October 2, 2006

Ms. Allison Hiltner
Mr. Bruce Duncan
U.S. EPA Region X
Duncan.Bruce@epamail.epa.gov

Re: Lower Duwamish Waterway Remedial Investigation: Phase 2 Remedial Investigation Report, Appendix A: Baseline Ecological Risk Assessment

Dear Ms. Hiltner and Mr. Duncan:

The Duwamish River Cleanup Coalition (DRCC) is EPA's Community Advisory Group for the Duwamish River Superfund Site. DRCC represents ten organizations affected by the health of the Duwamish River and the plans for river cleanup, including the South Park Neighborhood Association, the South Park-based Environmental Coalition of South Seattle (ECOSS) and IM-A-PAL Foundation, the Georgetown Community Council, Duwamish Tribe and five regional environmental, social justice and health advocacy organizations. DRCC's members hold the State of Washington Public Participation Grant for the Duwamish River Superfund Cleanup and EPA's Technical Assistance Grant for the site, which provides funding for technical experts for the community.

DRCC has reviewed the Draft Phase 2 Baseline Ecological Risk Assessment (ERA) and offers the following comments:

General Comments

The Environmental Risk Assessment's purpose is to offer supporting data for risk analyses that will form the basis of future actions at the Lower Duwamish River Superfund cleanup site. It is important then, that this document be as transparent as possible about what is known *and unknown* about risks in the river, and to present the data and conclusions in a clear and objective manner. The accuracy of information and assumptions contained in the risk assessment may significantly impact future decisions about necessary remedial actions to protect the health of the Duwamish River's fish, wildlife and other ecological communities.

This ERA fails to provide sufficient rigor or transparency to provide the necessary confidence in its accuracy or the protectiveness of decisions based upon its conclusions. Contrary to the authors' repeated reference to "conservative" assumptions contained in the report, the document contains insufficient assumptions and inadequate endpoints, chemical screening levels and TRVs. Among the numerous shortfalls of the report are its failure to address bioaccumulative and synergistic effects of chemicals, inadequate species representation, limited sampling, lack of site-specific field studies, and insensitive endpoints. The cumulative result of the report's inadequacies are a fatally flawed document and related conclusions, which will fail to provide necessary protections for the Duwamish River's fish and wildlife.

Specify endpoints. Throughout the document, "adverse effects" are referenced. The ERA needs to clarify that the only endpoints included in this description of "adverse effects" are survival, growth and reproduction, whereas other endpoints, including growth, metabolic changes, neoplasm, etc. are omitted from consideration, despite their potential "adverse effects" on Duwamish River species. At a minimum, endpoints that can contribute to or are correlated with risks to survival, growth, and reproduction, such as those above, should be included in the ERA. For example, exposure of fish to dissolved metals (e.g., copper) can temporarily or permanently interfere with olfactory ability, thereby reducing or eliminating the ability of fish to locate prey and, in the case of salmon to locate their spawning areas. Clearly, these are "adverse effects" that may also influence the limited endpoints addressed by the ERA and should be included in the assessment.

TRV selection. The process of selecting TRVs is not conservative enough. Other commonly accepted toxicological endpoints should be incorporated, such as behavioral effects, biomarkers and histopathological effects. By failing to be specific, and using terms like "NOAEL" and "LOAEL," the authors imply that chemical concentrations below their chosen TRVs are harmless, which is not accurate.

Minimization of risk. Throughout the document, the authors confuse uncertainty with lowered risk. In addition, the report uses language that implies the ecological risks are less than they may be. All phrases with this bias should be deleted or restated with factual accuracy. These examples are not intended to be comprehensive, but serve as examples from the text:

