EXPLANATION OF SIGNIFICANT DIFFERENCES

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Lower Duwamish Waterway Superfund Site
Seattle, Washington

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Date

U.S. Environmental Protection Agency Region 10

Seattle, Washington

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ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
BaP	benzo(a)pyrene
BaP-eq	benzo(a)pyrene equivalent
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
cm	centimeter
COC	Contaminant of Concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSF	Cancer Slope Factor
Dioxins/furans	polychlorinated dibenzo-p-dioxins and furans
dw	dry weight
EAA	Early Action Area
Ecology	Washington Department of Ecology
ENR	enhanced natural recovery
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
FS	Feasibility Study
ft	feet
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
MNR	Monitored Natural Recovery
NCP	National Contingency Plan
PCB	polychlorinated biphenyl
RAL	Remedial Action Level
RAO	Remedial Action Objective
RBTC	Risk-Based Threshold Concentration
RM	River Mile
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SCO	Sediment Cleanup Objective
Site	Lower Duwamish Waterway Superfund Site
SMS	Sediment Management Standards
TTL	Target Tissue Level
UCL95	95 percent Upper Confidence Limit on the Mean
ww	wet weight
μg/kg	microgram per kilogram

EXPLANATION OF SIGNIFICANT DIFFERENCES
LOWER DUWAMISH WATERWAY SUPERFUND SITE

1.0 INTRODUCTION

This Explanation of Significant Difference (ESD) documents changes to the Record of Decision (ROD) issued in 2014 for the Lower Duwamish Waterway Superfund Site (LDW) in Seattle, Washington. The U.S. Environmental Protection Agency (EPA) considered public comments on a proposed ESD prior to issuing a final ESD and response to comments.

1.1 SITE NAME AND LOCATION

The Lower Duwamish Waterway (LDW) Superfund Site (Site) was included on the National Priorities List on September 13, 2001. The EPA identification number for the Site is WA00002329803. The Site includes upland sources of contamination as well as the waterway.

The in-waterway portion of the Site extends approximately five miles, from River Mile (RM) 5 in Tukwila, Washington, to the southern tip of Harbor Island at RM 0 (Figure 1) in Seattle. The LDW includes approximately 441 acres of intertidal and subtidal habitat. The average width of the LDW is 440 ft (feet).

1.2 LEAD AND SUPPORT AGENCIES

EPA is the lead agency for the in-waterway portion of the Site. The Washington Department of Ecology (Ecology) is the support agency. Ecology is the lead agency for addressing upland sources of contamination to the waterway.

1.3 STATEMENT OF PURPOSE

This ESD provides the basis for changes to the Selected Remedy. The LDW ROD, which documents the selection of the remedy for the in-waterway portion of the Site, was signed on November 21, 2014 (EPA, 2014). The Selected Remedy is summarized in Section 2.3, below. The changes are significant but not fundamental. The changes will become effective when the ESD is signed.

This ESD is issued in accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and based on EPA published guidance for preparation of decision documents (EPA, 1999).

As described herein, the changes affect human cancer risk-based concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) established in the ROD as remedial action levels and cleanup levels to achieve remedial action objectives. The remedial action objectives remain the same.

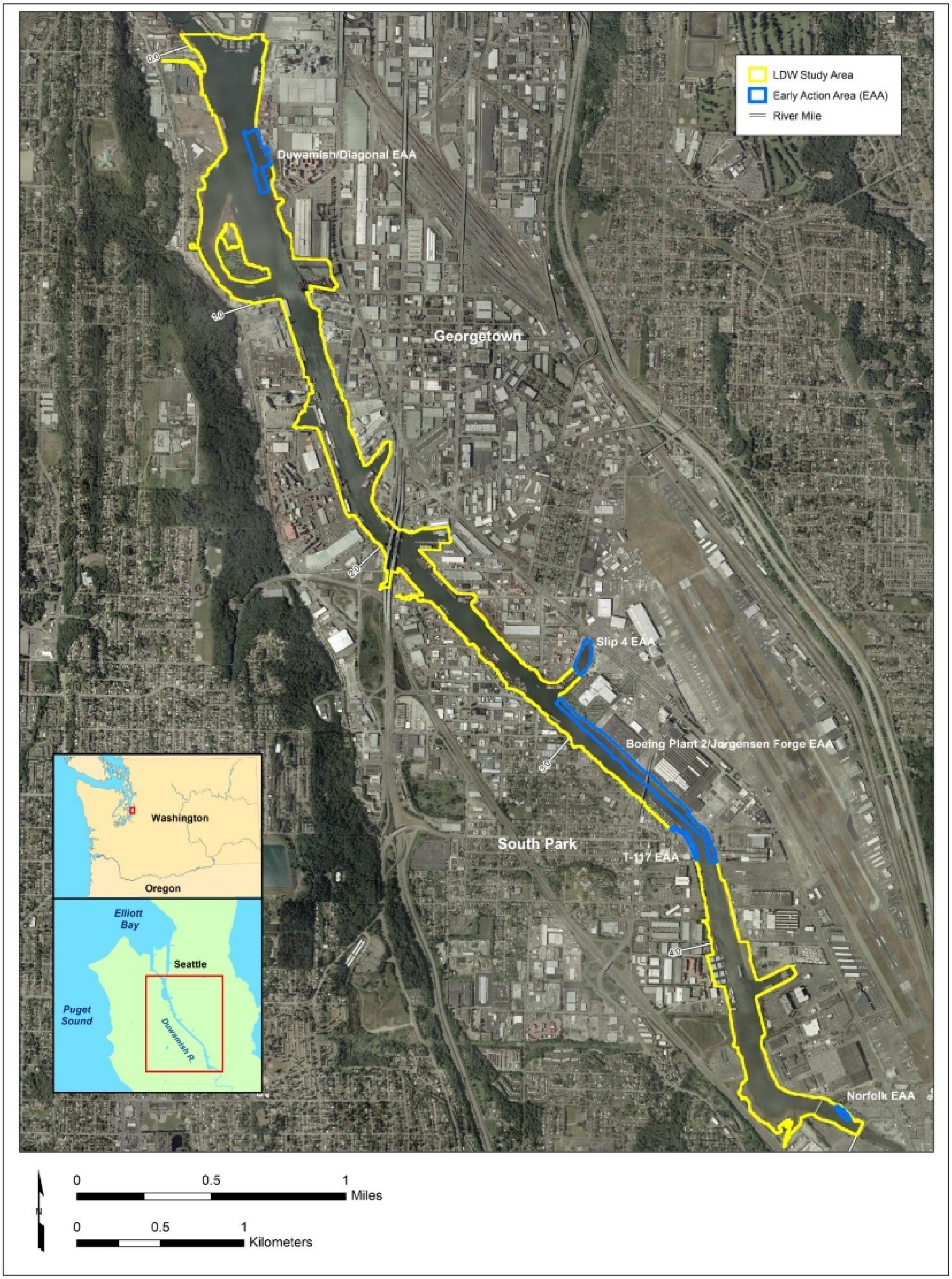

Figure 1. Lower Duwamish Waterway and Early Action Areas

1.4 ADMINISTRATIVE RECORD

The ESD and supporting documents are part of the Site Administrative Record, in accordance with the National Contingency Plan (NCP), 40 CFR § 300.825. The administrative record is available online and at the following locations:

EPA Region 10 Superfund Records Center
1200 Sixth Avenue
Seattle, WA 98101
(206) 553-4494 or (800) 424-4372
Monday through Friday 9 am–4 pm

South Park Central Library
8604 8th Ave. S.
Seattle, WA 98108
(206) 615-1688
Monday, Tuesday 1 pm–8 pm
Wednesday through Saturday 11 am–6 pm
Sunday 12 pm–5pm

2.0 SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

2.1 SITE HISTORY

The LDW and adjacent upland areas have served as Seattle's major industrial corridor since the early twentieth century, when part of the Duwamish River was straightened through dredging and filling. The Duwamish River is a continuation of the Green River, which flows from headwaters in the Cascade Mountains. A few miles after changing to the Duwamish River in Tukwila, the estuarine river flows through the channelized 5-mile Lower Duwamish Waterway in Tukwila and Seattle, then splits into the East and West Waterways at the south end of Harbor Island before discharging into Elliott Bay in Seattle, Washington.

2.2 SOURCES OF CONTAMINATION

Hazardous substances generated by industrial and urban activities entered the waterway environment through direct discharges, spills, leaks, dumping, and other inappropriate management practices. See ROD Section 2 for additional information.

2.2.1 Contaminated Media

Site contaminants have been documented in intertidal and subtidal sediment, suspended sediment, stormwater and surface water, groundwater seeps and sediment porewater, biota tissue, and some bank soils.

2.2.2 Nature and Extent of Contamination

A summary of site contamination, based on the dataset developed for the remedial investigation and feasibility study (RI/FS), is included in Section 5.3 of the ROD.

Polychlorinated biphenyls (PCBs) are the most widespread contaminant in LDW surface sediment. They were detected at 94 percent of the locations where samples were analyzed for PCBs. Forty-one hazardous substances, including PCBs and individual polycyclic aromatic hydrocarbons, were detected in LDW sediment at concentrations that exceed the benthic chemical Sediment Cleanup Objectives (SCO) set forth in the Washington Sediment Management Standards (SMS).

The cPAH concentrations in surface sediments ranged from 9.7 to 11,000 µg/kg dry weight (dw) benzo(a)pyrene equivalents (BaP-eq), with a spatially weighted average concentration of 388 µg/kg dw BaP-eq. Map 4-37 of the Remedial Investigation (RI) shows the distribution of cPAH concentrations in surface sediment (LDWG, 2010). Map 4-38 of the RI shows the distribution of cPAH by percentile.

The RI evaluated fish, shellfish, and invertebrate tissues. Concentrations of cPAHs were highest in clam, mussel, and benthic invertebrate tissue. No strong relationship was evident between sediment and clam tissue cPAH concentrations.

2.3 SUMMARY OF SITE RISKS AND CONTAMINANTS OF CONCERN

Section 7 of the ROD summarizes the results of the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) completed as part of the RI/FS.

2.3.1 Human Health Risk Assessment

The HHRA (LDWG, 2007, 2009) identified potentially complete human exposure pathways and estimated the health risks associated with those exposures. The exposure pathways evaluated in the HHRA were:

- Water recreation
- Beach play in intertidal areas
- Human consumption of resident seafood
- Fishing/shellfishing in intertidal areas
- Occupational exposure (netfishing)

The majority of human health risks associated with consumption of seafood are due to PCBs and arsenic in resident fish, crabs, and clams. The vast majority of risks due to inorganic arsenic and cPAHs (96-98 percent) were attributable to consumption of clams.

Lower risks were associated with activities that involve direct contact with sediment, such as clamming, beach play, and net-fishing. Figure 2 (see also Figure 6 of the ROD) identifies LDW areas with beach play activities and potential for clamming.

2.3.2 Ecological Risk Assessment (ERA)

The baseline ERA estimated risks for four types of ecological receptors of concern exposed to the contaminants in the LDW, either directly or via ingestion of prey: benthic invertebrates and crabs, fish, birds, and certain wildlife species (river otter, harbor seal) (LDWG, 2010).

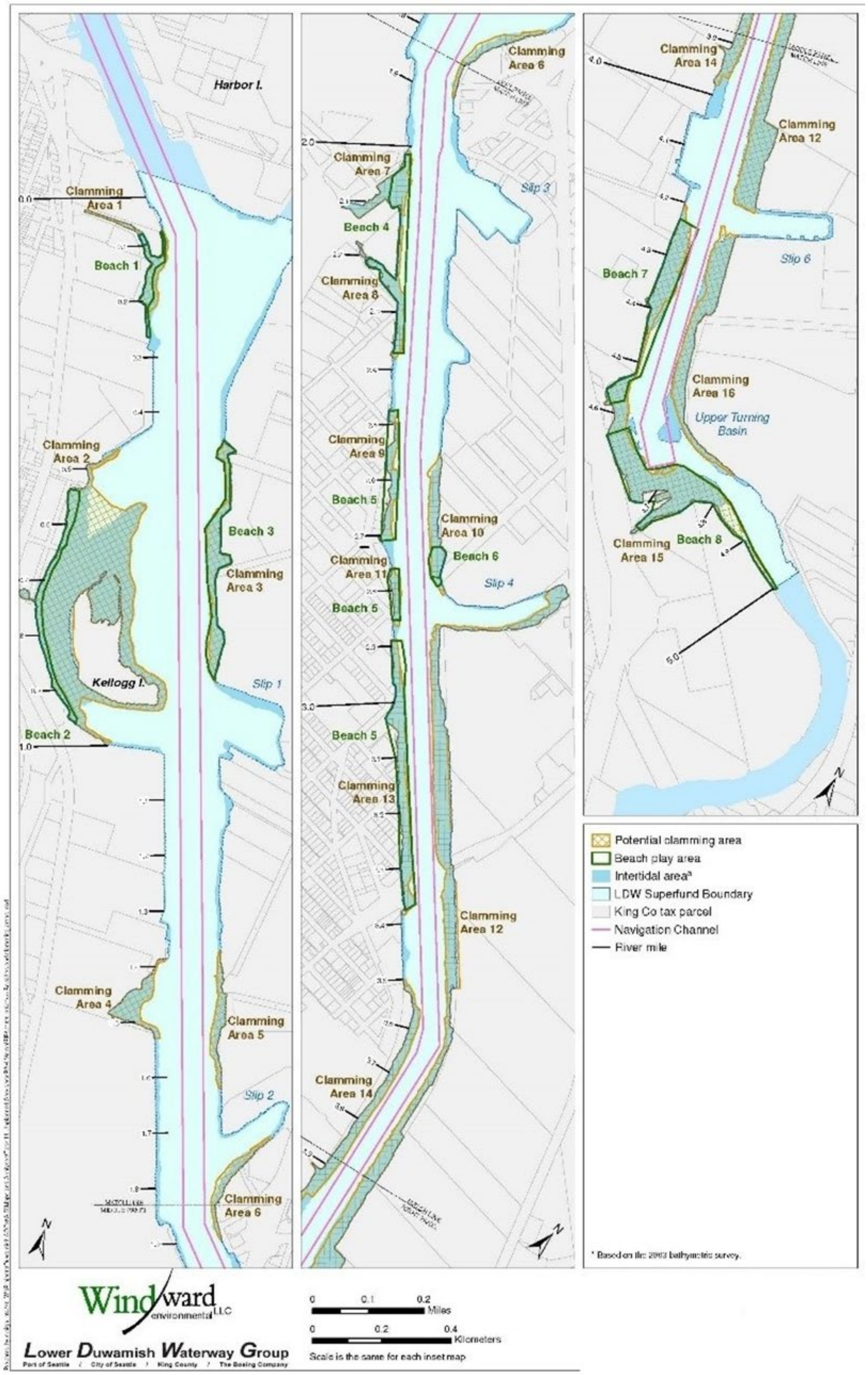

Figure 2. Potential intertidal clamming areas and beach play areas in the LDW

2.3.3 Contaminants of Concern

Four Contaminants of Concern (COCs) for human health (PCBs, arsenic, cPAHs, and dioxins/furans (polychlorinated dibenzo-p-dioxins and furans) were identified based on the HHRA (see ROD Section 7.1), and Risk-Based Threshold Concentrations (RBTCs) calculated for use as preliminary remediation goals (PRGs).

