PORTLAND HARBOR RI

APPENDIX G
BASELINE ECOLOGICAL RISK ASSESSMENT

ATTACHMENT 12
INDIVIDUAL SAMPLE AND DIETARY COMPONENT ASSESSMENT FOR FISH

DRAFT

DO NOT QUOTE OR CITE
This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

August 19, 2009

Prepared for
The Lower Willamette Group

Prepared by
Windward Environmental LLC

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 TISSUE RESIDUE LOE 2

3.0 DIETARY DOSE LOE 5

3.1 Largescale Sucker 5
3.1.1 Sample-by-Sample HQs.....5
3.1.2 HQs Calculated Over Site-Wide Exposure Area 6

3.2 Juvenile White Sturgeon 7
3.2.1 Sample-by-Sample HQs.....7
3.2.2 HQs Calculated Over Site-Wide Exposure Area 8

3.3 Juvenile Chinook Salmon 9
3.3.1 Sample-by-Sample HQs.....9
3.3.2 HQs Calculated Over Site-Wide Exposure Area 9

3.4 Peamouth.....10
3.4.1 Sample-by-Sample HQs.....10
3.4.2 HQs Calculated Over Site-Wide Exposure Area 11

3.5 Sculpin 12
3.5.1 Sample-by-Sample HQs.....12
3.5.2 HQs Calculated Over Individual Exposure Areas 13

3.6 Smallmouth Bass 13
3.6.1 Sample-by-Sample HQs.....13
3.6.2 HQs Calculated Over 1-Mile Exposure Areas 14

3.7 Northern Pikeminnow.....16
3.7.1 Sample-by-Sample HQs.....16
3.7.2 HQs Calculated Over 1-Mile Exposure Areas 17

3.8 Summary of COPCs Retained for Further Evaluation.....19

4.0 REFERENCES 20

LIST OF TABLES

Table 2-1. Number of Individual Fish Tissue Samples with HQs > 1.0 2

Table 3-1. Number of Largescale Sucker Prey and Sediment Samples with LOAEL HQs > 1.0.....6

Table 3-2. Largescale Sucker Site-Wide Exposure Prey and Sediment LOAEL HQs 6

Table 3-3. Number of Juvenile White Sturgeon Prey and Sediment Samples with LOAEL HQs > 1.0 7

Table 3-4. Juvenile White Sturgeon Site-Wide Exposure Prey and Sediment LOAEL HQs 8

Table 3-5. Number of Juvenile Chinook Salmon Prey and Sediment Samples with NOAEL HQs > 1.0 9

Table 3-6. Juvenile Chinook Salmon Site-Wide Exposure Prey and Sediment NOAEL HQs.....10

Table 3-7. Number of Peamouth Prey and Sediment Samples with LOAEL HQs > 1.0 10

Table 3-8. Peamouth Site-Wide Exposure Prey and Sediment LOAEL HQs.....12

Table 3-9. Number of Sculpin Prey and Sediment Samples with LOAEL HQs > 1.0 12

Table 3-10. Number of Smallmouth Bass Prey and Sediment Samples with LOAEL HQs > 1.0.....14

Table 3-11. Smallmouth Bass 1-Mile Exposure Area Prey and Sediment LOAEL HQs 15

Table 3-12. Number of Northern Pikeminnow Prey and Sediment Samples with LOAEL HQs > 1.0 16

Table 3-13. Northern Pikeminnow 1-Mile Exposure Area Prey and Sediment LOAEL HQs.....17

Table 3-14. COPCs Further Evaluated in the Fish Risk Characterization.....19

LIST OF MAPS

Map 3-1. Sculpin Prey Dietary HQs for Cadmium

Map 3-2. Sculpin Prey Dietary HQs for Copper

Map 3-3. Sculpin Prey Dietary HQs for Tributyltin

1.0 INTRODUCTION

The following presents the sample-by-sample assessment for the fish tissue residue LOE (Section 2.0) and the sample-by-sample and dietary component assessment for the fish dietary dose LOE (Section 3.0).

2.0 TISSUE RESIDUE LOE

The risk evaluation of fish chemicals of potential concern (COPCs) using the receptor-tissue residue approach involves two steps, including:

1. The derivation of hazard quotients (HQs[1]) on an individual sample-by-sample basis
2. The derivation of HQs over a relevant exposure area[2]

HQs in the first step were calculated per EPA (2008), as outlined in EPA's Problem Formulation (Attachment 2). The HQ results from the first step were used to narrow the list of COPCs for evaluation in the second step. COPCs with HQs > 1.0 in the second step were retained as chemicals of concern (COCs).

Table 2-1 presents an overview of the results for the tissue residue HQs on a sample-by-sample basis. HQs were derived from a comparison of tissue concentrations to no-observed-adverse-effect levels (NOAELs) for juvenile Chinook salmon and Pacific lamprey ammocoetes and from a comparison of tissue concentrations to lowest-observed-adverse-effect level (LOAELs) for all other fish receptors.

Table 2-1. Number of Individual Fish Tissue Samples with HQs > 1.0

	Large Home-range Fish					Small Home-range Fish		
COPC	**Large-scale Sucker**	**Juvenile White Sturgeon**	**Juvenile Chinook Salmon**	**Pea-mouth**	**Pacific Lamprey**	**Sculpin**	**Small-mouth Bass**	**Northern Pike-minnow**
Metals								
Antimony	NA	NA	NA	NA	NA	NA	0/32	NA
Cadmium	NA	NA	NA	NA	NA	NA	0/32	NA
Chromium	0/6	0/15	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	**4/4 (2.2)**	**3/38 (2.3)**	NA	NA
Lead	NA	NA	NA	**1/4 (2.7)**	NA	NA	**2/32 (280)**	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	**1/6 (1.1)**
Zinc	NA	NA	0/15	NA	NA	NA	NA	NA

[1] HQs are defined as the exposure chemical concentration divided by an effects threshold.

