APPENDIX A. RELEVANT ROD TABLES AND FIGURES

Table 4. Summary of PCB, Arsenic, cPAH, and Dioxin/Furan Data for Natural Background Concentrations in Fish and Shellfish Tissue

Species	Natural Background Fish and Shellfish Tissue Data			
	Detected Samples / Total Samples	Range of Detected Concentra-tions	Mean	95th Percentile Upper Confidence Limit on the Mean (UCL95)
PCBs (µg/kg ww)				
English sole, rock sole (fillet)	158 / 238	1.3 – 75.4	11	12
Dungeness crab (edible meat)	17 / 17	0.43 – 1.9	0.87	1.1
Dungeness crab (whole body)	15 / 15	3.0 – 16	7.1	9.1
Butter clam, geoduck, horse clam, littleneck clam (whole body)	24 / 70	0.09 – 1.4	0.3	0.42
Inorganic arsenic (mg/kg ww)				
Eastern softshell clams (whole body)[a,b]	6 / 0	0.047 / 0.112	0.064	0.09
cPAH TEQ (µg/kg ww)				
Butter clam, geoduck, littleneck clam (whole body)[a]	3 / 11	0.069 – 0.17	0.088	0.12
Dioxin/furan TEQ (ng/kg ww)				
Starry flounder, rock sole (whole body)[c]	7 / 7	0.17 – 0.92	0.28	0.35
Dungeness crab (edible meat)	27 / 27	0.027 – 1.4	0.57	0.53
Dungeness crab (whole body)	25 / 25	0.089 – 5.1	0.81	2.0
Butter clam, geoduck, horse clam, littleneck clam (whole body)	43 / 43	0.011 – 1.6	0.34[d]	0.71

a. Only clams are shown for inorganic arsenic and cPAH TEQ because most of the risk associated with these COCs was due to consumption of clams.

b. Only clams collected from Dungeness Spit were selected by EPA for this category, as these were the only ones in the dataset likely unaffected by the atmospheric deposition of arsenic from the former Tacoma ASARCO smelter.

c. There were insufficient data to derive a background value for pelagic fish (e.g., perch) for total PCBs, cPAHs, and dioxins/furans; there were insufficient data for benthic fish (e.g., English sole) fillets for dioxins/furans.

d. This is a nonparametric mean, as there was no discernible distribution according to ProUCL v. 4.1.

Table 14. Summary of COPCs and Rationale for Selection as COCs for Human Health Exposure Scenarios

COPC	COC?	Maximum RME Risk Estimate	Rationale for Selection or Exclusion as COC
Seafood Consumption Scenarios			
PCBs	Yes	2×10^{-3}	Risk magnitude, high percent contribution to the cumulative excess cancer risk (58%), and high detection frequency in tissue samples (97%).
Inorganic arsenic	Yes	2×10^{-3}	Risk magnitude, percent contribution to the cumulative excess cancer risk (29%), and high detection frequency in tissue samples (100%).
cPAHs	Yes	8×10^{-5}	Risk magnitude and high detection frequency in tissue samples (72%).
Dioxins/furans	Yes	nd	No dioxin/furan tissue data were available. However, because excess cancer risks were assumed to be unacceptably high, dioxins/furans were identified as a COC.
Bis(2-ethylhexyl) phthalate	No	6×10^{-6}	Low percent contribution to the cumulative excess cancer risk (less than or equal to 3%) and rarely detected in tissue samples (particularly when samples were re-analyzed to evaluate the effect on RLs of analytical dilutions in the initial analysis).
Pentachlorophenol	No	9×10^{-5}	
Tributyltin	No	HQ = 3	HQs for these metals were only slightly greater than 1 and were driven by the child tribal RME seafood consumption scenario, for which Ingestion rates are uncertain.
Vanadium	No	HQ = 2	
Aldrin	No	5×10^{-5}	All organochlorine pesticides were low contributors to the cumulative excess cancer risk (less than or equal to 3% of the cumulative risk). In addition, because of analytical interference of these contaminants with PCBs, much of the tissue data for these contaminants were qualified JN, which indicates the presence of an analyte that has been ‘tentatively identified,’ and the associated numerical value represents its approximate concentration. The JN-qualified organochlorine pesticide results are highly uncertain and likely biased high.
alpha-BHC	No	2×10^{-5}	
beta-BHC	No	6×10^{-6}	
Carbazole	No	4×10^{-5}	
Total Chlordane	No	6×10^{-6}	
Total DDTs	No	2×10^{-5}	
Dieldrin	No	1×10^{-4}	
gamma-BHC	No	5×10^{-6}	
Heptachlor	No	1×10^{-5}	
Heptachlor epoxide	No	3×10^{-5}	
Hexachlorobenzene	No	1×10^{-5}	
Direct Sediment Exposure Scenarios			
PCBs	Yes	8×10^{-6}	Lower risk magnitude and percent contribution to cumulative excess cancer risk than the other sediment risk drivers, but selected because of importance in the seafood consumption scenarios.
Inorganic arsenic	Yes	2×10^{-5}	Risk magnitude, percent contribution to cumulative excess cancer risk (14 to 19%), and high detection frequency in surface sediment samples (92%).
cPAHs	Yes	4×10^{-5}	Risk magnitude, percent contribution to cumulative excess cancer risk (3 to 85%), and high detection frequency in surface sediment samples (94%).
Dioxins/furans	Yes	1×10^{-4}	Risk magnitude, percent contribution to cumulative excess cancer risk (35 to 72%), and high detection frequency in surface sediment samples (100%).
Toxaphene	No	6×10^{-6}	Low percent contribution to cumulative excess cancer risk (6% or less) and low detection frequency in surface sediment samples (1%).