Forty-one contaminants (including PCBs and arsenic) identified based on the ERA (see ROD Section 7.2) were selected as COCs for benthic protection. The human health RBTCs, an RBTC for otters, and the SCOs for benthic protection were selected as PRGs for the Feasibility Study (FS), except for arsenic, PCBs and dioxins/furans. Because background concentrations of these COCs are higher than RBTCs, the PRGs for these COCs were based on background concentrations.

PRGs were considered in developing draft remedial action levels (RALs) to identify areas for evaluation of cleanup alternatives in the FS (LDWG, 2012).

2.4 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) describe what the proposed cleanup is expected to accomplish to protect human health and the environment. The RAOs for LDW are listed in Section 8 of the ROD and summarized below:

RAO 1: Reduce risks associated with the consumption of contaminated resident LDW fish and shellfish by adults and children with the highest potential exposure to protect human health.

RAO 2: Reduce risks from direct contact (skin contact and incidental ingestion) to contaminated sediments during netfishing, clamming, and beach play to protect human health.

RAO 3: Reduce to protective levels risks to benthic invertebrates from exposure to contaminated sediments. Risks will be reduced by reducing sediment concentrations of the 41 contaminants listed in Table 20 of the ROD to the chemical or biological benthic SCO.

RAO 4: Reduce to protective levels risks to crabs, fish, birds, and mammals from exposure to contaminated sediment, surface water, and prey.

3.0 SELECTED REMEDY

3.1 OVERALL CLEANUP STRATEGY

The overall strategy for addressing contamination and the associated risks in the LDW Site includes:

1) early identification and cleanup of Early Action Areas (EAAs) to address the most contaminated areas in the waterway;

2) controlling sources of contamination to the waterway; and

3) cleanup of the remaining contamination in the waterway, including long-term monitoring to assess the success of the remedy in achieving cleanup goals.

These three components together are designed to address the areal extent of waterway contamination, including sediment contamination, resident seafood tissue (edible portions of fish and shellfish) concentrations, and water quality, to the extent practicable. The Selected Remedy in the ROD addresses the third element of the overall strategy.

3.2 ROD Cleanup Levels, Target Tissue Levels, and Remedial Action Levels

The ROD identified sediment cleanup levels and tissue concentration goals (called Target Tissue Levels or TTLs) for seafood, established Remedial Action Levels (RALs), and specified the remedial technologies that apply in areas exceeding the RALs (See ROD, Section 8).

Sediment cleanup levels for human health RAOs 1 and 2 are calculated as RBTCs set at a 1 x 10^{6} excess cancer risk level for individual carcinogens or a noncancer Hazard Quotient (HQ) or Hazard Index (HI) of 1, consistent with the NCP and SMS (WAC 173-204-560 and 561). In accordance with EPA policy, where risk-based cleanup goals are less than background concentrations, the cleanup goals are generally set at the background concentration (see ROD Section 5.3.4.1).

Consistent with the SMS (WAC 173-204-562), cleanup levels associated with RAO 3 (protection of benthic invertebrates) are based on the SCO for the protection of benthic invertebrates, which are defined by chemical and biological criteria for specific hazardous substances, as explained in ROD Section 5.3.1.1. A cleanup level for PCBs in sediment was established for RAO 4.

3.3 Description of the Selected Remedy

Section 13 of the ROD described specific cleanup technologies and where they are applied based on comparison of RI/FS sediment contamination levels to the RALs in ROD Table 28, and according to the decision trees in Figures 19 and 20, as corrected in the ROD erratum. The RALs and the application of the technologies differ, depending on location (intertidal, subtidal, navigation channel), the potential for natural recovery, and other features.

The ROD anticipated the following active remediation (as shown in Figure 18 of the ROD):

- Dredging or partially dredging and capping approximately 105 acres of highly contaminated sediments (approximately 960,000 cubic yards).
- Placing engineered sediment caps on approximately 24 acres of highly contaminated sediments where there is sufficient water depth for a cap.
- Placing a thin layer (6 to 9 inches) of clean material (referred to as Enhanced Natural Recovery [ENR]) on approximately 48 acres of sediments in areas that meet the criteria for ENR.
- Applying location-specific cleanup technologies to areas with structural or access restrictions (such as under-pier areas and in the vicinity of dolphins/pilings, bulkheads, and riprapped or engineered shorelines).

In addition, the ROD estimated 235 acres for Monitored Natural Recovery (MNR). MNR relies on natural processes to reduce ecological and human health risks to acceptable levels while monitoring sediments over time to determine remedy success. Within the LDW, the natural burial of contaminants through sedimentation from upstream is the primary natural recovery mechanism.

The ROD required sampling and analysis during remedial design, construction, post-construction, and long-term monitoring, as described in ROD Section 13.2.3, and called for effective and appropriate institutional controls.

4.0 BASIS FOR THE ESD

EPA released the final *Toxicological Review of Benzo(a)pyrene* on January 19, 2017 (EPA, 2017). The review, a comprehensive review of available animal studies and other toxicological information, replaced the 1987 Integrated Risk Information System (IRIS) cancer slope factor (CSF) for benzo(a)pyrene (BaP) of 7.3 $(mg/kg\text{-}day)^{-1}$ with an updated value of 1 $(mg/kg\text{-}day)^{-1}$. It also established a reference dose for BaP non-cancer effects, based on a developmental endpoint (neurobehavioral changes), of 3×10^{-4} mg/kg-day. These toxicity values were published on EPA's IRIS website and documented in the toxicological review for BaP (EPA 2017).

EPA uses BaP as an index to estimate cancer risk from exposure to mixtures of cPAHs. Since cPAHs, as a group, are a contaminant of concern for human health at LDW, EPA determined that an ESD may be warranted. EPA used the exposure assumptions in the HHRA and the new CSF to calculate changes in the human cancer risk-based cPAH cleanup levels, TTLs, and RALs in the ROD. See Appendix A for a detailed discussion of the revised risk calculations.

When a chemical has both cancer and non-cancer modes of toxicity, EPA uses the toxic endpoint that results in the most stringent level when selecting cleanup levels or other remediation targets. Cancer is a more sensitive endpoint for cPAHs than non-cancer. Cancer RBTCs based on the revised CSF are more stringent than those based on the new BaP non-cancer reference dose (See Section 1.4 of Appendix A). Thus cleanup actions that achieve PRGs based on a target cancer risk of 1×10^{-6} will be protective for both cancer and non-cancer effects.

The change in the human toxicological values for BaP does not affect cleanup levels or RALs in the LDW ROD for RAOs 3 and 4, protection of ecological receptors.

5.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

The changes to the Selected Remedy are summarized below and consist of changes to cleanup levels, TTLs and RALs for cPAHs. The ESD does not change the RAOs: the target cancer risks used to develop cleanup levels, TTLs, and RALs for RAO 1 and RAO 2 are the same as those in the ROD. The change in the BaP CSF does not affect RAO 3 and RAO 4, which focus on non-cancer endpoints for ecological receptors.

Concentrations of cPAHs, including the cleanup levels, target tissue levels, and remedial action levels, were expressed in the RI/FS and ROD as µg TEQ/kg dw. The ESD describes mixtures of cPAH in terms of benzo(a)pyrene equivalent concentrations, or BaP-eq dw. The terms differ, but the values are calculated identically.

All other elements of the Selected Remedy, including Applicable or Relevant and Appropriate Requirements (ARARs), remain unchanged.

The EPA has determined that the Selected Remedy, incorporating the significant differences below, is protective of Ftable 3human health and the environment.

5.1 CHANGES TO CPAH CLEANUP LEVELS

The sediment cleanup levels are contaminant concentrations in sediment that will be used to measure the success of the cleanup alternatives in meeting the RAOs. Sediment cleanup levels for RAOs 1, 2, and 4 are shown in the ROD in Table 19, while RAO 3 cleanup levels for benthic protection are listed in ROD Table 20.

The sediment cleanup levels for cPAH for RAO 2 direct contact scenarios, calculated based on a 1×10^{-6} cancer risk, are changed as described below and shown in Revised Table 19 (Table 1). Revised Table 19 (Table 1) supersedes ROD Table 19.

5.1.1 cPAH Cleanup level for Sediment Direct Contact – Netfishing Scenario

The sediment cleanup level selected in the ROD of 380 µg/kg dw for the LDW-wide 0–10 cm sediment interval is revised to **2,800 µg/kg dw**. (Table 1).

The FS estimated that completion of the Early Action Area cleanups as planned would achieve sitewide average cPAH concentrations for the 0-10 cm interval at 360 µg/kg dw, a concentration lower than the revised cleanup level.

5.1.2 cPAH Cleanup level for Sediment Direct Contact – Clamming Scenario

The sediment cleanup level selected in the ROD of 150 µg/kg dw for all clamming areas for the 0–45 cm sediment interval is revised to **1,100 µg/kg dw.** (Table 1).

5.1.3 cPAH cleanup level for Sediment Direct Contact – Beach Play Scenario

The sediment cleanup level selected in the ROD of 90 µg/kg cPAHs at each of eight individual beach play areas is revised to **590 µg/kg dw**. (Table 1).

5.2 CHANGE TO CPAH TARGET TISSUE LEVEL

Table 21 of the ROD identifies TTLs, goals for contaminant concentrations in seafood to address RAO 1. The TTLs are based on the higher of either risk-based threshold concentrations or non-urban Puget Sound background concentrations.

Because clam consumption accounts for more than 95 percent of the total seafood consumption risk from cPAHs, the TTL for cPAH is for clam tissue only. This ESD changes the cPAH TTL from 0.24 µg/kg ww to **1.5 µg/kg ww**, as shown in Table 2. Table 2 supersedes ROD Table 21.

Table 1. Revised ROD Table 19 - Cleanup Levels for PCBs, Arsenic, cPAHs, and Dioxins/Furans in Sediment for Human Health and Ecological COCs (RAOs 1, 2 and 4) with updates for cPAH (in italics)

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**	**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 BaP-eq (µg/kg dw)[e]	NA	*2800*[f]	NA	RBTC	LDW-wide	UCL95	0 – 10 cm
	NA	*1100*[g]	NA	RBTC	All Clamming Areas	UCL95	0 – 45 cm
	NA	*590*[h]	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] Human-health direct contact cleanup levels (for PCBs, arsenic, cPAHs, and dioxins/furans) in intertidal areas, including beaches used for recreation and clamming.

[c] Clamming areas are identified in Figure 2 of the ESD.

[d] Beach play areas are identified in Figure 2 of the ESD.

[e] Change in terminology: cPAH µg TEQ/kg dw and cPAH BaP-eq are the same.

[f] Value increased by ESD from 380 to 2,800 µg/kg dw.

[g] Value increased by ESD from 150 to 1,100 µg/kg dw.

[h] Value increased by ESD from 90 to 590 µg /kg dw.

Table 2. Revised ROD Table 21 - LDW Resident Fish and Shellfish Target Tissue Concentrations with updates for cPAH (in italics)

Species/Group and Tissue Type	Species[a]	Target Concentration	Source of Target Concentration [b,c]
PCBs (µg/kg ww)			
Benthic fish, fillet	English sole	12	Non-urban background
Pelagic fish, whole body	Perch	1.8	RBTC
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[d]	Eastern softshell clam	0.09	Non-urban background
cPAH BaP-eq[e] (µg/kg ww)			
Clams[d]	Eastern softshell clam	*1.5*[f]	Species-specific RBTC[g]
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] 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] Only clam tissue values are shown for inorganic arsenic and cPAH BaP-eq because most of the risk associated with these COCs was associated with consumption of clams.

[e] Change in terminology: cPAH µg TEQ/kg dw and cPAH BaP-eq are the same

[f] Value increased from 0.24 to 1.5 µg/kg ww.

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

5.3 CHANGES TO CPAH REMEDIAL ACTION LEVELS (RALS)

RALs are contaminant-specific sediment concentrations that trigger the need for active remediation (dredging, capping, or ENR). The LDW RALs are generally higher than cleanup levels, which represent the long-term cleanup standards that must be achieved. The RALs consider the magnitude of risk reduction achieved, the rate of natural recovery, and the different types of remedial actions, such as dredging or enhanced natural recovery. The development of RALs for the LDW is detailed in the Feasibility Study (LDWG, 2012).

Table 28 of the ROD presents the selected RALs for contaminants of concern for human and ecological health. The RALs apply to the sediment depth intervals associated with the exposure scenarios. The RALs also consider the recovery category assigned (indicating whether natural recovery is presumed to be limited, less certain, or likely). While the cleanup levels apply across specific areas at specified depths of compliance, the RALs are applied point by point.

The ROD also established concentrations below which the technology of ENR could be applied. These upper limits, or ULs, for ENR, were provided only for Recovery Category 2 and 3 areas and were calculated by applying a factor of 3 (0-10 cm interval) or 1.5 (0-45 cm intertidal interval) to the applicable RAL.

This ESD changes the RALs and ENR ULs for cPAHs as described below and shown in ESD Table 3. Table 3 supersedes ROD Table 28.

5.3.1 cPAH RAL for Intertidal and Subtidal Sediments for the 0-10 cm depth interval

The FS evaluated several potential cPAH RALs for the overall reduction of average cPAH concentrations (FS Figure 6-2c and Figure 6-3). A potential RAL of 5,500 µg TEQ/kg dw was considered, to address hot spots, and two other potential RALs, 3,800 and 1,000 µg TEQ/kg, were used to provide a range. The ROD selected the cPAH RAL of 1,000 µg/kg dw for the 0–10 cm sediment interval (ROD Table 28), applicable in intertidal and subtidal areas.

This ESD changes the cPAH RAL for the 0-10 cm depth interval from 1,000 µg/kg dw to **5,500 µg/kg dw** to address hotspots.

5.3.2 cPAH RAL for Subtidal Sediments for the 0-60 cm depth interval and for Shoaled Areas of the Navigation Channel

The ROD selected a cPAH RAL of 1,000 µg/kg dw for the 0-60 cm depth interval of subtidal sediments in Recovery Category 1 areas and for shoaled areas of the navigation channel (Table 28) to ensure that erosion, scour, or dredging would not result in concentrations above the RAL in the 0-10 cm sediment interval.

Consistent with the change to the RAL for the 0-10 cm interval, this ESD changes the RAL for the 0-60 cm interval from 1,000 µg/kg to **5,500 µg/kg dw** (See Table 3).

