Duwamish River Cleanup Coalition

Community Coalition for Environmental Justice • The Duwamish Tribe• Georgetown Community Council • IM-A-PAL • ECOSS • People for Puget Sound • Puget Soundkeeper Alliance • South Park Neighborhood Association • Washington Toxics Coalition • Waste Action Project

June 30, 2009

Ms. Allison Hiltner
Superfund Program
EPA Region 10
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Dear Ms. Hiltner:

The Duwamish River Cleanup Coalition (DRCC) is EPA's Community Advisory Group for the Duwamish River ("Lower Duwamish Waterway") Superfund Site. DRCC represents a diverse group of stakeholder organizations affected by the health of the Duwamish River and the plans for river cleanup, including the South Park Neighborhood Association, Georgetown Community Council, Environmental Coalition of South Seattle (ECOSS), the Duwamish Tribe, Community Coalition for Environmental Justice, IM-A-PAL Foundation, Washington Toxics Coalition, People for Puget Sound, Puget Soundkeeper Alliance, and the Waste Action Project. DRCC and its affiliate, DRCC/TAG (Technical Advisory Group), hold the Washington State Public Participation Grant and EPA's Technical Assistance Grant for the site, which provides funding for technical experts for the community.

DRCC, its members and its technical consultants have reviewed the Lower Duwamish Waterway Group's (LDWG) preliminary Draft Feasibility Study for the Duwamish River Superfund Site and hereby submit the following comments on behalf of itself, its member organizations and its community stakeholders:

General Comments

1. **Timeframe and objectives.** The Lower Duwamish Waterway Group's Draft Feasibility study ("the FS") presents a set of "building blocks" with information used to frame a range of cleanup alternatives and provide time and cost estimates for each. The "building blocks" include: a sediment transport model, background concentrations of risk driver chemicals, numerical chemical concentrations required to meet federal and state regulations, production rates for sediment removal, and cost estimates for each alternative. Much of this information has been previously submitted and commented on in the form of the Draft Remedial Investigation, released in 2007, but some components, such as cleanup alternative cost estimates, are new.

   The FS includes five alternatives and a total of 11 sub-alternatives, listed as #1–#5, with four variations – "a" through "d" – for alternatives #3 and #4. The alternatives range from minimum (#1) to "maximum" removal (#5), and evaluate a range of removal, capping, enhanced natural recovery (ENR) and monitored natural recovery (MNR) in the mid-range, with varying remedial action levels (RALs) and projected time to attainment, as follows:

(a) series: achieves CSL (cleanup screening level) @ year 10
(b) series: achieves SQS (sediment quality standard) @ year 10
(c) series: achieves CSL @ year 0, and SQS @ year 10
(d) series: achieves SQS @ year 0

All timeframes are measured from the date of completion of the remedial action. Alternative #5, designed to achieve "background" concentrations, is not carried through the full evaluation, based on a finding of "disproportionate" cost. Applying the assumptions of the models used, LDWG states that all alternatives will meet the RAOs (remedial action objectives), though also acknowledges that none will achieve human health objectives for tribal and subsistence fishermen without adding "institutional controls," i.e., fishing restrictions.

2. **Purpose.** The purpose of an FS is to present a list of methods and technologies for remediation, and then evaluate each to determine if it is appropriate and applicable for the given site. This two-step method is intended to give a clear, logical, and transparent consideration of how the final selections are made, and prevent a method, technology or cleanup alternative from being selected or excluded without clear justification and a factual basis. If an available and applicable method is dismissed, the FS must provide an explanation. In order to accomplish this, the FS must use properly vetted, accurate and appropriate data about the condition of the site (i.e., the FS must be based on data obtained through a complete and accurate Remedial Investigation). In addition, data on costs and logistics of technologies evaluated must be correct, and the FS must provide an accurate and realistic range of cleanup methods, among other features. Further, it must include alternatives that meet the applicable legal requirements and achieve human health and environmental protections, as described in the Remedial Objectives defined for the site.

   This FS fails to meet these criteria. Indeed, the apparent purpose of this Draft FS is to convey the message that a Duwamish River cleanup that protects both the environment and human health is too difficult, too time consuming, and too costly to attempt to implement at this site.

3. **Lack of carry through of alternatives**. LDWG's Draft FS does not carry its "maximum" cleanup alternative through the full FS evaluation, based on a premature determination that its costs are "disproportionate" – an argument that is biased by, among other things, the exclusion of intermediary and progressively "cleaner" alternatives between Alternatives #4 and #5. Several other remedial technologies and alternatives are excluded as well, such as silt curtains and hydraulic dredging, with little or no evidence or documentation. Combinations of sediment removal methods, besides capping, mechanical dredging, and "natural recovery" are also given little consideration,

4. **Operable units**. Due to the complexity of the site, a more appropriate approach for evaluating cleanup alternatives for the Duwamish River would be to divide the site into Operable Units, representing a variety of distinct conditions. For each Operable Unit, the FS should provide a range of alternatives tailored to the conditions of the unit. Operable Units are commonly used for large and complex sites, like the Duwamish, where there are geographic, environmental or

other variations that make management of the entire site as one unit undesirable. In each area, an evaluation of each potential cleanup method should be presented, in order to determine which would be most appropriate, rather than conducting an overly broad riverwide evaluation that generalizes the applicability of the remedies. For the Duwamish, a sectional approach has already been implemented in the sampling effort and sediment transport modeling. It makes sense to follow this approach through in the FS.

Specific Comments

The following comments summarize some of the major inaccuracies and weaknesses of the draft FS. These issues identified collectively reflect a pervasively inaccurate and incomplete document. If this document is allowed to guide selection of a cleanup decision for the river, it could result in a failure of the remedy selected, and cause a significant waste of public and private funds. In addition, this document fails to adequately address ongoing health risks to the river's natural and human communities who are most at risk, most notably its "environmental justice" communities – tribes, immigrant/subsistence fishermen, and low-income residents.

I. Science: Data & Models

A. Background data incorrect

LDWG's background value ranges are shown in Table ES-1 and discussed in section 4 of the draft FS. The upper values of the ranges are then used throughout the document, and form the basis of LDWG's Alternative 5 ("Maximum Removal"). EPA's preliminary values are also discussed in section 4, and demonstrate that the LDWG numbers are exaggerated relative to the EPA analysis, e.g., 100 mg/kg PCBs (LDWG) vs, 53 mg/kg PCBs (EPA). These numbers are also reflected in maps and figures throughout the document, resulting in a misleading representation. The effect of this upward bias is to limit the scope of Alternative 5 to include only those areas of the river exceeding 100 mg/kg PCBs, thereby limiting the "maximum" attainable human health protections evaluated in the document. For the purpose of this draft FS, the EPA values should be used, to provide a more accurate picture of the extent of removal needed to achieve background conditions, and the resulting level of human health protection "maximum" cleanup can be expected to achieve. In the next draft FS, the results of Ecology's background study will be available and should replace the LDWG values. Based on preliminary review of Ecology's data, the updated background values are expected to be even lower than EPA's preliminary values, enlarging the definition of "maximum" cleanup, increasing attainable human health protections, and expanding the range of alternatives.

B. Uncertainties of Sediment Transport Model (STM) not transparent

Section 5 of the draft FS discusses the Sediment Transport Model, designed to predict sedimentation rates and therefore "natural recovery" potential throughout the Duwamish. While uncertainties of the Bed Composition Model (BCM) regarding sediment chemistry are discussed, there is little discussion of the uncertainties of the STM, described as "well understood" in the document, despite the fact that it is based on 30–50 year old data, does not clearly explain its assumptions, and does not discuss possible future influences on flow and sedimentation rates. In addition to a narrative discussion of all uncertainties, the numbers presented in text, figures and tables should indicate the estimated range of uncertainties in sedimentation rates.

i. Include possible future changes, e.g., effects of climate change

The STM is based on data from 1960–80. Flow and sedimentation rates may not be reflective of future or even current conditions. Particular consideration should be given to the as yet unmeasured (and unmodeled) effects of climate change, e.g., higher or lower annual flows and more frequent and severe flood events. Such events would directly affect the accuracy and reliability of the STM and significantly affect the BCM and modeled distribution of chemicals within the LDW. An additional point of concern in this regard is the recent subsidence events occurring at the Howard Hanson Dam, resulting in higher flows through the dam. The STM uncertainties should include future changes in flow from the Green River, stormwater flows, stormwater sediment inputs, Green River sediment inputs, lateral flows, and lateral sediment inputs. While it may not be possible to model for such changes, the potential effects on modeled sedimentation rates should be discussed as a significant uncertainty that could impact the predicted performance of MNR as a remedy.