Notes:

BHC = benzene hexachloride.

Except for TBT and Vanadium, the maximum RME risk estimates shown are excess cancer risks for the adult Tribal RME seafood consumption based upon Tulalip tribal data. Only RME scenarios were used to designate COCs. The highest risk estimate for any of the RME scenarios is shown in this table (adult tribal RME based on Tulalip data for seafood consumption, and various scenarios for direct contact). Note that the estimates reported here differ slightly from those reported in Appendix B (the HHRA) and Section 6 of the RI (LDWG 2010), based on a 2009 erratum (LDWG 2009) that adjusted the proportion of crabs and clams consumed by the Tulalip Tribe.

Table 18. Rationale for Selection of Contaminants as COCs for Ecological Risk

COPC	ROC	Maximum NOAEL-Based HQ	Maximum LOAEL-Based HQ	Additional Considerations	COC?
Total PCBs	crabs	10	1.0	Uncertainty in exposure data: whole-body concentrations were estimated Uncertainty in effects data: LOAEL-based HQ was based on a study with Aroclor 1016 and grass shrimp, and NOAEL was estimated using an uncertainty factor; selection of next higher TRV would result in LOAEL-based HQ < 1.0	no
	river otter	5.8	2.9	Uncertainty in exposure data: low uncertainty in diet assumptions and home range Uncertainty in effects data: low uncertainty in TRV (growth endpoint in kits)	yes
	English sole	4.9 – 25[a]	0.98 – 5.0[a]	Uncertainty in exposure data: low uncertainty in tissue concentrations Uncertainty in effects data: high uncertainty in lowest LOAEL TRV because of uncertain statistical significance of the fecundity endpoint for the low dose, a lack of dose-response in the fecundity endpoint, uncertain number of fish used in the experiment, and uncertainties associated with fish handling and maintenance protocols	no
	Pacific staghorn sculpin	3.8 – 19[a]	0.76 - 3.8[a]	Same considerations as listed above for English sole	no
PCB TEQ[b]	spotted sandpiper –Area 2 (high-quality foraging habitat)	15	1.5	Uncertainty in exposure data: low uncertainty in diet assumptions and home range Uncertainty in effects data: high uncertainty in TRV, which was based on study of reproduction with weekly IP injection; high uncertainty in TEFs; effects data for total PCBs are less uncertain than for PCB TEQs and the LOAEL-based HQ for total PCBs was < 1.0	no
Cadmium	juvenile chinook salmon	5.0	1.0	Uncertainty in exposure data: LOAEL-based HQ < 1.0 if empirical juvenile chinook salmon stomach contents data from the LDW are used to estimate exposure, instead of estimating exposure based on ingestion of benthic invertebrates Uncertainty in effects data: high uncertainty in the lowest TRV because selection of next higher TRV would result in LOAEL-based HQ < 1.0, all salmonid-specific studies for cadmium with NOAELs result in NOAEL-based HQs less than 0.01	no
	English sole	6.1	1.2	Uncertainty in exposure data: low uncertainty (LDW-collected benthic invertebrate tissue samples) Uncertainty in effects data: high uncertainty in the lowest TRV because selection of next higher TRV would result in LOAEL-based HQ < 1.0; all other NOAELs and LOAELs were orders of magnitude higher than the selected LOAEL	no
	Pacific staghorn sculpin	5.2	1.0	Uncertainty in exposure data: low uncertainty (LDW-collected shiner surfperch and benthic invertebrate tissue samples) Uncertainty in effects data: high uncertainty in the lowest TRV because selection of next higher TRV would result in LOAEL-based HQ < 1.0; all other NOAELs and LOAELs were orders of magnitude higher than the selected LOAEL	no