5.3.1 cPAH RAL for Intertidal 0-45 cm Sediment

The ROD selected a RAL of 900 µg/kg for the 0-45 cm depth interval in all intertidal areas to achieve overall risk reduction. The RAL in the ROD is a risk-based threshold concentration based on beach play exposure and a target risk of 1×10^{-5}.

This ESD uses the same target risk and incorporates the updated BaP slope factor to revise the intertidal RAL for cPAHs from 900 µg/kg to **5,900 µg/kg dw** (See Table 3)

.

Table 3. Revised ROD 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[a] in Federal Navigation Channel**
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)[b]	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[c] for ENR	--	--	36	97	--	--	36	195	--
Arsenic (Total)	mg/kg dw	RAL	57	28	57	28	57	57	57	--	57
		UL for ENR	--	--	171	42	--	--	171	--	--
cPAH BaP-eq[d]	µg/kg dw	RAL	*5,500*[e]	*5,900*[e]	*5,500*[e]	*5,900*[e]	*5,500*[e]	*5,500*[e]	*5,500*[e]	--	*5,500*
		UL[c] for ENR	--	--	*16,500*[e]	*8,850*[e]	--	--	*16,500*[e]	--	--
Dioxins/Furans	ng TEQ/kg dw	RAL	25	28	25	28	25	25	25	--	25
		UL[c] for ENR	--	--	75	42	--	--	75	--	--
Benthic Protection RALs											
39 SMS COCs[f]	Contaminant- specific	RAL	Benthic SCO	Benthic SCO	2x Benthic SCO	--	Benthic SCO	Benthic SCO	2x Benthic SCO	--	Benthic SCO
		UL[c] for ENR	--	--	3x RAL	--	--	--	3x RAL	--	--

Notes: This table reflects changes from the 2020 ESD to Table 28 in the ROD.
-- not applicable

[a] 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.

[b] Applied only in potential vessel scour areas. These are defined as subtidal areas (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 in the ROD).

[c] The ENR 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).

[d] Change in terminology: cPAH µg TEQ/kg dw and cPAH BaP-eq are the same

[e] Intertidal RAL modified by ESD, based on beach play RBTC at 1×10^{-5}. The RAL of 5,500 µg/kg dw for subtidal and intertidal 0-10 cm sediments is to address hotspots. As in the ROD, the Upper Limits for ENR, where applicable, are 1.5 times the 0-45 cm RAL (in intertidal areas) and 3 times the 0-10 cm RAL (in subtidal and intertidal areas).

[f] There are 41 SMS COCs, but total PCBs and arsenic ENR ULs are based upon human health based RALs only (see Table 20 in the ROD).

6.0 RAO EVALUATION AND EXPECTED OUTCOMES

This ESD does not change the RAOs in Section 8 of the ROD or the expected outcomes described in Section 13 of the ROD.

The Selected Remedy, as modified by this ESD, will achieve substantial risk reduction by dredging and capping the most contaminated sediments, reduce remaining risks to the extent practicable through ENR and MNR, and manage remaining risks to human health through institutional controls.

RAO 1 seeks to reduce cancer risks associated with the consumption of contaminated seafood, which is largely attributable to cPAHs in clams. The ROD does not include a cleanup level or RAL for cPAHs in sediment to address RAO 1, as data collected during the RI/FS showed and additional studies completed following the ROD indicate that cPAH concentrations in sediment are not predictive of cPAH concentrations in clam tissue (LDWG, 2020). EPA will use the clam TTL for cPAHs, as revised by the ESD, to measure progress toward achieving RAOs 1 and 4.

6.1 EFFECT OF THE ESD ON REMEDIAL ACTION AREAS

The ROD identified areas requiring active cleanup (dredging, capping, or ENR) based on sediment concentrations greater than any of the RALs, as shown in Figure 18 of the ROD. To assess the effect of the changes to cPAH RALs on remedial action areas and costs, EPA assessed whether any of the cleanup areas in Figure 18 were determined based only on samples with cPAH concentrations greater than the applicable RAL for cPAHs in the ROD. If a different COC exceeded its RAL at or close to that location, cleanup would be required regardless of the cPAH concentration. Based on this analysis, the effect of changing the cPAH RAL is minor and within the uncertainty of the remedial action area estimate in the ROD. See Appendix B for details to support this analysis.

6.2 EFFECT ON REMEDIAL QUANTITIES AND COST

Based on the evaluation above, greater than 98 percent of the remedial action areas identified in the ROD would still require remedial action, regardless of whether the RAL for cPAHs is increased in the ESD. EPA estimated the areas associated with the remedial technology applied in the ROD to adjust the cost estimate (Table 4 ESD Effects on Remedial Areas and Costs). The changes result in approximately 1 percent reduction in the ROD cost estimate, within the FS goal of +50/-30 percent accuracy.

As cleanup progresses, remedial design investigations will be used to refine the ROD estimates of remedial action areas and technologies, dredge volumes, and costs. EAA cleanups, source control efforts, and ongoing deposition of Green River sediments have led to reductions in average sediment concentrations since the RI/FS (LDWG, 2020).

Table 4. ESD Effect on Remedial Areas and Costs

Remedial Technology	Estimated Acres in ROD (Section 3.2)	Estimated Cost[a] (ROD Table 29)	Areas Reduced by Change in cPAH RAL			Cost Reduction by Technology
			Location (RM)[b]	Estimate of Acres	Sum of Acres reduced	
Dredge	105	$33,496,452	0.1W	0.38	2.89	$920,570
			0.9E	1.25		
			1.3W	0.25		
			2.1E	1.00		
ENR	48	$6,143,912	0.8W	1.05	1.53	$196,475
			2.2W	0.49		
MNR	235	0	4.4E	0.38	0.38	0
					Total Cost Reduction	$1,117,045
					Total Remedy Cost Estimate in ROD	$342,233,932
					Cost with Reduced Acreage (cPAH only areas removed)	**$341,116,887**

[a] Does not include cost for disposal, dredge residuals, backfill, or monitoring line items (assumed to be nominal).

[b] All locations included where cPAH-only RAL exceedance (RAL = 1,000 BaP-eq µg/kg dw) without nearby exceedances of other RALs are identified. Select locations with cPAH-only RAL exceedance also included on a case-by-case basis if determined remedy assignment would be substantially impacted.

6.3 ENVIRONMENTAL JUSTICE CONCERNS

EPA acknowledges environmental justice concerns, and in Section 13.2.8 of the ROD, identified means to address these issues before, during, and after implementation of the remedy. The ESD does not change the commitments made in the ROD.

7.0 SUPPORT AGENCY AND TRIBAL COMMENTS

EPA coordinated with Ecology on the development of this ESD. Ecology supports the use of the updated 2017 IRIS toxicity value and is using it in other State regulatory decisions. Ecology did not submit any comments on the proposed ESD.

EPA offered consultation to the Muckleshoot Tribe, the Suquamish Tribe, and the Yakama Nation in advance of releasing the proposed ESD. None of the three federally recognized tribes requested consultation or commented during the public comment period. Comments received from the Duwamish Tribe were added to the Administrative Record.

8.0 STATUTORY DETERMINATIONS

The Selected Remedy for the LDW Superfund Site, as modified by this ESD, continues to satisfy the statutory requirements of Section 121 of CERCLA, 42 USC § 9621, to protect human health and the environment, comply with federal and state requirements that are applicable or relevant and appropriate to the remedial action, are cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

9.0 PUBLIC PARTICIPATION COMPLIANCE

The public participation requirements set out in the NCP, 40 CFR § 300.435(c)(2), have been met. EPA made the ESD and supporting information available to the public in the administrative record established under §300.815. EPA published a notice that briefly summarizes the final ESD, including the reasons for the differences described in the ESD, in a major local newspaper of general circulation.

EPA recognizes that there is strong community interest in the LDW Superfund Site. In addition to meeting the requirements above, EPA held a virtual public information meeting to discuss the changes to the Selected Remedy in the proposed ESD and invited public comment. Community involvement activities, the public comments received, and EPA's responses are summarized in the Responsiveness Summary (Appendix C).

10.0 KEY TERMS

Applicable or relevant and appropriate requirements (ARARs) - ARARs are promulgated, or legally enforceable federal and state requirements. They are generally divided into three categories: (1) chemical-specific ARARs, (2) location-specific ARARs, and (3) action-specific ARARs, depending on whether the requirement is triggered by the presence or emission of a chemical, by a vulnerable or protected location, or by a particular action. ARARs provide the basis for certain cleanup levels. A complete list of ARARs is shown in Table 26 of the ROD.

CERCLA – the Comprehensive Environmental Response, Compensation, and Liability Act—also known as Superfund—CERCLA is a federal law which authorizes response actions to reduce the dangers associated with releases or threats of releases of hazardous substances, pollutants, or contaminants that may endanger public health or welfare or the environment.

Contaminant of Concern (COC) – a hazardous substance or group of substances that pose an unacceptable risk to human health or the environment.

Cleanup Levels (CULs) - The selected cleanup levels are contaminant concentrations that will be used to measure the success of the cleanup alternatives in meeting the RAOs.

Sediment cleanup levels for RAOs 1 and 2 (for protection of human health) are calculated as RBTCs at a 1 x 10^{-6} excess cancer risk level for individual carcinogens and noncancer HQ or HI of 1. Where RBTCs are more stringent than the background, cleanup levels are set at the natural background level (see Section 5.3.4.1 of the ROD).

Cancer Risk – also referred to as Excess Lifetime Cancer Risk, the incremental probability of an individual developing cancer over a lifetime as a result of exposure to site-related contamination.

Hazard Index (HI) – the sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. An HI may be used to evaluate the potential for adverse health effects from exposure to more than one hazardous substance with similar modes of toxic action.

Hazard Quotient (HQ) –the ratio of estimated exposure to a specific chemical to its reference dose.

Human Health Risk Assessment (HHRA) – The process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future.

Mean Lower Low Water (MLLW) – the average height of the lowest tide recorded at a tide station each day over the period from 1983 to 2001.

Reasonable Maximum Exposure (RME) – an estimate of the highest level of human exposure that would reasonably be expected to occur.

Remedial Action Levels (RALs) – contaminant-specific sediment concentrations designed to identify specific areas of sediments that require active remediation, taking into consideration the human health and ecological risk reduction achieved by the different remedial technologies.

Remedial Action Objectives (RAOs) – objectives that describe what the cleanup is expected to accomplish to protect human health and the environment.

Risk-based Threshold Concentrations (RBTCs) – the calculated concentrations in any medium estimated to be protective of a particular receptor for a given exposure pathway and target risk level. RBTCs are calculated using the assumptions and methods from the baseline risk assessments conducted during the RI.

Sediment Cleanup Objective (SCO) – SCO represents the environmental goal for establishing sediment cleanup levels under the Washington State Sediment Management Standards.

Sediment Management Standards (SMS) - The SMS are State standards designed to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination.

Cancer Slope Factor (CSF) – An upper bound estimate of the increased cancer risk from exposure to an agent at a dose of 1 mg/kg-day for a lifetime. The CSF can be multiplied by an estimate of lifetime exposure (in mg/kg-day) to estimate the lifetime cancer risk.

Target Tissue Levels (TTLs) - Target tissue levels, or concentrations, are not cleanup levels. They will be used for informational purposes to assess ongoing risks to people who may consume resident LDW fish and shellfish. Tissue monitoring data will also inform the content or degree of any potential future fish advisories, other institutional controls intended to minimize risk to the LDW fishing community, or other response actions.

Upper Confidence Limit (95 percent) on the Mean (UCL95) – A value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true population mean 95 percent of the time. The UCL95 is used as the exposure concentration in risk assessment. It accounts for variability in the distribution of the data and the potential for exposure throughout different areas. The use of this statistic assures no more than a 5 percent chance that the average exposure concentration is actually higher.

11.0 REFERENCES

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APPENDIX A

CALCULATION OF HUMAN HEALTH RISK-BASED BENZO(A)PYRENE-EQUIVALENT THRESHOLD CONCENTRATIONS FOR cPAHS

BASIS FOR REVISED cPAH CLEANUP LEVELS AND TARGET TISSUE LEVELS

1.0 Calculation of Human Health Risk-Based Benzo(a)pyrene-equivalent Threshold Concentrations for cPAHs – Basis for Revised cPAH Cleanup Levels and Target Tissue Levels

This section presents the calculation of human health risk-based threshold concentrations (RBTCs) for cPAHs, expressed as a benzo(a)pyrene-equivalent concentration in sediment and clam tissue, assuming a target excess cancer risk of 1×10^{-6}. The revised RBTCs were calculated using the exposure assumptions and values from Section B.3.2 of the Lower Duwamish Waterway (LDW) Human Health Risk Assessment (HHRA, LDWG 2005), and errata (LDWG, 2009). When RBTCs are greater than established background concentrations, they are the basis for the revised cleanup levels in this Explanation of Significant Differences (ESD).

RBTCs associated with Remedial Action Objective 2, direct contact with sediment, were calculated to account for incidental ingestion and dermal exposures. These values were then combined to derive a single RBTC protective of both exposure pathways as follows:

$$RBTC_{sed} = \frac{1}{\dfrac{1}{RBTC_{sed-Ingestion}} + \dfrac{1}{RBTC_{sed-Dermal}}}$$

1.1 Netfishing/Clamming

RBTCs protective of the adult tribal netfishing and clamming RME scenarios were calculated using the exposure assumptions described in Tables B.3-15 and 16, and B.3-23 and 24 of the HHRA, respectively.

RBTCs protective of incidental ingestion of sediment were calculated using the following equation:

$$RBTC_{sed\text{-}ingestion} = \frac{TR \times BW \times AT_c}{EF \times ED \times CSF \times IR_{sed} \times CF_{kg/mg} \times CF_{mg/\mu g}}$$

RBTCs for dermal contact with sediment were calculated using the following equation:

$$RBTC_{sed-dermal} = \frac{TR \times AT_c \times BW_a}{EF \times ED \times CSF \times SA \times AF \times ABS \times CF_{kg/mg} \times CF_{mg/\mu g}}$$

$RBTC_{sed\text{-}ingestion}$	=	risk-based threshold concentration in sediment (µg/kg)
$RBTC_{sed\text{-}dermal}$	=	risk-based threshold concentration in sediment (µg/kg)
IR_{sed}	=	incidental sediment ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)

BW_a	=	body weight – adult (kg)
ABS	=	dermal absorption factor
SA	=	exposed skin surface area (cm^2)
AF	=	soil-to-skin adherence factor (mg/cm^2)
AT_c	=	averaging time (days)
$CF_{kg/mg}$	=	conversion factor – kg/mg (0.000001)
$CF_{mg/\mu g}$	=	conversion factor – mg/µg (0.001)
CSF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$
TR	=	target excess cancer risk

Exposure assumptions are shown in Table 1.