Weather events predicted to result from global warming include changes in major storm events and associated precipitation. It is predicted that increasingly frequent storm events will affect the majority of coastal states in the United States, and Washington is no exception. The U.S. government's report on climate change, released June 16, 2009, states that, "sea-level rise will increase erosion of the Northwest coast and cause the loss of beaches and significant coastal land areas. Among the most vulnerable parts of the coast is the heavily populated south Puget Sound region, which includes the cities of Olympia, Tacoma, and *Seattle*, Washington" (emphasis added). In addition to sea-level rise, a 2007 report from Environment America analyzed data from the National Climatic Data Center, the Department of Commerce, and the National Oceanic and Atmospheric Administration, among others, and determined that the percent of extreme precipitation frequency has increased thirty percent (30%) from 1948-2006. A direct result of increased precipitation is increased likelihood of flooding. The implications of heavier rainfall in the Seattle area on the Duwamish River cleanup are twofold: (1) The FS relies on the combination of source control and MNR as a remediation strategy. Increased precipitation and flooding can overload storm drains and create sewage overflows, both of which will amplify land-based pollution inputs to the river; and (2) increased rainfall often results in flooding events that increase the velocity of the river's flow, as well as the amount of debris transported through the watershed. These two factors create a high probability of sediment disruption and scour that can result suspension and recontamination of the river if MNR is the dominant remedy selected. LDWG must consider climate change and its implications for the Seattle area and the Duwamish River before proposing an alternative that does not remove contaminated sediment and relies on a 20-30 year time frame to complete remediation.

ii. Provide range of sedimentation rates, based on uncertainties in the STM

The draft FS should include a range of sedimentation rates and factors that could affect sedimentation rates and bed chemistry, e.g., using the 50% and 200% sedimentation values and clearly presenting that range in the FS. A cleanup alternative based on the most conservative, i.e. lowest, sedimentation assumptions should be included in the draft FS.

iii. Ship scour

Ship scour is an important concern for the river, and remains poorly represented in the STM. The FS focuses on the potential for mixing of the sediment but not enough on the potential for unanticipated scour events resulting from excessive speeds or accidents (i.e., not ambient conditions).

iv. Worst-first vs. upstream to downstream.

The sediment transport model argues that there is a substantial flow of sediment downriver, and that little material is carried any significant distance upriver, as stated on page 5-20: "The Upper Turning Basin sediment composition and chemistry is only minimally affected (less than 0.01%) by sediment moving upstream with tidal currents" yet, the FS does not consider that dredging upriver sites *after* dredging downriver sites could result in recontamination as a result of the downriver movement of sediment carrying contaminants to the cleaned areas. It is not clear that the present plan to address the most contaminated sites first, regardless of their location in the river, is the most logical or protective approach. It is possible that beginning upstream and continuing downstream may be a more effective strategy for the river cleanup, and should be evaluated as part of the alternatives analysis.

C. Risks and uncertainties of capping and MNR are not transparent

The FS does not adequately explain uncertainty, nor is it carried through as an analysis separate from a sensitivity analysis. Discussions of uncertainties in the document are generally addressed in the appendices, rather than incorporated into the relevant chapters. Both quantifiable and non-quantifiable uncertainties must be clearly referenced and discussed in the relevant chapter. For example, estimates of sedimentation rates in the STM may be off by a factor of 2, resulting in burial timeframes that could be twenty years (twice as long) or five years (half as long). This quantifiable uncertainty must be clearly and transparently addressed in the body of the alternatives analysis. Non-quantifiable uncertainties include the effect of climate change and seismic activity.

While the draft FS discusses the need to monitor areas subject to "natural recovery" to confirm that sedimentation and burial is in fact occurring, there is no discussion of other disturbances and the associated potentially catastrophic risks inherent in both capping and, especially, MNR. A review of possible and reasonably predictable disturbances, with particular emphasis on seismic activity (the LDW lies directly above the Seattle fault), and the associated risks must be discussed (and easily accessible) in the document. Other factors include floods, scour and ship accidents. The FS needs to present a more thorough analysis of shipping traffic and accidents on the Duwamish. Ship accidents pose a risk to the physical integrity of caps or of areas left to burial by the river sedimentation processes and at other sites general strongly considered in cleanup decisions. These data need to be presented and the consequences discussed in the FS. A discussion of all of these uncertainties is critical to risk management and public evaluation of the remedial alternatives.

D. Provide residual eco and human health risks under each alternative

The remaining ecological and human health risks associated with each alternative is the single most important piece of information for informed public review and evaluation of the alternatives. The draft FS's discussion of risks remaining under each alternative is difficult to locate and to understand. This information must be provided in a clear format with the basic information presented for each alternative, such as in the summary in Table ES-1 that shows acreage and cost associated with each alternative, and Table ES-2 that shows the Remedial Action Levels (RALs) for the risk-driver chemicals.

It is important to note that based on the tables provided in section 9, *none* of the alternatives appear to achieve the most protective human health goals (10-6 or 1/1,000,000) for either fish consumption *or direct contact*. An alternative that cleans up to (corrected) background levels must be carried through the entire analysis and residual risks clearly listed.

E. Chemical interactions and breakdown products not evaluated

Several major contaminants, including PCBs, dioxins, arsenic, and other metals, are listed as "drivers" for the river cleanup. These persistent chemicals do not easily breakdown into less toxic products, if at all, and are not degraded by microbial activity to any measurable extent. The persistence of these contaminants limits the range of possibilities for handling contaminated sediments in the cleanup.

According to EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, "When dealing with mixed contaminants at a site, the project manager should not focus unduly on one contaminant without understanding the effects of natural processes on the other contaminants, *including breakdown products*. Understanding the interactions between effects and prioritizing the significance of these effects to the MNR remedy should be part of a natural process analysis" (emphasis added).

An analysis of the driver chemicals identified at the Duwamish site clearly indicates that if breakdown should occur, the products will still be highly toxic chemicals. Thus, the natural process analysis for the site should take into account that leaving the driver chemicals in sediment may result in degradation products of similar toxicity to the original chemicals. If and when these sediments are disturbed through anthropogenic or natural events, the resulting re-suspension and recontamination can be expected to be no less toxic.

II. Regulatory Requirements

A. MTCA regulatory requirements omitted

The draft FS states that EPA does not set cleanup levels below "man-made" background levels of contamination in the area of the site, but fails to include Washington state requirements that final cleanups must meet natural background levels (for example, naturally occurring concentrations of arsenic in the Duwamish Valley). Under state law, any "man-made" regional contamination must be cleaned up in order to complete cleanup of the Duwamish River; attaining "anthropogenic" or "area" background is only an interim action. The draft FS ignores this requirement.

B. MTCA SMS dw conversions misapplied

The AELs, shown as ug/kg dw in Table ES-2, are incorrect and do not conform to state law. MTCA provides these values as fixed numbers (just as for other SMS values – SQS and CSL). LDWG performed a TOC (total organic carbon) conversion to obtain the numbers shown in the table; this conversation is not permissible under MTCA (per Glen St. Amant, Muckleshoot Tribe). The AELs must be corrected, e.g., total PCBs of 1,300 ug/kg dw corrected to MTCA standard of 1,000 ug/kg dw (equivalent to CSL of 65 mg/kg) and total PCBs of 240 ug/kg dw corrected to 130 ug/kg dw (equivalent to SQS of 12 mg/kg). The misapplied conversions have the effect of skewing the RALs upward to exceed the corresponding SMS.

C. Ineffectiveness and tribal treaty rights limit application of "institutional controls"

Institutional controls are discussed as part of several of the proposed alternatives, and are defined as "administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use." Examples might include restrictive covenants prohibiting land or beach use for activities that could breach a cap. While some institutional controls are described as ineffective or otherwise inapplicable for the Duwamish, the draft FS includes the use of fishing advisories as an "implementable" and "effective" institutional control. Not only are fishing advisories not effective for certain segments of the population (e.g., low-income or homeless anglers who cannot afford other sources of food), but relying on fishing advisories as part of the selected remedy likely violates the treaty rights of recognized tribes for whom the Duwamish River is part of their Usual and Accustomed Fishing Area (the Muckleshoot and Suquamish Tribes). Fishing advisories as part of a "remedy" for contaminated Duwamish sediments are unacceptable.

