	4.38	0.248255936 P6	0.04194952
0.004624	1	ug/kg	SF-06	F-6	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-06PCBs as Bird TEQ (KM-capped, RDL-based)	7.69	0.06013238 No Sed Location	0.04194952
0.001214	1	ug/kg	SF-07	F-7	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-07PCBs as Bird TEQ (KM-capped, RDL-based)	4.62	0.02627619 No Sed Location	0.04194952
0.00239	1	ug/kg	SF-08	F-8	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-08PCBs as Bird TEQ (KM-capped, RDL-based)	4.05	0.059011605 P14	0.04194952
0.000998	1	ug/kg	SF-09	F-9	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-09PCBs as Bird TEQ (KM-capped, RDL-based)	4.22	0.023645047 No Sed Location	0.04194952
0.00127	1	ug/kg	SF-10	F-10	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-10PCBs as Bird TEQ (KM-capped, RDL-based)	3.15	0.040319365 No Sed Location	0.04194952
0.001464	1	ug/kg	SF-11	F-11	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-11PCBs as Bird TEQ (KM-capped, RDL-based)	4.85	0.030180825 P15	0.04194952
0.002687	1	ug/kg	SF-12	F-12	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-12PCBs as Bird TEQ (KM-capped, RDL-based)	4.39	0.061209112 P17	0.04194952
0.000512	1	ug/kg	SF-13	F-13	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-13PCBs as Bird TEQ (KM-capped, RDL-based)	1.51	0.033917881 P18	0.04194952
0.001608	1	ug/kg	SF-14	F-14	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-14PCBs as Bird TEQ (KM-capped, RDL-based)	3.69	0.043579675 P65	0.04194952
0.000644	1	ug/kg	SF-15	F-15	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-15PCBs as Bird TEQ (KM-capped, RDL-based)	1.88	0.034275532 No Sed Location	0.04194952
0.002061	1	ug/kg	SF-16	F-16	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-16PCBs as Bird TEQ (KM-capped, RDL-based)	3.23	0.063796594 No Sed Location	0.04194952
0.001683	1	ug/kg	SF-17	F-17	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCSF-17PCBs as Bird TEQ (KM-capped, RDL-based)	4.24	0.039703774 P21	0.04194952
0.000861	1	ug/kg	P110	090429110SC	PCBs as Bird TEQ (KM-capped, RDL-based)	SC	SCP110PCBs as Bird TEQ (KM-capped, RDL-based)	4.2059	0.020474976 P110	0.04194952
0.000406	1	ug/kg	SF-01	F-1	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-01PCBs as Mammal TEQ (KM-capped, RDL-based)	3.59	0.011297827 P88	0.020197108
0.001048	1	ug/kg	SF-02	F-2	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-02PCBs as Mammal TEQ (KM-capped, RDL-based)	4.83	0.021696646 P89	0.020197108
0.07766	1	ug/kg	SF-03	F-3	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-03PCBs as Mammal TEQ (KM-capped, RDL-based)	3.94	1.97106599 P5	0.020197108
0.011	1	ug/kg	SF-04	F-4	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-04PCBs as Mammal TEQ (KM-capped, RDL-based)	2.56	0.4296875 No Sed Location	0.020197108
0.007367	1	ug/kg	SF-05	F-5	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-05PCBs as Mammal TEQ (KM-capped, RDL-based)	4.38	0.168197032 P6	0.020197108
0.002045	1	ug/kg	SF-06	F-6	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-06PCBs as Mammal TEQ (KM-capped, RDL-based)	7.69	0.02659883 No Sed Location	0.020197108
0.000654	1	ug/kg	SF-07	F-7	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-07PCBs as Mammal TEQ (KM-capped, RDL-based)	4.62	0.014146429 No Sed Location	0.020197108
0.000749	1	ug/kg	SF-08	F-8	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-08PCBs as Mammal TEQ (KM-capped, RDL-based)	4.05	0.018494395 P14	0.020197108
0.000389	1	ug/kg	SF-09	F-9	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-09PCBs as Mammal TEQ (KM-capped, RDL-based)	4.22	0.009217844 No Sed Location	0.020197108
0.00053	1	ug/kg	SF-10	F-10	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-10PCBs as Mammal TEQ (KM-capped, RDL-based)	3.15	0.016836984 No Sed Location	0.020197108
0.000689	1	ug/kg	SF-11	F-11	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-11PCBs as Mammal TEQ (KM-capped, RDL-based)	4.85	0.014205423 P15	0.020197108
0.001209	1	ug/kg	SF-12	F-12	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-12PCBs as Mammal TEQ (KM-capped, RDL-based)	4.39	0.027542597 P17	0.020197108
0.000286	1	ug/kg	SF-13	F-13	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-13PCBs as Mammal TEQ (KM-capped, RDL-based)	1.51	0.018909073 P18	0.020197108
0.000819	1	ug/kg	SF-14	F-14	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-14PCBs as Mammal TEQ (KM-capped, RDL-based)	3.69	0.022200325 P65	0.020197108
0.000389	1	ug/kg	SF-15	F-15	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-15PCBs as Mammal TEQ (KM-capped, RDL-based)	1.88	0.020717447 No Sed Location	0.020197108
0.001056	1	ug/kg	SF-16	F-16	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-16PCBs as Mammal TEQ (KM-capped, RDL-based)	3.23	0.032702693 No Sed Location	0.020197108
0.000834	1	ug/kg	SF-17	F-17	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCSF-17PCBs as Mammal TEQ (KM-capped, RDL-based)	4.24	0.019676769 P21	0.020197108
0.000363	1	ug/kg	P110	090429110SC	PCBs as Mammal TEQ (KM-capped, RDL-based)	SC	SCP110PCBs as Mammal TEQ (KM-capped, RDL-based)	4.2059	0.008640671 P110	0.020197108
13	0	ug/kg	SF-01	F-1	Total PCBs as Aroclors (MDL-based)	SC	SCSF-01Total PCBs as Aroclors (MDL-based)	3.59	362.1169916 P88	785.9078591
43	0	ug/kg	SF-02	F-2	Total PCBs as Aroclors (MDL-based)	SC	SCSF-02Total PCBs as Aroclors (MDL-based)	4.83	890.2691511 P89	785.9078591
1700	1	ug/kg	SF-03	F-3	Total PCBs as Aroclors (MDL-based)	SC	SCSF-03Total PCBs as Aroclors (MDL-based)	3.94	43147.20812 P5	785.9078591
470	1	ug/kg	SF-04	F-4	Total PCBs as Aroclors (MDL-based)	SC	SCSF-04Total PCBs as Aroclors (MDL-based)	2.56	18359.375 No Sed Location	785.9078591
130	1	ug/kg	SF-05	F-5	Total PCBs as Aroclors (MDL-based)	SC	SCSF-05Total PCBs as Aroclors (MDL-based)	4.38	2968.03653 P6	785.9078591
130	0	ug/kg	SF-06	F-6	Total PCBs as Aroclors (MDL-based)	SC	SCSF-06Total PCBs as Aroclors (MDL-based)	7.69	1690.507152 No Sed Location	785.9078591
28	0	ug/kg	SF-07	F-7	Total PCBs as Aroclors (MDL-based)	SC	SCSF-07Total PCBs as Aroclors (MDL-based)	4.62	606.0606061 No Sed Location	785.9078591
20	0	ug/kg	SF-08	F-8	Total PCBs as Aroclors (MDL-based)	SC	SCSF-08Total PCBs as Aroclors (MDL-based)	4.05	493.8271605 P14	785.9078591
27	0	ug/kg	SF-09	F-9	Total PCBs as Aroclors (MDL-based)	SC	SCSF-09Total PCBs as Aroclors (MDL-based)	4.22	639.8104265 No Sed Location	785.9078591
19	0	ug/kg	SF-10	F-10	Total PCBs as Aroclors (MDL-based)	SC	SCSF-10Total PCBs as Aroclors (MDL-based)	3.15	603.1746032 No Sed Location	785.9078591
28	0	ug/kg	SF-11	F-11	Total PCBs as Aroclors (MDL-based)	SC	SCSF-11Total PCBs as Aroclors (MDL-based)	4.85	577.3195876 P15	785.9078591
23	0	ug/kg	SF-12	F-12	Total PCBs as Aroclors (MDL-based)	SC	SCSF-12Total PCBs as Aroclors (MDL-based)	4.39	523.9179954 P17	785.9078591
35	0	ug/kg	SF-13	F-13	Total PCBs as Aroclors (MDL-based)	SC	SCSF-13Total PCBs as Aroclors (MDL-based)	1.51	2317.880795 P18	785.9078591
29	0	ug/kg	SF-14	F-14	Total PCBs as Aroclors (MDL-based)	SC	SCSF-14Total PCBs as Aroclors (MDL-based)	3.69	785.9078591 P65	785.9078591
27	0	ug/kg	SF-15	F-15	Total PCBs as Aroclors (MDL-based)	SC	SCSF-15Total PCBs as Aroclors (MDL-based)	1.88	1436.170213 No Sed Location	785.9078591
37	0	ug/kg	SF-16	F-16	Total PCBs as Aroclors (MDL-based)	SC	SCSF-16Total PCBs as Aroclors (MDL-based)	3.23	1145.510836 No Sed Location	785.9078591
32	0	ug/kg	SF-17	F-17	Total PCBs as Aroclors (MDL-based)	SC	SCSF-17Total PCBs as Aroclors (MDL-based)	4.24	754.7169811 P21	785.9078591
14.9619	1	ug/kg	SF-01	F-1	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-01Total PCBs as Congeners (KM-based, capped)	3.59	416.7660167 P88	930.3687541