[2] Individual tissue HQs were calculated based on upper confidence limits on the mean from within relevant exposure areas. If insufficient data were available to derive a UCL concentration (fewer than six detected concentrations were available), the HQ was based on maximum prey species or sediment concentration.

Table 2-1. Number of Individual Fish Tissue Samples with HQs > 1.0

	Large Home-range Fish					Small Home-range Fish		
COPC	**Large-scale Sucker**	**Juvenile White Sturgeon**	**Juvenile Chinook Salmon**	**Pea-mouth**	**Pacific Lamprey**	**Sculpin**	**Small-mouth Bass**	**Northern Pike-minnow**
PCBs								
Total PCBs	**2/6 (2.2)**	NA	NA	NA	NA	**4/38 (9.4); [57[b]/1,100 (13)][c]**	**9/32 (7.1)**	**2/6 (2.0)**
Pesticides								
beta-HCH	NA	NA	NA	NA	NA	0/38	NA	NA
4,4′-DDD	0/6	NA	0/15	NA	0/6	0/38	0/32	NA
4,4′-DDT	NA	NA	NA	NA	NA	**1/38 (1.1)**	NA	NA
Total DDx	0/6	NA	NA	NA	NA	**1/38 (1.9); [1/1,128 (1.2)][c]**	0/32	0/6
BEHP	0/6 [d]	NA	NA	NA	NA	**1/38 (2.9)[d]**	**2/32 (9.1)[d]**	NA

[a] HQs based on LOAELs for all fish except for juvenile Chinook salmon and Pacific lamprey HQs based on NOAELs.
[b] HQs based on predicted sculpin tissue concentrations using biota-sediment accumulation regressions (BSARs) and individual surface sediment samples.
[c] An additional 9 samples had DLs that were greater than the TRV. The maximum HQ based on a DL is 3.8.
[d] No BEHP LOAEL was identified; HQs based on the only NOAEL identified.
BEHP – bis(2-ethylhexyl) phthalate
COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
HCH – hexachlorocyclohexane
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
NA – not applicable; not a COPC-receptor pair
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
Total DDx - sum of all six DDT isomers (2,4′-DDD; 4,4′-DDD; 2,4′-DDE; 4,4′-DDE; 2,4′-DDT; and 4,4′-DDT)
Bold identifies HQs > 1.0.

COPC-receptor pairs with HQs > 1.0 based on an individual sample-by-sample analysis were further evaluated in the fish risk characterization section of the BERA (Table 2-2). HQs for these COPCs were calculated based on relevant exposure areas and these results are presented in the fish risk characterization section of the BERA.

Table 2-2. Tissue Residue COPCs Further Evaluated in the Fish Risk Characterization

	Large-Home-Range Fish			Small-Home-Range Fish		
COPC	**Large-scale Sucker**	**Pea-mouth**	**Pacific Lamprey**	**Sculpin**	**Small-mouth Bass**	**Northern Pike-minnow**
Metals						
Copper			X	X		
Lead		X			X	
Mercury						X
PCBs						
Total PCBs	X			X	X	X
Pesticides						
4,4′-DDT				X		
Total DDx				X		
BEHP				X[a]	X[a]	

[a] No BEHP LOAEL was identified; retained as a COPC-receptor pair based on an HQ > 1.0 derived from a NOAEL.
COPC – chemical of potential concern
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
PCB – polychlorinated biphenyl
Total DDx - sum of all six DDT isomers (2,4′-DDD; 4,4′-DDD; 2,4′-DDE; 4,4′-DDE; 2,4′-DDT; and 4,4′-DDT)

Juvenile white sturgeon and juvenile Chinook salmon were not further evaluated because individual sample COPC concentrations were all less than their respective LOAELs and NOAELs (for sturgeon and Chinook, respectively).Six COPCs (i.e., antimony, cadmium, chromium, zinc, beta-HCH and 4,4′-DDD) were not further evaluated for any fish receptor, because these COPC concentrations were less than their respective TRVs for any fish receptor on a sample-by-sample basis. No LOAEL TRV was identified from the literature for BEHP; however a NOAEL TRV was available. BEHP was retained as a COPC for sculpin and smallmouth bass based on the exceedance of a NOAEL.

3.0 DIETARY DOSE LOE

The risk evaluation of fish COPCs using the dietary dose approach involves multiple steps, including:

1. The derivation of diet HQs on an individual prey/sediment sample-by-sample basis
2. The derivation of HQs over a relevant exposure area for individual prey species and sediment[3]
3. The derivation of HQs over a relevant exposure area accounting for the ingestion of multiple prey species

HQs in the first two steps were calculated per EPA (2008), as outlined in EPA's Problem Formulation (Attachment 2). The HQ results from the first two steps were used to narrow the list of COPCs for evaluation in the third step. COPCs with HQs > 1.0 in the third step were retained as COCs.

This attachment presents the HQs calculated for both the dietary evaluation on a sample-by-sample basis and HQs calculated for individual prey species within relevant exposure areas. HQs based on multiple prey species within relevant exposure areas are presented in the fish risk characterization section of the BERA.

3.1 LARGESCALE SUCKER

This section presents the largescale sucker HQs on a sample-by-sample basis (Section 2.1) and over a relevant exposure area for individual prey species and sediment (Section 2.2).

3.1.1 Sample-by-Sample HQs

Five largescale sucker COPCs were identified through the screening-level ecological risk assessment (SLERA): cadmium, copper, mercury, tributyltin (TBT), and total PAHs. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based threshold tissue concentrations (TTCs) and threshold sediment concentrations (TSCs). Table 3-1 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

[3] Individual prey species and sediment HQs were calculated based on upper confidence limits on the mean from within relevant exposure areas. If insufficient data were available to derive a UCL concentration (fewer than six detected concentrations were available), the HQ was based on maximum prey species or sediment concentration.