D. Fish consumption. DRCC believes that the Suquamish survey should be used rather than the Tulalip one as it more accurately reflects fish consumption. The cleanup decisions should be focused on future use and treaty rights.

E. Is 10 year achievement of RAOs measured from ROD or project completion?
The draft FS needs to clarify whether it appropriately measures time to RAO achievement from *completion of construction*, or whether MTCA requires RAO achievement within 10 years of the ROD. It appears, from a preliminary review of the governing statutes, that attainment is required within 10 years of completion of remedial actions for areas subject to active remedial measures, but within 10 years of the issuance of the ROD for areas subject to MNR (passive) remediation. Please clarify.

III. Alternatives

A. Incomplete range of alternatives

i. Spectrum of alternatives

An effective FS presents a range of alternatives, scaling from "no action" to utilizing every effort and cleaning up to the highest standards in every area. Within that range, an alternative will be selected that meets required criteria including: adherence to the highest ecological, human health, and local community considerations; state, local, and federal regulations (including ARARs); cost-effectiveness; and overall implementability. This FS presents a restricted range of alternatives that falls far short of considering all available options, leaving the reader with a limited and likely biased perspective. Readers of the FS should be able to review the alternatives presented with the confidence that all available options are adequately presented. The FS must be revised to include the entire range of cleanup alternatives available for the Lower Duwamish Superfund site.

ii. Treatment options too limited

The draft FS only includes a single "treatment" option, represented in Alternative #4d. The option evaluated is sediment washing, a process by which contaminants are physically separated from the sediments after dredging, but are not actually reduced in volume or toxicity (the volume of highly contaminated sediment is reduced, as the contaminants are removed from the soil particles, but the chemical component is not destroyed). There may be cost-savings as a result of soil washing, but DRCC considers this only partial "treatment" as it does not reduce the total volume or toxicity of the chemicals of concern. More complete treatment alternatives, including chemical (e.g., BioGenesis), thermal (e.g., CementLock), and biological (e.g., mycofiltration) treatment options and their associated efficiencies, byproducts and costs need to be included in the FS for public review and evaluation.

iii. No consideration of Granular Activated Carbon

Granular activated carbon (GAC) is an engineering/treatment option used in conjunction with capping that should be included in the FS analysis. Typically, a layer of GAC is placed on top of any contaminated sediments remaining at depth prior to capping. Due to its high adsorption coefficient, persistent organic compounds, such as the "driver" chemicals within the Duwamish, adhere to the carbon, isolating the contaminants from the sediment.

iv. Jump from Alt 4 to Alt 5 exaggerated

Alternative 5 is eliminated from consideration based on an analysis that the cost of the alternative is "disproportionately" high. This conclusion is inappropriate and misleading, based on two major omissions:

(1) the "disproportionate" assessment fails to include a consideration of risks and uncertainties associated with the other alternatives presented – only #5 eliminates the long term uncertainties and risks associated with possible catastrophic disturbances of capped and buried contaminants; and

(2) a full range of alternatives between #4 and #5 are missing – the FS jumps from consideration of nine alternatives removing and/or capping 193 acres of sediment (#2 – 4d) to one alternative removing 315 acres (#5). The apparent "disproportionality" is a function of the omission of additional incremental alternatives between these two acreage targets, unreasonably biasing the analysis.

In addition, each alternative needs to be carried through the full evaluation prior to any "disproportional cost" assessment, so that all costs and benefits can be fully and transparently evaluated by the public, to determine if the benefits are truly equal. The draft FS prematurely excludes Alternative 5 based solely on cost.

v. Ecological and human health risks are not used to frame alternatives

All alternatives need to be designed and transparently evaluated based on their resulting reductions in ecological and human health risks. Rather than relying solely on SQS and CSL (benthic measures) as targets for remedial goals, eco- and human health risk levels (i.e., 10-5, 10-6) should be used as target remedial goals for the development of alternatives. Likewise, the residual risks remaining after implementation of each alternative need to be clearly presented, as discussed in section 1.d, above.

vi. The FS makes limited use of combining technologies and methods.

The FS does not present adequate combinations of methods and technologies, but rather includes general and unsupported statements that some available methods will not work and then drops these options from further consideration. Continuing to explore the use of all available methods that are applicable will provide a more robust and complete picture of the range of cleanup results and alternatives. Any approaches that are eliminated from consideration must be justified with empirical information and references.

IV. Procedural Assumptions

A. Time to cleanup

i. Production rates too conservative

The draft FS uses a production rate of 1,000 tons/day, based on estimates of transfer and transportation capacities for removing dredged sediment by rail to regional landfills. The removal rate in turn determines the overall estimated time to completion for each of the remedial alternatives, ranging from 10 – 43 years for the listed alternatives. However, a production rate of twice the estimate (2,000 tons/day) is cited as the actual removal capacity, though it is not considered sustainable over the long term. It is not clear why 50% of capacity is selected as the "sustainable" rate, but certainly a higher rate of production is possible, at least part of the time, and the effect of higher production rates on overall time to completion should be evaluated. Further, LDWG acknowledges that the production rates do not take stockpiling of dredged material into consideration. Given that dredging is only possible during the approved fish windows, removal and stockpiling dredged material for year-round transfer to regional landfills by rail, as transportation capacity allows, is a strategy that requires serious consideration and analysis – the delay in reducing human health risks resulting from the failure to consider year-round removal is irresponsible and subjects the public to unnecessary and potentially dangerous risks. It is possible that periodic maximum or increased removal capacity, coupled with year-round removal and stockpiling of dredged material, could significantly shorten the overall time to completion required for each of the alternatives – a major factor in the evaluation.

It is also important to consider the economic value of a faster schedule, which could result in (1) lower overall cost, (2) short term job creation during a significant economic crisis, and (3) the potential availability of federal stimulus or other cleanup funds specifically allocated for this purpose.

The current, limited analysis in the draft FS appears designed to bias the reviewer against those alternatives with higher removal/dredging volumes (i.e., more cleanup).

iii. Elevated fish tissue evidence well documented?

Please provide a summary of the evidence and citations for the predicted elevated fish concentrations during dredging discussed in the draft FS.

The Draft FS seems to assume that dredging will not be well controlled and that substantial re-suspension of contaminated sediments will occur and be widespread. This is curious, given the document's dismissal of techniques specifically designed to control and minimize suspension and spillage of dredged material (e.g., silt curtains and specialized environmental dredges). With environmental bucket dredges and silt curtains, experience suggests re-suspension rates should be less than 0.5 % of the fine fraction. There are data available on this matter, and the Corps of Engineers provides information on their web site.

iv. Future conditions

It is unclear what consideration, if any, has been given to future chemical concentrations entering the river and contributing to background levels of contaminants? How will the "adaptive management" approach be applied to future background concentrations of chemicals of concern if those levels decline during implementation of the river cleanup?

B. Public acceptance

The draft FS states that there is currently insufficient information to evaluate public and community acceptance of the cleanup alternatives. However, more is known about public acceptance of alternatives at this site than perhaps any other site in the country, as a result of "enhanced" public involvement and previous Early Action Area cleanup decisions. For example, disposal of contaminated sediments in a CAD – even one in another location in Puget Sound – was rejected during development of the Early Action Area #1 (Duwamish/Diagonal CSO) cleanup project; and cleanup levels that were not protective of human health were rejected during development of plans for the Early Action Area #5 (Terminal 117) cleanup site. While public acceptance will continue to be a modifying factor in the Duwamish remedial decisions, there is sufficient information currently available to begin to help shape the FS alternatives. This information needs to be included in the analysis, and should inform the draft FS. Specifically, the high public interest in treatment should be reflected in a more robust evaluation of treatment alternatives in the FS, and the established public rejection of disposal in a CAD is well established, and should be sufficient to exclude consideration of a CAD from the draft FS, *particularly* in light of the potential treaty rights issues should a CAD be proposed within the LDW.

V. Remediation Strategies

A. Overdependence on "natural recovery" as a cleanup strategy

The term "natural recovery" (NR) refers to the passive reliance on the processes of sedimentation in the river to "clean up" contamination by covering contaminated sediments with relatively clean, or less contaminated sediment. Other functions included in natural recovery include microbes decomposing the chemicals, oxygen and sunlight breaking down the chemicals, and plants breaking down the chemicals. Unfortunately, in the Duwamish River, most of the key contaminants of concern cannot be broken down by these other methods, leaving burial through sedimentation the only applicable function. Metals (arsenic, lead, mercury) never break down and will remain forever in the sediment. PCBs and dioxins are highly persistent and resistant to breakdown by "natural" processes. We address our specific concerns with natural recovery later in these comments.