48.813	1	ug/kg	SF-02	F-2	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-02Total PCBs as Congeners (KM-based, capped)	4.83	1010.621118	P89	930.3687541
4776.36	1	ug/kg	SF-03	F-3	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-03Total PCBs as Congeners (KM-based, capped)	3.94	121227.4112	P5	930.3687541
914.886	1	ug/kg	SF-04	F-4	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-04Total PCBs as Congeners (KM-based, capped)	2.56	35737.73438	No Sed Location	930.3687541
558.885	1	ug/kg	SF-05	F-5	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-05Total PCBs as Congeners (KM-based, capped)	4.38	12759.93151	P6	930.3687541
141.1891	1	ug/kg	SF-06	F-6	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-06Total PCBs as Congeners (KM-based, capped)	7.69	1836.008609	No Sed Location	930.3687541
22.896	1	ug/kg	SF-07	F-7	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-07Total PCBs as Congeners (KM-based, capped)	4.62	495.5844156	No Sed Location	930.3687541
26.076	1	ug/kg	SF-08	F-8	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-08Total PCBs as Congeners (KM-based, capped)	4.05	643.8518519	P14	930.3687541
12.29048	1	ug/kg	SF-09	F-9	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-09Total PCBs as Congeners (KM-based, capped)	4.22	291.2435521	No Sed Location	930.3687541
23.055	1	ug/kg	SF-10	F-10	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-10Total PCBs as Congeners (KM-based, capped)	3.15	731.9047619	No Sed Location	930.3687541
24.13287	1	ug/kg	SF-11	F-11	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-11Total PCBs as Congeners (KM-based, capped)	4.85	497.5850433	P15	930.3687541
39.591	1	ug/kg	SF-12	F-12	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-12Total PCBs as Congeners (KM-based, capped)	4.39	901.8451025	P17	930.3687541
9.902468	1	ug/kg	SF-13	F-13	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-13Total PCBs as Congeners (KM-based, capped)	1.51	655.7925828	P18	930.3687541
35.39013	1	ug/kg	SF-14	F-14	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-14Total PCBs as Congeners (KM-based, capped)	3.69	959.0820976	P65	930.3687541
19.557	1	ug/kg	SF-15	F-15	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-15Total PCBs as Congeners (KM-based, capped)	1.88	1040.265957	No Sed Location	930.3687541
35.59985	1	ug/kg	SF-16	F-16	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-16Total PCBs as Congeners (KM-based, capped)	3.23	1102.162607	No Sed Location	930.3687541
40.65704	1	ug/kg	SF-17	F-17	Total PCBs as Congeners (KM-based, capped)	SC	SCSF-17Total PCBs as Congeners (KM-based, capped)	4.24	958.8924057	P21	930.3687541
8.1567	1	ug/kg	P110	090429110SC	Total PCBs as Congeners (KM-based, capped)	SC	SCP110Total PCBs as Congeners (KM-based, capped)	4.2059	193.9347108	P110	930.3687541
8.4	1	ug/Kg	P112	111019P112TC	4,4'-DDE	TC	TCP1124,4'-DDE	1.2	700	P112	557.1895425
8	1	ug/Kg	P113	111019P113TC	4,4'-DDE	TC	TCP1134,4'-DDE	1.6	500	P113	557.1895425
9.5	1	ug/Kg	P114	111019P114TC	4,4'-DDE	TC	TCP1144,4'-DDE	1.7	558.8235294	P114	557.1895425
10	1	ug/Kg	P115	111018P115TC	4,4'-DDE	TC	TCP1154,4'-DDE	1.8	555.5555556	P115	557.1895425
16	1	ug/Kg	P112	111019P112TC	Chlordane (gamma)	TC	TCP112Chlordane (gamma)	1.2	1333.333333	P112	915.4411765
18	1	ug/Kg	P113	111019P113TC	Chlordane (gamma)	TC	TCP113Chlordane (gamma)	1.6	1125	P113	915.4411765
12	1	ug/Kg	P114	111019P114TC	Chlordane (gamma)	TC	TCP114Chlordane (gamma)	1.7	705.8823529	P114	915.4411765
5.9	1	ug/Kg	P115	111018P115TC	Chlordane (gamma)	TC	TCP115Chlordane (gamma)	1.8	327.7777778	P115	915.4411765
9.3	0	ug/Kg	P112	111019P112TC	Dieldrin	TC	TCP112Dieldrin	1.2	775	P112	465.8088235
8.6	0	ug/Kg	P113	111019P113TC	Dieldrin	TC	TCP113Dieldrin	1.6	537.5	P113	465.8088235
6.7	0	ug/Kg	P114	111019P114TC	Dieldrin	TC	TCP114Dieldrin	1.7	394.1176471	P114	465.8088235
3.1	0	ug/Kg	P115	111018P115TC	Dieldrin	TC	TCP115Dieldrin	1.8	172.2222222	P115	465.8088235
5.3	0	ug/Kg	P112	111019P112TC	Endosulfan I	TC	TCP112Endosulfan I	1.2	441.6666667	P112	132.5367647
1.7	1	ug/Kg	P113	111019P113TC	Endosulfan I	TC	TCP113Endosulfan I	1.6	106.25	P113	132.5367647
2.7	1	ug/Kg	P114	111019P114TC	Endosulfan I	TC	TCP114Endosulfan I	1.7	158.8235294	P114	132.5367647
0.85	1	ug/Kg	P115	111018P115TC	Endosulfan I	TC	TCP115Endosulfan I	1.8	47.22222222	P115	132.5367647
3.8	1	ug/Kg	P112	111019P112TC	Endrin	TC	TCP112Endrin	1.2	316.6666667	P112	213.4191176
4.1	1	ug/Kg	P113	111019P113TC	Endrin	TC	TCP113Endrin	1.6	256.25	P113	213.4191176
2.9	1	ug/Kg	P114	111019P114TC	Endrin	TC	TCP114Endrin	1.7	170.5882353	P114	213.4191176
1.4	1	ug/Kg	P115	111018P115TC	Endrin	TC	TCP115Endrin	1.8	77.77777778	P115	213.4191176
0.006608	1	ug/kg	P04	08022604TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP04PCBs as Bird TEQ (KM-capped, RDL-based)	3	0.220264	P04	0.09953897
0.003133	1	ug/kg	P05	08031905TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP05PCBs as Bird TEQ (KM-capped, RDL-based)	3	0.104437667	P05	0.09953897
0.00383	1	ug/kg	P06	08031806TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP06PCBs as Bird TEQ (KM-capped, RDL-based)	2.9	0.132056897	P06	0.09953897
0.002699	1	ug/kg	P07	08021507TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP07PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.103818846	P07	0.09953897
0.002507	1	ug/kg	P08	08021508TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP08PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.096406538	P08	0.09953897
0.001869	1	ug/kg	P10	08021410TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP10PCBs as Bird TEQ (KM-capped, RDL-based)	2	0.093445	P10	0.09953897
0.002317	1	ug/kg	P11	08021411TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP11PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.089125385	P11	0.09953897
0.032312	1	ug/kg	P112	111019P112TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP112PCBs as Bird TEQ (KM-capped, RDL-based)	1.2	2.692695917	P112	0.09953897
0.03553	1	ug/kg	P113	111019P113TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP113PCBs as Bird TEQ (KM-capped, RDL-based)	1.6	2.220625	P113	0.09953897
0.0242	1	ug/kg	P114	111019P114TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP114PCBs as Bird TEQ (KM-capped, RDL-based)	1.7	1.423529412	P114	0.09953897
0.010586	1	ug/kg	P115	111018P115TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP115PCBs as Bird TEQ (KM-capped, RDL-based)	1.8	0.588121111	P115	0.09953897
0.005135	1	ug/kg	P117	111018P117TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP117PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.197496538	P117	0.09953897
0.006404	1	ug/kg	P118	111018P118TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP118PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.246306923	P118	0.09953897
0.002667	1	ug/kg	P13	08031713TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP13PCBs as Bird TEQ (KM-capped, RDL-based)	2.7	0.098784074	P13	0.09953897
0.002777	1	ug/kg	P14	08031814TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP14PCBs as Bird TEQ (KM-capped, RDL-based)	2.8	0.099176786	P14	0.09953897
0.002263	1	ug/kg	P15	08022115TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP15PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.087056538	P15	0.09953897