COPC	ROC	Maximum NOAEL-Based HQ	Maximum LOAEL-Based HQ	Additional Considerations	COC?
Chromium	spotted sandpiper –Area 2 (high- and poor-quality foraging habitat)	8.8	1.8	Uncertainty in exposure data: high uncertainty because LOAEL-based HQ would be less than 1.0 if the single anomalously high benthic invertebrate tissue sample from RM 3.0 west was excluded; chromium concentrations in sediment were low in this area Uncertainty in effects data: high uncertainty; only one study with reported effects, and study was unpublished and could not be obtained for review	no
Copper	spotted sandpiper –Area 3 (high- and poor-quality foraging habitat)	1.5	1.1	Uncertainty in exposure data: low uncertainty Comparison to natural background: concentration in sediment (Surface Weighted Average Concentration of 57 mg/kg dw) from Area 3 (high- and poor-quality foraging habitat) similar to PSAMP rural Puget Sound concentrations (50 mg/kg dw [90th percentile]) Residual risk: following planned sediment remediation within early action areas, LOAEL-based HQ would be < 1.0	no
Lead	spotted sandpiper –Area 2 (high- and poor-quality foraging habitat)	19	5.5	Uncertainty in exposure data: high uncertainty because LOAEL-based HQ would be less than 1.0 if the single anomalously high benthic invertebrate tissue sample from RM 3.0 west was excluded; lead concentrations in sediment were low in this area Uncertainty in effects data: low uncertainty (reproductive endpoint)	no
	spotted sandpiper –Area 3 (high- and poor-quality foraging habitat)	5.0	1.5	Uncertainty in exposure data: low uncertainty Uncertainty in effects data: low uncertainty (reproductive endpoint) Residual risk: following planned sediment remediation within early action area, LOAEL-based HQ would be < 1.0	
Mercury	spotted sandpiper –Area 3 (high-quality foraging habitat)	5.3	1.0	Uncertainty in exposure data: low uncertainty Uncertainty in effects data: low uncertainty (TRV was based on a growth endpoint) Residual risk: following planned sediment remediation within early action area, LOAEL-based HQ would be < 1.0	no
Vanadium	English sole	5.9	1.2	Uncertainty in exposure data: low uncertainty Uncertainty in effects data: high uncertainty in TRV because only one study was available Comparison to natural background: exposure concentration in LDW sediment (SWAC of 58 mg/kg dw) was less than PSAMP rural Puget Sound concentration (64 mg/kg dw [90th percentile])	no
	Pacific staghorn sculpin	3.2 – 5.9	0.65 – 1.2	Same considerations as listed for English sole above	no
	spotted sandpiper – all exposure areas	2.0 – 2.7	1.0 – 1.4	Uncertainty in exposure data: low uncertainty Uncertainty in effects data: TRV was based on a 4-week growth endpoint, with uncertainty (two available studies: one with reduced body weight in chickens after 4 weeks and the other with no effect on body weight in mallards after 10 weeks) Comparison to natural background: mean exposure concentrations in sandpiper exposure areas ranged from 49 to 57 mg/kg dw, compared to Puget Sound Ambient Monitoring Program rural Puget Sound background concentration of 64 mg/kg dw (90th percentile)	no
41 SMS contaminants[c]	benthic invertebrates	range of values	range of values	Each of these 41 contaminants had at least one detected exceedance of benthic SCO in baseline surface sediment dataset	yes