Table 3-1. Number of Largescale Sucker Prey and Sediment Samples with LOAEL HQs > 1.0

COPC	Number of Samples with HQs > 1.0 (Max HQ)				Sum of Tissue and Sediment HQ > 1.0?
	Clam	Lab Clam[a]	Lab Worm[a]	Sediment	
Metals					
Cadmium	**1/38 (1.1)**	0/35	**2/35 (1.3)**	**1/1,348 (2.8)**	**Yes**
Copper	**16/38 (1.4)**	0/35	**1/35 (2.1)**	**2/1,358 (3.6)**	**Yes**
Mercury	0/35	0/35	0/34	**1/1,345 (3.0)**	**Yes**
Butyltins					
Tributyltin ion	**2/34 (13)**	**1/35 (16)**	**2/35 (41)**	**5/405 (14)**	**Yes**
PAHs					
Total PAHs	0/39	0/35	0/35	0/1,406	No

[a] Chemical concentrations of PAHs and butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Individual prey samples had HQs > 1.0 for three COPCs (i.e., cadmium, copper, and TBT).

Total PAHs had no individual prey tissue or sediment samples with concentrations greater than TTCs or TSCs, respectively, so dietary risks from these COPCs were found to be negligible, and no additional evaluation of these COPCs was conducted for the BERA. Mercury was also not evaluated further because only one sediment sample had a mercury concentration greater than the TSC and no prey tissue sample mercury concentrations were greater than the TTC.

3.1.2 HQs Calculated Over Site-Wide Exposure Area

COPCs with individual samples that resulted in HQs > 1.0 (i.e., cadmium, copper, and TBT) were further evaluated within a site-wide exposure area. HQs were calculated for all prey species and sediment within the entire Study Area based on upper confidence limit on the mean (UCL) concentrations. Where insufficient data were available (i.e., fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations. Site-wide LOAEL HQs are presented in Table 3-2.

Table 3-2. Largescale Sucker Site-Wide Exposure Prey and Sediment LOAEL HQs

COPC	Site-Wide HQ[a]			
	Clam	Lab Clam	Lab Worm	Sediment
Cadmium	0.49	0.27	0.42	0.027
Copper	1.0	0.42	0.41	0.087
Tributyltin ion	**2.9**	**3.6**	**8.7**	0.61

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.
COPC – chemical of potential concern

EPC – exposure point concentration
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
UCL – upper confidence limit on the mean
Bold identifies HQs > 1.0.

Site-wide tissue and sediment cadmium and copper concentrations were less than TTC and TSCs, so these COPC are not expected to pose risks to largescale sucker, and no additional evaluation of these COPCs was conducted for this BERA. LOAEL HQs for TBT were > 1.0 for all prey species. Risks to largescale sucker were calculated for TBT and are presented in the fish risk characterization section of the BERA.

3.2 JUVENILE WHITE STURGEON

This section presents the juvenile white sturgeon HQs on a sample-by-sample basis (Section 3.1) and over a relevant exposure area for individual prey species and sediment (Section 3.2).

3.2.1 Sample-by-Sample HQs

Six juvenile white sturgeon COPCs were identified through the SLERA: cadmium, copper, mercury, TBT, benzo(a)pyrene, and total PAHs. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based TTCs and TSC). Table 3-3 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-3. Number of Juvenile White Sturgeon Prey and Sediment Samples with LOAEL HQs > 1.0

	Number of Samples with HQs > 1.0 (Max HQ)							Sum of Tissue and Sediment HQ > 1.0?
COPC	**Clam**	**Lab Clam[a]**	**Lab Worm[a]**	**Mussel**	**Stomach Contents**	**Sediment (56%)[b]**	**Sediment (8%)[b]**	
Metals								
Cadmium	0/38	0/35	0/35	0/7	0/3	**7/1,348 (14)**	**1/1,348 (2.0)**	**Yes**
Copper	**1/38 (1.0)**	0/35	**1/35 (1.6)**	0/7	0/3	**64/1,358 (18)**	**1/1,358 (2.5)**	**Yes**
Mercury	0/35	0/35	0/34	0/7	0/3	**2/1,345 (15)**	**1/1,345 (2.2)**	**Yes**
Butyltins								
Tributyltin ion	**2/34 (9.3)**	**1/35 (12)**	**1/35 (30)**	0/7	NA	**15/405 (68)**	**5/405 (9.7)**	**Yes**
PAHs								
Benzo(a)-pyrene	0/39	0/35	0/35	0/7	0/3	0/1,406	0/1,406	No
Total PAHs	0/39	0/35	0/35	0/7	0/3	**1/1,406 (1.2)**	0/1,406	**Yes**

[a] Chemical concentrations of PAHs and butyltins were adjusted to reflect steady-state conditions.
[b] HQs based on a high (56%) and low (8%) incidental sediment ingestion rates were evaluated.

COPC – chemical of potential concern
HQ – hazard quotient
NA – not analyzed in sample(s)
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Individual prey samples had HQs > 1.0 for two COPCs: copper and TBT.

Benzo(a)pyrene had no individual prey tissue or sediment samples with concentrations greater than TTCs or TSCs, respectively, so dietary risk from this COPC was found to be negligible, and no additional evaluation of this COPC was conducted for this BERA. Cadmium, mercury, and total PAHs were also not evaluated further. For these COPCs, at least one sediment sample had a chemical concentration greater than the TSC; however, no prey tissue sample chemical concentrations were greater than the TTC.

3.2.2 HQs Calculated Over Site-Wide Exposure Area

COPCs with individual samples resulting in HQs > 1.0 (i.e., cadmium and TBT) were further evaluated within a site-wide exposure area. HQs were calculated for all prey species and sediment within the entire Study Area based on UCL concentrations. Where insufficient data were available (fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations. Site-wide LOAEL HQs are presented in Table 3-4.