0.002137	1	ug/kg	P16	08022116TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP16PCBs as Bird TEQ (KM-capped, RDL-based)	2.3	0.092897391 P16	0.09953897
0.002103	1	ug/kg	P17	08022117TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP17PCBs as Bird TEQ (KM-capped, RDL-based)	2.2	0.09559 P17	0.09953897
0.002276	1	ug/kg	P18	08021118TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP18PCBs as Bird TEQ (KM-capped, RDL-based)	2.4	0.094852083 P18	0.09953897
0.002212	1	ug/kg	P21	08021221TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP21PCBs as Bird TEQ (KM-capped, RDL-based)	2.4	0.092184583 P21	0.09953897
0.00297	1	ug/kg	P65	08022965TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP65PCBs as Bird TEQ (KM-capped, RDL-based)	3.3	0.089996667 P65	0.09953897
0.002799	1	ug/kg	P88	08031788TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP88PCBs as Bird TEQ (KM-capped, RDL-based)	2.8	0.099946786 P88	0.09953897
0.002597	1	ug/kg	P89	08031789TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP89PCBs as Bird TEQ (KM-capped, RDL-based)	2.6	0.099901154 P89	0.09953897
0.002274	1	ug/kg	P110	090429110TC	PCBs as Bird TEQ (KM-capped, RDL-based)	TC	TCP110PCBs as Bird TEQ (KM-capped, RDL-based)	2.9545	0.076957184 P110	0.09953897
0.003563	1	ug/kg	P04	08022604TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP04PCBs as Mammal TEQ (KM-capped, RDL-based)	3	0.118778 P04	0.024175407
0.00094	1	ug/kg	P05	08031905TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP05PCBs as Mammal TEQ (KM-capped, RDL-based)	3	0.0313236 P05	0.024175407
0.001198	1	ug/kg	P06	08031806TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP06PCBs as Mammal TEQ (KM-capped, RDL-based)	2.9	0.04131069 P06	0.024175407
0.000917	1	ug/kg	P07	08021507TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP07PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.035282077 P07	0.024175407
0.000725	1	ug/kg	P08	08021508TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP08PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.027894308 P08	0.024175407
0.0005	1	ug/kg	P10	08021410TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP10PCBs as Mammal TEQ (KM-capped, RDL-based)	2	0.02500135 P10	0.024175407
0.000518	1	ug/kg	P11	08021411TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP11PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.019919308 P11	0.024175407
0.01408	1	ug/kg	P112	111019P112TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP112PCBs as Mammal TEQ (KM-capped, RDL-based)	1.2	1.173333333 P112	0.024175407
0.01507	1	ug/kg	P113	111019P113TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP113PCBs as Mammal TEQ (KM-capped, RDL-based)	1.6	0.941875 P113	0.024175407
0.008937	1	ug/kg	P114	111019P114TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP114PCBs as Mammal TEQ (KM-capped, RDL-based)	1.7	0.525715882 P114	0.024175407
0.004134	1	ug/kg	P115	111018P115TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP115PCBs as Mammal TEQ (KM-capped, RDL-based)	1.8	0.229667778 P115	0.024175407
0.00192	1	ug/kg	P117	111018P117TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP117PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.073856538 P117	0.024175407
0.002844	1	ug/kg	P118	111018P118TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP118PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.109399231 P118	0.024175407
0.000623	1	ug/kg	P13	08031713TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP13PCBs as Mammal TEQ (KM-capped, RDL-based)	2.7	0.023056815 P13	0.024175407
0.000654	1	ug/kg	P14	08031814TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP14PCBs as Mammal TEQ (KM-capped, RDL-based)	2.8	0.023349464 P14	0.024175407
0.000492	1	ug/kg	P15	08022115TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP15PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.018926769 P15	0.024175407
0.000502	1	ug/kg	P16	08022116TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP16PCBs as Mammal TEQ (KM-capped, RDL-based)	2.3	0.021809174 P16	0.024175407
0.000435	1	ug/kg	P17	08022117TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP17PCBs as Mammal TEQ (KM-capped, RDL-based)	2.2	0.0197685 P17	0.024175407
0.000461	1	ug/kg	P18	08021118TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP18PCBs as Mammal TEQ (KM-capped, RDL-based)	2.4	0.019228917 P18	0.024175407
0.000495	1	ug/kg	P21	08021221TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP21PCBs as Mammal TEQ (KM-capped, RDL-based)	2.4	0.020625 P21	0.024175407
0.000641	1	ug/kg	P65	08022965TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP65PCBs as Mammal TEQ (KM-capped, RDL-based)	3.3	0.019420667 P65	0.024175407
0.000629	1	ug/kg	P88	08031788TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP88PCBs as Mammal TEQ (KM-capped, RDL-based)	2.8	0.022454536 P88	0.024175407
0.000587	1	ug/kg	P89	08031789TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP89PCBs as Mammal TEQ (KM-capped, RDL-based)	2.6	0.022571577 P89	0.024175407
0.000379	1	ug/kg	P110	090429110TC	PCBs as Mammal TEQ (KM-capped, RDL-based)	TC	TCP110PCBs as Mammal TEQ (KM-capped, RDL-based)	2.9545	0.012836622 P110	0.024175407
355	1	ug/kg	A1	070926A1TC	Total PCBs as Aroclors (MDL-based)	TC	TCA1Total PCBs as Aroclors (MDL-based)	3.3	10757.57576 A1	1288.537549
250	1	ug/kg	A2	070926A2TC	Total PCBs as Aroclors (MDL-based)	TC	TCA2Total PCBs as Aroclors (MDL-based)	3.6	6944.444444 No Sed Location	1288.537549
180	1	ug/kg	A3	070927A3TC	Total PCBs as Aroclors (MDL-based)	TC	TCA3Total PCBs as Aroclors (MDL-based)	3.3	5454.545455 A3	1288.537549
120	1	ug/kg	A5	070925A5TC	Total PCBs as Aroclors (MDL-based)	TC	TCA5Total PCBs as Aroclors (MDL-based)	3.5	3428.571429 No Sed Location	1288.537549
120	1	ug/kg	P04	08022604TC	Total PCBs as Aroclors (MDL-based)	TC	TCP04Total PCBs as Aroclors (MDL-based)	3	4000 P04	1288.537549
23	1	ug/kg	P05	08031905TC	Total PCBs as Aroclors (MDL-based)	TC	TCP05Total PCBs as Aroclors (MDL-based)	3	766.6666667 P05	1288.537549
32	1	ug/kg	P06	08031806TC	Total PCBs as Aroclors (MDL-based)	TC	TCP06Total PCBs as Aroclors (MDL-based)	2.9	1103.448276 P06	1288.537549
74	0	ug/kg	P07	08021507TC	Total PCBs as Aroclors (MDL-based)	TC	TCP07Total PCBs as Aroclors (MDL-based)	2.6	2846.153846 P07	1288.537549
55	0	ug/kg	P08	08021508TC	Total PCBs as Aroclors (MDL-based)	TC	TCP08Total PCBs as Aroclors (MDL-based)	2.6	2115.384615 P08	1288.537549
49	0	ug/kg	P09	08021409TC	Total PCBs as Aroclors (MDL-based)	TC	TCP09Total PCBs as Aroclors (MDL-based)	2.3	2130.434783 P09	1288.537549
36	0	ug/kg	P10	08021410TC	Total PCBs as Aroclors (MDL-based)	TC	TCP10Total PCBs as Aroclors (MDL-based)	2	1800 P10	1288.537549
32	0	ug/kg	P11	08021411TC	Total PCBs as Aroclors (MDL-based)	TC	TCP11Total PCBs as Aroclors (MDL-based)	2.6	1230.769231 P11	1288.537549
800	1	ug/Kg	P112	111019P112TC	Total PCBs as Aroclors (MDL-based)	TC	TCP112Total PCBs as Aroclors (MDL-based)	1.2	66666.66667 P112	1288.537549
1200	1	ug/Kg	P113	111019P113TC	Total PCBs as Aroclors (MDL-based)	TC	TCP113Total PCBs as Aroclors (MDL-based)	1.6	75000 P113	1288.537549
620	1	ug/Kg	P114	111019P114TC	Total PCBs as Aroclors (MDL-based)	TC	TCP114Total PCBs as Aroclors (MDL-based)	1.7	36470.58824 P114	1288.537549
370	1	ug/Kg	P115	111018P115TC	Total PCBs as Aroclors (MDL-based)	TC	TCP115Total PCBs as Aroclors (MDL-based)	1.8	20555.55556 P115	1288.537549
22	1	ug/kg	P13	08031713TC	Total PCBs as Aroclors (MDL-based)	TC	TCP13Total PCBs as Aroclors (MDL-based)	2.7	814.8148148 P13	1288.537549
22	1	ug/kg	P14	08031814TC	Total PCBs as Aroclors (MDL-based)	TC	TCP14Total PCBs as Aroclors (MDL-based)	2.8	785.7142857 P14	1288.537549
32	0	ug/kg	P15	08022115TC	Total PCBs as Aroclors (MDL-based)	TC	TCP15Total PCBs as Aroclors (MDL-based)	2.6	1230.769231 P15	1288.537549
30	0	ug/kg	P16	08022116TC	Total PCBs as Aroclors (MDL-based)	TC	TCP16Total PCBs as Aroclors (MDL-based)	2.3	1304.347826 P16	1288.537549
28	0	ug/kg	P17	08022117TC	Total PCBs as Aroclors (MDL-based)	TC	TCP17Total PCBs as Aroclors (MDL-based)	2.2	1272.727273 P17	1288.537549