1.2 Beach Play

As discussed in Section 8.5.1.1 of the HHRA, EPA guidance (EPA 2005) notes that exposures to a carcinogen in early life may result in higher lifetime cancer risks than a comparable duration adult exposure, and recommends the application of age-dependent adjustment factors of 10 and 3, respectively, for exposures occurring before 2 years of age and from ages 2 through 6 when a carcinogen is known to cause cancer through a mutagenic mode of action. RBTCs for the RME beach-play scenario were calculated using the exposure assumptions presented in Tables B.3-19 and 20 of the HHRA.

The RBTC based on incidental ingestion of sediment was calculated using the following equation:

$$RBTC_{sed-ingestion} = \frac{TR \times AT_c}{CSF \times IR_{beach-adj} \times CF_{kg/mg} \times CF_{mg/\mu g}}$$

Where:

$$IR_{beach-adj} = \left(\frac{(EF_{0\text{-}1} \times ED_{0\text{-}1} \times IR_{sed-beach}) \times 10}{BW_{0-1}} + \frac{(EF_{0\text{-}1} \times ED_{1-2} \times IR_{sed-beach}) \times 10}{BW_{1-2}} + \frac{(EF_{0\text{-}1} \times ED_{2-3} \times IR_{sed-beach}) \times 3}{BW_{2-3}} + \frac{(EF_{0\text{-}1} \times ED_{3-4} \times IR_{sed-beach}) \times 3}{BW_{3-4}} + \frac{(EF_{0\text{-}1} \times ED_{4-5} \times IR_{sed-beach}) \times 3}{BW_{4-5}} + \frac{(EF_{0\text{-}1} \times ED_{5-6} \times IR_{sed-beach}) \times 3}{BW_{5-6}} \right)$$

RBTCs for cPAHs based on dermal exposure to sediments was calculated using the following equation:

$$RBTC_{sed-dermal} = \frac{TR \times AT}{CSF \times DF_{beach-adj} \times ABS \times CF_{kg/mg} \times CF_{mg/\mu g}}$$

Where

$$DF_{beach-adj} = \left(\begin{array}{l} \frac{EF_{beach} \times ED_{0\text{-}1} \times AF_{beach} \times SA_{0-1} \times 10}{BW_{0-1}} + \frac{EF_{beach} \times ED_{1-2} \times AF_{beach} \times SA_{1-2} \times 10}{BW_{1-2}} + \frac{EF_{beach} \times ED_{2-3} \times AF_{beach} \times SA_{3-4} \times 3}{BW_{2-3}} \\ + \frac{EF_{beach} \times ED_{3-4} \times AF_{beach} \times SA_{3-4} \times 3}{BW_{3-4}} + \frac{EF_{beach} \times ED_{4-5} \times AF_{beach} \times SA_{4-5} \times 3}{BW_{4-5}} + \frac{EF_{beach} \times ED_{5-6} \times AF_{beach} \times SA_{5-6} \times 3}{BW_{5-6}} \end{array} \right)$$

and:

$RBTC_{sed\text{-}ingestion}$	=	risk-based threshold concentration in sediment (µg/kg)
$RBTC_{sed\text{-}dermal}$	=	risk-based threshold concentration in sediment (µg/kg)
IR_{beach_adj}	=	incidental sediment ingestion – beach play (mg/kg)
DF_{beach_adj}	=	dermal sediment contact factor – beach play (mg/kg)
EF_{beach}	=	exposure frequency – beach play (days/year)
ABS	=	dermal absorption factor
AF_{beach}	=	soil-to-skin adherence factor – beach play (mg/cm^2)
$ED_{0\text{-}1}$	=	exposure duration age 0-1 (years)
$ED_{1\text{-}2}$	=	exposure duration age 1-2 (years)
$ED_{2\text{-}3}$	=	exposure duration age 2-3 (years)
$ED_{3\text{-}4}$	=	exposure duration age 3-4 (years)
$ED_{4\text{-}5}$	=	exposure duration age 4-5 (years)
$ED_{5\text{-}6}$	=	exposure duration age 5-6 (years)
$SA_{0\text{-}1}$	=	exposed skin surface area age 0-1 (cm^2)
$SA_{1\text{-}2}$	=	exposed skin surface area age 1-2 (cm^2)
$SA_{2\text{-}3}$	=	exposed skin surface area age 2-3 (cm^2)
$SA_{3\text{-}4}$	=	exposed skin surface area age 3-4 (cm^2)
$SA_{4\text{-}5}$	=	exposed skin surface area age 4-5 (cm^2)
$SA_{5\text{-}6}$	=	exposed skin surface area age 5-6 (cm^2)
$BW_{0\text{-}1}$	=	body weight age 0-1 (kg)
$BW_{1\text{-}2}$	=	body weight age 1-2 (kg)
$BW_{2\text{-}3}$	=	body weight age 2-3 (kg)
$BW_{3\text{-}4}$	=	body weight age 3-4 (kg)
$BW_{4\text{-}5}$	=	body weight age 4-5 (kg)
$BW_{5\text{-}6}$	=	body weight age 5-6 (kg)
$CF_{kg/mg}$	=	conversion factor – kg/mg (0.000001)
$CF_{mg/\mu g}$	=	conversion factor – mg/µg (0.001)
AT_c	=	averaging time (days)
TR	=	target excess cancer risk
CSF	=	cancer slope factor (mg/kg-day)$^{-1}$
TR	=	target cancer risk

Exposure assumptions are shown in Table 1. RBTCs for cPAHs in sediment are shown in Table 2.

1.3 Clam Tissue Risk-Based Concentrations

As discussed in the LDW ROD Section 8.2.3, fish and shellfish Target Tissue Levels (TTLs) were included to measure progress toward achieving RAOs 1 and 4. The TTL for cPAHs is a risk-based concentration in clam tissue, calculated based on tribal clam consumption rates.

The RBTC based on consumption of clams by adults was calculated using the following equation:

$$RBTC_{clams} = \frac{TR \times BW_a \times AT_c}{ED_a \times EF_{cc} \times CSF \times CR_{a-cc} \times CF_{kg/mg} \times \mathrm{CF}_{\mathrm{mg}/\mu\mathrm{g}} \times \mathrm{CF}_{\mathrm{mg/g}}}$$

The RBTC based on consumption of clams by children was calculated using the following equation:

$$RBTC_{clams} = \frac{TR \times AT_c}{CSF \times CR_{cc-c-adj} \times CF_{kg/mg} \times CF_{mg/\mu g} \times \mathrm{CF}_{\mathrm{mg/g}}}$$

where:

$$CR_{cc-c-adj} = \left(\frac{EF_{cc} \times ED_{0\text{-}1} \times CR_{cc-c} \times 10}{BW_{0-1}} + \frac{EF_{cc} \times ED_{1-2} \times CR_{cc-c} \times 10}{BW_{1-2}} + \frac{EF_{cc} \times ED_{2-3} \times_c \times CR_{cc-c} \times 3}{BW_{2-3}} + \frac{EF_{cc} \times ED_{3-4} \times CR_{cc-c} \times 3}{BW_{3-4}} + \frac{EF_{cc} \times ED_{4-5} \times CR_{cc-c} \times 3}{BW_{4-5}} + \frac{EF_{cc} \times ED_{5-6} \times CR_{cc-c} \times 3}{BW_{5-6}} \right)$$

and:

$RBTC_{clams}$	=	risk-based concentration in clams (µg/kg, wet-weight)
CR_{c-cc}	=	consumption rate clams – child (g/day, wet-weight)
CR_{a-cc}	=	consumption rate – clams – adult (g/day, wet-weight)
$CR_{cc-c-adj}$	=	consumption rate clams – age-adjusted (g/kg)
EF_{cc}	=	exposure frequency clam consumption (days/year)
ED_c	=	exposure duration – child (years)
ED_a	=	exposure duration – adult (years)
ED_{0-1}	=	exposure duration age 0-1 (years)
ED_{1-2}	=	exposure duration age 1-2 (years)
ED_{2-3}	=	exposure duration age 2-3 (years)
ED_{3-4}	=	exposure duration age 3-4 (years)
ED_{4-5}	=	exposure duration age 4-5 (years)
ED_{5-6}	=	exposure duration age 5-6 (years)
BW_{0-1}	=	body weight age 0-1 (kg)
BW_{1-2}	=	body weight age 1-2 (kg)
BW_{2-3}	=	body weight age 2-3 (kg)
BW_{3-4}	=	body weight age 3-4 (kg)
BW_{4-5}	=	body weight age 4-5 (kg)

BW_{5-6} = body weight age 5-6 (kg)
BW_a = body weight – adult (kg)
$CF_{kg/mg}$ = conversion factor – kg/mg (0.000001)
$CF_{mg/\mu g}$ = conversion factor – mg/µg (0.001)
$CF_{mg/g}$ = conversion factor – mg/g (1,000)
AT_c = averaging time, cancer (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$
TR = target cancer risk

The exposure assumptions are shown in Table 1. Revised RBTCs for cPAHs are shown in Table 3. Consistent with selection of the TTL in the ROD, the more stringent value is the basis for the TTL in the ESD.

1.4 Risk-Based Threshold Concentrations for Benzo(a)pyrene Based on a Non-Cancer Endpoint

The 2014 ROD did not provide cleanup goals based on noncancer effects of cPAHs because no noncancer reference doses were available at that time. However, as part of the 2017 revised cancer assessment for benzo(a)pyrene, EPA established a reference dose (RfD) for benzo(a)pyrene of 0.003 mg/kg-day. Unlike the cancer slope factor, which may be applied to the other cPAHs through the application of Potency Equivalency Factors, the RfD is only applicable to benzo(a)pyrene. In order to assess whether the revised cleanup goals based on a cancer endpoint would be protective of non-cancer effects associated with benzo(a)pyrene, EPA conducted a screening assessment using its Regional Screening Levels (RSLs, EPA 2020) as a basis for such a comparison. The RSLs are risk-based screening levels, regularly updated using the latest toxicity values and default exposure assumptions. Because cancer risk and noncancer hazard are directly proportional to the degree of exposure and the toxicity of a chemical, a comparison of RSLs calculated based on cancer and noncancer endpoints can be used to determine which value is more protective. Assuming default exposure assumptions for incidental ingestion and dermal exposure associated with residential land use and a target cancer risk of 1×10^{-6} or noncancer hazard quotient of 1, the RSLs are 0.1 mg/kg and 18 mg/kg, respectively. Thus, cleanup goals calculated in the ESD based on the noncancer RfD for benzo(a)pyrene would be greater than those based on a cancer risk of 1×10^{-6} by more than two orders of magnitude.

Table 1. Human Health Exposure Values

Symbol	Description	Units	Value
ABS	Dermal absorption factor	unitless	0.13
$AF_{\_beach}$	Soil to skin adherence factor- beach play	mg/cm^2-event	0.2
$AF_{\_clam}$	Soil to skin adherence factor- clamming	mg/cm^2- event	0.2
AF_{net}	Soil to skin adherence factor- netfishing	mg/cm^2- event	0.2
AT_c	Averaging time - cancer	days	25,550
$BW_{0-!}$	Body weight <1 yr	kg	9.1
BW_{1-2}	Body weight 1-2 yrs	kg	11.3
BW_{2-3}	Body weight 2-3 yrs	kg	13.3
BW_{3-4}	Body weight 3-4 yrs	kg	15.3
BW_{4-5}	Body weight 4-5 yrs	kg	17.4
BW_{5-6}	Body weight 5-6 yrs	kg	19.7
BW_a	Body weight - adult	kg	81.8
CF	Conversion factor - kg/mg	kg/mg	0.000001
CF	Conversion factor - mg/µg	mg/µg	0.001
CF	Conversion factor - mg/g	mg/g	1000
CR_{cc_a}	Clam consumption rate - adult	g/day	43.4
CR_{cc_c}	Clam consumption rate - child	g/day	17.4
$CR_{cc\_c\_adj}$	Age-adjusted clam consumption factor	g/kg	15047
DF_{beach_adj}	Age-adjusted dermal factor	mg/kg	62141
$ED_{\_clam}$	Exposure duration – clamming	years	64
ED_{a-cc}	Exposure duration – clam consumption- adult	years	70
ED_{0-1}	Exposure duration <1 yr– beach play	years	1
ED_{1-2}	Exposure duration 1-2 yrs– beach play	years	1
ED_{2-3}	Exposure duration 2-3 yrs– beach play	years	1
ED_{3-4}	Exposure duration 3-4 yrs– beach play	years	1
ED_{4-5}	Exposure duration 4-5 yrs– beach play	years	1
ED_{5-6}	Exposure duration 5-6 yrs– beach play	years	1
ED_{net}	Exposure duration - netfishing	years	44
$EF_{\_beach}$	Exposure frequency - beach play	days/yr	65
$EF_{\_clam}$	Exposure frequency - clamming	days/yr	120
EF_{cc}	Exposure frequency – clam consumption	days/yr	365
EF_{net}	Exposure frequency - netfishing	days/yr	119
$IR_{\_sed\_clam}$	Incidental sediment ingestion rate - clamming	mg/day	100
IR_{beach_adj}	Age-adjusted sediment ingestion rate	mg/kg	35493
$IR_{sed-beach}$	Incidental sediment ingestion rate	mg/day	200
$IR_{sed-net}$	Incidental ingestion rate	mg/day	50
$SA_{\_clam}$	Skin surface area exposed – adult - clamming	cm^2	6,040

Table 1. Human Health Exposure Values

Symbol	Description	Units	Value
SA_{0-1}	Skin surface area < 1 yr	cm^2	1,330
SA_{1-2}	Skin surface area 1-2 yrs	cm^2	1,750
SA_{2-3}	Skin surface area 2-3 yrs	cm^2	2,069
SA_{3-4}	Skin surface area 3-4 yrs	cm^2	2,298
SA_{4-5}	Skin surface area 4-5 yrs	cm^2	2,515
SA_{5-6}	Skin surface area 5-6 yrs	cm^2	2,751
SA_{net}	Skin surface area exposed – adult - netfishing	cm^2	3,600
CSF	Cancer slope factor - benzo(a)pyrene	$(mg/kg\text{-}day)^{-1}$	1
TR	Target cancer risk	unitless	1E-06

Table 2. Risk-Based BaP-equivalent Threshold Concentrations in Sediment

Scenario	Ingestion (µg/kg dw)	Dermal (µg/kg dw)	Total (µg/kg dw)
Netfishing	7,983	4,265	2,780
Clamming	2,721	1,733	1,059
Beach Play	720	3,163	586

Table 3. Risk-Based BaP-equivalent Threshold Concentrations in Clam Tissue

Child (µg/kg ww)	Adult (µg/kg ww)
1.5	1.9

2.0 References

EPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. Washington, D.C. EPA/630/R-03/003F. March 2005.