B. Over reliance on capping contaminated sediments

Capping refers to covering contaminated sediments with clean sand, gravel, stone, etc. from a clean source. Caps may be ordinary covering caps that are only intended to isolate contaminated sediment, and are usually 2-3 feet thick, or they may be thinner caps that are intended to allow or encourage biological activity to breakdown the contaminants. Thin-layer caps intended to encourage natural breakdown processes, unfortunately, are ineffective for persistent toxins such as PCBs, dioxins, arsenic and other metals. These chemicals are either elemental and do not break down or are highly resistant to microbial activity and degradation.

Capping has been used most successfully in places that are not subjected to much ship traffic, are in deep waters (>30 feet); are not subject to groundwater flows through the site; are not subjected to scouring or other flow- related events; and are not likely to experience physical stresses from the waterway above (e.g., trees and cultural debris). However, these conditions all occur in the Duwamish. Of particular concern is groundwater flow. Groundwater flow has been very poorly characterized in and adjacent to the river. At this point, no studies show where contaminated groundwater from deeper aquifers surface within the river. Due to the constricted valley floor that receives high volumes of groundwater from the Duwamish drainage area, we know that groundwater could be a significant problem for caps, particularly if, and where, it is contaminated with solvents and is moving through PCB-contaminated soils.

Capping or burial of contaminated sediments with either less contaminated or clean sediments poses additional problems. As a new layer of clean sediment is deposited, a richer fauna will inhabit the new surface sediment, but the underlying contaminants will be drawn into the clean sediments from below. Each successive layer of clean sediment will both add to the distance between contaminants and the overlying water, and provide a suitable (or more suitable) substrate for benthic organisms. But as benthic organisms populate the overlying sediments, the actions of the benthos will draw contaminants into the overlying sediments, through bioturbation, increasing the concentrations of contaminants migrating upward. The result is not a layer of clean sediments on top of contaminated sediments, but rather a gradation in concentrations. This phenomenon has been demonstrated in the James River with the chemical contaminant chlordecone (trade name Kepone). Thirty-five years after capping, Kepone is not isolated in the contaminated sediments beneath clean sediments, but still is found in surface sediments and in fish at concentrations sufficiently high to warrant fish consumption advisories.

Several issues arise with applying a capping-driven strategy to the Duwamish. A great deal of acreage is proposed to be capped by either conventional caps or caps intended to promote biodegradation. However, the driver chemicals in the Duwamish are not amenable to breakdown. Additionally, the Duwamish is not a deep and isolated waterway, but will remain an active shipping area (indeed, shipping is expected to increase). The sediment transport model presented by LDWG indicates scour in the central channel, with river-wide flows sufficient to create problems for a cap, even one that might be covered with stone (armored). Additionally, any vessel accidents have the potential to damage a cap that will then have to be repaired. Accidents will create havoc by releasing untold amounts of contaminated sediments back into the water column for dispersal or transport. In this particular case, heavy reliance on capping is not a feasible remediation strategy.

Projections of future shipping volumes indicate increases, which probabilistically will increase the chances of scour and shipping accidents. The FS must include data relevant to current and projected shipping rates as an indicator for how much scour and boat traffic could impact sediment transport, and ultimately, the most feasible alternative.

Enhanced natural recovery (ENR) is essentially light capping of contaminated sediments. In EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, enhanced natural recovery is referred to as "thin-layer placement" and "is not designed to provide long-term isolation of contaminants from benthic organisms." In a 1993 remediation project focused on Pier 53 in Elliott Bay on the Duwamish, three feet of sediment was used to cap the contaminated site. In the shallower areas around the pier it was determined that three feet of sediment would decrease navigational depth and adversely affect the benthic habitat. For these reasons, one foot of sediment was deposited with the idea that small amounts of mixing of clean sediment and contaminated sediment would cause accelerated biodegradation. Of course, sampling afterward showed that the capped area had a lower concentration of chemicals than the surrounding area simply due to burial. However, the cap depth varied across the site as some of the sediment drifted away and the existing benthic community was obliterated. A benthic community did slowly return to the capped area but it was completely different than the previous set of organisms. The enhanced natural remediation sacrificed an established benthic community to simply cover up contaminated sediments that will eventually resurface in the shallow reaches around the pier due to boat traffic.

C. Environmental bucket dredges are not explicitly mentioned and hydraulic dredging is not carried through.

Environmental dredging, as defined by the EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, "is intended to remove sediment contaminated above certain levels while minimizing the spread of contaminants to the surrounding environment during dredging." It is the most frequent cleanup method used at Superfund sites. It utilizes mechanical (buckets) and hydraulic (pumping) methods of sediment removal. Each method has requirements for sediment removal efficiency and proper disposal.

On page 7-3, the FS states, "Areas large enough to site a facility capable of dewatering hydraulically dredged sediment with meaningful dredging production rates are not available."

In the statement above, LDWG cites lack of space for a dewatering facility, complications from debris, and re-suspension as the primary arguments against employing hydraulic dredging as an alternative; in fact, the FS does not carry through any discussion of hydraulic dredging. The FS simply states that there is too much water in the hydraulically dredged sediments and not enough space to handle it once dredged. However, a more thorough investigation of current dredging practices indicates that hydraulic and other environmental dredging are in fact feasible options for the Duwamish site. New technologies have been developed specifically to treat the issues raised. Indeed, Boeing conducted a cleanup at the Norfolk CSO on the Duwamish using hydraulic dredging – including dewatering – since the Duwamish site listing. In addition to hydraulic dredging, environmental clamshell dredges and silt curtains, when used concurrently, present an alternative that results in timely, cost-effective cleanups. The most protective cleanup technologies, including dredging technologies, should be selected on a site-by-site (unit-by-unit) basis within the river. As Potentially Responsible Parties, Boeing, the Port, the City and County, and others have an obligation to ensure that the cleanup is conducted to the highest standards. Based on the options currently available, LDWG needs to reconsider the possibilities available for environmental and hydraulic dredging.

The presence of debris in the Duwamish is cited as an issue because excess debris, large rocks, etc. can clog or jam the dredge. With current technologies, considerable amounts of debris do not automatically preclude the option of hydraulic dredging. The problem with debris may be solved with screens over the intake for the dredge, for example, used to prevent debris from damaging the equipment. In addition to addressing the treatment of debris in hydraulic dredging, the FS should include a more thorough discussion of the feasibility of the environmental clamshell dredges (explained below) as an alternative for remediation of the sediments.

Page 7-3 states, "The environmental dredging literature contains no documented quantitative evaluations that distinguish between the re-suspension and recontamination characteristics of mechanical and hydraulic dredging under other than ideal debris-free site conditions (USACE 2008). Therefore, no compelling technical reason exists for developing parallel remedial alternatives using both process options."

The FS fails to examine the re-suspension of sediments in a meaningful way. The technical literature on dredging and the ACOE website and library have reports and results of re-suspension, including the results of modeled distributions and rates for several different situations. This topic needs further examination in detail in the FS. The FS needs to explicitly indicate the environmental bucket as the type of dredge discussed and carry this technology forward through the entire evaluation. There is no explicit mention of using environmental bucket dredges, widely recognized as the current and best technology for dredging contaminated sediments with a clamshell type dredge. The text does mention various features of the environmental bucket equipment, including operating guidelines, but fails to identify an environmental bucket as the name/type of equipment.

A hydraulic dredge is a suction dredge that "vacuums" up the sediment, and operates in softer sediment. Some types of hydraulic dredge are equipped with a "cutter head" that can dig into compacted sediments, and these dredges are usually referred to as "cutter head" dredges. A hydraulic dredge can also be fitted with a smaller horizontal auger dredge to be used in even shallower areas. Hydraulic dredges operate in soft sediment and have the advantage of removing large amounts with less disturbance and re-suspension of sediments. The equipment consists of a small barge containing the hydraulic dredge and a tube that siphons the sediments out to a settling pond. The process is nimble and can be readily used in shallower waters, along banks and near piers. Hydraulic dredging is being used along several river miles of the Hudson River outside of the deeper navigation channel, and has been used by The Boeing Company on the Duwamish River during its cleanup of contamination at the Norfolk CSO.