28	0	ug/kg	P18	08021118TC	Total PCBs as Aroclors (MDL-based)	TC	TCP18Total PCBs as Aroclors (MDL-based)	2.4	1166.666667	P18	1288.537549
30	0	ug/kg	P21	08021221TC	Total PCBs as Aroclors (MDL-based)	TC	TCP21Total PCBs as Aroclors (MDL-based)	2.4	1250	P21	1288.537549
21	1	ug/kg	P65	08022965TC	Total PCBs as Aroclors (MDL-based)	TC	TCP65Total PCBs as Aroclors (MDL-based)	3.3	636.3636364	P65	1288.537549
21	1	ug/kg	P67	08030367TC	Total PCBs as Aroclors (MDL-based)	TC	TCP67Total PCBs as Aroclors (MDL-based)	3.7	567.5675676	P67	1288.537549
23	1	ug/kg	P88	08031788TC	Total PCBs as Aroclors (MDL-based)	TC	TCP88Total PCBs as Aroclors (MDL-based)	2.8	821.4285714	P88	1288.537549
21	1	ug/kg	P89	08031789TC	Total PCBs as Aroclors (MDL-based)	TC	TCP89Total PCBs as Aroclors (MDL-based)	2.6	807.6923077	P89	1288.537549
14	0	ug/kg	P110	090429110TC	Total PCBs as Aroclors (MDL-based)	TC	TCP110Total PCBs as Aroclors (MDL-based)	2.9545	473.8534439	P110	1288.537549
311.5994	1	ug/kg	P04	08022604TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP04Total PCBs as Congeners (KM-based, capped)	3	10386.64503	P04	1380.377811
65.80281	1	ug/kg	P05	08031905TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP05Total PCBs as Congeners (KM-based, capped)	3	2193.42688	P05	1380.377811
95.06451	1	ug/kg	P06	08031806TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP06Total PCBs as Congeners (KM-based, capped)	2.9	3278.0866	P06	1380.377811
65.667	1	ug/kg	P07	08021507TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP07Total PCBs as Congeners (KM-based, capped)	2.6	2525.653846	P07	1380.377811
51.516	1	ug/kg	P08	08021508TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP08Total PCBs as Congeners (KM-based, capped)	2.6	1981.384615	P08	1380.377811
30.63016	1	ug/kg	P10	08021410TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP10Total PCBs as Congeners (KM-based, capped)	2	1531.508155	P10	1380.377811
26.712	1	ug/kg	P11	08021411TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP11Total PCBs as Congeners (KM-based, capped)	2.6	1027.384615	P11	1380.377811
2028.84	1	ug/kg	P112	111019P112TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP112Total PCBs as Congeners (KM-based, capped)	1.2	169070	P112	1380.377811
1877.79	1	ug/kg	P113	111019P113TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP113Total PCBs as Congeners (KM-based, capped)	1.6	117361.875	P113	1380.377811
1081.677	1	ug/kg	P114	111019P114TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP114Total PCBs as Congeners (KM-based, capped)	1.7	63628.05882	P114	1380.377811
449.1434	1	ug/kg	P115	111018P115TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP115Total PCBs as Congeners (KM-based, capped)	1.8	24952.41361	P115	1380.377811
184.9137	1	ug/kg	P117	111018P117TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP117Total PCBs as Congeners (KM-based, capped)	2.6	7112.066	P117	1380.377811
303.1575	1	ug/kg	P118	111018P118TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP118Total PCBs as Congeners (KM-based, capped)	2.6	11659.90319	P118	1380.377811
33.18968	1	ug/kg	P13	08031713TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP13Total PCBs as Congeners (KM-based, capped)	2.7	1229.247467	P13	1380.377811
33.99617	1	ug/kg	P14	08031814TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP14Total PCBs as Congeners (KM-based, capped)	2.8	1214.149043	P14	1380.377811
26.871	1	ug/kg	P15	08022115TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP15Total PCBs as Congeners (KM-based, capped)	2.6	1033.5	P15	1380.377811
25.53603	1	ug/kg	P16	08022116TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP16Total PCBs as Congeners (KM-based, capped)	2.3	1110.262061	P16	1380.377811
24.46157	1	ug/kg	P17	08022117TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP17Total PCBs as Congeners (KM-based, capped)	2.2	1111.889468	P17	1380.377811
25.91624	1	ug/kg	P18	08021118TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP18Total PCBs as Congeners (KM-based, capped)	2.4	1079.843225	P18	1380.377811
24.645	1	ug/kg	P21	08021221TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP21Total PCBs as Congeners (KM-based, capped)	2.4	1026.875	P21	1380.377811
33.072	1	ug/kg	P65	08022965TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP65Total PCBs as Congeners (KM-based, capped)	3.3	1002.181818	P65	1380.377811
33.34909	1	ug/kg	P88	08031788TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP88Total PCBs as Congeners (KM-based, capped)	2.8	1191.038996	P88	1380.377811
31.641	1	ug/kg	P89	08031789TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP89Total PCBs as Congeners (KM-based, capped)	2.6	1216.961538	P89	1380.377811
21.44926	1	ug/kg	P110	090429110TC	Total PCBs as Congeners (KM-based, capped)	TC	TCP110Total PCBs as Congeners (KM-based, capped)	2.9545	725.9861533	P110	1380.377811