EPA 2020, Regional Screening Levels, May 2020 update. https://www.epa.gov/risk/regional-screening-levels-rsls

LDWG. 2005. Lower Duwamish Waterway Remedial Investigation, Remedial Investigation Report. Appendix B: Baseline Human Health Risk Assessment

LDWG. 2007. Lower Duwamish Waterway Remedial Investigation, Remedial Investigation Report. Appendix B: Baseline Human Health Risk Assessment. Errata: Adjustment to Tulalip Tribes Seafood Consumption Rates and the Impact on Risk Estimates.

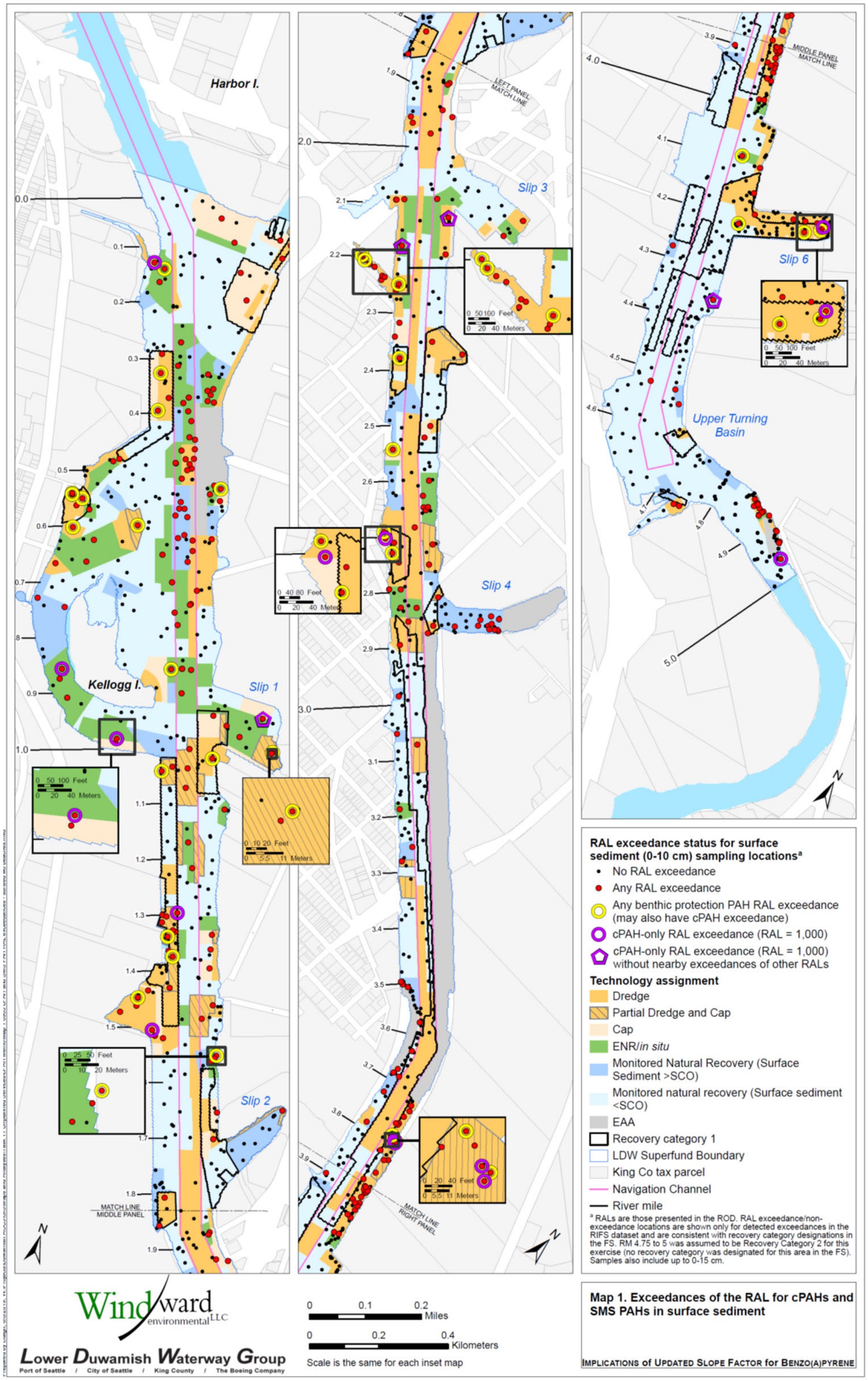
APPENDIX B

EVALUATION OF cPAH RAL CHANGES ON REMEDIAL ACTION AREAS AND COSTS

1 Evaluation of cPAH RAL Changes on Remedial Action Areas and Costs

1.1 Evaluation of Surface Sediment

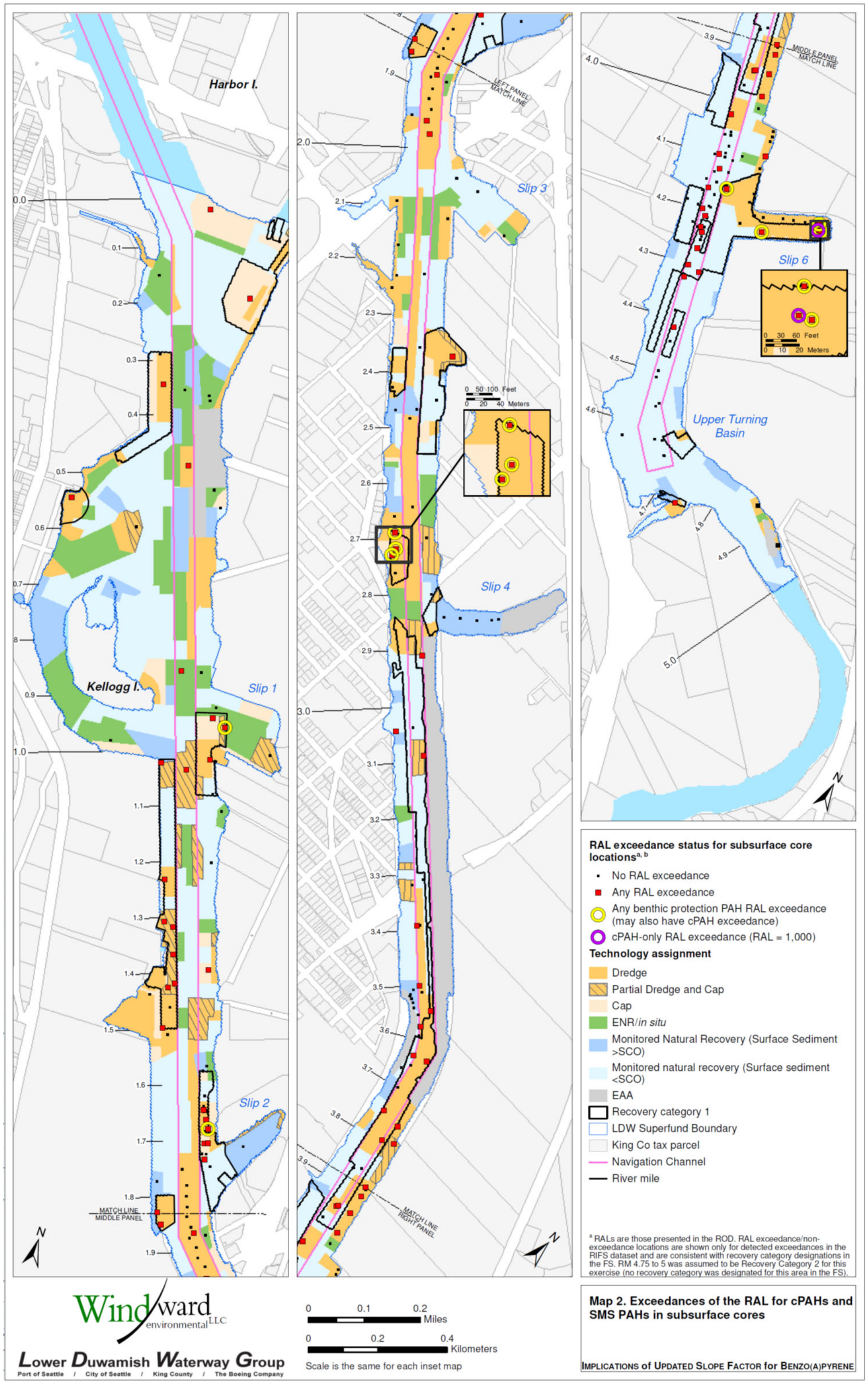
As an initial step to determine the potential magnitude of changes to remedial action areas and costs, surface sediment data was evaluated for cPAH only exceedances of the RAL. Based on a technical analysis conducted by LDWG (LDWG, 2019), Map 1 indicates cPAHs were detected at concentrations greater than the ROD RAL of 1,000 µg/kg dw at 49 of the 711 sample locations in the RI/FS (LDWG, 2012) dataset for the 0-10 cm depth interval. Of the 49 sample locations, four locations had sediment concentrations greater than only the cPAH RAL and were located far enough from other locations to potentially affect remedial area boundaries (see purple symbols on Map 1). These findings formed the basis for determining the potential changes to remedial actions for surface sediment and associated acreage so that subsequent cost impacts could then be estimated.



Map 1. Exceedances of the RAL for cPAHs and SMS PAHs in Surface Sediment (Source: LDWG, 2019)

1.2 Evaluation of Subsurface Sediment

Data for the 0-60 cm depth interval in the RI/FS (LDWG, 2010) dataset for subtidal areas indicate that cPAHs were detected at concentrations greater than the ROD RAL of 1,000 µg/kg dw at only one sample location (see purple-circled locations on Map 2). This location is adjacent to sample locations where concentrations were greater than RALs for one or more other COCs. Based on this analysis, the effect on remedial action areas of revising the cPAH RAL for the 0-60 cm depth interval and for shoaled area depth intervals to 5,500 µg/kg dw is minor and within the uncertainty of the remedial action area estimate in the ROD (EPA, 2014).



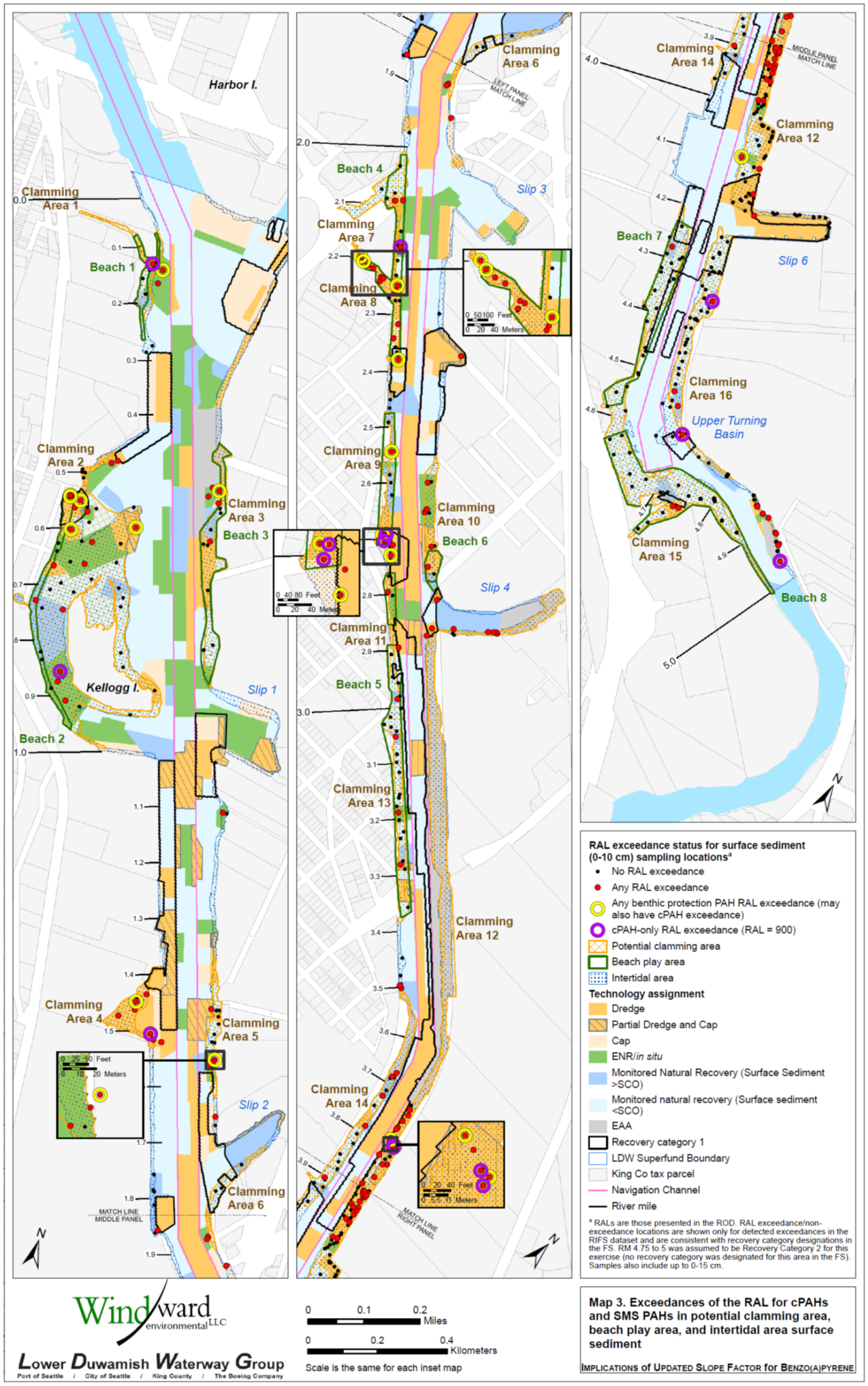
Map 2. Exceedance of the RAL for cPAHs and SMS PAHs in Subsurface Cores (Source: LDWG, 2019)

For intertidal sediments in the 0-45 cm depth interval, the RI/FS dataset is limited. As shown on Map 3, EPA compared data for intertidal sediments to the ROD intertidal RAL of 900 µg/kg using RI/FS data for the 0-10 cm interval and, where available, the 0-45 cm interval. Almost all of the sediment samples with concentrations greater than the ROD RAL for cPAHs also had concentrations of other COCs exceeding RALs or were located close to such samples and fell within the remedial action areas shown on ROD Figure 18 (EPA, 2014). Based on this comparison, the remedial action areas would not be affected by an increase in the RAL for cPAHs.

Three intertidal sediment samples with cPAH concentrations greater than the ROD RAL, between RM 4.3 and RM 5, were not close to samples where concentrations of other COCs exceeded RALs. These are in areas where monitored natural recovery, rather than active remediation, is indicated in Figure 18.

Based on this analysis, the effect of the proposed cPAH RAL for subsurface depth intervals on remedial action areas and volumes is minor and within the uncertainty of the remedial action area estimate in the ROD.

Likely, dredging volume estimates would also not change significantly, given that, as indicated above, the results of the 0-45 cm and 0-60 cm samples indicate concentrations of other COCs greater than RALs, which would drive remedial action. As such, impacts to the total project cost estimate were primarily driven by changes identified for surface sediment.