The latest in environmental clamshell buckets for sediment removal come from Cable Arm Inc., which has engineered an environmental clamshell that has features that reduce the impacts of environmental dredging. A venting system allows water to move through the clamshell as it is lowered to the sediment surface, decreasing water displacement and minimizing re-suspension. As it is raised, water stays within the bucket until it reaches the surface where excess water is drained, reducing dewatering costs. The environmental clamshell also features level cutting to ensure complete sediment removal and overlapping sides with rubber seals that keep sediments in the bucket until unloaded. The clamshells are GPS-guided and have a lower overall weight because they do not need counterweights. In shallower areas where the water depth may not support the weight of a scow for containment of sediment after dredging, hydraulic transport may be used to pipe the dredged material to a dewatering site. These features make environmental clamshell buckets ideal for environmental dredging in most any riverine system. Cable Arm Inc. environmental clamshell buckets have been used in New Bedford, Yankee Rowe, Calumet, Saginaw, Searsport, and the St. Lawrence River. The cleanup of the Hudson River is also utilizing environmental clamshell buckets.

During the dredging process, silt barriers can be used in the area of dredging to cut down on turbidity and to prevent the movement of contaminated sediments further downstream, even on a tidal river. Given site specific conditions, they are effective in currents less than 3-5 knots when installed properly. Also, starting upstream and continually working downstream will help prevent recontamination of a previously cleaned area of the river. Clean up of the lower Passaic River in New Jersey included continual monitoring of water temperature, river velocity, currents, tides, salinity, suspended solids and sediment particle size both upstream and downstream of the dredging site. Environmental clamshell buckets in conjunction with silt curtains and monitoring of water quality conditions can ensure a productive, clean, and cost effective method for contaminated sediment removal.

D. Treatments

New technologies for treating contaminated sediments once they have been dredged have created the opportunity to turn waste into a usable resource. BioGenesis Enterprises, Inc. in 2006 unveiled a new technology that strips away contaminants from dredged sediment and leaves behind clean, quality topsoil. This technology was used in a Woodbridge, New Jersey facility to treat more than 4500 cubic yards of contaminated sediment from the lower Passaic River. In addition to sediment washing technology, Endesco Clean Harbors has patented a technology that heats the sediment and blends it with cement. This process is being used to treat sediment stored on the Raritan River at Bayshore Recycling in New Jersey.

E. Confined Aquatic Disposal and Confined Disposal Facility options should be removed.

On pages 7-9, 8-2, and 8-5, the FS provides information regarding an in-water disposal option using Confined Aquatic Disposal (CAD). However, CAD is not an acceptable option here, as per agreement among the stakeholders and agencies more than 2 years ago. A CAD is more often a hole or depression in the bottom that is then filled in with sediments and covered over with a thick layer of clean sediment. The idea is to put it all in one place and cover it with a layer thick enough to isolate from the animals and water above. If there is a possibility that some physical force may disturb the capping, then stone is placed over the surface as "armoring." Armoring is also common for any work near shorelines. Not only are there are too many problems with the logistics of a CAD, the parties already agreed to not consider a CAD likely based on knowledge of these issues.

On page 7-10, the FS includes a discussion regarding a small Confined Disposal Facility (CDF) The Duwamish has never been a good location for a CDF, and as for the CAD, above, stakeholders and agencies agreed to eliminate CDFs from consideration during previous document productions. There is no reason to include the CDF other than to explain at the beginning that it is not under consideration and explain why.

A CDF is somewhat different in design from a CAD, but the general idea is similar: all the sediments are put in a single location and isolated from the river system. CDFs are structures with concrete or steel walls to create a bunker that holds the sediments. CDFs are generally not lined on the bottom, but sit on the natural sediment. It has not been uncommon to create a CDF on a very shallow area that is far from the channel, or in an unused slip area out of the way of any ship activity. However, public acceptance, treaty rights issues, and the presence of a seismic fault under the Duwamish River are all reasons why this option was ruled out by stakeholders early in the process.

F. Monitored Natural Recovery and Appendix F.

LDWG dedicated Appendix F to various data and case studies regarding monitored natural recovery. To date, there have been no studies concluding with certainty that "natural recovery" is an effective means of remediation for persistent chemicals. The problem with MNR is twofold: that there is no evidence that it works to either a) cover the sediments with a sufficient layer of clean sediment to provide permanent containment, nor b) isolate the contamination to the point where the chemicals do not move into the aquatic food web. These two processes are related but not at all the same. The first process is the physical burial of sediments with freshly deposited sediment. The second process is preventing migration of contaminants into the food web. This second process may also be considered as biological activity that brings contaminants up to the surface from below. Burial can be predicted (more or less) from some models and measured information on sedimentation. Isolation is not so easily predicted and there is not a "model" to help predict it. The majority of the information in Appendix F is not supported by technical data and the sites listed do not share major site characteristics with the Duwamish River. The information below compiles comments specific to Appendix F.

Overview

MNR is based on the depositional nature of larger waterways. Over time, sediments from upstream are deposited in contaminated locations, theoretically isolating the pollutants on the stream or river bottom from the water column and biota over time (EPA 2005). Once isolated, the pollutants can then begin to degrade. Regulatory officials evaluate on a site-specific basis the amount of time that it takes for the pollutants to break down, which depends on a number of variables such as sediment chemistry (% organic carbon, etc.), the constituents and concentrations of the chemical mixture in question, and temperature. Often, the timeframe selected is greater than 20 years. Currently, there are no sites where MNR is in use that have implemented the remedy for the amount of time required to be called successful. The examples and case studies listed in Appendix F of the Draft Feasibility Study will be further discussed below.

Mechanisms of the Breakdown of POPs

The breakdown of toxic compounds is generally defined as any transformation that reduces the toxicity of the pollutant. For most POPs (or persistent organic pollutants) such as PCBs and dioxins, this is accomplished through the removal of the chlorine atoms bound to the molecule that give them their toxicity. Unfortunately, this is much easier said than done, and an entire industry has been created trying to create new and innovative ways to accomplish this. To date, these efforts have been met with limited success.

POPs, as their name implies, are long-lived in the environment. They resist biological breakdown by bacteria and other microbes, and were often created and used because of their stability and lack of reactivity with other compounds. Many are also quite resistant to thermal breakdown, with some congeners of dioxins requiring temperatures in excess of 700°C (1,292°F) for decomposition (Rice et al 2003). When POPs enter aquatic systems such as streams and rivers, they become even more stable and difficult to break down.

The two most effective processes for the natural degradation of POPs like dioxins and PCBs are exposure to sunlight and decomposition by some anaerobic bacteria. Anaerobic (without oxygen) metabolism by microbes has been shown to have a limited ability to dechlorinate toxic POPs (Adriaens et al 1995, Ballerstedt et al 1997, Barkovskii and Adriaens 1996, Bedard et al 2007). Unfortunately, when the compounds are bound to sediments this ability is greatly reduced (Albrecht et al 1999). The US EPA has acknowledged these limitations in their assessment of monitored natural recovery, *Monitored Natural Attenuation: USEPA Research Program - An EPA Science Advisory Board Review*.

Light does not have the opportunity to act on PCBs during MNR since the principle behind the approach requires that contaminated sediments be buried and isolated from the environment. When the sediments are isolated in this fashion it prevents sunlight from reaching and breaking down contaminants. Therefore, once POPs are bound to sediment and subsequently buried, they are effectively isolated from the natural processes that work to break them down.

The Sangamo-Weston/Twelvemile Creek/ Lake Hartwell, Pickens County, SC case study states that dechlorination is actually occurring as a result of natural recovery. However, per the reasons listed above, this information would seem doubtful unless some other cleanup strategy is at work. Appendix F does not list the congeners, purportedly resulting from the breakdown, nor does it give a detailed explanation for how this breakdown is occurring. It seems highly unlikely, or at least suspect, that PCBs are undergoing chemical transformations solely by ongoing sedimentation.

The Interplay of Water and Sediments in Aquatic Systems

Even though POPs bind tightly with sediments and are not soluble in water, they are not completely immobile in aquatic systems even once they are buried beneath layers of sediment. Many aquatic environments, particularly streams and rivers, are quite dynamic. Conditions vary significantly over both temporal and spatial scales, and can have significant effects on sediments within the water body. These changes are critical in understanding the spatial distribution and concentrations of

POPs within these systems. Furthermore, because biota seek out the organic fraction of sediments that contains the highest levels of organic POPs, biological activity is likely to mobilize POPs into the food web.