- Repeated use of the term "negligible" where risks are in fact unknown. In these instances, the associated uncertainties are often such that the level of risk cannot be estimated with the information provided. Similar terms that should be examined for bias include "overestimated," "probably," "lower," and "conservative." A few examples:
    - ES-2: "…a risk-based screening process that used **highly conservative** assumptions." – delete **highly**.
    - ES-4: "…available water data indicated **negligible** risks…" – change to **low**.
    - 70 and 81: "In the second step of this **conservative** screening process…" – delete **conservative**.
    - 77: "Based on the above **conservative** COPC screen…" – delete **conservative**.
    - 237: "…there is uncertainty, **although likely low**, associated with the risk estimates." – delete **although likely low**.
- In addition, the following phrases should be amended, as shown:
    - 218: "An exposure falling between the NOAEL and LOAEL **may not** result in any adverse effect." – change to **may or may not**.
    - 246: "…**although** it is possible that reproductive endpoints **might be** more sensitive." – change to "…**and** it is possible that reproductive endpoints **are** more sensitive."
    - 247: "…does not necessarily **indicate a risk of** adverse effects to crabs." – change to "…does not necessarily **predict** adverse effects to crabs **with certainty**."
    - 261: At the end of the "Chemical Mixtures" section, add "; but it is likely that risk is underestimated."
    - 267: "The effect of uncertainties associated with chemical mixtures is unknown." – append "**but is likely to increase risk**."
    - 267: "…salmonid-specific TRVs were selected…" – change to "…salmonid-specific TRVs **from short-term (subchronic) studies** were selected…"
    - 276: "…may be much lower than those presented…" – change to "…may be much lower **or much higher** than those presented…"

Dioxins and furans. On page ES-5 and elsewhere, dioxins and furans are exempted from consideration in the ERA with the explanation that their levels will be compared to "urban background" and remedial decisions made accordingly. As in the HHRA, this approach is flawed *and* poorly explained: (1) the assessment of risk should be based on what is actually in the sediment and tissues, not on the portion that may be attributable to the river; (2) the background points selected elsewhere in the Seattle area (and described in the HHRA document) are in areas that may have had significant site-specific industrial inputs of their own – therefore, DRCC would oppose using "urban background" as a justification for not cleaning up dioxins and furans the Duwamish; and (3) the lack of dioxin and furan data in tissue is in itself a shortcoming that should have been addressed earlier in the assessment process, and should be corrected in order to complete the ERA.

Given their extreme toxicity even in minute amounts, cleaning up dioxin/furan contamination can be a daunting prospect. Nevertheless, these industrial pollutants should not be exempted from assessment and remediation. The fact that other areas also have contaminated sediments does not justify ignoring dioxin/furan contamination in the Duwamish River.

Sediment standards and salinity. Washington State Sediment Management Standards as laid out in WAC 173-204 are intended to apply to marine sediments. As explained on page 3, the Duwamish is an estuarine system with levels of salinity that vary both spatially and temporally. The uncertainty section should include a discussion of how salinity levels lower than those found in marine systems, such as the upper portions of the LDW, especially during outgoing tides, could affect chemical toxicity in the ROCs.

Surface sediment data. All of the data presented in this ERA comes from "surface sediments" of 15 cm or less (page 230). This leaves out potentially substantial subsurface contamination in areas that don't meet screening standards and will not be investigated further. 15 cm is inadequate to eliminate these sediments as an exposure route, particularly for burrowing benthic organisms and some fish. Common disturbances of surface sediments, such as burrowing organisms, prop wash, scouring and groundwater seeps may easily transport contamination from below 15 cm to the surface, where it is bioavailable. Sediment should be characterized and risks assessed to the depths necessary to eliminate potential exposure through natural and/or anthropomorphic processes, including remediation activities. At the *very* least, it should be noted in the uncertainty analysis that the data used is a limited subset that cannot fully predict all existing exposure pathways and levels of risk to benthic organisms, fish and wildlife.

Screening value selection. On page 57, the report states that Sediment Quality Standards (SQS) "were promulgated to address risks to benthic invertebrate communities as a whole, except for higher trophic level invertebrates, such as crabs, that may be at greater risk of exposure through bioaccumulation.[13] SQS values are based on apparent effects thresholds (AETs), which are defined as the highest 'no effect' chemical concentration above which a significant adverse biological effect always occurred among the several hundred samples used for its derivation. Biological endpoints included in derivation of the SQS chemical standard were field measures of benthic infaunal abundance, laboratory toxicity tests with marine benthic invertebrate organisms (i.e., amphipods [survival] and oysters [percent abnormal development of oyster larvae]), and laboratory toxicity tests with bacteria (Microtox [decrease luminescence from the bacteria *Vibrio fisheri*]). Representatives of these groups are found throughout the LDW. Under the provisions of the SMS [sediment management standards], surface sediments with chemical concentrations equal to or less than all the SQS are designated as having no adverse effects on biological resources (173-204-310(1)(a)).[14]"