Map 3. Exceedances of the RAL for cPAHs and SMS PAHs in Potential Clamming Area, Beach Play Area, and Intertidal Area Surface Sediment (Source: LDWG, 2019)

1.3 Estimation of Area Impacts to Determine Cost Changes

In order to calculate the change in costs resulting from the RAL change for cPAHs, acreage was estimated based on the analysis conducted to determine sediment samples impacted by the change in RALs. Only seven locations were determined to have a quantifiable impact on the change to remedial technologies and associated acreage (Table 1).

Table 1. Locations, Acreage, and Technology Assignment Impacted by cPAH RAL changes

Location (RM)*	Acres Reduced	Technology Assigned in ROD
0.1W	0.38	Dredge
0.8W	1.05	ENR
0.9E	1.25	Dredge
1.3W	0.25	Dredge
2.1E	1.00	Dredge
2.2W	0.49	ENR
4.4E	0.38	MNR

*All locations included where cPAH-only RAL exceedance (RAL = 1,000) without nearby exceedances of other RALs are identified in accompanying map. Select locations with cPAH-only RAL exceedance (RAL = 1,000) also included on a case by base basis if determined remedy assignment would be substantially impacted.

A linear reduction in cost was then assumed for the decrease in acreage assigned to the three remedial technologies impacted by the cPAH RAL change. Costs from Table 29 of the ROD were accordingly scaled down to reflect the reduction in remedial action (Table 2).

Table 2. Estimated Cost Reduction by Remedial Technology

	Estimate Acres in ROD (Section 3.2)	**Estimated Cost*** (Table 29 in ROD)	**Acreage Reduced as a Result of cPAH Toxicity Update**	**Total Cost with Reduced Acreage**
Total Acres to be Dredged	105	$33,496,452	2.89	$920,569.78
Total Acres for ENR	48	$6,143,912	1.53	$196,474.93
Total Acres for MNR	235	0	0.38	0

* Does not include cost for disposal , dredge residuals, backfill, or monitoring line items (assumed to be nominal)

Lastly, this cost reduction was applied to the total project cost identified in the ROD to calculate a new total project cost of 341,116,887 (Table 3).

Table 3. Reduction in Total Project Cost

Total Project Cost Estimate in ROD	$342,233,932
Updated Project Cost Less cPAH Only Locations	$341,116,887
Percent Reduction in Cost	0.33%

2 References

EPA. (2014, November). Record of Decision for the Lower Duwamish Waterway Superfund Site.

LDWG. (2010). Lower Duwamish Waterway Remedial Investigation, Remedial Investigation Report Final. Submitted to U.S. EPA.

LDWG. (2012). Final Feasibility Study Lower Duwamish Waterway Superfund Site.

LDWG. (2019, June). Technical Memorandum: Implications of Updated Toxicity Values for Benzo(a)pyrene.

APPENDIX C

RESPONSIVENESS SUMMARY

TABLE OF CONTENTS

1 INTRODUCTION

This responsiveness summary is Appendix C of the Explanation of Significant Difference (ESD) and provides a summary of the public's comments submitted to the U.S. Environmental Protection Agency (EPA) regarding the Proposed ESD for the Lower Duwamish Waterway Superfund site, issued on February 4, 2021. It presents paraphrased comments by topic and provides EPA's responses. Selected excerpts of comment language are provided.

Public comment on a proposed ESD and a responsiveness summary are not required by Superfund regulations (National Contingency Plan at 40 Code of Federal Regulation § 300.430(f)(3)(F)). However, given the community interest in the Lower Duwamish Waterway Superfund site, EPA chose to take public comment before making a final decision. EPA provides this responsiveness summary in the interest of transparency and public engagement.

We received a total of 623 comments, including 331 by email, 42 by physical mail, and 250 in a spreadsheet enclosed with a letter from the Duwamish River Cleanup Coalition (DRCC/TAG), the Community Advisory Group (CAG) and Technical Advisory Grant recipient for the site.

All of the comments we received have been considered in EPA's final decision. Many commenters voiced concern that the ESD will result in less protection of human health and the environment. While we acknowledge the concern, the ESD provides the same level of protection of human health and the environment as the Record of Decision (ROD) issued in 2014, consistent with CERCLA. EPA did not receive information from commenters that changes our proposal to revise the carcinogenic polycyclic aromatic hydrocarbon (cPAH) cleanup levels, target tissue levels, and remedial action levels to incorporate the 2017 Integrated Risk Information System (IRIS) cancer slope factor for benzo(a)pyrene (BaP). The decision is based on EPA policy and guidance and on the best available scientific information and is consistent with CERCLA. The following are EPA's responses to the comments received.

2 BACKGROUND

The Lower Duwamish Waterway ROD established Remedial Action Objectives (RAOs) to reduce the human health and ecological risks posed by the contamination at the site. RAOs are narrative statements. The ROD also established numerical sediment cleanup levels, concentrations of contaminants that are protective of human health and the environment to be achieved in the long term, through active cleanup and monitored natural recovery, to meet the RAOs. The ROD also established Remedial Action Levels (RALs) for the contaminants of concern that define the areas where active cleanup technologies will be applied.

The ROD established sediment cleanup levels and RALs for protection of the environment for 41 contaminants and for protection of human health for four contaminants: PCBs, arsenic, dioxins/furans, and cPAHs. The ROD also includes target concentrations of these contaminants in fish and shellfish tissue to measure progress in reducing risks associated with seafood consumption.

The cleanup levels for cPAHs are associated with direct contact with sediments by tribal net fishers, tribal clam harvesters, and children playing on beaches and are based on an excess cancer risk of 1×10^{-6} (the risk of one additional occurrence of cancer out of one million people).

The target tissue concentration for cPAHs applies to clams and is based on an excess cancer risk of 1×10^{-6}. The ROD cleanup levels, RALs, and target tissue concentrations for cPAHs were calculated using the 1987 cancer slope factor of 7.3 per mg/kg-day. BaP serves as the reference against which the cancer potency of the six additional cPAHs are compared using relative potency factors.

The IRIS *Toxicological Review of Benzo(a)pyrene* (EPA 2017) calculated a cancer slope factor for BaP of 1 per mg/kg-day. When compared to the previous value, the 2017 slope factor results in lower risk estimates associated with exposure to BaP and mixtures of cPAHs. Risk-based cleanup levels, target tissue levels, and RALs for cPAHs can thus be higher, meet the same RAOs, and be protective under CERCLA. This ESD does not change any of the RAOs. As such, EPA determined that the new cancer slope factor should be incorporated into the Lower Duwamish Waterway ROD before cleanup started.

The ESD changes to the cPAH RALs will affect the remedial footprint only where cleanup is driven solely by cPAHs (in other words, where other contaminant concentrations are below RALs). Other contaminants, particularly PCBs, are widespread above RALs. Based on information available at the time of the ROD, changing the cPAH RAL reduces the 177-acre area the ROD estimated would require active cleanup by approximately five acres. Cleanup areas and cost estimates will be refined during remedial design as new data becomes available to define the active remediation areas.

The changes set forth in the ESD are consistent with the original objectives of the ROD. The remedy still reduces risks within a reasonable time frame, is implementable, provides for long-term reliability of the remedy and minimizes reliance on institutional controls. The remedy will continue to achieve substantial risk reduction by dredging or capping in areas with the most contaminated sediments, reducing remaining risks to the extent practicable through enhanced natural recovery and monitored natural recovery, and managing remaining risks to human health through institutional controls. The remedy continues to provide the same level of cancer and non-cancer risk reduction to people. It does not change the remedy's protection of human health or the environment.

2.1 TRIBAL CONSULTATION AND COMMUNITY INVOLVEMENT

The Muckleshoot Indian Tribe, Suquamish Tribe, and Confederated Tribes and Bands of the Yakama Nation are federally recognized tribes with treaty protected fishing rights in the Duwamish River. The LDW is one of the locations of the Muckleshoot Tribe's commercial, ceremonial, and subsistence fishery for salmon. The Suquamish Tribe actively manages aquatic resources north of the Spokane Street Bridge, just north of the LDW study area. In June 2019, EPA provided information about the potential implications of the new BaP slope factor to the Suquamish and Muckleshoot Tribes' fisheries contacts and discussed the information with them in July 2019. In October 2020, EPA offered formal government-to-government consultation to the three federally recognized tribes. None of the tribes accepted the offer. In February 2021, EPA contacted the Duwamish Tribe to inform them in advance of the proposed ESD.

EPA released the proposed ESD for a 30-day public comment period on February 4, 2021. In response to requests from the public, EPA extended the comment period three times (see Attachment 1). The public comment period closed on April 21, 2021. During the comment period, EPA held a virtual public meeting which included a pre-recorded presentation about the ESD in English, Spanish, Vietnamese, and Khmer. The presentations were followed by a real-time question and answer session, with interpreters for the same languages. EPA also posted links to the slides and pre-recorded presentation on the Lower Duwamish Waterway webpage, and a question-and-answer document in the four languages was posted shortly after the meeting.

During the public comment period, EPA also presented at a Georgetown Community Council meeting and met with the Community Health Advocates.

3 PUBLIC COMMENTS AND RESPONSES

A majority of the comments opposed modification of the 2014 ROD or requested that EPA delay the ESD for additional studies or community involvement. Some questioned the scientific basis for the assessment of BaP and raised concern that the ESD would provide less protection for human health than the ROD. A number of commenters raised environmental justice concerns, given the characteristics of communities in the Duwamish Valley, and concern that proposed changes would harm the Duwamish Tribe. Commenters were also concerned that the change would provide less protection of water quality, fish, and wildlife. One comment requested formatting changes, clarifications, and corrections in the ESD itself.

3.1 SUPPORTING THE ESD

EPA received four comments expressing support for the ESD.

Comment summary

Comments expressing support for the ESD noted agreement with the scientific basis and included perspectives on balancing costs, benefits, and the impacts of cleanup.

> "I would like to thank EPA for considering the best available science and adjusting the RALs appropriately. The changes in the ESD are reasonable and appropriate. Using cleanup action levels that are too low not only result in unnecessary costs, it causes unnecessary impacts to the waterway and waterway users for no benefit to environment or the public."

> "I am a lifelong Seattle resident and I value a clean environment. At the same time, I believe cost/benefits must be considered. … The EPA's cleanup will never make the Duwamish a totally safe source of frequently consumed food. And it doesn't need to be."

> "Remedial goals under CERCLA should always be tied to protection of the public health and the environment, together with technical and economic feasibility. The starting point should always be applicable and relevant promulgated standards or risk based standards predicated upon the best available toxicological data and acceptable risk. Where the most current toxicological assessment reflects that initial remedial goals were overly conservative, it is both necessary and appropriate for EPA to revise the goals. Whether remediation is paid for by the Fund or by PRPs, response costs should not be incurred to achieve remedial goals that are no longer valid."

> "We support the U.S. Environmental Protection Agency's proposed changes issued on January 2021 for carcinogenic polycyclic aromatic hydrocarbon (cPAH) cleanup levels

> and remedial action levels based on the final Toxicological Review of Benzo(a)pyrene issued on January 19, 2017. These changes set cleanup levels to achieve the same risk levels supported by the current science regarding toxicity of benzo(a)pyrene and associated cPAHs."

EPA response

The 2017 *Toxicological Review of Benzo(a)pyrene* (EPA 2017) reflects the current science and EPA agrees that it is necessary and appropriate to incorporate the new information in the remedy selected in the ROD through this ESD.

3.2 Opposed to the ESD

Many of the comments (373 of 623) were submitted as one of two form letters opposing the ESD. The content of these letters is provided in Attachment 2. The remainder were unique comments. A representative sample is provided below:

> "… it is shameful that the EPA would attempt to further shirk its duties even more than in the 2014 agreement for the cleanup."
>
> "The community urges the EPA to remove sediments and have the river cleaned up according to the December 2014 Record of Decision."
>
> "It is imperative that EPA fulfills its 2014 commitment to fully clean up the Duwamish River and Waterway to standards that are safe for human activities including subsistence fishing. Do not backtrack on this commitment that has been held in good faith for the past 7 years by all of the community stakeholders."
>
> "[W]e demand that any further consideration of the amendment be overseen by a Title VI Committee to ensure the protection and rights of the impacted communities which have been deemed Environmental Justice communities."

EPA response

The changes to the cPAH cleanup levels, RALs, and target tissue levels are protective under CERCLA and will meet the unchanged RAOs presented in the ROD. EPA addresses specific concerns below.

3.3 Human Health Risk-Related Issues

3.3.1 The science behind the change in BaP slope factor is flawed

Comment summary:

DRCC/TAG prepared and distributed a fact sheet referencing concerns raised by scientists outside EPA about the selection of the IRIS slope factor for BaP. Many other comments echoed or expanded on this aspect of the DRCC/TAG fact sheet. The comments gave various reasons why the IRIS cancer slope factor for BaP should not be used, including that it is based on only two studies; did not consider available studies that would have led to more protective slope factor; does not account for uncertainty or weight of evidence; relied on old studies; and that the conclusions were driven by politics.

> “The science indicating that BaP is "less carcinogenic" than in previous estimates is highly disputed. Scientists, including those at nearby -- and well-respected -- University of Washington, believe there is not enough data to make that determination, given that the data relied on are over 20 years old.”
>
> “… it makes no sense to follow a determination that may well be simply politics, not good policy.”
>
> “Only 2 recent studies on BaP found a decrease in cancer risk while an additional 13 studies were either discarded as poorly executed or demonstrated increased risk associated with BaP exposure.”
>
> “We don’t know what all these chemicals do yet, and what their potential impact to the environment and human health is. I urge you NOT to lessen the amount of cleanup.”
>
> “In my experience, the number of chemicals originally thought to be carcinogenic that were subsequently deemed safe or not as toxic as originally feared pales by comparison to the number of chemicals initially considered safe that turned out to have serious health risks. Therefore, I am skeptical of the revised higher allowable levels of BaP.”
>
> “I understand there are multiple challenges to the scientific validity of the studies that have led to this proposed change, but I feel that the most important reason to reject this amendment is that it is short-changing our most vulnerable and undermining the mission of the EPA.”
>
> “There seems to be sufficient conflicting data on this issue that it would be premature to determine a lower health risk to the community. … Now is not the time to hedge that effort on the evidence of just two studies.”
>
> “In light of the uncertainty of the studies involved, the potential cost saving does not justify the health risk to the community.”
>
> “EPA looked at 15 research studies. They excluded 12 that did not test for lifetime exposure, and of the three that were left, they eliminated one more due to its use of less stringent protocols and reporting than the two newest studies. The two remaining studies indicated that BaP is 7-times less toxic than the previous standard used by EPA, while the excluded lifetime study indicated that BaP is about 1.5-times more toxic than previous standard (other studies also indicated a higher cancer risk than the new EPA standard).”