APPENDIX F

Yakima Nation Comments on Draft Upland/River OU BHHERAs

Comment Number	Comments by Yakama Nation as forwarded to the US Army Corps of Engineers by letter, dated 28 January 2016	US Army Corps of Engineers Response/Action Taken
Concerns about the Remedial Investigation		
1.	1. Contaminant Sources a. The RI does not adequately evaluate historic PCB use with respect to potential releases. The Yakama Nation requests the following information: i. The history of PCBs use at the Bonneville Dam complex that may have led to releases, besides in-water disposal of transformers. For example, historically many dams' power generating equipment was designed to slowly leak (PCB-containing) hydraulic oil; PCBs have also been used in the past as a component of paints at fish hatcheries, dust control oils, etc.	Early work on this project included record searches, review of aerial photographs, interviews of employees, etc. We are confident that any historical releases to the Bonneville Dam forebay have been identified. No attempt was made to broaden the investigation to include the Bonneville Dam project, as a whole (see Note 1, below). The downstream sediment samples, collected in 2008, do not indicate that historic or unknown releases of PCBs are impacting resources below the dam; see 3.b.viii, below). No revisions to the Baseline Human Health or Ecological Risk Assessments (BHHRAs) are necessary.
2.	1. Contaminant Sources a. The RI does not adequately evaluate historic PCB use with respect to potential releases. The Yakama Nation requests the following information: ii. Efforts made to eliminate PCB use in Bonneville Dam power-generating equipment and any other sources.	Efforts made to eliminate PCB usage or impacts from legacy PCB usage at Bonneville Dam are not a part of the scope of this CERCLA project; however, contact information for the offices that are actively working this can be provided (see Note 1, below). No revisions to the BHHRAs are necessary.
3.	1. Contaminant Sources b. Upland: In general, the information supports the delineation of upland contamination in the former disposal areas. However, it is unclear how the areas of concern were initially identified to begin delineating the site uplands. It appears upland investigations may have been limited to a decision unit (i.e. the area surrounding the landfill) rather than a comprehensive site investigation. Outside of the eastern portion of the Bradford Island Upland OU, please provide a summary of evaluations conducted to identify recognized environmental conditions on the remaining Bonneville Dam complex and surrounding nearshore mainland.	In 1992, Portland District conducted its first Environmental Review of Government Operations (ERGO) assessment at Bonneville Dam. The intent of the assessment was to make sure that all applicable environmental laws were being followed and to identify any instances of non-compliance. In that 1992 report, the landfill on the eastern tip of the island was noted. A recommendation to take samples of soil in the landfill (completed in 1996) led to a determination that contaminants were present. Work was then initiated to determine the nature and extent of any release of contaminants at/from the landfill. As the investigation moved forward, additional sites were identified, including the in-water location where disposal of capacitors had occurred, the bulb slope, the sandblast area and the pistol range (see 1.a.i., above; some of these additional sites were identified during the literature searches, some by interviews, some by our contractors during the course of working at the site, etc.). A decision was made to complete one Remedial Investigation for all of the sites as opposed to conducting distinct investigations for each one.

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		Once it was known that the release associated with the in-water disposal of capacitors had crossed state lines (PCBs in sediments on the north side of the forebay in Washington state), the decision was made to move under CERCLA (as opposed to working under the State of Oregon's Voluntary Cleanup Program.) No revisions to the BHHRAs are necessary.
4.	1. Contaminant Sources c. River: There appears to be a data gap regarding the location or source of PCBs, which will make remedy selection difficult. The older data (in Appendix G of the RI) include samples that show very high PCB concentrations in sediment samples from the forebay prior to any removal actions. The highest PCB concentrations tended to be associated with coarse sediments, with high fractions of gravel and coarse sand. High concentrations of PCBs in coarser sediments indicates the release of product directly to the sediments, rather than through upland releases. The data are inconclusive as to whether additional sources exist and further evaluation is needed. For example, no samples were collected in the deeper forebay in front of the dam or farther upstream.	We agree that the high concentrations of PCBs in coarse sediment indicate a direct release of product. We attribute this to the release of PCB laden oils from the capacitors. Each of the 6 inerteen capacitors were capable of holding 2-3 gallons of oil. And, PCBs were present in the oil at a 20% concentration. Also, oil with PCB residue was released through the sandblast area outfalls (a known oil spill). We could find no record of any other direct release of product (see 1.a.i, above). And, the grid systems devised for the equipment removal in 2002 and the sediment removal in 2007 give us confidence that no additional equipment was missed on the river bottom. So, while we agree with your assessment that the high PCB levels are consistent with a release of product, as opposed to run off, we believe that the current condition of the site is consistent with the sources already identified. To summarize, we do not believe there is another, as yet, unidentified PCB source. No revisions to the BHHRAs are necessary.
5.	2. Contaminant transport and migration: a. If PCB-laden product was released directly to sediment, it would be much denser than the river water and would flow into porous (coarse) sediments, cracks in bedrock, and down slope along any retaining barrier such as bedrock. The data analysis presented in the 2014 River OU Data Evaluation Tech Memo (Figure 3-1) shows a number of locations associated with the debris piles where the PCB concentrations exceeded 1,000 micrograms per kilogram (ug/kg) in the most riverward sample, indicating that contaminants have likely migrated farther beyond the area delineated.	In 2003, seventeen depositional samples were collected from several areas around the forebay. A few of these are in deep water and in front of the powerhouses and spillway (as close as we could safely get). The samples in deep water were difficult to obtain (two locations were unsuccessful due to depth and strong currents). The majority of samples were non-detect for PCBs (Aroclor 1254). Three of the samples had low detections (the highest is 2.9 ug/kg). Our earlier discreet sampling efforts did not find a bright line for the extent of the release. Detection of PCBs at low levels is found in front of the spillway (on both the north and south sides), on the south side of Bradford Island, and near the west end of Goose Island. Levels of contamination are lower as you move away (following the currents) from the original sources of the release. In 2012, it was determined that

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		enough information was already available (see Remedial Investigation report, June 2012) to determine that risks to the environment and human health were present and that further sampling would not further inform the remedial options that would be considered in the Feasibility Study. (Note: sampling and analysis takes approximately 2 years to complete from start to finish.) We agree that further sampling may be warranted, or even preferred (to delineate the exact footprint for the remedial action.) But, additional samples would not further inform the risk assessments or feasibility study alternatives. No revisions to the BHHRAs are necessary.
6.	2. Contaminant transport and migration: b. The Yakama Nation still requires hydraulic model information requested December 15 and 28, 2015. The most recent data, indicate higher concentrations of PCBs are located toward the eastern end of Bradford Island, possibly residual contamination deposits, but also possibly contributions of contaminated sediments carried along shore.	We are working to provide all requested materials. We agree that the eastern tip of Bradford Island, where Debris Pile #1 was located, is the most impacted location. No revisions to the BHHRAs are necessary.
7.	3. Site delineation: a. The adequacy of the sampling to define the extent of contamination, both in space and over time, is a major concern. Without adequate site characterization and delineation, the effectiveness of any remedy is uncertain.	We believe that enough sampling has been done to determine that the forebay is the 'extent' of the release. And, that the north side and eastern tip of Bradford Island are the most impacted areas within the forebay. No other sources were found after 15 years of direct sampling and investigation. Also, the most contaminated locations are consistent with the location of the debris piles and the outfall. Therefore, the data we currently have is adequate for the purposes of conducting a baseline risk assessment and to select a remedial alternative. No revisions to the BHHRAs are necessary.
8.	3. Site delineation: b. River: i. It is unclear how the River OU eastern delineation line was drawn, since there are no data upriver of this line besides the reference area (approximately 2 miles upstream). Based on RI information and the more recent River OU RA, Figure 2-7, sediment and tissue samples indicate HH risk extends across the entire unit, including locations at upriver boundary.	The eastern boundary for the In Water OU was determined with hydraulic models. Currents can flow upstream under certain operational scenarios (spillways closed). The western end of Goose Island is the most upstream point that the hydraulic model shows currents extending. The eastern end of Goose Island was chosen for the upstream boundary to be conservative. Although a few bass have been caught along Goose Island with high PCB concentrations, sediment and clam data from the 2008 sampling event are consistent with the setting of this eastern boundary (i.e. no elevated levels of contaminants east of the western tip