Table 3-4. Juvenile White Sturgeon Site-Wide Exposure Prey and Sediment LOAEL HQs

	Site-Wide HQ[a]					
COPC	**Clam**	**Lab Clam**	**Lab Worm**	**Mussel**	**Stomach Contents**	**Sediment[b]**
Copper	0.74	0.31	0.3	0.13	0.85	0.43 (0.062)
Tributyltin ion	**2.1**	**2.6**	**6.3**	0.18	NA	**3.0** (0.43)

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.

[b] HQs are based on 56% incidentally ingested sediment (and 8% incidentally ingested sediment).

COPC – chemical of potential concern
EPC – exposure point concentration
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
NA – not analyzed in sample(s)
UCL – upper confidence limit on the mean
Bold identifies HQs > 1.0.
Italics identify HQs derived from maximum concentration; UCL concentration could not be derived (n detects < 6).

Site-wide tissue and sediment copper concentrations were less than TTC and TSCs, so these COPC are not expected to pose risks to juvenile white sturgeon, and no additional evaluation of these COPCs was conducted for this BERA. LOAEL HQs for TBT were > 1.0 for all prey species. Risks to juvenile white sturgeon were calculated for TBT and are presented in the fish risk characterization section of the BERA.

3.3 JUVENILE CHINOOK SALMON

This section presents the juvenile Chinook salmon HQs on a sample-by-sample basis (Section 4.1) and over a relevant exposure area for individual prey species and sediment (Section 4.2).

3.3.1 Sample-by-Sample HQs

Four juvenile Chinook salmon COPCs were identified through the SLERA: cadmium, copper, mercury, and TBT. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to NOAEL-based TTCs and TSC). Table 3-5 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-5. Number of Juvenile Chinook Salmon Prey and Sediment Samples with NOAEL HQs > 1.0

	Number of Samples with HQs > 1.0 (Max HQ)						Sum of Tissue and Sediment HQ > 1.0?
COPC	**Stomach Contents**	**Clam**	**Lab Clam[a]**	**Lab Worm[a]**	**Epibenthic Invertebrates**	**Sediment**	
Metals							
Cadmium	NA	**38/38 (10)**	**35/35 (3.1)**	**35/35 (12)**	**2/2 (1.7)**	**2/1,348 (4.6)**	**Yes**
Copper	NA	**38/38 (5.2)**	**35/35 (2.3)**	**10/35 (7.7)**	**2/2 (2.3)**	**1/1,358 (2.4)**	**Yes**
Mercury	NA	0/35	0/35	0/34	NA	**1/1,345 (2.6)**	**Yes**
Butyltins							
Tributyltin ion	NA	**16/34 (120)**	**5/35 (150)**	**7/35 (370)**	NA	**7/405 (2.2)**	**Yes**

[a] Chemical concentrations of butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
NA – not analyzed in sample(s)
NOAEL – no-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Individual samples had HQs > 1.0 for three COPCs: cadmium, copper, and TBT.

Mercury was not evaluated further for this BERA. One sediment sample had a mercury concentration greater than the TSC, and no prey tissue sample mercury concentrations were greater than the TTC.

3.3.2 HQs Calculated Over Site-Wide Exposure Area

COPCs for individual samples that resulted in HQs > 1.0 (i.e., cadmium, copper, and TBT) were further evaluated within a site-wide exposure area. HQs were calculated for all prey species and sediment within the entire Study Area based on UCL concentrations. Where

insufficient data were available (i.e., fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations. Site-wide NOAEL HQs are presented in Table 3-6.

Table 3-6. Juvenile Chinook Salmon Site-Wide Exposure Prey and Sediment NOAEL HQs

	Site-Wide HQ[a]					
COPC	**Clam**	**Lab Clam**	**Lab Worm**	**Epibenthic Inverts**	**Stomach Contents**	**Sediment**
Cadmium	**4.5**	**2.4**	**3.9**	***1.7***	NA	0.045
Copper	**3.7**	**1.5**	**1.5**	***2.3***	NA	0.058
Tributyltin ion	**26**	**33**	**79**	NA	NA	1.0

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.

COPC – chemical of potential concern

EPC – exposure point concentration

HQ – hazard quotient

NOAEL – no-observed-adverse-effect level

NA – not analyzed in sample(s)

UCL – upper confidence limit on the mean

Bold identifies HQs > 1.0.

Italics identify HQs derived from maximum concentration; UCL concentration could not be derived (n detects < 6).

NOAEL HQs for cadmium, copper, and TBT were > 1.0 for all prey species. Risks to juvenile Chinook salmon were calculated for TBT and are presented in the fish risk characterization section of the BERA.

3.4 PEAMOUTH

This section presents the peamouth HQs on a sample-by-sample basis (Section 5.1) and over a relevant exposure area for individual prey species and sediment (Section 5.2).

3.4.1 Sample-by-Sample HQs

Five peamouth COPCs were identified through the SLERA: cadmium, copper, mercury, TBT, and total PAHs. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based TTCs and TSCs). Table 3-7 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-7. Number of Peamouth Prey and Sediment Samples with LOAEL HQs > 1.0

	Number of Samples with HQs > 1.0 (Max HQ)						Sum of Tissue and Sediment HQ > 1.0?
COPC	**Clam**	**Lab Clam[a]**	**Lab Worm[a]**	**Epibenthic Inverts**	**Sculpin**	**Sediment**	
Metals							
Cadmium	**4/38 (1.6)**	0/35	**2/35 (1.8)**	0/2	0/38	**1/1,348 (3.5)**	**Yes**
Copper	**34/38**	0/35	**1/35**	0/2	**1/38**	**4/1,358**	**Yes**

Table 3-7. Number of Peamouth Prey and Sediment Samples with LOAEL HQs > 1.0

COPC	Number of Samples with HQs > 1.0 (Max HQ)						Sum of Tissue and Sediment HQ > 1.0?
	Clam	Lab Clam[a]	Lab Worm[a]	Epibenthic Inverts	Sculpin	Sediment	
	(2.0)		**(3.0)**		**(1.1)**	**(4.4)**	
Mercury	0/35	0/35	0/34	NA	0/39	**1/1,345 (3.8)**	**Yes**
Butyltins							
Tributyltin ion	**3/34 (18)**	**2/35 (23)**	**2/35 (58)**	NA	0/12	**6/405 (17)**	**Yes**
PAHs							
Total PAHs	0/39	0/35	0/35	NA	0/38	0/1,406	No

[a] Chemical concentrations of PAHs and butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
NA – not analyzed in sample(s)
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Three COPCs had individual prey samples that resulted in HQs > 1.0: cadmium, copper and TBT.