This conceptual approach to selecting screening values is not protective or conservative, and is not consistent with EPA guidance and precedent. Screening values for use at Superfund sites typically are selected to be concentrations below which only 5% of species are adversely affected, i.e. that are protective of 95% of species (e.g. see Dyer et al. 2000). It is essential to recognize and acknowledge that screening levels are intentionally chosen to be conservative; the purpose of the screening process is to identify contaminants that *may* pose a risk and that, therefore, deserve further evaluation to assess whether actual risk does, in fact, exist. In contrast, the screening levels (SQSs (AETs)) selected in the Duwamish ERA are, by definition, those concentrations at which adverse effects have been empirically observed to occur in *all* species evaluated. This is completely unacceptable. A revised set of appropriately conservative screening values should be selected based on (1) screening values used at other Superfund sites, and (2) criteria promulgated in EPA guidance (U.S. EPA 1997, 1999). See also comments below regarding Pages 65 and 109-110.

COPCs for benthic invertebrates based on sediment concentrations. On Pages 58-60 (Table A.2-11) 44 COPCs (plus TBT) were identified. Sediment screening levels are given for each COPC (Table 1 below). Note that the screening values proposed for the Duwamish average *14 times higher* than EPA's TEL values, i.e. the screening values selected for the Duwamish are more than *an order of magnitude less protective* than they should be.

Table 1. Sediment screening values used in the Lower Duwamish Waterway versus Threshold Effect Levels (TELs) used by EPA[1].

Contaminant	Duwamish Screening Value (µg/kg OC)[2]	EPA TEL (µg/kg OC)[2]
Metals		
Arsenic	5,700,000	724,000
Cadmium	510,000	67,600
Chromium	26,000,000	5,230,000
Copper	39,000,000	1,870,000
Lead	45,000,000	3,020,000
Mercury	41,000	13,000
Nickel	14,000,000	1,590,000
Silver	610,000	73,300
Zinc	41,000,000	12,400,000
PAHs		
Acenaphthene	16,000	671
Anthracene	220,000	4,690
Benz(a)anthracene	110,000	7,480
Benzo(a)pyrene	99,000	8,880
Chrysene	110,000	10,800
Dibenzo(a,h)anthracene	12,000	622
Fluoranthene	160,000	11,300
Fluorene	23,000	2,120
Naphthalene	99,000	3,460
Phenanthrene	100,000	8,670
Pyrene	260,000	15,300
HPAH	960,000	65,500
LPAH	370,000	31,200

Phthalates		
Bis(2-ethylhexyl) phthalate	130,000	18,200
Other SVOCs		
1,2 Dichlorobenzene	3,500	
1,4 Dichlorobenzene	11,000	
1,2,4 Trichlorobenzene	3,100	
2-Methylnaphthalene	38,000	2,020
4-Methylphenol	67,000	
2,4-Dimethylphenol	2,900	
Benzoic Acid	65,000	
Benzyl Alcohol	5,700	
Dibenzofuran	15,000	
Hexachlorobenzene	380	
N-Nitrosodiphenylamine	2,800	
Pentachlorophenol	36,000	
Phenol	42,000	
PCBs		
Total PCBs	12,000	2,100
Organochlorine Pesticides		
Total DDT	56,700	389
Total Chlordane	2,800	226

[1] USEPA 1996 – Screening values for chemicals evaluated.
[2] Values assume 1% organic carbon (OC) content in sediment.

Selection of LOECs. In Table A.2-12 (pp. 61-62), most of the LOECs are based on LC50s. As this number represents the chemical concentration that kills 50% of organisms, it is not a conservative choice of parameter. In addition, many LOECs are based on an exposure of short duration – as few as 48 hours. If benthic invertebrates are living in sediment with these levels for weeks to years (in the case of long-lived organisms such as some species of clams), a logical assumption is that toxic effects will increase. Again, this approach is in no way conservative and is likely to underestimate actual risk.

Table 2 below includes an additional column on the right that indicates screening levels (ambient water quality criteria, AWQC) for these COPCs by EPA in Region 10, including Washington State (Burt Shephard, USEPA, pers. comm.). Although many of the Duwamish screening values are less than those advocated by EPA, some Duwamish screening values are considerably higher than those suggested by EPA.