EPA response

The changes in the ESD are based on current science about the health risks associated with BaP. EPA’s IRIS program followed a standardized, rigorous, and transparent process to identify and evaluate scientific information about BaP. The 2017 IRIS assessment for BaP is not the subject of EPA’s request for comments on the ESD. However, many of the comments on the ESD are based on concerns about how the IRIS value was developed. The toxicological review of BaP provides detailed information supporting the selection of the slope factor for BaP. For additional information, please visit the IRIS webpage regarding the BaP assessment: https://cfpub.epa.gov/ncea/iris2/chemicallanding.cfm?substance_nmbr=136.

3.3.2 Cumulative and Synergistic Effects Have Not Been Evaluated

Comment summary

The cleanup levels for cPAHs do not consider either cumulative or synergistic effects of cPAHs and other contaminants.

> "[The ESD] does not take into effect the cumulative nature of the toxic stew that is already in the Duwamish…"

EPA Response

Information on the interactions between different contaminants found at Superfund sites is rarely available. EPA's risk assessment practice when assessing cancer risks is to assume that the risk from different chemicals is additive. Where interactions are truly synergistic, simple addition may underestimate the total risk. Conversely, metabolic processes may result in instances where the contribution from different chemicals is competitive or antagonistic, and the overall risk may be less than the additive risks of the two chemicals alone. EPA's risk assessment process makes conservative (or health protective) assumptions to address the uncertainties encountered. These conservative assumptions include that exposures are as high as reasonably expected and setting toxicity values to be protective of sensitive individuals in the population. It is EPA's position that the conservative assumptions used in the risk assessment process are likely to overestimate rather than underestimate risks.

3.3.3 Potency Equivalency Factors Should Not Be Used with the New Slope Factor for BaP to Assess cPAH Mixtures.

Comment Summary

Some commenters expressed concern that the use of potency equivalency factors (PEFs) to quantify the cancer risks of carcinogenic PAHs other than BaP may understate the risk of those chemicals.

> "[H]ealth risk estimates for other carcinogenic polycyclic aromatic hydrocarbons (cPAHs) have long been based on the toxicity of BaP. However, more recent science indicates these assumptions may not be protective and researchers who specialize in cPAHs say each chemical needs to be studied individually."

> "It is my understanding that this proposal is based on research that one chemical BaP (benzo(a)pyrene) is less toxic. First of all I do not believe that there is sufficient research to support the health claim for this chemical for the long term effects. Second I would question the conclusion that there are no increased deleterious health effects by raising the level of the other cPAHs and that this has not been demonstrated."

> "I understand that the 2017 EPA update indicated that the cancer risk associated with BaP is less than previous estimates. However, reportedly there are other studies which indicate that using BaP to evaluate carcinogenicity of other PAHs is insufficient." [*Comment included links to two Oregon State University (OSU) studies]*

EPA Response

EPA briefly reviewed the OSU references cited above and in the handout for the Portland Harbor site. While the studies provide information that suggests that PEFs may under- or overestimate the carcinogenic potential of complex mixtures of PAHs, the studies do not identify alternate PEFs. EPA has always acknowledged the uncertainties associated with estimating the risks from complex mixtures. However, use of the PEFs remains the recommended approach available at this time (EPA 1993) and is independent of the assessment of the carcinogenic potential of benzo(a)pyrene alone.

3.3.4 THE ESD DOES NOT ACCOUNT FOR EARLY LIFE EXPOSURE TO cPAHS

Comment Summary

One commenter raised the issue of increased risk associated with early life exposure to cPAHs and asserted that this was not considered by EPA in the ESD.

> "The changes which only correspond to the new CPAH cleanup levels still put the most impacted in danger which are children who play on the beach, clam gatherers, tribal fishers, and all who fish and eat from the Duwamish River. DRAG calls to the attention of the EPA the fact that we do not know the impact of BaP exposure on early children. From the EPA's own Toxicological Review of Benzo[a]pyrene Executive Summary:
>
> According to the Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens (U.S. EPA, 2005a), individuals exposed during early life to carcinogens with a mutagenic mode of action are assumed to have an increased risk for cancer. The oral slope factor of 1 per mg/kg-day and inhalation unit risk of 0.0006 per µg/m3, calculated from data applicable to adult exposures, do not reflect presumed early life susceptibility to this chemical. Although some chemical-specific data exist for benzo[a]pyrene that demonstrate increased early life susceptibility to cancer, these data were not considered sufficient.
>
> Repeatedly the report indicates increased risk with early exposure, and yet, the EPA also states that we do not know the rate of increased risk due to early childhood exposure. Thus, the EPA's amendment is not only scientifically unfounded, but all signs point to it also being quite unsafe. To go ahead with the amendment would be wholly irresponsible, and could easily be considered an attack on the people of the Environmental Justice neighborhoods of South Park and Georgetown, and the tribal community members who live on and off of the Lower Duwamish River and are most impacted."

EPA Response

The ESD cleanup levels for cPAHs account for increased risks associated with childhood exposures. As noted in Appendix A to the ESD, age-dependent adjustment factors (ADAFs) were applied when calculating revised risk-based cleanup levels. Use of ADAFs is consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA 2005a), which recommends using default ADAFs when insufficient information is available to determine a specific early-life risk. Increased risk from early-life exposures to cPAHs were accounted for in the human health risk assessment for the Lower Duwamish, as well as when calculating cleanup levels for the ROD and ESD.

3.3.5 The Cancer Slope Factor for BaP is Based on Old Studies and Isn't Corroborated by Other Studies

Comment Summary

The critical studies used for the new risk assessment are newer than the ones used in the previous assessment, but they are still over 20 years old.

> "What is worrisome about the re-assessment for benzo(a)pyrene, is that the data used to support the new estimate are from studies that are more than 20 years old and there is no discussion of additional studies that are in agreement with these data in the IRIS document. The "weight of evidence" discussion typically includes a comparison of the results from studies conducted before and after the "critical studies" to provide confidence that the new estimate is supported by other research. In this case, the results of the two studies certainly are not consistent with prior research which indicates that benzo(a)pyrene is 5 to 10 times more potent than the new estimate; and more importantly there are no data presented (weight of evidence) in support of the new estimate from studies published over the past 20 years. The current scientific weight of evidence, therefore, does not support using the new estimate for risk management decisions, such as the ESD."

EPA Response

EPA disagrees with the commenter's conclusion that current science does not support the use of the 2017 cancer slope factor when making remedy decisions in the Superfund program. The 2017 toxicological review of benzo(a)pyrene is based on a comprehensive review of scientific studies conducted through 2014, with an additional search for relevant information for the period between 2014 and 2016.

As described in the toxicological review, there are limited animal studies of sufficient quality on which to base a quantitative dose-response assessment for benzo(a)pyrene cancer risk. Under EPA's Guidelines for Carcinogen Risk Assessment (EPA, 2005b), the "weight-of-evidence" evaluation consists of assessing the available evidence that an agent is carcinogenic to humans and the conditions under which cancer is likely. This assessment is narrative rather than quantitative. However, one of the questions EPA asked of the expert external peer-review panel (Scientific Advisory Board) was whether the proposed cancer slope factor of 1 per mg/kg-day was scientifically supported given the preceding steps of selecting studies appropriate for dose-response analysis and calculating points of departure. The SAB did not express any concern that the current estimate differed from previous conclusions.

3.4 ENVIRONMENTAL ISSUES

3.4.1 THE ESD HARMS WILDLIFE AND THE ENVIRONMENT

Comment summary

The ESD must protect orcas, salmon, fish, wildlife, and ecosystems.

> "that is a small price to pay for the survival of salmon, orcas and clean air and water for people."
>
> "It's important to keep the river clean for the river wildlife"
>
> "Our river valley suffers from pollution in the air and water. We need to keep our standards high to allow us all to live with our river now and in the future, and to protect the wildlife in the Duwamish Valley."
>
> "It's important to keep the river clean because it sustains many forms of life including entire ecosystems of animal and plant life. Fish also depend on its purity as trash and other contaminants are deadly. Disrupting the ecosystem can cause irreversible damage to the plant/animal/fish population as well as the surrounding plant life and the people who depend on it."
>
> "As a resident of Seattle, I am deeply concerned about the state of the Duwamish River. It has been the dumping ground for industry for far too long with harmful consequences for the environment, wildlife, the health of nearby residents, and the entire Puget Sound ecosystem."
>
> "It is imperative that we as a community do everything possible to repair the damage that has been done to the Duwamish waterway and surrounding area. Please do not allow increased levels of toxins to be permitted in our environment - we know that these chemicals are harmful to all non-human and human life and are responsible for the health of current and future generations who will inhabit this land."
>
> "I ask that you choose to be the best stewards and caretakers of our natural environment as you can be."
>
> "I am happy that the chemical is safer from the new study, but a pollution is still a pollution in the river; it doesn't belong there naturally. It should be cleaned up the best we can. I feel EPA don't need to make the change and stay with the cleanup plan before. The river will be much cleaner and will have less chemicals in the water and in the seafood too. I feel safe that way."
>
> "I live in the neighborhood, fish in the Sound. I believe cleanup of the Duwamish should be a priority for Seattle, the State, and Federal Government and that a refreshed riverway will provide a range of benefits for people, the economy, and the local environment. I am not in favor of lessening the cleanup efforts and funding."

EPA response

The cleanup levels in the ROD for the protection of ecological receptors are based on the baseline ecological risk assessment (LDWG, 2007) and Washington Sediment Management

Standards. This ESD does not change these levels. The ROD, as modified by the ESD, is protective of human health and the environment.

3.4.2 THE cPAH TARGET TISSUE LEVELS IN THE ESD WILL NOT PROTECT CLAMS

Comment Summary

Target tissue levels in the ESD for cPAHs in clam tissue may not protect clams.

> "…the clam tissues concentrations (~1,100 ppb), which are not protective of human health and are probably not protective of the clams themselves. We need to be protective of both types of exposures."

EPA Response

EPA is not aware of the basis for the cited "…the clam tissues concentrations (~1,100 ppb)." The 1,100 µg/kg cPAH cleanup level for intertidal sediment in the ESD is based on human direct contact with sediment. The target clam tissue concentration of 1.5 µg/kg cPAH in the ESD is a human health-based value for the protection of people consuming clams. It is not possible to equate sediment cleanup levels with tissue concentration in clams as no relationship between sediment and tissue concentrations could be established for PAHs. Sediment cleanup levels for PAHs protective of benthic organisms (including clams) were established in Table 20 of the ROD. They are unchanged by this ESD and therefore still apply to sediment where benthic organisms are expected to be present.

3.4.3 THE RISK-BASED SEDIMENT CLEANUP LEVELS IN THE ESD FOR HUMAN HEALTH PROTECTION SHOULDN'T BE HIGHER THAN ECOLOGICAL SCREENING VALUES

Comment summary

The IRIS value must not be valid, as it results in higher cleanup levels for ecological health than for human health protection, which is not typically the case.

> "Cancer endpoints are normally far more sensitive and therefore far lower than ecotoxicity-based endpoints, and yet these [National Status and Trends] NS&T values are uniformly stricter and more protective than the proposed RAL values in the ESD!"

EPA Response

The comment conflates cleanup levels with RALs. RALs are used to delineate areas that require active remediation (dredging, capping and enhanced monitored recovery) and are generally higher than cleanup levels as they include consideration of natural recovery following dredging, capping, or ENR. The cleanup levels are long-term levels that the remedy is expected to meet for the site.

Cleanup levels in sediment for the protection of human health are dependent on not only toxicity information, but also the amount and duration of estimated exposures. Thus, a direct comparison of human health and ecological cleanup levels is not appropriate and is not informative as to which value is more protective. Further, it is not correct to compare a NOEL (no observed effects level) in any given species to a cleanup level for the protection of human heath based on a cancer endpoint. The former represents a concentration at which no effects were observed, which by definition is lower than a concentration that may elicit any effect, adverse or otherwise. Cleanup levels based on an acceptable cancer risk are explicitly based on an adverse effect, defined for a given exposure as either an excess risk of cancer to an individual or an acceptable number of excess cancers in a population.

3.4.4 EPA SHOULD CONSIDER UPDATING CLEANUP LEVELS FOR ECOLOGICAL PROTECTION

Comment Summary

EPA's approach to setting RALs for PAHs should consider recent ecotoxicological research showing BaP toxicity to invertebrates and fish.

> "Although the carcinogenicity of B(a)P is arguably the most serious concern, abundant recent ecotoxicological research has shown that B(a)P is more toxic to a variety of marine and freshwater aquatic invertebrates in fish than originally thought. Recent research from NOAA's Northwest Fisheries Science Center (NWFSC) has released a flurry of peer-reviewed publications documenting sublethal and potentially long-term effects of BaP and other PAH in the aquatic and marine environment …"

EPA Response

The changes in cPAH cleanup levels in the ESD are prompted by new information about human health. The baseline ecological risk assessment performed during the Remedial Investigation (LDWG, 2007) considered risks to marine aquatic invertebrates and fish. The assessment considered risks to fish from dietary pathways of PAHs and concluded that effects on growth in Chinook salmon (the most sensitive endpoint available at the time) occurred at PAH concentrations higher than maximum values detected in LDW in benthic prey organisms. For this reason, PAHs were not selected as a contaminant of concern for fish. New information regarding the toxicity of BaP and other PAHs to fish will be considered, if available, when EPA conducts statutorily required five-year reviews.

3.4.5 BAP SHOULD NOT BE USED AS A SURROGATE FOR OTHER ECOTOXIC AND CARCINOGENIC CPAHS.

Comment Summary

Commenter questions the appropriateness of using BaP as a surrogate.

> "Other similar non-polar, hydrophobic high molecular weight PAHs are very similar to B(a)P and are both ecotoxic and carcinogenic (they are also cPAHs). They all have comparable ER-L values (as published by NOAA's National Status & Trends program). Key examples include chrysene (384 ppb), Benz(a)anthracene (261 ppb), dibenz(a,h)anthracene (63.4 ppb), and fluorene (19 ppb). In other words, it isn't appropriate to simply use B(a)P as a blanket surrogate for each of these other toxic homologs, especially when the toxicity and ecotoxicity characteristics have been well studied and documented."

EPA Response

PAH cleanup levels for the protection of benthic receptors do not use BaP as a surrogate but are established individually for each PAH as shown in Table 20 of the ROD. The use of BaP as an index for human health risks associated with cPAHs is discussed in Section 3.2.3 above.

3.4.6 SEDIMENT CPAH LEVELS IN THE ESD WILL NOT PROTECT WATER QUALITY

Comment summary

The ESD will allow higher sediment concentrations of cPAHs. These sediment concentrations may affect water quality. EPA should consider using National Water Quality Criteria to back calculate sediment RALs (using Equilibrium Partitioning assumptions).