Total PAHs had no individual prey tissue or sediment samples with concentrations greater than TTCs or TSCs, respectively, so dietary risk from this COPC was found to be negligible, and no additional evaluation of total PAHs was conducted for this BERA. Mercury was not evaluated further because while at least one sediment sample had a mercury concentration greater than the TSC and no prey tissue sample mercury concentrations were greater than the TTC.

3.4.2 HQs Calculated Over Site-Wide Exposure Area

COPCs with individual samples that resulted in HQs > 1.0 (i.e., cadmium and TBT) were further evaluated within a site-wide exposure area. HQs were calculated for all prey species and sediment within the entire Study Area based on UCL concentrations. Where insufficient data were available (i.e., fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations. Site-wide LOAEL HQs are presented in Table 3-8.

Table 3-8. Peamouth Site-Wide Exposure Prey and Sediment LOAEL HQs

	Site-Wide HQ[a]					
COPC	**Clam**	**Lab Clam**	**Lab Worm**	**Sculpin**	**Epibenthic Invertebrates**	**Sediment**
Cadmium	0.71	0.38	0.6	0.079	*0.26*	0.034
Copper	**1.4**	0.6	0.58	0.3	*0.90*	0.11
Tributyltin ion	**4.1**	**5.1**	**12**	*0.14*	NA	0.75

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.

COPC – chemical of potential concern
EPC – exposure point concentration
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
NA – not analyzed in sample(s)
UCL – upper confidence limit on the mean
Bold identifies HQs > 1.0.
Italics identify HQs derived from maximum concentration; UCL concentration could not be derived (n detects < 6).

Site-wide tissue and sediment cadmium concentrations were less than TTC and TSCs, so these COPC are not expected to pose risks to peamouth, and no additional evaluation of these COPCs was conducted for the BERA. LOAEL HQs for copper and TBT were > 1.0 for at least one prey species. Risks to peamouth were calculated for copper and TBT and are presented in the fish risk characterization section of the BERA.

3.5 SCULPIN

This section presents the sculpin HQs on a sample-by-sample basis (Section 6.1) and over a relevant exposure area for individual prey species and sediment (Section 6.2).

3.5.1 Sample-by-Sample HQs

Five sculpin COPCs were identified through the SLERA: cadmium, copper, mercury, TBT, and total PAHs. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based TTCs and TSC). Table 3-9 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-9. Number of Sculpin Prey and Sediment Samples with LOAEL HQs > 1.0

	Number of Samples with HQs > 1.0 (Max HQ)					Sum of Tissue and Sediment HQ > 1.0?
COPC	**Clam**	**Lab Clam[a]**	**Lab Worm[a]**	**Sculpin**	**Sediment**	
Metals						
Cadmium	**7/38 (1.8)**	0/35	**2/35 (2.2)**	0/38	**1/1,348 (4.2)**	**Yes**
Copper	**38/38 (2.4)**	**1/35 (1.1)**	**1/35 (3.6)**	**1/38 (1.3)**	**9/1,358 (5.3)**	**Yes**
Mercury	0/35	0/35	0/34	0/39	**1/1,345 (4.5)**	**Yes**

Table 3-9. Number of Sculpin Prey and Sediment Samples with LOAEL HQs > 1.0

COPC	Number of Samples with HQs > 1.0 (Max HQ)					Sum of Tissue and Sediment HQ > 1.0?
	Clam	Lab Clam[a]	Lab Worm[a]	Sculpin	Sediment	
Butyltins						
Tributyltin ion	**3/34 (21)**	**2/35 (28)**	**2/35 (69)**	0/12	**7/405 (20)**	**Yes**
PAHs						
Total PAHs	0/39	0/35	0/35	0/38	0/1,406	No

[a] Chemical concentrations of PAHs and butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Three COPCs had individual prey samples that resulted in HQs > 1.0: cadmium, copper, and TBT.

Total PAHs had no individual prey tissue or sediment samples with concentrations greater than TTCs or TSCs, respectively, so dietary risk from this COPC was found to be negligible, and no additional evaluation of total PAHs was conducted for this BERA. Mercury was also not evaluated further. One sediment sample had a mercury concentration greater than the TSC; however, no prey tissue sample mercury concentrations were greater than the TTC.

3.5.2 HQs Calculated Over Individual Exposure Areas

Prey and sediment HQs were calculated at all sampling locations representing a small exposure scale for sculpin. HQs at individual sampling locations were calculated for the three COPCs for individual samples that resulted in HQs > 1.0 (cadmium, copper, and TBT). LOAEL HQs at individual sampling locations are presented on Maps 3-1 to 3-3.

Risks to sculpin were calculated for these three COPCs (i.e., cadmium, copper, and TBT) and are presented in the fish risk characterization section of the BERA.

3.6 SMALLMOUTH BASS

This section presents the smallmouth bass HQs on a sample-by-sample basis (Section 7.1) and over a relevant exposure area for individual prey species and sediment (Section 7.2).