Table 2. Water Screening Levels (NOEC and LOEC) proposed for use in the Lower Duwamish Waterway relative to screening values used by EPA and at another Superfund site.

COPC	NOEC (µg/L)	LOEC (µg/L)	EPA AWQC values (µg/L)	Portland Harbor (µg/L)
1,1-Dichloroethane	7,800	39,600		47
1,1-Dichloroethene	2,400	11,600	11600	25
1,2-Dichlorobenzene	11	550	763	14
1,2-Dichloroethane	139	6,927	20000	910
1,2-Dichloropropane	840	42,000	3040	590
1,4-Dichlorobenzene	3	147	763	15
Benzene	180	1,100	700	130
Carbon disulfide	38	1,900		.92
Chlorobenzene	1,400	2,500	50	50
cis-1,2-Dichloroethene	136	6,785	11600	590
Isopropylbenzene	N/A	N/A		7.3
Tetrachloroethene	331	332	450	840
Toluene	737	14,700	5000	9.8
trans-1,2-Dichloroethene	136d	6,785	11600	590
Trichloroethene	2,200	14,000	2000	21900
Vinyl chloride	12,800b	65,300		3880

Rejection of field-based studies. Several sections (for example, pages 64, 71, 82 and 139) note that "field-collected data were not considered acceptable." Laboratory environments and single-chemical studies are no more or less representative of environmental conditions in the LDW than field data from a non-Duwamish site. In particular, field-collected data can yield valuable information about synergistic toxicity of co-contaminants, and can further demonstrate the need to be looking at more sensitive endpoints. For example, NOAA Fisheries has conducted relevant field studies from the

Duwamish (as well as nearby Commencement Bay) looking at impacts to two of the receptors of concern: English sole and juvenile Chinook salmon. The results show that two chemicals of concern, PCBs and PAHs, do have adverse effects on the ROCs, and therefore should be included in this ERA. It is not acceptable to throw out such valuable and well-established studies just because the QA/QC protocols aren't exact.

Furthermore, because specific approaches have varied so much from site to site, it is difficult to make generalizations about toxicity profiles and TRV derivation strictly by comparing values. Instead, it is more instructive to compare the methodologies and results of two sites in order to contrast the TRVs that were derived and examine the methodological choices that influenced the divergent results. We chose the Hudson River Superfund site Baseline Ecological Risk Assessment to compare to this ERA.

In order to make a fair comparison between the two studies, only results for PCBs in fish are presented. However, it is important to note that the receptor species differ for the two sites (juvenile Chinook, Pacific staghorn sculpin and English sole for the Duwamish; pumpkinseed spottail shiner, brown bullhead, yellow perch, white perch, smallmouth bass and striped bass for the Hudson). However, the resulting TRVs for the two sites are greater than any interspecies variability in sensitivity to PCBs. In the Hudson River, TRVs for laboratory study-based NOECs and LOECs were 1.9 and 9.3 mg/kg wet weight (ww), respectively. For field study-based NOECs and LOECs, TRVs ranged from 0.3-5.25 and 0.4-13.7 mg/kg ww, depending on species. In the Duwamish, the NOAEL was 1.9 mg/kg ww and the LOAEL 4.02 mg/kg ww.

The key reason for the differences in these TRVs is the difference in selection criteria for the identification of relevant studies. The most important difference between these is that no field-based studies are considered for the Duwamish. The justification for this choice stems from the fact that field studies are affected by the environmental complexities of the area. However, to claim that the effects of the contaminant of interest cannot be accurately assessed in such cases is a flawed conclusion. Both field and laboratory studies have strengths and weaknesses, and there is no clearly superior approach. Thus it makes sense to examine them both. Because laboratory tests take place in carefully controlled conditions, effects levels tend to be significantly higher than in field studies, which accounts for much of the difference in the two effects assessments.

Hudson	Duwamish
Consult studies conducted **solely in the laboratory, as well as studies including a field component**. If appropriate field studies are not available for a test species in the same taxonomic family as the receptor species of concern, laboratory studies or field studies on less closely related species will be used to establish TRVs for the receptor species.	Consult **laboratory studies** reported in the toxicological literature.
Conservative interspecies uncertainty factors used with studies pertaining to related species.	No interspecies uncertainty factors applied.
Some studies performed in the Hudson River were considered for TRV calculation.	No studies performed in the Duwamish River were considered for TRV calculation.