COPC	ROC	Maximum NOAEL-Based HQ	Maximum LOAEL-Based HQ	Additional Considerations	COC?
Nickel	benthic invertebrates	6.6	2.5	Uncertainty in exposure data: low uncertainty Uncertainty in effects data: medium uncertainty in the TRV (i.e., the ML) because only no-effects data (amphipod mortality and community abundance Apparent Effects Thresholds) were available; no information was available regarding concentrations associated with adverse effects Residual risk: ML was exceeded at four locations in LDW – all within early action areas with planned sediment remediation	no
Total DDTs	benthic invertebrates	5.1	2.7	Uncertainty in exposure data: medium uncertainty (i.e., likely interference in pesticide analyses from PCBs) Uncertainty in effects data: medium uncertainty; based on a single study with spiked sediment Residual risk: LOAEL was exceeded at only one location in LDW, location is within early action area with planned sediment remediation	no
Total chlordane	benthic invertebrates	82	48	Uncertainty in exposure data: highly uncertain because all total chlordane concentrations in samples from Phase 2 locations were JN-qualified as a result of probable PCB interference; except one location at RM 2.2, all locations with detected total chlordane concentrations co-occurred with elevated PCB concentrations Uncertainty in effects data: TRV is highly uncertain because it was based on a general Canadian sediment guideline (PEL); this guideline is based mainly on field-collected data with complex mixtures of contaminants Residual risk: LOAEL was exceeded at 14 locations in LDW; all but one of these locations are associated with an early action area with planned sediment remediation	no

Note: HQs for fish are the highest HQs in cases where more than one approach was used.

a. LOAEL-based HQs were calculated from a range of effects concentrations reported in Hugla and Thome (1999) because of uncertainty in the LOAEL. The NOAEL TRV range was estimated by dividing the LOAEL TRV range by an uncertainty factor of 5. Ranges reported for Pacific staghorn sculpin also included the range in exposure estimates for areas smaller than the entire LDW.

b. Risk estimates based on TEQs were calculated using only tissue data for dioxin-like PCB congeners because dioxin and furan tissue data were not available. Thus, risks associated with exposure to all dioxin-like contaminants were likely underestimated; the degree of underestimation is uncertain.

c. Arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo (a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3,-c,d)pyrene, naphthalene, phenanthrene, pyrene, total benzofluoranthenes, HPAH, LPAH, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, dimethyl phthalate, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, 2-methylnaphthalene, 4-methylphenol, 2,4-dimethylphenol, benzoic acid, benzyl alcohol, dibenzofuran, hexachlorobenzene, n-nitrosodiphenylamine, pentachlorophenol, phenol, total PCBs.

NOTE: arsenic and total PCBs are also human health contaminants of concern.

Table 19. Cleanup Levels for PCBs, Arsenic, cPAHs, and Dioxins/Furans in Sediment for Human Health and Ecological COCs (RAOs 1, 2 and 4)

COC	Cleanup Levels				Application Area and Depth		
	RAO 1: Human Seafood Consumption	RAO 2: Human Direct Contact	RAO 4: Ecological (River Otter)	Basis for Cleanup Levels[a]	Spatial Scale of Application[b]	Spatial Compliance Measure[e]	Compliance Depth[b]
PCBs (µg/kg dw)	**2**	1,300	128	background (RAO 1) RBTC (RAO 2) RBTC (RAO 4)	LDW-wide	UCL95	0 – 10 cm
	NA	500	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	1,700	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm
Arsenic (mg/kg dw)	NA	7	NA	background	LDW-wide	UCL95	0 – 10 cm
	NA	7	NA	background	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	7	NA	background	Individual Beaches[d]	UCL95	0 – 45 cm
cPAH (µg TEQ/kg dw)	NA	380	NA	RBTC	LDW-wide	UCL95	0 – 10 cm
	NA	150	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	90	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm
Dioxins/Furans (ng TEQ/kg dw)	**2**	37	NA	background (RAO 1) RBTC (RAO 2)	LDW-wide	UCL95	0 – 10 cm
	NA	13	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	28	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm

NOTE: where there are multiple cleanup levels for a cleanup area, the lowest cleanup level is shown in bold.

a. Background – see Table 3 and Section 5.3.4.1; RBTC – Risk-based threshold concentration (based on 1 in 1,000,000 excess cancer risk or HQ of 1)

b. In intertidal areas including beaches used for recreation and clamming, human-health direct contact cleanup levels (for PCBs, arsenic, cPAHs, and dioxins/furans) must be met in the top 45 cm because in intertidal areas exposure to sediments at depth is more likely through digging or other disturbances. Human health cleanup levels for RAO 1 (seafood consumption) and ecological cleanup levels must be met in surface sediments (top 10 cm). In subtidal areas, cleanup levels for all COCs must be met in surface sediments (top 10 cm).

c. Clamming areas are identified in Figure 6.

d. Beach play areas are identified in Figure 6.

e. The UCL 95 is the upper confidence limit on the mean. The determination of compliance with RAOs 1, 2 and 4 cleanup levels will be made by one of two methods: 1) comparison of the UCL 95 of LDW data with the RBTC or background-based cleanup level, or 2) for background-based cleanup levels, a statistical comparison of the distribution of LDW data to the OSV BOLD study background dataset (USACE et al. 2009) may be used. In either case, testing will use an alpha level of 0.05 and a beta level of 0.10. For details, see ProUCL technical manual (EPA 2013b) or most current version). For either method, a sufficient number of samples must be collected to assure statistical power for the test.

Table 20. Sediment Cleanup Levels for Ecological (Benthic Invertebrate) COCs for RAO 3[a]

Benthic COC	Cleanup Level for RAO 3[a]	Benthic COC	Cleanup Level for RAO 3[a]
Metals, (mg/kg dw)[c]		***OC-normalized Organic Compounds (continued) (mg/kg OC)***	
Arsenic	57	Total PCBs	12
Cadmium	5.1	Benzo(g,h,i)perylene	31
Chromium	260	Chrysene	110
Copper	390	Dibenz(a,h)anthracene	12
Lead	450	Indeno(1,2,3-cd)pyrene	34
Mercury	0.41	Fluoranthene	160
Silver	6.1	Fluorene	23
Zinc	410	Naphthalene	99
Dry Weight Basis Organic Compounds, (µg/kg dw)		Phenanthrene	100
4-methylphenol	670	Pyrene	1,000
2,4-dimethylphenol	29	HPAH	960
Benzoic acid	650	LPAH	370
Benzyl alcohol	57	Bis(2-ethylhexyl)phthalate	47
Pentachlorophenol	360	Butyl benzyl phthalate	4.9
Phenol	420	Dimethyl phthalate	53
		1,2-dichlorobenzene	2.3
OC-normalized Organic Compounds, (mg/kg OC)[b]		1,4-dichlorobenzene	3.1
Acenaphthene	16	1,2,4-trichlorobenzene	0.81
Anthracene	220	2-methylnaphthalene	38
Benzo(a)pyrene	99	Dibenzofuran	15
Benz(a)anthracene	110	Hexachlorobenzene	0.38
Total benzofluoranthenes	230	n-Nitrosodiphenylamine	11

a. Cleanup Levels for RAO 3 are based on the benthic SCO chemical criteria in the SMS (WAC 173-204-562). Benthic SCO biological criteria (WAC 173-204-562, Table IV) may be used to override benthic SCO chemical criteria where human health-based RALs are not also exceeded.

b. PCBs and arsenic are also human health COCs; see Table 19.