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		of the island). No revisions to the BHHRAs are necessary.
9.	3. Site delineation: b. River: ii. Goose Island Slough was constructed in 1989-1993 by removing a portion of the southeastern tip of Bradford Island. One of the most heavily impacted sediment locations is at the eastern tip of Bradford Island. At the time of construction this material was not evaluated for the presence of contamination; however, limited sampling of slough sediments and fish tissue post-construction has been completed. This data are inconclusive about whether or not contaminated sediments were re-located into this area. The Yakama Nation requests discussion of the hydrodynamic model and any older data that indicate the potential for borrowed sediments to have become contaminated.	To place material in water in the state of Oregon requires a 404(b) permit and a 401 permit. These permits would only have been issued if the soils / sediments met State and EPA guidelines for in-water placement. We can look for and share those records. No revisions to the BHHRAs are necessary.
10.	3. Site delineation: b. River: iii. The information available to date are not adequate to narrow down the focus area for cleanup decisions in the FS. The highest PCBs concentration in fish tissue are found in the forebay and Goose Island areas. In addition, very highPCB concentrations were observed at the upriver site boundary (e.g., 69,276 µg/kg PCB, equivalent to 7% PCBs in fish tissue sample 68), again leaving questions as to whether high or higher concentrations might be observed if fish from farther upstream were sampled. The higher concentration at Goose Island should be further considered to determine whether there is a proximate or upstream source of PCBs.	See Note 2, below. Also, sampling at Goose Island was completed in 2009 at the request of the TAG, after some Goose Island bass (fish caught in the slough in 2008) were found to have high PCB levels. No new source areas were found. It is our opinion that fish are an inadequate media for tracking down new sources of contamination. No revisions to the BHHRAs are necessary.
11.	3. Site delineation: b. River: iv. In the recent data (2011), the concentrations of PCBs in fish, clams, and sediments were still high along the north side of Bradford Island, with concentrations in all media increasing toward the eastern end of the island. The sampling at Bradford Island was limited to the north side of the island; however, it did not bound the extent of the high concentration area to the south around the end of the island, nor riverward. One of the debris piles was located near the eastern end of the island and river current flow is around the tip of the island at least some of the time (per conversation with USACE, December 15, 2015), providing a reasonable basis for residual high concentrations of PCBs to be found in this location. Considered together with the potential for heterogeneity in the PCB distributions, these data are simply too limited to confidently delineate the present distribution of PCB contamination.	The 2011 sampling event was done to supplement the 2008 sampling results. In 2008, samples were not taken in the removal areas (at the time, we did not believe there would be enough sediment present to obtain samples because the sediment removal action had just taken place a few months earlier). Taken together, the 2008 and 2011 sampling data adequately describes the forebay in the shallower shoreline areas (within 150 feet of the shoreline). Deeper areas, beyond 150 feet, were not sampled during this timeframe. Some samples were taken in 2003 (see 2.a., above). These samples were non-detect or had very low detections for PCBs. Also, these areas present a safety risk to divers and they are not normal habitat for bass, sculpin, etc. For these reasons, no additional deep water samples were taken in 2008 and 2011.

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		No revisions to the BHHRAs are necessary.
12.	3. Site delineation: b. River: v. USACE assumes the primary source of residual PCBs is located in cracks of the river bottom disposal areas. The Yakama Nation requests information on direct support exists for this assumption.	We can provide the diver logs from the 2011 sampling event. They note that surface sediment was not available for collection and that they had to get sediment material from the cracks and crevices in the rocky river bottom. No revisions to the BHHRAs are necessary.
13.	3. Site delineation: b. River: vi. The use of organisms with smaller home ranges (sculpin, crayfish, clams, periphyton and macroinvertebrates) for evaluation of ecological receptors might be more conclusive.	We prepared a comprehensive Work Plan (2007) for sampling, including media to be utilized. We agree that smaller home range organisms are desirable, but media at all levels of the food chain are required for a complete risk assessment. No revisions to the BHHRAs are necessary.
14.	3. Site delineation: b. River: vii. The Yakama Nation requests information to support USACE's conclusion that sediments in general, and especially contaminated sediments, do not accumulate behind the Bonneville Dam in the forebay.	High velocity areas are not depositional. Hydraulic models will show that the area in front of the spillway is a high velocity area. Samples do exist on the Oregon side of powerhouse 1. These samples show non-detect for PCBs. No sampling was ever contemplated in front of powerhouse 2. Hydraulic modeling does not support the idea that sediments could reach this area. No revisions to the BHHRAs are necessary.
15.	3. Site delineation: b. River: viii. We are concerned about the adequacy of the sediment investigation downstream of the Bonneville Dam. The Yakama Nation requests information on how the 4 downstream sediment samples listed in the RI were selected to evaluate downstream sediment impacts. In addition, we request all historic downstream data not used in the RI.	Hydraulic modeling was utilized to determine the most likely depositional areas downstream of the dam. Six locations (not 4) were sampled (see RI, page 8-10) for more on this topic. No other sampling events have occurred below Bonneville Dam. No revisions to the BHHRAs are necessary.
16.	3. Site delineation: b. River: ix. Older data: 1. Older data should be considered. The Yakama Nation disagrees with USACE that including historic data will add uncertainty to the RI (USACE response to Oregon Department of Environmental Quality comments, 2011). Because the forebay is a dynamic environment, understanding where contamination has come to be located over time will inform a cleanup selection and design. Not considering this information in the conceptual site model adds greater uncertainty.	At the request of ODEQ, most of the older data was included in the In Water baseline risk assessment. Please see the In Water OU Technical Memo (June 2014) for a full explanation of what data was added to the risk assessment data set. No revisions to the BHHRAs are necessary.

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17.	3. Site delineation: b. River: ix. Older data: 2. For example, these older data show that the PCB contamination was heterogeneously distributed in the sediments (e.g., Figure 3-1 of 2014 Data Evaluation Technical Memorandum, River OU), indicating that a high frequency sampling was necessary to identify the "hot spots" at that time. There is no reason to assume that the same heterogeneity is not present today, leaving the possibility that areas with higher contamination have just been missed in the limited recent sampling.	All sampling done after 2003 uses a compositing method. Up to 10 discreet samples are collected within a 50 foot gridded area and combined for analysis. We agree that discreet samples would give wildly varied results, which is why we started using the compositing method. No amount of sampling will be enough to locate every hot spot on the river bottom. But, we believe enough sampling has already been done to tie the hot spots to the debris piles and the outfalls (our PCB sources). No revisions to the BHHRAs are necessary.
18.	3. Site delineation: b. River: ix. Older data: 3. RI, appendix G (historical data not used) does not include a map or adequate location information. We request location information for this data.	See 3.b.ix.1, above. The RI, Appendix G no longer reflects the data used in the RA. Please refer to the In Water OU Technical Memo (June 2014) for more up to date information. No revisions to the BHHRAs are necessary.
19.	3. Site delineation: b. River: ix. Older data: 4. We understand that past efforts were made to sample clam tissue in the forebay close to the dam (early 2000s). We request information on this sampling event.	In 2003, sediment and clam tissue was collected (over 120 locations). However, the clam tissue samples were never analyzed. After 3 years, they were discarded. No revisions to the BHHRAs are necessary.
20.	3. Site delineation: c. Upland: i. The groundwater VOC plume needs further evaluation. Fairly high concentrations of volatile organic compounds (VOCs) were observed, as were apparent groundwater plumes of those substances. In general, VOCs do not accumulate in sediments or biota and are not highly toxic to aquatic biota. However, the VOC plumes could provide a vector (solvent) for the transport of other organic contaminants.	While groundwater data from borings delineated a PCE plume in 2004 with concentrations greater than 10 times the SLV, subsequent sampling in 2008 suggested that the mass of VOCs available to leach to groundwater is decreasing over time. The breakdown products of PCE (1,1-DCA , cis-1,2-DCE, and vinyl chloride) were also present in groundwater but at generally lower concentrations and with fewer SLV exceedances. The hypothesis that the groundwater VOC plume can function as a vector for transport of other organic contaminants is legitimate but is not reflected in other groundwater and seep data. From data collected in support of the RI, limited or no detection of contaminants, including butyltins, herbicides, pesticides, PCBs, PAHs, and SVOCs, were identified in groundwater and seep water. No revisions to the BHHRAs are necessary.
21.	3. Site delineation: c. Upland: ii. The Yakama Nation requests information on how the FS will address	Surface water was evaluated in the screening level ecological risk assessment and was not found to pose unacceptable risk. Surface water