For all TRV determinations, it would be useful to have not only the lists of studies used that were provided in the Attachments section, but also a representative list of studies that were considered and rejected, along with the reason for rejection. This would allow a better comparison with other sites, and provide a better idea of the scope of research conducted. This is particularly important given the high numbers of COIs for which TRVs were not determined.

Additionally, data from field studies, such as the USGS Osprey egg data, should be acknowledged and discussed, and if published before the RI is final, should be used to confirm or revise risk estimates in this ERA.

NOAEL for PCBs/juvenile Chinook salmon. On page 6 of Attachment 8, the first study in the PCB section lists a NOAEL of 980 μg/kg Aroclor 1254 for juvenile Chinook salmon. Why was this NOAEL not used? It is lower than the chosen NOAEL of 1,900 μg/kg. It is within the factor of 5 noted as usual for LOAEL-NOAEL differences (page 261). It also closer to (although still higher than) corresponding values chosen at several other Superfund sites (see Table 3 below for summary).

Table 3. Fish Tissue TRVs for PCBs at a variety of Superfund sites.

Calcasieu Estuary Chronic TRV (µg/kg ww)	Lower Fox River NOAEL (µg/kg ww)	Housatonic TRV (µg/kg ww)	Portland Harbor (µg/kg ww)
484	760	610	720

Incorrect conceptualization of LOAEL. On page 65, the LDWG states, "For each COI, a TRV was selected for both the NOAEL and the lowest-observed adverse-effect level (LOAEL). The NOAEL represents the level below which adverse effects would not be expected. The NOAEL was compared to the maximum exposure concentration for each COI to identify COPCs. The LOAEL represents the level above which an effect would be expected. LOAELs are presented in this section for informational purposes only; they were not used in the screening process." The document appears to be using an incorrect definition of a LOAEL/LOEC. A LOAEL/LOEC (also referred to as threshold effect level/concentration (TEL/TEC)) is the lowest level at which adverse effects have been observed. The level at which adverse effects are expected to occur would be a probable effects level/concentration (PEC/PEL). Further, the document states that LOAELs were not used in the screening process, but this is not strictly true. In cases where a COI exceeds the NOAEL but is less than the LOAEL, the document states that risk is unknown because the COI does not exceed the LOAEL. In addition, contaminants are not retained as COPCs if a LOAEL was not found. This ERA in fact uses the LOAEL as a major criterion for assessing whether it is likely that risk exists or not from exposure to specific COIs.

Consideration of organochlorine pesticides. Throughout the ERA, organochlorine pesticides are dismissed from consideration due to analytical interference from PCBs. There may be difficulty in precisely measuring their amounts; however, they cannot be dismissed from consideration in the final solution. The lack of data on this important family of contaminants leads DRCC to the conclusion that additional sampling should be required.

Identification of TRVs for crabs. Regarding assessment of risk to crabs, TRVs were identified for only 14 of 55 COIs (pages 65-66). Note that EPA's TRVs (for fish species, presented below) are much lower for most COIs than those suggested for application to crabs in the Duwamish.

Table 4. TRVs for Crab in the Duwamish vs. TRVs selected by EPA[1]

COPC	Units	Duwamish NOEC TRVs	EPA TSCs[3]
Arsenic	mg/kg	1.28	1.6
Cadmium	mg/kg	0.6	.083
Chromium	mg/kg	1	.25[2]
Copper	mg/kg	50	.17
Mercury	mg/kg	0.99	.06
Vanadium	mg/kg	0.6	
Zinc	mg/kg	12.7	3.1
TBT	µg/kg	120	6.9
Naphthalene	µg/kg	5.0	6500
Total PCBs	µg/kg	110	440
Total chlordane	µg/kg	710	56
Total DDTs	µg/kg	46	
Heptachlor epoxide	µg/kg	54	52
Methoxychlor	µg/kg	15	47

[1] (Burt Shephard, USEPA Region 10, pers. comm.)
[2] for Chromium $^{+6}$
[3] TSC = Tissue Screening Concentration

TRVs for fish. TRVs were selected for 45 of 86 COIs. It is noteworthy that the authors selected separate TRVs for crabs vs. fish. Although TRVs were available for 45 of the 86 fish COIs (Table A.2-18), only "selected" TRVs are presented in Tables A.2-19 and A.2-20 for COIs evaluated using the dietary approach and critical tissue-residue approach, respectively." Data for all COIs for which TRVs exist should have been presented. Total DDT has the same value for both the NOAEL and LOAEL (1800 ug/kg) in Table A.2-20.