3.6.1 Sample-by-Sample HQs

Four smallmouth bass COPCs were identified through the SLERA: cadmium, copper, mercury, and TBT. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based TTCs and TSC). Table 3-10

presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-10. Number of Smallmouth Bass Prey and Sediment Samples with LOAEL HQs > 1.0

COPC	Number of Samples with HQs > 1.0 (Max HQ)				Sum of Tissue and Sediment HQ > 1.0?
	Crayfish	Lab Worm[a]	Sculpin	Sediment	
Metals					
Cadmium	0/32	**2/35 (1.4)**	0/38	0/1,348	**Yes**
Copper	**32/32 (2.3)**	**1/35 (2.3)**	0/38	0/1,358	**Yes**
Mercury	0/32	0/34	0/39	0/1,345	**Yes**
Butyltins					
Tributyltin ion	0/5	**2/35 (45)**	0/12	**2/405 (3.2)**	**Yes**

[a] Chemical concentrations of butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Individual prey samples had HQs > 1.0 for three COPCs: cadmium, copper and TBT.

No individual prey tissue or sediment samples had mercury concentrations greater than TTCs or TSCs,[4] respectively, so dietary risks from these COPCs were found to be negligible, and no additional evaluation of these COPCs was conducted for the BERA.

3.6.2 HQs Calculated Over 1-Mile Exposure Areas

The three COPCs with individual samples that resulted in HQs > 1.0 were further evaluated within 1-mile exposure areas of the Study Area. HQs were calculated for all prey species and sediment within 1-mile exposure areas based on UCL concentrations. Where insufficient data were available (i.e., fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations within a 1-mile exposure area. LOAEL HQs calculated over 1-mile exposure areas are presented in Table 3-11.

[4] The sum of sediment and prey HQs were > 1.0 for mercury; however, these COPCs were not further evaluated. No single individual prey tissue or sediment samples exceeded TTCs or TSCs, respectively, so dietary risks from these COPCs were found to be negligible.

Table 3-11. Smallmouth Bass 1-Mile Exposure Area Prey and Sediment LOAEL HQs

Exposure Area by COPC	HQ[a]			
	Crayfish	Lab Worm	Sculpin	Sediment
Cadmium				
RM 1.5 to RM 2.5	*0.15*	***1.3***	*0.12*	0.011
RM 2.5 to RM 3.5	*0.16*	*0.59*	*0.06*	0.0043
RM 3.5 to RM 4.5	*0.16*	**1.1**	0.077	0.0068
RM 4.5 to RM 5.5	*0.12*	*0.42*	*0.093*	0.0086
RM 5.5 to RM 6.5	*0.2*	*0.32*	*0.038*	0.0035
RM 6.5 to RM 7.5	*0.11*	*0.36*	*0.038*	0.0046
RM 7.5 to RM 8.5	*0.082*	*0.32*	*0.033*	0.0059
RM 8.5 to RM 9.5	*0.071*	*0.3*	*0.049*	0.0064
Swan Island Lagoon	*0.13*	*0.45*	*0.088*	0.025
RM 9.5 to RM 10.5	*0.06*	*0.28*	*0.1*	0.0062
RM 10.5 to RM 11.8	*0.12*	ND	*0.027*	0.0058
Copper				
RM 1.5 to RM 2.5	***1.4***	*0.3*	*0.14*	0.012
RM 2.5 to RM 3.5	***1.9***	*0.34*	*0.16*	0.0091
RM 3.5 to RM 4.5	***1.8***	0.34	0.15	0.013
RM 4.5 to RM 5.5	***1.8***	*0.3*	*0.16*	0.011
RM 5.5 to RM 6.5	***2.1***	*0.4*	*0.4*	0.03
RM 6.5 to RM 7.5	***2.0***	*0.3*	*0.17*	0.021
RM 7.5 to RM 8.5	***1.6***	*0.26*	*0.18*	0.024
RM 8.5 to RM 9.5	***1.9***	*0.3*	*0.3*	0.022
Swan Island Lagoon	***2.0***	***2.3***	*0.16*	0.054
RM 9.5 to RM 10.5	***2.0***	*0.22*	*0.82*	0.021
RM 10.5 to RM 11.8	***2.3***	ND	*0.6*	0.088
Tributyltin ion				
RM 1.5 to RM 2.5	ND	*0.016*[b]	ND	*0.00026*
RM 2.5 to RM 3.5	ND	*0.068*	ND	*0.0012*
RM 3.5 to RM 4.5	ND	*0.52*	*0.024*[b]	0.59
RM 4.5 to RM 5.5	ND	*0.055*	*0.073*	0.0059
RM 5.5 to RM 6.5	*0.06*	*0.071*	*0.06*	0.014
RM 6.5 to RM 7.5	ND	*0.2*[b]	*0.065*	0.024
RM 7.5 to RM 8.5	ND	*0.038*[b]	*0.024*[b]	0.069
RM 8.5 to RM 9.5	*0.015*	*0.19*	*0.024*[b]	0.0026
Swan Island Lagoon	ND	***45***	*0.1*	**1.5**

Table 3-11. Smallmouth Bass 1-Mile Exposure Area Prey and Sediment LOAEL HQs

Exposure Area by COPC	HQ[a]			
	Crayfish	Lab Worm	Sculpin	Sediment
RM 9.5 to RM 10.5	*0.0046*[b]	*0.033*[b]	*0.024*[b]	0.0004
RM 10.5 to RM 11.8	*0.0046*[b]	ND	*0.024*[b]	*0.0004*

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.

[b] Maximum concentration is based on 1/2 DL (where 1/2 DL > maximum detected concentration or where COPC is not detected).

COPC – chemical of potential concern
DL – detection limit
EPC – exposure point concentration
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
ND – no data available
RM – river mile
UCL – upper confidence limit on the mean

Bold identifies HQs > 1.0.

Italics identify HQs derived from maximum concentration; UCL concentration could not be derived (n detects < 6).

LOAEL HQs for cadmium, copper, and TBT were > 1.0 for at least one prey item in at least one 1-mile exposure area. Risks to smallmouth bass were calculated for these three COPCs and are presented in the fish risk characterization section of the BERA.

3.7 NORTHERN PIKEMINNOW

This section presents the northern pikeminnow HQs on a sample-by-sample basis (Section 8.1) and over a relevant exposure area for individual prey species and sediment (Section 8.2).