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	groundwater to surface water contaminant contributions. This pathway was not carried forward into the RA for further evaluation, despite toxicity criteria exceedances.	was also evaluated as an exposure medium in the baseline human health risk assessment and was found to not pose unacceptable risk. Any contaminant contribution from groundwater to surface water is considered negligible given the results of the risk assessments. No revisions to the BHHRAs are necessary.
22.	3. Site delineation: c. Upland: iii. The FS cleanup alternatives should still include preventative measures to eliminate current and future transport of upland soil and groundwater contamination to the river. In general, upland risks are limited in comparison to river OU PCBs and the RI reasonably discussed the possible inputs from the upland sites to the river, but the quantitative impact of those inputs has been poorly characterized, e.g., associated with slope failure. It also seems very unlikely that the upland sites are the source of the high PCB concentrations observed in the river.	Quantitative characterization of a landfill is not possible. Mass wasting of soil has been confirmed by a recent geotechnical report. Agree that the Upland Landfill alternatives need to address upland soil. No revisions to the BHHRAs are necessary.
Comments on the Upland and River OUs Draft Risk Assessments		
23.	1. River and Upland Combined: a. With respect to these limited or focused RAs, observations are prefaced by noting that there are risks posed by a number of substances at this site including metals and a variety of organic chemicals. Although the risks posed by these substances are lower than the risks posed by the PCB contamination, the risks from all substances should be identified.	Risks, both cancer and non-cancer, for all identified COPCs and CEPCs were calculated in the baseline risk assessments. These calculated risks are presented in Tables 2-6.1 through 2-12 and 3-15 through 3-19 in the River OU baseline RA and Tables 2-9 through 2-25 and 3-11a through 3-19d in the Upland OU baseline RA. No revisions to the BHHRA are necessary.
24.	1. River and Upland Combined: b. Tribal exposure scenario: USACE made assumptions about future tribal use to estimate risk at Bradford Island and we appreciate effort to use conservative assumptions in its RA; however, Yakama Nation reiterates its request to have further dialogue on this issue.	We would welcome further dialogue. No revisions to the BHHRA are necessary.
25.	2. River OU: a. Lipid normalization should be done when comparing concentrations among species. Similarly, for the bass, age differences should be considered as well. It was not clear when the River OU Baseline Ecological Risk Assessment (BERA) states that the concentration in fish tissue were substantially greater than in clams or crayfish whether those measurements were lipid normalized. Lipid content has a major control over the concentrations and the fish have greater lipid content than the shellfish.	Lipid normalization was conducted for all calculations. As stated in the in River OU baseline RA, the median site-specific clam, crayfish, sculpin, and bass lipid contents are 2.6%, 0.73%, 4.1%, and 3%, respectively (page 3-5, River OU Baseline RA). These values were used calculate relevant tissue concentrations. No revisions to the BHHRA are necessary.

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26.	2. River OU: b. For the dietary uptake by mink it would be useful to discuss in the uncertainty section the effects of assuming the mink ate only the most contaminated food to demonstrate the possible upper limit of the risks.	The results for the mink are likely a conservative, over estimate of risk in both the River and Upland OU baseline RAs. Excerpts from the River OU baseline RA are provided below for reference. Based on the assumed dietary fractions identified in the baseline RA, the EPC (95% UCL on the mean) was used to calculate CPEC exposure. Use of the 95% UCL on the mean is in accordance with the most recent USEPA guidance regarding statistical methodology to be used in EPC estimation and more conservative than ODEQ's guidance. Because of this conservative methodology, USACE feels a discussion regarding the possible upper limit of risk is unwarranted. *Several sources of information on the mink's diet were consulted while developing the response to ODEQ's Specific Comment #22 to the Final RI (URS 2012), and the consensus is that mink's diet primarily consists of crayfish, fish, and other aquatic-related prey. Typically, 10% or less of their diet is comprised of terrestrial prey (e.g., birds and small mammals) (USEPA 1993b, 1995). Although the Upland OU BERA assumed 15% small mammals for the upland RA, mink were conservatively assumed to have a dietary composition of 100% prey from the River OU for this River OU BERA. This was done because it is likely that mink preferentially use the River OU (i.e., permanent water source, riverine habitat) rather than the Upland OU to forage. Therefore, the uncertainty that risk may have been underestimated in the River OU BERA is minimal and unlikely to impact risk management decisions in the FS.* *In addition, although the mink was assumed to consume more the one type of riverine food item (i.e., crayfish, sculpin, and bass), the mink's diet was assumed to be comprised of each equally (i.e., 33.3% each). In actuality, mink dietary composition is likely to fluctuate with availability, season, and, potentially, animal preference. Additionally, in instances when an CPEC was not analyzed in all three tissues, the dietary composition was adjusted for that particular analyte based on available tissue analysis (e.g., 50% each if only analyzed in two tissues, or 100% if analyzed in a single tissue type). Both of these uncertainties may over- or underestimate risk to the mink; the direction and magnitude of this uncertainty is difficult to quantify.* No revisions to the BHHRA are necessary.

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27.	2. River OU: c. Similarly, since there is uncertainty in the biomagnification factor (BMF) it would be helpful to discuss the range of possible BMF values compared to the resulting risk estimate. We request calculations using these BMF values to determine if there's a change in risk, both cancerous and non-cancerous.	The BMF values selected for the baseline RA were ODEQ's default values. As stated in the baseline RA, the study for which the default eagle BMFs are from (Buck 2004) noted that the PCB BMFs varied "quite markedly" among the Columbia River segments evaluated (i.e., ranged from 90 to 155) and used prey fish tissue from a wider range of prey items than the assumed dietary assumptions for this BERA (i.e., 100% bass). The use of the default BMFs, which showed variations among the study river segments from studies on which they are based, introduces a level of uncertainty that is hard to quantify and may over- or underestimate risk. However, combined with the dietary assumption of 100% bass (with highest detected CPEC concentrations), this likely conservatively skews the uncertainty toward overestimation. Given that the risk results provide a likely overestimation of risk, USACE feels a discussion regarding the possible upper limit of risk is unwarranted No revisions to the BHHRA are necessary.
28.	2. River OU: d. Table 3-13. It would be helpful to include the maximum concentrations observed in the reference areas in the table since the upper prediction limit (UPL) can exceed the maximum if the sample size is small and variable.	It is generally believed that the UPL is a more statistically reliable value and a better representation of the data set, as compared to the maximum detected value. However, maximum concentrations can be found in the risk assessments, Tables 1-1 through 1-8 for the River OU baseline RA and Tables 1-1 through 1-9 for the Upland OU baseline RA. The tables relevant to the reference area samples present both the UPL and maximum detected value. No revisions to the BHHRA are necessary.
29.	2. River OU: e. In comparison to data from the Portland Harbor BERA, the fish tissue no-observed-adverse-effect concentrations (NOAELs) used in the Bradford Island BERA are similar, but the Portland Harbor lowest-observed-adverse-effect levels (LOAELs) are usually less than 3 times the NOELs, rather than the 5 times used as the default in the BI BERA. For PCBs, the NOELs are virtually the same (Portland Harbor -0.42 milligrams/kilogram wet weight (mg/kg ww) versus Bradford Island -0.43 mg/kg ww), but the Portland Harbor LOEL is 0.93 mg/kg ww verses 2.2 mg/kg ww. For PCBs and other substances using the lower LOELs from Portland Harbor would increase some of the LOEL-based HQs, better characterizing the risks posed by those substances.	During a May 20, 2015 meeting between USACE and ODEQ, it was agreed ODEQ toxicity reference values (TRVs) would be the first choice in the hierarchy of TRV selection. This was done in response to some of ODEQ's expressed concerns regarding the TRVs utilized in the Portland Harbor RA. As a result, some TRVs results in both higher and lower characterized risks. Ultimately, PCBs are still identified as a COC/CEC with unacceptable risk warranting remedial action. No revisions to the BHHRA are necessary.