Conditions change substantially the further one goes upstream in a river system. Large rivers are mostly depositional, murky with sediments that have runoff from it's the surrounding watershed. This turbidity acts to substantially limit the penetration of light into the river, and prevents submerged plant communities from becoming established. As one goes upstream, erosion becomes more significant than deposition (Paul and Meyer 2001). Flash flooding becomes more common because streambeds are smaller and have a reduced capacity to accept runoff. There are significant and regular interactions between the floodplain and the stream in these smaller systems. Scouring of the streambed is common in these streams, particularly in highly developed areas accepting large amounts of sediments. These low order streams are much more dynamic than large rivers, and conditions change constantly.

This is not to say that large rivers are static. Large flooding events can move significant amounts of sediment downstream and bring large debris into the river, which can cause significant scouring of the riverbed. One flood in the Colorado River increased the streambed by nearly five feet (Leopold 1962). In colder climates, ice can also disturb the bottom of even large rivers. In the lower Fox River in WI, ice scours as much as four feet deep have been recorded (WDNR 2006). The creation of frazil ice, or ice crystals that are formed within the water column in turbulent waters at very cold temperatures, can also cause significant scouring of sediments.

Rivers and watersheds are the primary pathways of sediment transport in most areas. Events both large and small have the potential to disturb streambed sediments. Most of these events happen with enough frequency that it is not so much a matter of *if* but *when* they will occur.

Long-Term Effectiveness
There is little information on the long-term effectiveness of MNR. Preliminary data indicate that these techniques may not be as effective as predicted. One example is the James River in Richmond, VA. Illegal dumping of the pesticide Kepone contaminated the river and resulted in a ban on fishing in 1975. The pesticide is highly toxic and also stable in the environment in ways similar to PCBs and dioxins. The ban was replaced in 1988 with a fish consumption advisory which remains in place to this day. Fish tissue concentrations, sampled in the James River, indicate that chemical concentrations of Kepone have fallen over time. More importantly, however, the most recent data available from Virginia DEQ indicates that samples of fish tissue concentrations continue to exceed the limit of 0.03 ppm. Figure 1 displays the decline in Kepone concentrations in white perch and striped bass from 1976 to 2002, sampled from various zones within the James River estuary. Though concentrations have decreased, white perch and bass tissues have continued to be sampled at concentrations higher than the level set by the Virginia Department of Health as protective of human health. Data from 2004 indicates that fish tissue samples in striped bass were still as high as 0.09, three times the DOH limit, and samples in white perch were as high as 0.07 (Virginia DEQ). Despite the overall decline, data indicates that the James River fish populations have had 28 years to prove that natural recovery is effectively cleaning up the river. In those 28 years, fish tissues are still coming back higher than Virginia's Department of Health deems protective of human consumption. After three decades, monitored natural recovery, the remediation alternative chosen for a river very similar to the Duwamish, has not successfully reduced chemical concentration to levels acceptable for human health.

Figure 1. Average Kepone concentrations in white perch and striped bass from zones D–A (Hopewell to the mouth of the James River) (Luellen et. al 2006)

The possibility that the Duwamish River could result in the same prolonged contamination should not be surprising given the extreme persistence in the environment of many of these compounds. The same processes that isolate contaminated sediments from aquatic organisms also serve to prevent or inhibit natural recovery mechanisms. Considering that many POPs have the potential to remain in sediment for over 100 years, it is almost a statistical certainty that a significant scouring event (such as a 100 year flood event) will occur during the timeframe required for MNR to run its course. These events redistribute the essentially un-degraded POPs and make them readily accessible to aquatic organisms such as fish where they can re-enter and accumulate in the food chain. The long-term effectiveness of MNR is countered by many of the same natural processes that it wishes to exploit. In most cases MNR is not a desirable remedial option for persistent organic pollutants, particularly if the objective is to reduce fish tissue concentrations below levels that require consumption advisories, as every source from the Remedial Action Objectives to the Governor of Washington has stated.

Feasibility Study Comments – Appendix F

Appendix F covers the evidence of natural recovery as a usable method of cleanup for the Lower Duwamish. Monitored natural recovery simply relies on burial rather than removal, which only alleviates the current, immediate contamination issue. This approach is short sighted and relies heavily on assumptions that natural occurrences such as storms, extreme high tides and seismic activity, as well as man-made disturbances, will not disrupt the remediation process. The effort to remediate chemicals of concern found in the Duwamish River cannot be accomplished by sedimentation alone. In addition, the sediments that are being deposited to cover older contaminated sediments must themselves not be contaminated. This requires a reduction in sources of contamination by atmospheric deposition, runoff and regulated point sources. Section F.1.4.2: State Guidance cites the *Sediment Cleanup User Manual,* which states that natural recovery through chemical degradation and deposition of clean sediment are essential to remediation for low chemical concentrations. However, the Duwamish River is a Superfund site, i.e. a site with some of the highest levels of toxicity in the country. LDWG is not protecting human health or protecting the environment by relying on methods designed to clean up areas with lower concentrations of chemicals than those found in the Duwamish.

Monitored natural recovery relies on sedimentation rates to adequately deposit a protective layer over the existing contaminated sediments. The Sediment Transport Analysis Report stated that sedimentation rates analyzed in the Remedial Investigation ranged from 0.7 cm/yr to >4 cm/yr. Despite whether sedimentation rates may or may not be sufficient for remediation, deposition of clean material must be used, which may not be occurring due to continued contamination by upland sources and combined sewer outfalls. Also, little to no natural chemical degradation will occur when sediments are cut off from oxygen, light and biological organisms that might naturally degrade these contaminants, if at all. The PCBs in the LDW cannot be expected to degrade through biological means.

The draft FS justifies the possibility of MNR at the Duwamish site using analysis of the river's sedimentation rates. According to the FS, due to sedimentation rates of 10cm/year, burial of contaminated sediments will be efficient and effective and will result in safety for humans and the environment. A comparable site in Virginia, however, indicates that much higher rates of sedimentation have done little to mitigate the effects of Kepone contamination, even thirty-five years after natural recovery was chosen as the remediation alternative. Sedimentation rates in the James River (Virginia) are as high as 60cm annually, which is much higher than the predictions at the Duwamish. Despite the James' high rate of sedimentation, fish tissue samples still today reveal Kepone concentrations higher than the Virginia Department of Health's accepted levels (VA DEQ 2004). Fish advisories remain in effect for protection of human health. Not only is the James' overall rate higher than the Duwamish, sedimentation rates in key areas of concern, i.e. sources of contamination, are comparable to those anticipated at the Duwamish, approximately 10cm/yr (Nichols 1990). If MNR at a site receiving comparable to, or higher than, Duwamish rates of sedimentation has not been successful in thirty-five years, MNR at the Duwamish cannot be expected achieve Remedial Action Objectives in the time span predicted by LDWG. Furthermore, LDWG's main objection to performing the "maximum" cleanup is that it will take 20 to 30 years. It can be reasonably expected that MNR will take at least as long or longer. The time frame is simply not enough of a reason to throw out more aggressive and effective methods of remediation, and as we can see from the example of the James, the rate of sedimentation is not a sound argument for MNR as a remedial strategy for POPs.

According to F.1.3: Conceptual Site Model of Natural Recovery in the LDW**,** active mixing in the upper 10 cm in the biologically active zone takes place. The report states that this plays a role in natural recovery by causing newer sediments to mix with older sediments. This mixing approach does not make sense if we are also to be concerned about scour by boats and high tide events that would move and displace depositional material. These are one and the same concern, just by different mechanisms. The deepest scour predicted is 22 cm, below the biologically active zone. The combination of an area of high concentrations of contamination, a direct source of contamination, and the possibility for deep scours is a recipe for disaster. As these ridges do represent established vessel traffic patterns, this increases the chances for churning of sedimentation, not less. The bathymetry used is also just a snapshot and does not show the changes over time because there is no other data for comparison.