Table 5 below presents tissue TRVs from a variety of Superfund sites. Note that some of the TRVs presented in Table A.2-20 (page 74) are considerably higher than the corresponding TRVs suggested by EPA and used at these other Superfund sites.

Table 5. Fish tissue TRVs for the Lower Duwamish Waterway vs. those suggested by EPA and selected for use at other Superfund sites.

COI	Duwamish TRV (µg/kg ww)	Calcasieu Estuary Chronic TRV (µg/kg ww)	Passaic River Chronic TRV (µg/kg ww)	Lower Fox River NOAEL (µg/kg ww)	Housa-tonic TRV (µg/kg ww)	Portland Harbor (µg/kg ww)
Mercury	230	7210	1.0	250		460
Selenium	1,200	975	12			1,100
TBT	18					49.9
Bis(2-ethylhexyl) phthalate	390		78,200			390
Butyl benzyl phthalate	6,450		62,400			
Diethyl phthalate	1,102					
Dimethyl phthalate	498					
Di-n-butyl phthalate	1,170	85	55,660			
4-Methylphenol	1,530					76,500
Benzoic acid	3,380					
Hexachlorobenzene	468,000	506				490
Phenol	1,470					
Total PCBs	1,900	484		760	610	720
alpha-Endosulfan	0.62					73
beta-Endosulfan	0.62					73
Total DDTs	1,800	6,100		300		290
Dieldrin	120	1,700	69	370		220
Endrin	1.15					25
gamma-BHC (Lindane)	1,580	961	74			23
Heptachlor	30					60
Heptachlor epoxide	80					55
Methoxychlor	50		62			200
Total chlordane	710		74			550

Consideration of fish consumption by sculpin. Equation 2-1 on page 78 does not seem to account for sculpin's fish consumption, and only mentions benthic invertebrate consumption. Is the 44% of diet from fish accounted for elsewhere? If not, it should be addressed here.

Calculation of risk from sediment ingestion. Section A.5.1.2 shows calculations using body weight and metabolic rate that result in estimated total daily diet necessary for each wildlife species. Different sections evaluate dietary risk to these species, and include a measure of sediment ingestion. For example, Equation 2-2 on page 88 allots 20% of sandpiper "food" to intertidal sediment. This approach is flawed. The calculations performed in section A.5.1.2 result in a weight representing 100% of necessary calories for the animal; the animal does not eat fewer calories because it concurrently ingests some sediment. If an average of 20% of material ingested by sandpipers is sediment, then Equation 2-2 needs to include 120% of the total weight of the necessary food derived in section A.5.1.2. Equations 2-1 (p. 78) and 2-2 should be rewritten to reflect this, and the related dietary exposure doses, hazard quotients and uncertainty recalculated. In addition, the uncertainty sections dealing with risks calculated from sediment ingestion (pages 274-275, 298-301, 304, 310, 315, 319, 323, 331 and 336) must be changed to reflect these considerations.

Only Equation 5-1 (page 155) appears to use correct assumptions. In short, the FIR should not be associated with anything other than food items. A separately determined SIR should be used for the volume of sediment ingested.

Uncertainty for wildlife exposure. In general, the exposure and effects assessment for wildlife (pages 154-217) is well done. However, when calculated just from diet, risk to wildlife is likely to be underestimated because the calculations do not take into account direct exposure from contact with contaminated intertidal and shallow sediments. This should be addressed in the uncertainty section.

Missing species. No provision is made in this ERA to determine whether/which species that were historically present in the LDW no longer are, and to what extent their disappearance can be explained by exposure to contamination. This applies in particular to species in the benthic community.