Table 21. LDW Resident Fish and Shellfish Target Tissue Concentrations

Species Group and Tissue Type	Species[a,b,]	Target Concentration	Source of Target Concentration [c]
PCBs (µg/kg ww)			
Benthic fish, fillet	English sole	12	Non-urban background
Pelagic fish, whole body	Perch	1.8	Species-specific RBTC[d]
Crab, edible meat	Dungeness crab	1.1	Non-urban background
Crab, whole body	Dungeness crab	9.1	Non-urban background
Clams	Eastern softshell clam	0.42	Non-urban background
Inorganic arsenic (mg/kg ww)			
Clams[e]	Eastern softshell clam	0.09	Non-urban background
cPAH TEQ (µg/kg ww)			
Clams[e]	Eastern softshell clam	0.24	Species-specific RBTC[d]
Dioxin/furan TEQ (ng/kg ww)			
Benthic fish, whole body	English sole	0.35	Non-urban background
Crab, edible meat	Dungeness crab	0.53	Non-urban background
Crab, whole body	Dungeness crab	2.0	Non-urban background
Clams	Eastern softshell clam	0.71	Non-urban background

a Substitutions of similar species may be made if sufficient numbers of the species listed here are not available.

b. For non-urban background statistics, see also Table 4. Non-urban background is based on UCL95.

c. The statistic used to compare site data to target tissue concentrations will be based on the UCL95 for each compound listed for fish and crabs collected throughout the waterway; and each compound for clams collected across all clamming areas in the waterway.

d. Species-specific RBTCs were used to determine target concentration when RBTCs exceed background, or background data were not available.

e. Only clam tissue values are shown for inorganic arsenic and cPAH TEQ because most of the risk associated with these COCs was associated with consumption of clams.

Table 27. Selected Remedy RAO 3 RALs

SMS Contaminant of Concern for RAO 3	RAL for Recovery Category 1 Areas[a] (Benthic SCO)	RAL for Recovery Category 2 & 3 Areas (2 x Benthic SCO)[b]
Metals (mg/kg dw)		
Arsenic	57	n/a
Cadmium	5.1	10.2
Chromium	260	520
Copper	390	780
Lead	450	900
Mercury	0.41	0.82
Silver	6.1	12.2
Zinc	410	820
PAHs (mg/kg OC)		
2-Methylnaphthalene	38	76
Acenaphthene	16	32
Anthracene	220	440
Benzo(a)anthracene	110	220
Benzo(a)pyrene	99	198
Benzo(g,h,i)perylene	31	62
Total benzofluoranthenes	230	4650
Chrysene	110	220
Dibenzo(a,h)anthracene	12	24
Dibenzofuran	15	30
Fluoranthene	160	320
Fluorene	23	46
Indeno(1,2,3-cd)pyrene	34	68
Naphthalene	99	198
Phenanthrene	100	200
Pyrene	1,000	2,000
Total HPAHs	960	1,920
Total LPAHs	370	740

SMS Contaminant of Concern for RAO 3	RAL for Recovery Category 1 Areas[a] (Benthic SCO)	RAL for Recovery Category 2 & 3 Areas (2 x Benthic SCO)[b]
Phthalates (mg/kg OC)		
Bis(2-ethylhexyl)phthalate	47	94
Butyl benzyl phthalate	4.9	9.8
Dimethyl phthalate	53	106
Chlorobenzenes (mg/kg OC)		
1,2,4-Trichlorobenzene	0.81	1.62
1,2-Dichlorobenzene	2.3	4.6
1,4-Dichlorobenzene	3.1	6.2
Hexachlorobenzene	0.38	0.76
Other SVOCs and COCs, (µg/kg dw except as shown)		
2,4-Dimethylphenol	29	58
4-Methylphenol	670	1,340
Benzoic acid	650	1,300
Benzyl alcohol	57	114
n-Nitrosodiphenylamine, mg/kg OC	11	22
Pentachlorophenol	360	720
Phenol	420	840
PCBs (mg/kg OC)		
Total PCBs	12	n/a

Notes:

General:

- PCBs and arsenic are also human health COCs (see Table 28 for RALs for human health COCs), and RALs for the the human health category take precedence over RAO 3 RALs. The surface sediment (10 cm) Recovery Category 1 RALs for PCBs and arsenic are the same for human health and benthic invertebrates, but the 2 X SCO Recovery Category 2 and 3 criteria are not applicable to PCBs and arsenic. Figure 22 and Figure 23 list all RALs for human health COCs.
- Table 23 describes Recovery Categories and Figure 12 shows Recovery Category areas.

a. The RAL applies to the 10 cm and 45 cm depth intervals for intertidal areas and to the 10 cm and 60 cm depth intervals for subtidal areas. See Figure 22 and Figure 23 .

b. For Recovery Category 2 and 3 areas, the RAL applies to the 10 cm depth interval. See Figure 22 and Figure 23.

Table 28. Remedial Action Levels, ENR Upper Limits, and Areas and Depths of Application

			Intertidal Sediments (+11.3 ft MLLW to -4 ft MLLW)				Subtidal Sediments (-4 ft MLLW and Deeper)				
			Recovery Category 1 RALs, ENR ULs, and Application Depths		Recovery Category 2 and 3 RALs, ENR ULs, and Application Depths		Recovery Category 1 RALs, ENR ULs, and Application Depths		Recovery Category 2 and 3 RALs, ENR ULs, and Application Depths		Shoaled Areas[b] in Federal Navigation Channel
Risk Driver COC	**Units**	**Action Levels**	Top 10 cm (4 in)	Top 45 cm (1.5 ft)	Top 10 cm (4 in)	Top 45 cm (1.5 ft)	Top 10 cm (4 in)	Top 60 cm (2 ft)	Top 10 cm (4 in)	Top 60 cm (2 ft)[c]	Top to Authorized Navigation Depth Plus 2 ft
Human Health Based RALs											
PCBs (Total)	mg/kg OC	RAL	12	12	12	65	12	12	12	195	12
		UL[a] for ENR	--	--	36	97	--	--	36	195	--
Arsenic (Total)	mg/kg dw	RAL	57	28	57	28	57	57	57	--	57
		UL[a] for ENR	--	--	171	42	--	--	171	--	--
cPAH	µg TEQ/kg dw	RAL	1000	900	1000	900	1000	1000	1000	--	1000
		UL[a] for ENR	--	--	3000	1350	--	--	3000	--	--
Dioxins/Furans	ng TEQ/kg dw	RAL	25	28	25	28	25	25	25	--	25
		UL[a] for ENR	--	--	75	42	--	--	75	--	--
Benthic Protection RALs											
39 SMS COCs [d]	Contaminant-specific	RAL	Benthic SCO	Benthic SCO	2x Benthic SCO	--	Benthic SCO	Benthic SCO	2x Benthic SCO	--	Benthic SCO
		UL[a] for ENR	--	--	3x RAL	--	--	--	3x RAL	--	--

a. The ENR Upper Limit (UL) is the highest concentration that would allow for application of ENR in the areas described. For areas with no ENR limit listed, ENR is not a currently designated technology (see Section 13.2.1.2 for further discussion).

b. Shoaled areas are those areas in federal navigation channel with sediment accumulation above the authorized depth including a 2 ft over-dredge depth that USACE uses to maintain the channel for navigation purposes. The authorized channel depths are (1) from RM 0 to 2 (from Harbor Island to the First Avenue South Bridge), 30 ft below MLLW; (2) from RM 2 to RM 2.8 (from the First Avenue South Bridge to Slip 4), 20 ft below MLLW; and (3) from RM 2.8 to 4.7 (Slip 4 to the Upper Turning Basin), 15 ft below MLLW. For shoaled areas, the compliance intervals will be determined during Remedial Design; these are typically 2-4 ft core intervals. For areas in the channel that are not shoaled, Recovery Categories 1 or 2 & 3 RALs apply as indicated in the other subtidal columns.

c. Applied only in potential vessel scour areas. These are defined as subtidal areas (i.e., below -4 ft MLLW) that are above -24 ft MLLW north of the 1st Ave South Bridge, and above -18 ft MLLW south of the 1st Ave South Bridge (see Figure 17).

d. There are 41 SMS COCs, but total PCBs and arsenic ENR ULs are based upon human health based RALs only (see Table 20).