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30.	2. River OU: f. USACE needs a better data set to determine fish tissue contaminant concentration trends. Yakama Nation does not agree that PCB concentrations are decreasing in post-removal (2011) fish tissue. The river OU RA presents information that the highest concentrations were found in young fish and that the sampling efforts had a low sample size and low sample frequency.	Monitoring fish tissue concentrations will almost certainly be part of the recommended alternative. But, additional sampling is unnecessary to complete the In Water FS. No revisions to the BHHRA are necessary.
31.	3. Upland OU BERA: Erosion of the landfill at the north bank shoreline of Bradford Island, as identified in the 2015 slope stability analysis, is an ongoing concern and should be addressed in FS cleanup alternatives.	Agreed. This is being addressed in the Upland FS. No revisions to the BHHRA are necessary.
Global Comments		
32.	1. Reference Area: a. The appropriateness of the reference area data is a concern and should be re-evaluated. It is close to the site (i.e., within small mouth bass home range of approximately 0.7 to 1 mile) and under the direct influence of multiple releases from waterfront cleanup sites with confirmed and suspected contaminant sources also found at Bradford Island, including: i. Herman Creek PCBs, Cascade Locks, OR – confirmed PCBs in sediments ii. Cascade Locks Wastewater & Storage Facility, Cascade Locks, OR - PCBs suspected due to illegal dumping and storage of transformers (along Herman Creek) iii. Cascade Locks Lumber, Cascade Locks, OR – PCBs, TPH, metals, PAHs (along Herman Creek) iv. Pyramid Metals, Cascade Locks, OR – metals (along Herman Creek) v. Stevenson CoPly Mill, Stevenson, WA – Awaiting Cleanup Status (WA, Department of Ecology). Confirmed or suspected contaminants of concern for this facility include PCP, dioxins/furans, creosote, petroleum, PAHs, metals, corrosive wastes. vi. Multiple petroleum bulk storage facilities in both Stevenson, WA and Cascade Locks, OR that are in various stages of investigation and cleanup. Confirmed or suspected contaminants of concern include cPAHs and petroleum. vii. Multiple municipal and industrial wastewater outfalls in Stevenson, WA and Cascade, OR. These facilities have existing discharge permits to pollute the Columbia River.	Sample results from all reference area samples are statistically similar, no matter how close or how far from the cited locations of concern. Also, please note that approximately 8 of the reference area bass were actually caught several miles upstream (because they could not catch enough in the actual reference area). The results in these bass are comparable, if not slightly elevated, in PCBs, when compared to the other bass. We do understand the concern, but the sample data from the reference area does not indicate a problem. No revisions to the BHHRAs are necessary.
33.	1. Reference Area: b. It is inappropriate to eliminate COCs and CECs due to similar reference area (background) concentration ranges when the reference area is located in an	For the River OU reference area, the upstream reference area was selected based on modeling results characterizing the upstream extent of the river flow reversal caused by the powerhouses and the spillway that

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	industrial area directly influenced by releases from similar contaminant sources. Specifically mercury and arsenic (mentioned in Section 2 text) are of concern. Evaluation of these contaminants for elimination as a COC or CEC should be risk-based only.	could transport impacted sediment back upstream. The reference area was found to be statistically different from the source area. This reference area was subsequently used for comparative analyses in the Remedial Investigation and baseline RAs. For the Upland OU reference area, the location was selected because it was upgradient of and unaffected by the site related waste handling activities. The reference site was also found to have samples that generally reflected background or ambient concentrations of all COIs. Lastly, the reference area exhibited similar physical soil characteristics relative to the soil sampled in the four AOPCs in the Upland OU. Because the reference area exhibits these characteristics, USACE believes it is appropriate to use the reference area as site background concentrations and apply these concentrations when determining COCs and CECs. CERCLA guidance states that it is generally not feasible to set cleanup levels below background and thus can be used for helping to screen contaminants for risk management purposes. For mercury and arsenic, the 95% reference UPL (0.06 and 5.5 mg/kg, respectively) are either in line or much lower the Oregon DEQ's regional background values for inorganics in soil. No revisions to the BHHRAs are necessary.
34.	1. Reference Area: c. Yakama Nation is concerned about USACE's stated intentions to use reference area data as background values. It is inappropriate to set cleanup levels to a background value that is directly influenced by releases from contaminant sources.	As stated in response to Global Comment 1.b., the reference areas for the River and Upland OU were identified and justified with empirical information identifying the reference areas as statistically different from the source areas and justifiable as reference locations. There is no information supporting the idea that the reference areas are directly influenced by releases from contaminated sources. Further, the baseline RAs followed CERCLA guidance when developing and applying background concentrations to risk management decisions. "Under CERCLA, cleanup levels are not set at concentrations below natural background levels. Similarly, for anthropogenic contaminant concentrations, the CERCLA program normally does not set cleanup levels below anthropogenic background concentrations" (Reference: US EPA, 2002. Role of Background in the CERCLA Cleanup Program. OSWER 9285.6-07P). As such, USACE believes it is appropriate and in line with guidance to use the reference area to represent anthropogenic

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		background. No revisions to the BHHRAs are necessary.
35.	1. Reference Area: d. Comparisons of site data to those from reference area is principally a risk management issue. The presence of similar concentrations elsewhere does not reduce the risks at the site.	USACE agrees that in some cases deferring to background concentrations for select contaminants will not reduce risks to *de minimus* levels. This is because *de minimus* concentrations fall below background concentrations. It is infeasible to set preliminary remedial goals below background. This strategy is in line with both current CERCLA and ODEQ guidance regarding the consideration of background contamination concentrations. No revisions to the BHHRAs are necessary.
36.	2. CEPCs and COPCs not retained: Yakama Nation wants to make it clear that monitoring and evaluation of the broader CEPCs and COPCs list of contaminants exceeding toxicity levels should be continued in future response action stages.	Comment noted. This issue will be given full consideration when developing strategies for post construction confirmation sampling and long term monitoring. Risk driver contaminants, as well as the full set of identified COCs and CECs will be sampled for in post construction and long term monitoring sampling. CPECs and COPCs will be given consideration as warranted. No revisions to the BHHRAs are necessary.

Note 1: We understand the concern that the entire Bonneville Dam complex is not a part of the scope of this project. However, please note that the Bradford Island project is not the primary vehicle for managing waste at Bonneville Dam. In fact, most actions are managed by an Environmental Compliance Team following Resource Conservation and Recovery Act (**RCRA**) processes and protocols. This is a fully staffed team that is integral to the routine operation and maintenance of the project. Their mission manages the majority of actions related to the generation, transportation, treatment, storage, and disposal of hazardous waste at the project. Their process begins with ERGO assessments, which are now conducted on an annual basis (the first ERGO assessment was completed in 1992) and ends when an item of non-compliance is corrected. Some past actions have included removal of underground storage tanks and removal of soils associated with known localized spills.

The sites that have become the ‘Bradford Island’ project, are being managed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). These sites are either too large to be managed as part of a routine program or fit the definition of a ‘legacy’ site.

Note 2: After the sediment removal work was completed in 2007, the sediments in the barges were sampled for final disposition. PCBs could not be detected in the samples. This is relevant because it shows that PCBs in sediments that were removed from the hottest locations could not be detected once handled by the removal contractor. In the case of Goose Island millions of tons of material was removed and placed to form Goose Island. It is highly unlikely that any contamination could be detected after the material went through such a removal and placement action, given the results in 2007.