3.7.1 Sample-by-Sample HQs

Four northern pikeminnow COPCs were identified through the SLERA: cadmium, copper, mercury, and TBT. HQs were calculated for all COPCs in individual prey tissue and sediment samples based on a comparison to LOAEL-based TTCs and TSCs). Table 3-12 presents the number of individual prey tissue and sediment samples with COPC concentrations greater than TTCs and TSCs, respectively.

Table 3-12. Number of Northern Pikeminnow Prey and Sediment Samples with LOAEL HQs > 1.0

COPC	Number of Samples with HQs > 1.0 (Max HQ)								Sum of Tissue and Sediment HQ > 1.0?
	Carp	Cray-fish	Lab Worm[a]	Large-scale Sucker	Northern Pike-minnow	Pea-mouth	Sculpin	Sediment	
Metals									
Cadmium	0/15	0/32	**2/35 (1.4)**	0/6	0/6	0/4	0/38	0/1,348	**Yes**
Copper	0/15	**32/32 (2.3)**	**1/35 (2.3)**	0/6	0/6	0/4	0/38	0/1,358	**Yes**
Mercury	0/15	0/32	0/34	0/6	**3/6 (2.0)**	0/4	0/39	0/1,345	**Yes**

Table 3-12. Number of Northern Pikeminnow Prey and Sediment Samples with LOAEL HQs > 1.0

	Number of Samples with HQs > 1.0 (Max HQ)								Sum of Tissue and Sediment HQ > 1.0?
COPC	**Carp**	**Cray-fish**	**Lab Worm[a]**	**Large-scale Sucker**	**Northern Pike-minnow**	**Pea-mouth**	**Sculpin**	**Sediment**	
Butyltins									
TBT	0/9	0/5	**2/35 (43)**	NA	NA	NA	0/12	**2/405 (3.1)**	**Yes**

[a] Chemical concentrations of butyltins were adjusted to reflect steady-state conditions.
COPC – chemical of potential concern
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
NA – not analyzed in sample(s)
TSC – threshold sediment concentration
TTC – threshold tissue concentration
Bold identifies HQs > 1.0.

Individual prey samples had HQs > 1.0 for all four COPCs: cadmium, copper, mercury, and TBT.

3.7.2 HQs Calculated Over 1-Mile Exposure Areas

The four COPCs with individual samples that resulted in HQs > 1.0 were further evaluated within 1-mile exposure areas of the Study Area. HQs were calculated for all prey species and sediment within 1-mile exposure areas based on UCL concentrations. Where insufficient data were available (i.e., fewer than six detected concentrations), HQs were based on maximum prey species or sediment concentrations within a 1-mile exposure area. LOAEL HQs calculated over 1-mile exposure areas are presented in Table 3-13.

Table 3-13. Northern Pikeminnow 1-Mile Exposure Area Prey and Sediment LOAEL HQs

	HQ[a]							
Exposure Area by COPC	**Carp**	**Cray-fish**	**Lab Worm**	**Large-scale Sucker**	**Northern Pike-minnow**	**Pea-mouth**	**Sculpin**	**Sediment**
Cadmium								
RM 1.5 to RM 2.5	NA	*0.15*	***1.2***	NA	ND	NA	*0.12*	0.011
RM 2.5 to RM 3.5	NA	*0.16*	*0.58*	NA	*0.061*	NA	*0.059*	0.0042
RM 3.5 to RM 4.5	NA	*0.16*	1.0	NA	ND	NA	0.075	0.0065
RM 4.5 to RM 5.5	NA	*0.12*	*0.4*	NA	*0.064*	NA	*0.091*	0.0082
RM 5.5 to RM 6.5	NA	*0.19*	*0.31*	NA	*0.064*	NA	*0.037*	0.0033
RM 6.5 to RM 7.5	NA	*0.11*	*0.35*	NA	*0.043*	NA	*0.037*	0.0045
RM 7.5 to RM 8.5	NA	*0.08*	*0.31*	NA	*0.037*	NA	*0.032*	0.0057
RM 8.5 to RM 9.5	NA	*0.07*	*0.29*	NA	*0.037*	NA	*0.048*	0.0061
Swan Island Lagoon	NA	*0.12*	*0.43*	NA	*0.048*	NA	*0.086*	0.024
RM 9.5 to RM 10.5	NA	*0.059*	*0.27*	NA	ND	NA	*0.1*	0.006
RM 10.5 to RM 11.8	NA	*0.12*	ND	NA	ND	NA	*0.027*	0.0056