> "DRCC understands that there is no strong correlation between sediment cPAH concentrations and clam tissue concentrations. However, DRCC is concerned that the revised cPAH sediment cleanup levels may impact clam tissue levels as PAHs and other contaminants in sediments dissolve into the water column and change water quality. While DRCC acknowledges that Ecology is responsible for source control on the LDW, we are not convinced that their Green Duwamish "Pollutant Loading Assessment" model will sufficiently capture the effects of contaminants in sediments on water quality. We request that the EPA require testing of cPAH sediment partitioning to the water column in order to ensure a safe clam and fish consumption scenario. We believe that EPA should conduct testing and model cPAH water column concentrations with the revised sediment RALs before proceeding with the ESD."
>
> "I also support the request of the Duwamish River Clean Up Coalition that the EPA conduct testing and model cPAH water column concentrations with the revised sediment Remedial Action Levels and that you do so before finalizing the Explanation of Significant Decision."

EPA Response

The Remedial Investigation/Feasibility Study and the pre-design studies completed after the ROD assessed cPAH concentrations in sediment and surface water, but the relationship between them is not well understood. Although surface water will not be directly remediated, we expect source control and sediment cleanup to improve water quality. The ROD (see Section 13.4) describes EPA's long-term expectations for the remedy, including how water quality will be considered as active remediation, natural recovery and source control continue

3.5 PUBLIC PROCESS AND ENVIRONMENTAL JUSTICE

3.5.1 EPA'S COMMUNITY OUTREACH WAS INADEQUATE AND NOT TRANSPARENT

Comment summary

EPA received comments stating that this ESD was developed in a closed process without transparency, oversight, or adequate public participation. The barriers caused by the pandemic left some community members out.

> “Given the timing of this proposed change, the impacted fishing and resident communities of the Duwamish have been given inadequate opportunity to understand and meaningfully respond to the proposed change. Many members of the Duwamish communities remain in isolation due to the Covid-19 pandemic. Regular community meeting places and events have been suspended. Residents who do not have internet access have had absolutely no opportunity to learn about, let alone respond to, the proposed ESD.”
>
> “During the roundtable meeting for our community with EPA Reps, there was a lack of representation from all groups involved as well as a lack of transparency from the meeting not being filmed and made public to the community. The DRCC comment letter was also not made public until 3 days before commenting closed. There did not also seem to be attempts at reaching the public through door mailers or door-door knocking.”
>
> “The EPA does not yet have a new administrator in place for this region which would be necessary to provide the critical support regarding all the above-mentioned issues at hand, potentially shielding itself from further complications with cleanup amendment made in haste given the consortium of complicating factors.”

EPA response

Although Superfund regulations do not require EPA to seek public comment on an ESD, we have engaged in extensive outreach to the community. Refer to Section 1.2 above for a summary of public outreach related to the proposed ESD.

We work closely with DRCC/TAG to ensure they have the information they need to allow them to meet with and advise coalition members (organizations and individuals) and other community members.

In addition, over a year before issuing the ESD for public comment, EPA provided information about the IRIS BaP assessment to community and tribal representatives and presented similar information at a stakeholder meeting and Roundtable meetings. EPA shared a technical memorandum prepared by the Lower Duwamish Waterway Group about the potential implications of the IRIS assessment for the remedy selected in the ROD. At the October 2019 Roundtable meeting, EPA suggested a public comment process, which Roundtable members supported.

During periods when an appointed regional administrator is unavailable, the deputy regional administrator serves in that capacity, providing senior leadership. Additionally, Region 10 worked with EPA Headquarters to develop the proposed ESD, which will be signed by the EPA Administrator.

3.5.2 ENVIRONMENTAL JUSTICE IS NOT SERVED BY THE PROPOSED CHANGE

Comment Summary

Many commenters voiced environmental justice concerns about the ESD, with a focus on whether the ESD protects communities with environmental justice characteristics and vulnerable populations.

“We are the impacted marginalized community members who consume the seafood, live, and work by the river are happy to see the river is being cleaned, protect, and sustain for the many more generations to come. When this proposed changed of cleanup, we are still concerned about the health impacts since a certain level of PAHs are still allowed in the river, however, we are not a scientist and we trust, respect, and hope that the government agencies, like EPA are doing to serve to protect the health of ours and the environment.”

“The regions most impacted by this superfund site are in Seattle’s historically Black and Brown neighborhoods of South Park and Georgetown, areas that are also home to some of Seattle’s most economically disenfranchised households. The current cleanup plan was already a compromise to said impacted communities-- to further withdraw clean-up with this amendment goes directly against the EPA’s commitment to Environmental Justice, and Executive Order 12898: Federal Action To Address Environmental Justice in Minority Populations and Low-Income Populations.”

“The ROD was already finalized and should not be changed, especially changes that contribute to environmental racism.”

“…the EPA has not meaningfully engaged the Black, Indigenous, and People of Color (BIPOC) communities who will suffer the most from your plans to reduce cleanup efforts. To scale back the cleanup of the Duwamish River is to continue to poison BIPOC neighborhoods and to do increasing harm to the sovereign land of the Duwamish people”.

“The people living in these communities already have had years of exposure to toxic chemicals and have larger proportions of people of color whose health has been impaired because of the polluted environment where they have been forced to live by red-lining realty practices in Seattle.”

“This river runs through neighborhoods in south Seattle and South King County and we know that pollution doesn't stay in one place, especially involving water ways.”

“We need a process for dealing with Superfund responsibilities that is based in research: 1) scientific evidence of the risks of exposure form BAP and other CPAHs; and 2) the ample mixed-methods quantitative/qualitative research of environmental justice. The evidence is clear that low-income, poor, people of color, and Indigenous communities have been made to suffer the worst effects of contamination like that of the Duwamish River.”

“Our community wants all of the Duwamish River cleaned of the toxic pollutants that decades of riverside industry has caused. People live here! We are a majority bipoc neighborhood who are already marginalized by a racist system. We will not let you brush us off. We will not let you gaslight us. We will not be silenced. Neglecting to clean the river we live on from toxins you promised to remove is violence and environmental racism. We will not stand down. We are the people directly affected by the impacts and we demand all 5 acres be cleaned! Period.”

“Fundamentally, this cleanup is situated in a community whose members are still at most disproportionate risk of direct and indirect exposures to cPAHs. Children and elders use the shoreline for recreation, tribal fishers cast their nets which grace the sediment floor, and subsistence fishers/clammers use the river's resources to feed their families. These are the most vulnerable members of our community (and to the negative health risks associated with exposures to cPAHs) and they deserve the most thorough cleanup possible."

"Even if the proposed changes don't seem like a "big deal" to EPA scientists (as stated in the Feb 16th webinar), any reduction in the strength of the cleanup is a blatant disregard for the community's lived experiences with and along the Duwamish River and is disrespectful for the multiple environmental burdens they have been enduring for decades."

"This proposed change seems like a way to provide a "discounted" option for the polluters at the expense of the most vulnerable in our community - a rejection of environmental justice principles and preferential treatment for the parties most responsible for the harms in the community."

"To us, it appears that EPA is taking a large risk that could affect human health in an environmental justice community for a very small change (0.33% or $1,117,000) in the overall cleanup costs. This is an environmental injustice that is unfair and burdensome to our Duwamish communities."

EPA response

EPA recognizes that commenters have environmental justice concerns. EPA's commitments regarding environmental justice concerns are provided in the ROD (see ROD Section 13.2.8) and are not changed by this ESD. EPA will continue to provide meaningful involvement for affected community members as the cleanup of the Lower Duwamish Waterway moves forward.

3.5.3 THIS CHANGE FAILS TO RECOGNIZE THE IMPORTANCE OF THE CLEANUP TO THE DUWAMISH TRIBE AND VIOLATES TREATY RIGHTS

Comment summary

We received comments from the Duwamish Tribe opposing the ESD. Other commenters viewed the ESD as a failure to make reparations and to protect resources important to Native Americans, particularly the Duwamish Tribe, and as a violation of treaty rights.

"The entire river is sacred and of utmost importance to the Duwamish Tribe, and it is shameful that the EPA would attempt to further shirk its duties even more than in the 2014 agreement for the cleanup.*" [From the Duwamish Tribe's comment letter]*

"This Superfund site is on the traditional lands of the Duwamish tribe and cleaning it up is part of reparations."

"This potential reduction of clean up would violate tribal treaty rights and does not take into effect the cumulative nature of the toxic stew that is already in the Duwamish. We have an obligation to clean up the superfund site and make the river a healthy place for salmon, community's that depend on this river for subsistence and for all of us who live in this neighborhood that depend on a healthy watershed."

"The health of this river is important to our entire region, but its impact is especially felt by people living in the adjacent neighborhoods of Georgetown and South Park, neighborhoods with many low income communities, as well as the Native American people of the Duwamish tribe. Please consider cleaning the Duwamish river, so that God's grace can shine, and people can be restored."

EPA response

EPA agrees that the health of the Lower Duwamish Waterway is important to the entire region and particularly to the Native Americans, including members of the Duwamish Tribe, who live within or near the Site. As noted in prior responses, this ESD will result in a protective cleanup and does not change the remedial action objectives identified in the 2014 ROD. Implementation of the remedy, as modified by this ESD, will improve the overall health of the LDW.

EPA follows a formal process to consult with the Muckleshoot Indian Tribe, Suquamish Tribe, and Confederated Tribes and Bands of the Yakama Nation, federally recognized tribes which have treaty rights at or affected by the Lower Duwamish Waterway. EPA wrote to offer government-to-government consultation regarding the proposed ESD months before the start of the public comment period.

3.5.4 THE ESD IS AN ATTEMPT TO SAVE MONEY

Comment summary

Many of the commenters believe that potential reductions in cleanup costs are driving the change in cPAH cleanup and action levels, and that the savings come at the expense of human health and environmental protection.

"Our health is not negotiable for government profit and savings."

"The only possible benefit I can understand from this proposed change is that the responsible parties will find savings of $1 million; there is no community benefit to this or alternative benefits for wildlife or public health that is spurring this change."

"The EPA needs to commit to cleaning up the Duwamish River and put people's health over saving resources of money and staff by not cleaning up."

"Reducing the level of toxins cleaned up is not worth the money that would be saved."

"Avoiding a little cost now produces a lot of cost later."

"…funding should be maintained and prioritized for this effort of cleaning up the Duwamish River for the health of the entire ecosystem"

"The Duwamish River needs as much help as it can get. Cutting corners in cleanup will cost lives and save only an insignificant amount of money."

"It will be wholly unfair and inequitable to trade a .33% cleanup cost reduction for increased human health risks."

EPA response

The ESD implements changes to the cleanup levels for cPAHs consistent with EPA's *Toxicological Review of Benzo(a)pyrene* (EPA 2017) without changing protectiveness or the remedial action objectives. Any changes in the estimated costs of the remedy are simply a consequence of this change and were not a consideration in EPA's decision.

4 REFERENCES

EPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. Office of Health and Environmental Assessment, EPA/600/R-93/089. July.

EPA 2005a. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. Washington, D.C. EPA/630/R-03/003F. March.

EPA, 2005b. Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum. Washington D.C. EPA/630/P-03/001F. March.

EPA 2017. Toxicological Review of Benzo[a]pyrene. Integrated Risk Information System, National Center for Environmental Assessment, Office of Research and Development.

LDWG 2007. Lower Duwamish Waterway Remedial Investigation. Phase 2, Appendix A. Baseline Ecological Risk Assessment. Final. Prepared by Windward Environmental. July.

LDWG. (2010). Lower Duwamish Waterway Remedial Investigation, Remedial Investigation Report Final. Submitted to U.S. EPA.

ATTACHMENT 1: COMMENT PERIOD LIST-SERV COMMUNICATIONS

Date	Subject line	Topic
Wed 2/4/2021 4:40 PM	EPA proposes changes to the Lower Duwamish Waterway cleanup plan	Changes proposed to the Lower Duwamish cleanup plan based on updated health risk information Announcing comment period and February 17 meeting Comments accepted through March 8
Mon 2/22/2021 4:04 PM	Comment period extended to 3/22/21 - EPA proposes changes to the Lower Duwamish Waterway cleanup plan	"Per the request of our Community Advisory Group, the Duwamish River Cleanup Coalition, the comment period has been extended until March 22, 2021." Two-week extension
Tue 3/16/2021 1:24 PM	Lower Duwamish Waterway Superfund site updates: ESD comment period extended; grants; sampling at T-117, subscribe for NRDA updates	Comments on the Explanation of Significant Differences now accepted until April 6, 2021 Two-week extension
Tuesday, April 06, 2021 9:53 AM	Comments on the Explanation of Significant Differences now accepted until April 21, 2021	"Community members have requested additional time to comment on the proposed Explanation of Significant Differences for the Lower Duwamish Waterway Record of Decision. EPA is extending the public comment period by 15 days. Comments will now be accepted by email at Region10@epa.gov until midnight Wednesday, April 21. Further extensions beyond the current 75 days are not anticipated."

ATTACHMENT 2: EXAMPLES OF FORM LETTERS

Example one:

As a supporter of Washington Physicians for Social Responsibility and a concerned citizen, I urge the EPA to NOT reduce their efforts to clean the Duwamish River. There are significant public health implications of the plan to reduce cleanup efforts in this Superfund site.

Since colonization by white settlers of the region, the Duwamish River has been devastated by shortsighted industrial practices. For 20 years, the EPA has worked to clean this waterway whose health has an immediate impact on the health of tens of thousands of families in King County. You cannot slow these efforts now.

The risk of exposure to benzo(a)pyrene remains high. Your science suggesting otherwise is cherry picked to support this move. Only 2 recent studies on BaP found a decrease in cancer risk while an additional 13 studies were either discarded as poorly executed or demonstrated increased risk associated with BaP exposure.

Furthermore, the EPA has not meaningfully engaged the Black, Indigenous, and People of Color (BIPOC) communities who will suffer the most from your plans to reduce cleanup efforts. To scale back the cleanup of the Duwamish River is to continue to poison BIPOC neighborhoods and to do increasing harm to the sovereign land of the Duwamish people.

Again, I urge you: do NOT reduce, diminish, slow, or scale back the Duwamish River cleanup efforts.

Example two:

Dear Kay Morrison, EPA Region 10 Involvement Staff

Thank you for extending the comment period to April 21st and for providing the community time to provide input.

I urge the EPA to clean the Duwamish River according to the December 2014 Record of Decision (ROD) which dictates the timelines and level of cleanup required, including where and how much toxic sediment needs to be removed, capped, or treated with other alternatives. The EPA recommended the dredging remedy for the areas with the highest levels of toxic chemicals or where bottom river mud cannot be covered with a cap or natural river deposits.

The community has advocated for a thorough river clean up and the 2014 ROD was a compromise enough. To not clean 5 acres goes against previous agreements with the most impacted communities.

The river communities are suffering environmental impacts from the area being industrialized and deserve the most thorough cleanup to still include the cleanup of 177 acres and to not take short-cuts to save 1 million dollars. The community urges the EPA to remove sediments and have the river cleaned up according to the Dec 2014 Record of Decision.