Conceptual Site Model (CSM) for benthic invertebrate community, fish and wildlife. The CSM (pages 94-101) is not adequate. In order to assess the level of risk at the site, the CSM must synthesize the current information for the site and identify indicator species and why they were chosen. It must identify which receptors at the site are most at risk, regardless of species. The CSM must also summarize which chemicals are of greatest concern, and why. This provides the necessary information about ecological risk drivers at the site, which should be at the heart of an ERA. Evaluation and information from prior, related documents need to be incorporated and presented here. Figures A.2-2 and A.2-3 are not detailed enough to provide useful information. Conversely, figure A.2-4 is too detailed, with connections not discussed anywhere else in the document.

It is also important that the spatial scale at which risk is assessed for each assessment endpoint (species) is similar to the home range size of that species. So, for species with a small home range (e.g. clams), assessment should be on a point-by-point basis (e.g. no combining or averaging of data), whereas for species with large home ranges (e.g. osprey), averaging data from throughout the site may be reasonable.

This section needs to be extensively revised to provide its essential material in a more informative manner.

Sediment effects assessment. Pages 109-110 state, "An AET is the highest 'no effect' chemical-specific sediment concentration above which a significant adverse biological effect always occurred among the several hundred samples used in its derivation…. the lowest AET for each chemical was identified as the SQS; the second lowest AET was identified as the CSL. **The SQS corresponds to a sediment quality that will result in no adverse effects to biological resources**; the CSL corresponds to a sediment quality that will result in minor adverse effects (WAC 173-204). Table A.3-5 presents the biological effect endpoints that provide the basis for the SQS and CSL chemical criteria for COPCs." The emphasized statement above does not logically follow from the preceding operational definition of AETs/SQSs. To reiterate, the AET/SQS used in the Duwamish are the levels above which ALL receptors always responded adversely to exposure to the COI. For any specific COI, the AET/SQS does not imply anything about (1) the minimum concentration at which some receptors are adversely affected, or (2) how far below the AET/SQS this minimum level may be. Thus, to state that the SQS "corresponds to a sediment quality that will result in no adverse effects to biological resources" is simply inaccurate and must be corrected.

Bioassay testing and "hit" vs. "no-hit" criteria. Pages 113-114 explain how three lab toxicity tests were conducted. Survivorship was considered to be reduced (i.e. a "hit") if mortality of test samples exceeded mortality of reference/control samples by ≥25%; similarly, growth was considered to be reduced (i.e. a "hit") if growth of test samples was reduced by ≥30% relative to reference/control samples. These criteria are NOT conservative at all. At other Superfund sites, for both growth and mortality, 10% reduction in growth or survivorship of test samples relative to control / reference samples is considered a slight but statistically significant "hit." A 20% reduction is considered a "moderate" hit, and a reduction in growth or survivorship of ≥ 30% is considered a serious "hit." As a result of the non-protective "hit" and "no-hit" criteria above, the document concludes that a relatively small percentage of sediment samples are toxic. If, however, criteria similar to those used in Portland Harbor were applied, nearly all sediment samples would be identified as being toxic (i.e. 'hits"). There is no justification provided for the less conservative/protective approach proposed here.

Furthermore, on pg 238, the predictive reliability of amphipod mortality and echinoderm larvae abnormality AETs show a less than 50% sensitivity, "suggesting that the AETs for these two toxicity test were able to predict about half of the time whether a sediment that contains chemicals above their respective AETs will result in a test endpoint response that is considered a hit." Again, this is not a conservative screening approach, especially since these tests results accounted for 1/3 of the original sites dropping off the map.

Use of water quality data. In several places in the ERA, water quality data is used for various purposes. AWQC values are used as screening values for determining toxicity to biota, tissue TRVs are calculated based on AWQC and BCF or BMF values, and King County water quality data, which was collected for the limited purpose of determining CSO impacts, is used in the fish risk assessment. If this data is to be used, there must be an explanation included in the document of when, where and how it was collected; why it is relevant to use; and the weight it carries in the analysis.

Additional uncertainties not evaluated. The uncertainty section (pages 218-338) does not address the additional ecological risk that is not captured in the stated hazard quotients. This risk is threefold: 1) risk to organisms that were not selected as ROCs, 2) risk from chemicals that were not selected as COPCs and 3) cumulative risk to organisms from exposure to multiple chemicals with potentially synergistic effects.