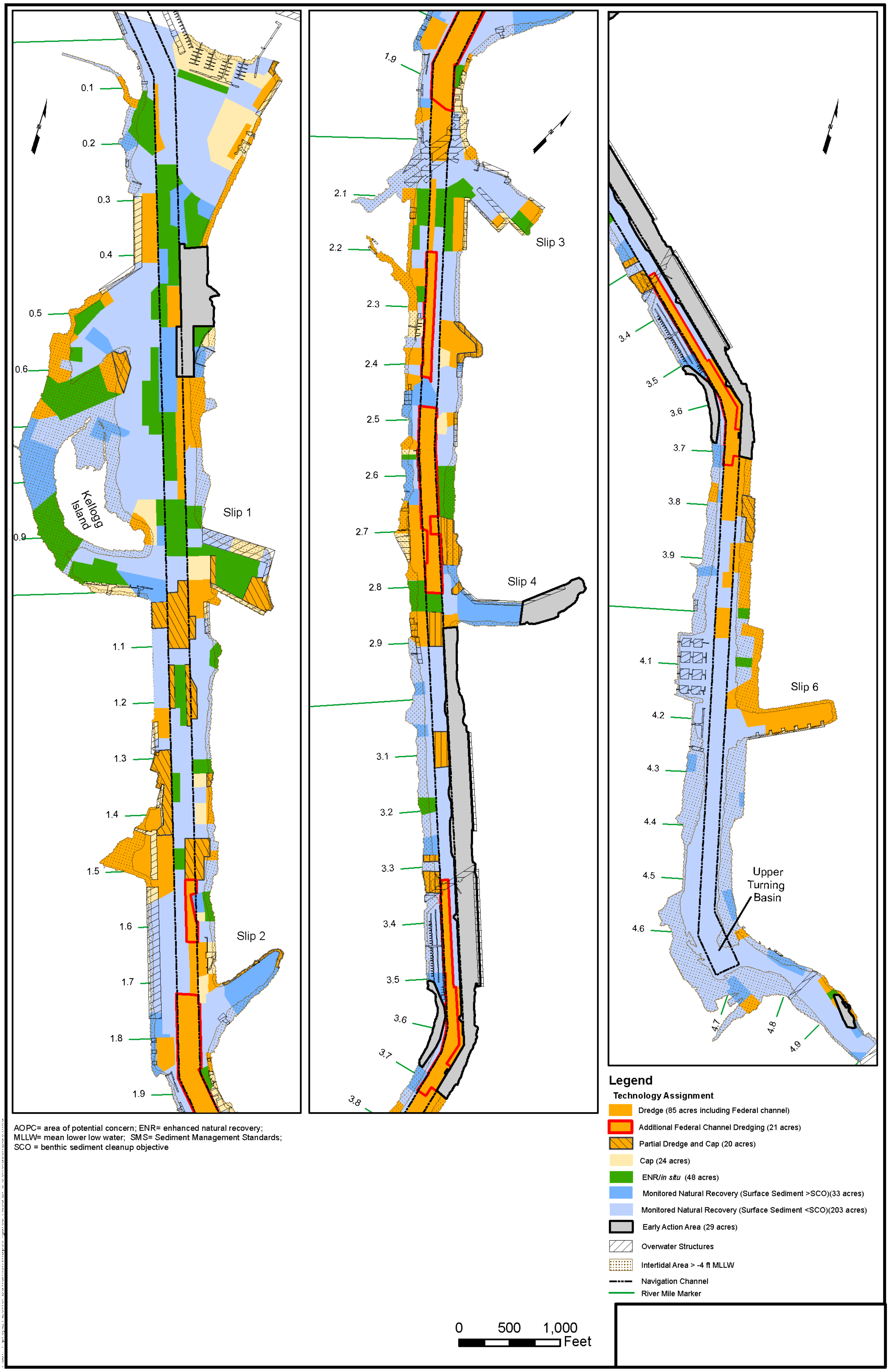

Figure 18. Selected Remedy