The bed concentration model predicted that in 10 years of natural remediation, PCB concentrations would decrease by 60% from baseline conditions, arsenic by 26%, and cPAHs by 30%. F.2.2.1.2: Location-by-Location Comparisons at Resampled Locations, also states that "natural recovery may be less pronounced for chemicals other than PCBs either because the chemical occurs naturally in soils and sediment (arsenic); it is in watershed soils from atmospheric deposition of particulates from emissions (arsenic, dioxins/furans, and cPAHs); or it is released from nonpoint urban sources (cPAHs and phthalates)." The success of capping is noted in the case study for the Norfolk Area, F.2.2.2.2. However, Norfolk is an area that has no boat traffic, reducing the risk of scouring. Success of this method alone is not useable in a navigable river like the Duwamish. According to the FS, Reach 3 has the highest sedimentation rates, causing the Army Corps of Engineers to conduct regular dredging to maintain depths necessary for navigation. Dredging simply undoes the work of natural deposition, and is thus counteractive to any form of natural recovery that LDWG anticipates in Reach 3. The Appendix does note in F.2.2.2: Recent Surface Sediment Chemistry in Dredged and/or Capped Areas, that previous removal of sediments due to dredging for navigational purposes decreases PCBs to below the sediment quality standards. Dredging, therefore, has proven to be an effective means of permanently reducing PCB concentration in the Duwamish, whereas natural recovery has not at any site across the country.

The information provided in Appendix F repeatedly attributes the decreases in PCB concentrations solely to natural recovery when in fact several remediation strategies are concurrently affecting the rate of reduction as well as the health of the biota. Section F.2.4.2 attempts to attribute the decrease in total PCB concentrations in fish tissue from the 1970s to the 1990s to monitored natural recovery. This deduction is narrow-minded and ignores the entire history of cleanup efforts at the Duwamish. Since the 1970s, source control has been instituted and sediment removals have occurred (both prior to Superfund work and as a part of Superfund). The FS cannot make the logical conclusion that monitored natural recovery is the cause of the total PCB decrease in fish tissues. In fact, the last paragraph in F.2.4.2. provides evidence that the decrease in PAH-related liver disease is directly attributable to source controls. If the incidence of PAH-related liver disease has decreased sharply, it is not due to doing nothing. MNR is not a control; it is equivalent to a "no action" decision. How is it possible then that the decreases in total PCBs attributed to monitored natural recovery are not in any way related to the implementation of source control? There are too many variables throughout the history of the Duwamish to say with any certainty that monitored natural recovery is the sole reason for increased fish health.

The issue of increased PCB concentrations after dredging is also not clearly represented. Section F.2.2.2.1: Duwamish/Diagonal, wholly discounts the effects of sediment dredging by attributing the decline in total PCB concentrations after dredging to natural recovery processes. Section F7.4: Biological Endpoints, confuses the issue by making a point that source control has been a primary means of PCB concentration decline since the 1980s and indicating that recent rises may be the result of dredging. There is no mention of how natural recovery has played into facilitating increased water quality and biota health. Regardless of an initial, transient increase in PCB concentrations that may or may not have been due to dredging, the point of sediment removal is to permanently reduce the concentrations of pollutants in a waterway; decreased PCB concentrations after dredging are certainly related to dredging. Any planned, or unplanned, sediment disturbance may result in initial increases, due to disturbance, and certainly to subsequent decreases of PCB concentrations. Dredging results in a net reduction of persistent organic pollutants, whereas natural recovery does not; relying on sedimentation and natural recovery is ineffective and prolongs an active remediation strategy. As a result of inaction, sediments will remain in the waterway and be available for re-suspension due to human and natural disturbances. These factors are the principal reason for sediment removal which is the most permanent, successful means of remediation for Duwamish River system.

Appendix F mentions the use of core profiles and predictive tools for sites including: the Passaic River, the Lower Fox River, Housatonic River, the Hudson River, and the Portland Harbor Superfund Site. None of the case studies or examples cited in Appendix F has been in place for the time required to call each respective remediation successful (Table 1). At the Housatonic River, there are no data for MNR because GE's Corrective Measures Study has not been accepted. As a result there is no Record of Decision, and therefore, natural recovery has not been a selected remedy for the Housatonic site. Furthermore, monitored natural recovery is meant to be tailor-made to the site before it is implemented, and the FS is incorrect to draw comparisons between physically incomparable water bodies. The Housatonic River is characterized by flowing upland water, and the site is located above the Piedmont (Table 1). Tidal impacts are nonexistent at the Housatonic, whereas salt wedges and tidal activities are of great importance when considering appropriate cleanup measures at the Duwamish. The cleanup at the Hudson River is also non-tidal, being located above the fall line (Table 1). The case study offered from South Carolina compares a small, fresh-water lake to the Duwamish. Again, these are not physically comparable sites and therefore the actions taken in South Carolina cannot reasonably be extrapolated to the Duwamish (Table 1).

In addition, monitored natural recovery for the examples cited in Appendix F has not been either (1) in place long enough to indicate successful cleanup, based on the issue dates of respective Records of Decision or (2) been the sole selected remediation remedy. Consequently, MNR alone cannot be attributed with the successes in cleanup at these sites. In fact, sediment removal has been the primary cause of successes in remediation at the Hudson and Passaic sites, as mentioned in a paragraph above. Natural recovery was adopted by the EPA as a remediation strategy for the Hudson after it was listed in 1984 as a Superfund site. On May 19, 2009, dredging began at the Hudson due to unacceptably high contamination remaining after 35 years of employing an inactive remediation strategy. The Hudson River project is a perfect example of why monitored natural recovery prolongs site remediation by requiring another strategy to ultimately fix the contamination problem when natural recovery fails to result in acceptable levels of improvement.

Table. 1 Comparison of Examples Given in Appendix F Where Natural Recovery is involved in Contaminated Site Cleanup

Site Name	**Location**	**Characteristics**	**Physiographically Comparable to LDW?**	**MNR as sole remediation strategy?**	**Decision Issue Date**
Lower Duwamish Waterway	WA	River Tidal Brackish	n/a	n/a	n/a
Whatcom Waterway, Bellingham Bay	WA	Bay Tidal Brackish	No	No	2007
Lower Fox River	WI	River	No	No	2002 and

		Nontidal Freshwater			2004
Housatonic River	MA	River Nontidal Freshwater	No	No	Decision not yet issued
Hudson River	NY	River Nontidal Freshwater	No	No	2002
Passaic River	NJ	River Tidal Brackish	Yes	No	1987
Willamette River, Portland Harbor	OR	River Tide Freshwater	No	No	No
Sangamo-Weston/Twelvemile Creek/Lake Hartwell	SC	Lake Nontidal Freshwater	No	Yes	1990

Source: Environmental Stewardship Concepts
Note: Bellingham Bay, the Lower Fox River, the Hudson River, and the Passaic River were not used as case studies in Appendix F. Rather, they were indicated as sites where core profile sampling has occurred to demonstrate that sedimentation occurs in water bodies. ESC agrees that sedimentation is a naturally occurring process in any water body, and that contaminated sediment will be buried under newer sediment. However, there is no guarantee that older sediment is buried in perpetuity and not available to the water column or biota. In fact, none of these sites has implemented MNR as their primary remediation strategy.

Specific section and page comments

Section 2.1 Environmental Setting

The FS states on page 2-1 that "The Upper Turning Basin serves as a trap for most of the bed load sediment carried downstream by the Green/Duwamish River. The Upper Turning Basin and portions of the navigation channel just downstream of the Upper Turning Basin are dredged periodically to remove accumulated sediment, reduce sediment transport into the lower reaches of the LDW, and maintain appropriate navigation depths."

Despite the statement that most of the sediments from the Green River are collected in the upper turning basin and then dredged by the ACOE, the document also states that sediments from the Green River are deposited downriver (Section 5) in sufficient volume for deposition to bury the contaminated sediments.

Figure 2.13a shows the vertical distribution of SMS contaminants in the lower Duwamish, from river mile 0 to 1.4. Contaminants exceeding standards are distributed in the sediments both 0-2 ft (16 sites) and > 2 feet in depth (22 sites). At 10 sites, contamination occurs above and below the 2 foot depth contour. These data do not support the conclusion that surface sediments are cleaner than deeper sediments at most locations in this reach. Surface sediments are less contaminated in isolated locations within the lower river, but not generally.

Section 2.6.1, page 2-44

This section describes the early action at Duwamish/Diagonal and explains that "Over time, the natural process of bioturbation is expected to mix this clean sand into the underlying sediment containing PCBs." This explanation of "enhanced natural recovery" quite clearly explains that the process is one of mixing the contaminants, not covering contamination to isolate and not providing a means of detoxifying the contaminants. The total mass of PCBs remains in the sediments without any lessening and seemingly with greater exposure to the overlying water and benthos as the mixing takes place.