Table 3-13. Northern Pikeminnow 1-Mile Exposure Area Prey and Sediment LOAEL HQs

Exposure Area by COPC	HQ[a]							
	Carp	Cray-fish	Lab Worm	Large-scale Sucker	Northern Pike-minnow	Pea-mouth	Sculpin	Sediment
Site-wide[b]	0.37	NA	NA	0.14	ND	*0.28*	NA	NA
Copper								
RM 1.5 to RM 2.5	NA	***1.4***	*0.29*	NA	ND	NA	*0.13*	0.012
RM 2.5 to RM 3.5	NA	***1.9***	*0.33*	NA	*0.067*	NA	*0.15*	0.0087
RM 3.5 to RM 4.5	NA	***1.8***	0.33	NA	ND	NA	0.14	0.012
RM 4.5 to RM 5.5	NA	***1.7***	*0.29*	NA	*0.067*	NA	*0.16*	0.01
RM 5.5 to RM 6.5	NA	***2.0***	*0.39*	NA	*0.067*	NA	*0.39*	0.029
RM 6.5 to RM 7.5	NA	***2.0***	*0.29*	NA	*0.065*	NA	*0.17*	0.021
RM 7.5 to RM 8.5	NA	***1.5***	*0.26*	NA	*0.099*	NA	*0.17*	0.023
RM 8.5 to RM 9.5	NA	***1.8***	*0.3*	NA	*0.099*	NA	*0.29*	0.021
Swan Island Lagoon	NA	***2.0***	***2.3***	NA	*0.08*	NA	*0.15*	0.052
RM 9.5 to RM 10.5	NA	***1.9***	*0.22*	NA	ND	NA	*0.8*	0.021
RM 10.5 to RM 11.8	NA	***2.3***	ND	NA	ND	NA	*0.59*	0.084
Site-wide	0.13	NA	NA	0.11	ND	0.18	NA	NA
Mercury								
RM 1.5 to RM 2.5	NA	*0.099*	*0.033*	NA	ND	NA	*0.29*	0.00087
RM 2.5 to RM 3.5	NA	*0.12*	*0.019*	NA	*0.71*	NA	*0.19*	0.00075
RM 3.5 to RM 4.5	NA	*0.12*	0.021	NA	ND	NA	0.17	0.00085
RM 4.5 to RM 5.5	NA	*0.15*	*0.034*	NA	***1.3***	NA	*0.21*	0.00085
RM 5.5 to RM 6.5	NA	*0.17*	*0.03*	NA	***1.3***	NA	*0.25*	0.002
RM 6.5 to RM 7.5	NA	*0.15*	*0.043*	NA	***2.0***	NA	*0.52*	0.013
RM 7.5 to RM 8.5	NA	*0.14*	*0.016*	NA	***1.6***	NA	*0.46*	0.0011
RM 8.5 to RM 9.5	NA	*0.099*	*0.041*	NA	***1.6***	NA	*0.35*	0.0015
Swan Island Lagoon	NA	*0.095*	*0.017*	NA	*0.63*	NA	*0.27*	0.0015
RM 9.5 to RM 10.5	NA	*0.14*	*0.037*	NA	ND	NA	*0.33*	0.0009
RM 10.5 to RM 11.8	NA	*0.097*	ND	NA	ND	NA	*0.22*	0.0017
Site-wide[b]	0.2	NA	NA	0.33	NA	*0.22*	NA	NA
TBT								
RM 1.5 to RM 2.5	NA	ND	*0.015*[c]	NA	ND	NA	ND	*0.00025*
RM 2.5 to RM 3.5	NA	ND	*0.066*	NA	ND	NA	ND	*0.0012*
RM 3.5 to RM 4.5	NA	ND	*0.51*	NA	ND	NA	*0.023*[c]	0.56
RM 4.5 to RM 5.5	NA	ND	*0.054*	NA	ND	NA	*0.071*	0.0057
RM 5.5 to RM 6.5	NA	*0.059*	*0.069*	NA	ND	NA	*0.059*	0.013
RM 6.5 to RM 7.5	NA	ND	*0.19*[c]	NA	ND	NA	*0.064*	0.023
RM 7.5 to RM 8.5	NA	ND	*0.037*[c]	NA	ND	NA	*0.023*[c]	0.066
RM 8.5 to RM 9.5	NA	*0.014*	*0.19*	NA	ND	NA	*0.023*[c]	0.0025
Swan Island Lagoon	NA	ND	***43***	NA	ND	NA	*0.1*	**1.5**

Table 3-13. Northern Pikeminnow 1-Mile Exposure Area Prey and Sediment LOAEL HQs

Exposure Area by COPC	HQ[a]							
	Carp	Cray-fish	Lab Worm	Large-scale Sucker	Northern Pike-minnow	Pea-mouth	Sculpin	Sediment
RM 9.5 to RM 10.5	NA	*0.0045*[c]	*0.032*[c]	NA	ND	NA	*0.023*[c]	0.00038
RM 10.5 to RM 11.8	NA	*0.0045*[c]	ND	NA	ND	NA	*0.023*[c]	*0.00038*
Site-wide[b]	0.18	NA	NA	ND	NA	ND	NA	NA

[a] HQs derived using EPCs based on UCLs. Maximum concentrations were used to represent EPCs where insufficient data (< 6 detected concentration values) were available and are noted.

[b] HQs for large-home-ranging fish based on site-wide UCL (or maximum) concentrations.

[c] Maximum concentration is based on 1/2 DL (where 1/2 DL > maximum detected concentration or where COPC is not detected)

COPC – chemical of potential concern
DL – detection limit
EPC – exposure point concentration
HQ – hazard quotient
LOAEL – lowest-observed-adverse-effect level
PAH – polycyclic aromatic hydrocarbon
NA – not applicable
ND – no data available
RM – river mile
UCL – upper confidence limit on the mean

Bold identifies HQs > 1.0.

Italics identify HQs derived from maximum concentration; UCL concentration could not be derived (n detects < 6).

LOAEL HQs for cadmium, copper, mercury, and TBT were > 1.0 for at least one prey species in at least one exposure area. Risks to northern pikeminnow for these four COPCs were calculated and are presented in the fish risk characterization section of the BERA.

3.8 SUMMARY OF COPCS RETAINED FOR FURTHER EVALUATION

Prey COPC concentrations with HQs > 1.0 in at least one exposure area were further evaluated in the fish risk characterization section of the BERA (Table 3-14). HQs for these COPCs were calculated based on a multi-species diet within relevant exposure areas. Risk characterization and risk conclusions for fish are presented in the BERA.

Table 3-14. COPCs Further Evaluated in the Fish Risk Characterization

COPC	Large-scale Sucker	Juvenile White Sturgeon	Juvenile Chinook Salmon	Peamouth	Sculpin	Small-mouth Bass	Northern Pike-minnow
Metals							
Cadmium			X		X	X	X
Copper			X	X	X	X	X
Mercury							X
Butyltins							
TBT	X	X	X	X	X	X	X

COPC – chemical of potential concern
TBT – tributyltin

4.0 REFERENCES

EPA. 2008. Problem formulation for the Baseline Ecological Risk Assessment at the Portland Harbor Site. Report and letter dated February 15, 2008 to Lower Willamette Group (from E. Blischke and C. Humphrey to J. McKenna and R. Wyatt). US Environmental Protection Agency Region 10, Oregon Operations Office, Portland, OR.