Conclusions. This section (pages 338-340) inappropriately de-emphasizes the risks to ecological receptors. The section for each receptor ends with a statement that leads the reader to believe that risk to the receptor is negligible, a tactic apparently calculated to minimize the appearance of risk. The conclusion needs to spell out the risk drivers at the site, including all species, chemicals and areas of concern, so that they can be addressed in the remediation plan. In addition, statements regarding managerial/remedial actions and assumptions about reduction of exposure from remedial actions are inappropriate here, particularly in the absence of analytical data to show that future cleanups have been effective.

Specific comments:

- On page 3, delete the sentence, "**Because of these alterations, the LDW is a unique ecological system that is not comparable to other estuaries in the Pacific Northwest.**" This sentence sets an unacceptable tone to the document. Every ecosystem is fundamentally unique. However, there are many aspects of the LDW ecosystem that are entirely comparable to other rivers and estuaries in the region, and it is disingenuous to state otherwise.
- On page 49, the LDWG states, "PCBs, as aroclors, were analyzed in almost all samples. Organochlorine pesticides and SVOCs, metals including mercury, and TBT, were also analyzed frequently in approximately 150 to 180 samples. Methylmercury and chromium VI were not analyzed in any of the tissue samples." These statements raise two questions: (1) Why were organochlorine pesticides and SVOCs, metals and TBT analyzed in only a subset of samples? (2) It appears that the metal analyses measured total chromium and total mercury, rather than different components of each. Is the assumption that *all* chromium is chromium VI, and *all* mercury is methylmercury? If not, why not, and what alternate assumptions/ arguments are made?
- Also on page 49, there is the statement, "Data associated with two individual shiner surfperch collected in Slip 4 and 10 individual shiner surfperch collected in subarea T2E (RM 2.1 to 2.4) were also excluded. These data were excluded because only data from

composite samples were included in the ERA, as per EPA (2000c) guidance." This does not make sense. First, EPA (2000c) does not state that individual data should not be used in ERAs. Second, individual data are useful for indicating the distribution of the data, e.g. whether the data are normally distributed or not and, therefore, whether parameters calculated from these data (e.g. mean, UCL) are likely to be accurate or not. Third, these data could be "converted" into a composite data point simply by calculating the mean of the individual values. Thus, there is no valid basis for excluding these data.

- On page 50, it is not clear if King County's analysis did not include detection limits for undetected congeners, or if the ERA's analysis did not. If the latter, the impact of this assumption should be discussed in the uncertainty section, as it is not a conservative assumption and could potentially introduce considerable uncertainty.
- Why is sediment consumption by fish at 10% on page 78 when 1% is the only amount mentioned on page 136?
- On page 240, each of two bullet points mentions a likelihood of "minor adverse effects." The word "minor" should be deleted from these phrases, as there is no reason to believe that sediment contaminant concentrations greater than the CSL will cause only minor and not major adverse effects.
- On page 244, an uncertainty statement is based on the comment, "This polychaete [*Armandia brevis*] is found in marine intertidal mud flats and would not be expected to be present in substantial numbers in the LDW." However, on page 2 of Attachment 1, it is listed as having been identified in the LDW. Because these are from references, any available abundance information should be explicitly referenced before making related statements of uncertainty.
- On pages 252 and 338, change "…except one neogastropod with imposex characterized as Stage 2…" to "except one **species of** neogastropod with imposex characterized as Stage 2…"
- On page 264, change "risks…for reduced immunocompetence are considered low." to " risks…for reduced **mortality from compromised** immunocompetence are considered low."

Acronyms

AET	Apparent Effects Threshold
COI	Chemical of Interest
CSL	Cleanup Screening Level
ERA	Ecological Risk Assessment
EPA	Environmental Protection Agency
FIR	Food Ingestion Rate
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LOAEL	Lowest-Observed-Adverse-Effect Level
LOEC	Lowest-Observed-Effect Concentration
NOAEL	No-Observed-Adverse-Effect Level
PCB	Polychlorinated Biphenyl
RI	Remedial Investigation
ROC	Receptor of Concern
SIR	Sediment Ingestion Rate
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
WAC	Washington Administrative Code

Literature Cited

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Thank you for the opportunity to comment on the Draft Ecological Risk Assessment for the Lower Duwamish River Superfund Site. We look forward to your comments and responses to the issues addressed above. If you have any questions about our comments on the draft report, please contact us at (206) 954-0218.

Sincerely,

BJ Cummings
Coordinator
Duwamish River Cleanup Coalition