Section 3.1.3 Risk Drivers for Ecological Receptors

This section fails to account for the combinations of chemicals that will interact on the same endpoint to pose an unacceptable risk. PCBs, TBT and other chemicals act on the reproductive systems of fish, combining sub-threshold doses to exert significant effects. The section needs to add in the risk drivers that act on common endpoints.

Section 4.1.1 Remedial Action Objectives

RAO 1 on page 4-3 refers to the deeper sediments being isolated from exposure pathways to the extent that fish are unaffected by deeper contaminated sediments that remain in place and undisturbed. This conclusion is not supported by all the contaminated sites. The deepest sediments (>4-6 feet) may be well isolated, so long as undisturbed.

Section 6.3.2.4, Dioxins/Furans

This section makes little sense and is wrong on the point that the areas will "recover." There is no recovery from dioxin/furan contamination - there is only washing away or covering up. There is no affirmative evidence that sediments in a site such as the Duwamish will both cover and isolate the contaminants.

Additional specific comments on the current draft FS narrative:

ES-3: Because early action areas are included in the "study area," the maps should include the known PCB and dioxin contaminated upland areas.

ES-4: "The LDW is an engineered waterway built in the early 1900s to serve developing industries in Seattle." Should be rephrased to an "existing river was modified…."

ES-4: This paragraph should include a sentence that describes ongoing restoration sites and efforts (rather than "remnant habitat."

ES-5: This entire page is misleading in its approach. The full extent of problem is not well described and even basic items like the actual number of early actions sites appears to be incorrect.

Figure ES-2: This figure is misleading in that the ranges chosen for depiction of concentrations are so limited.

ES-8: The information on background is not accurate. Further, the uncertainty is not about the true value of the area background numbers but rather the uncertainty of the value. The word "true" is misleading.

ES-10: Sediment modeling description acknowledges that mixing occurs. Does not adequately address propeller erosion other than the mixing aspect. (As a note, there are a large number of sites identified in Figure 6-2 that have evidence of scour – is that storm scour or propeller-induced scour?)
Specify the 2 unsponsored sites and discuss why they are ignored.

ES-18: Pie charts are misleading.

ES-20: Public acceptance needs to be included in the next draft.

ES-21: The FS evaluation factors for "Cost" should include a discussion of the benefit of jobs and other positive aspects for the local economy as a result of the cleanup.

ES-23: "However, this treatment also generates residuals and does not destroy chemicals."

P 2-18: Given the new information being generated about dioxin concentrations, it is not clear that enough dioxin samples have been collected in the river.

P 2-20: This statement should be supported by a map and much more text. As it is, it is an unsubstantiated statement: "Some areas exhibited high chemical concentrations in both subsurface and surface
sediment, coincident with low net sedimentation rates calculated in the STAR and supported by the STM"

P 2-21: PCBs continue to be discharged into the river.

P 2-22: This statement is, unfortunately, not substantiated, in this FS. An adequate assessment of the recontamination potential for all chemicals of concern has not been performed: "Although there are existing (current) releases of chemicals to the LDW, the magnitude
of these releases is likely smaller than historical releases"

P 2-22: We strongly disagree with this statement: "Groundwater is not generally considered to be a major source of the risk-driver chemicals to sediment in the LDW, based on the results of porewater and seep sampling and a review of available groundwater data." There are several areas of the river, including Boeing Plant #2 where the groundwater pathway has not been adequately characterized and solvent plumes may well be a transport mode for chemicals of concern into the river:

P 2-23: The PCB and other chemical stormdrain sampling, if it include inline sampling, that is described in this section involves samples that did not have a strong and agreed upon scientific basis and can only be considered preliminary screening samples. Therefore, the concentrations should

NOT be included in the FS. DRCC requests that improved inline sediment monitoring be required by USEPA/Ecology as soon as possible.

P 2-25 (top): Ecology should be focusing on chemical recontamination potential rather than source control at this phase of the investigation/study.

P 2-26: The Groundwater assessment should now be reconsidered based on new information that has been generated (this section is now out of date). In addition, groundwater monitoring wells should be installed, rather than relying on old data reports, in order to adequately characterize the groundwater pathway.

P 2-26: The bank erosion section is woefully deficient.

Figure 2-11: The BEHP figure (and all similar figures for other chemicals) should show more river detail. For example, this figure should show the locations of stormdrain outfalls and CSO outfalls.

Figure 2-14a: The term "historic" is misleading in this figure, even though it has a footnote. PCB-contaminated caulk may have been historically installed, but it continues to impact stormwater quality. Therefore, a new category should be created for the map, or these sources should be described as "Ongoing." The term "potentially ongoing" is also misleading. We know that these ARE ongoing sources. Also, there should be figures for some of the other important chemicals, such as BEHP.

P 4-4: Again, the emphasis should be on chemical recontamination potential, not source control at this phase. It is unacceptable at this stage that we do not have the knowledge to know whether this statement will be correct, or the degree to which it will not be correct: "An adequate level of source control is an assumed element of remedial design and implementation planning (see Sections 7 and 8) to preclude unacceptable levels of recontamination during or following the remediation of contaminated sediment areas.

P 4-4: This sentence does not make sense: "However, continuing sources contribute some fraction of the total ongoing contaminant loading to the LDW."

P 4-29 and Figure 4-15: In addition to our general concern about how background is being derived for the Duwamish site, DRCC continues to specifically disagree with the dioxin assessment for background. We have asked for a meeting on this topic and, to date, this meeting has not been scheduled.

P 5-5: The text should be revised to indicate the percentage of lateral load that impacts various segments of the river. If the bulk of the upriver load is deposited above RM 4.0, then the lateral loads in each area downriver (especially adjacent to outfalls) would be higher than 1% and should be so quantified (along with the percentage of fines, etc.) as is acknowledged on page 5-19.

Page 5-10: In-line sediment data should not be used for lateral calculations as these data have not been scientifically validated. In addition, DRCC disagrees with the manipulation of higher concentration samples. An adequate number of scientifically-valid samples should be collected so that valid modeling can be performed.

Page 5-11: Atmospheric deposition of chemicals from sources that are located in the Duwamish drainage should be included and to date, these data have not been adequately collected.

Page 5-13: The text on this page describing the BCM illustrates that adequate samples have not been collected. DRCC has requested and now requests again that a technical meeting among stakeholders be scheduled to discuss the BCM.

Page 5-14: This statement is concerning: "No post-remedy bed sediment replacement values were used for these points. If a point was located in an actively remediated area, it was considered to be remediated below the SQS and removed from the point counts describing effectiveness for each remedial alternative" Would the recontamination of these areas be an important factor to assess and then plug into the model (although treated in a different way within the model)?

5-19: Section 5.3.3.2 illustrates our concern that the generalized approach taken in both the BCM modeling and in the FS as a whole is inappropriate. Specific areas of the river behave in different ways and have different chemical-specific concerns, including loading potential. It is not adequate (page 5-20) to state that this information will only be assessed in the design phase ("Recovery estimates in some of these areas should be refined during remedial design.") . For other sites in Puget Sound as well as early action sites in the Duwamish, this approach was not allowed.

Page 5-22: These areas should be described here (in this section) in addition to elsewhere in the document. We should not have to dig this information out: "In areas where these lines of evidence are not similar or where recovery is not predicted, more attention is given to ascertain the reasons for these differences and these areas are prioritized in the FS."

Page 6-13: The grid system is very coarse. Rather than using a rigid grid approach, a more geographically based approach would be preferable so that local perturbations could be addressed (included). The resolution/scale of each site is inadequate (i.e., the text implies that one solution should apply to the entire SMA as shown on Figure 6-2). This emphasis on generalization is continued in table 8-3 and in the text on page 8-11.

General comment: It is inappropriate to completely screen out Early Action sites, as we have seen that these cleanups have not resulted in adequately clean sites. In fact, EPA does not consider the only Early Action Area cleanups that have been conducted to be complete or final.

Page 8-12: This section should be titled "Chemical recontamination potential" and should have that focus at this phase of the effort.

Page 8-13 (and Figure 8-13): Were generalized river-wide numbers used for the river, or were outfall specific locations used for this result: "This exercise first calculated the minimum percentage of lateral sediments needed to result in SQS exceedances at Year 10 for each chemical, and then identified those grid cells exceeding such percentages"?

Table 8-5: Again, this table is too generalized to be meaningful for each site.

Figures 8-1 onward are difficult to interpret because adequate information has not been provided.

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