Draft Feasibility Study Comments

April 24 – June 29, 2009

MWPAAC

Metropolitan Water Pollution Abatement Advisory Committee

King Street Center, 201 South Jackson Street, MS KSC-NR-0512
Seattle, WA 98104 206-263-6070

MEMBERS:

Alderwood Water and Wastewater District
City of Algona
City of Auburn
City of Bellevue
City of Black Diamond
City of Bothell
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City of Tukwila
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Woodinville Water District
0508_MWPAACltrhd.eps

May 28, 2009

To: Bob Warren, NW Regional Office Section Manager
Washington State Department of Ecology, Northwest Field Office
1440 - 10th Street, Suite 102
Bellingham, WA 98225

Sheila Eckman, Cleanup Unit Manager
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue Suite 900
Seattle, WA 98101

SUBJECT: Lower Duwamish Draft Feasibility Study

The Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) was created by state law (RCW 35.58.210) to advise the King County Council and King County Executive on matters related to water pollution abatement. MWPAAC's membership consists of representatives from cities and local sewer districts that operate sewer systems within King County and those local sewer utilities within Pierce and Snohomish Counties which are served by the King County Wastewater Treatment Division. MWPAAC offers the following comments on the Draft Feasibility Study of the Lower Duwamish Waterway Superfund site released April 24, 2009 (Draft FS).

MWPAAC recognizes the importance of improving sediment quality in the Lower Duwamish Waterway (LDW) and believes that the most cost effective approach should be used to cleanup the LDW. The cleanup of the LDW is complicated by a complex environment, including historical releases of chemicals, background levels of contamination and tidal action in the LDW. The alternatives outlined in the Draft FS vary widely in their scope, cost and time estimated to achieve preliminary remediation goals.

MWPAAC supports the adaptive management approach described in the Draft FS. As noted in the Executive Summary of the Draft FS, the adaptive management approach should focus on: cleaning up the most contaminated areas first to reduce risks the fastest, assessing the progress of natural recovery, learning from each incremental cleanup experience, and adjusting further actions based on the newest data and lessons learned. The adaptive management approach is also consistent with experiences at other complex sediment sites that point to the necessity of using adaptive management strategies.

Following remediation of the most contaminated sites, MWPAAC agrees with the Draft FS approach of progressively remediating the next most contaminated areas as necessary to achieve remedial action objectives. Before considering additional dredging beyond the most contaminated sites, the environmental, economic and social costs of more extensive dredging should be weighed against any benefits. Therefore, a decision to remediate any of the next most contaminated sites should be informed by the success of methods used to remediate the most contaminated sites and the benefits of ongoing natural sediment recovery processes.

MWPAAC recommends that the adaptive management approach be combined with any defined set of actions as an alternative because of the variability in the data and estimated success of cleanup efforts. The time required to implement a cleanup plan and achieve its goals suggests the cleanup actions will need to be revised based on the availability of new information. Although the alternatives discussed in the Draft FS include long-term monitoring and contingency actions, applying the adaptive management approach while cleaning the most contaminated sites in the LDW first will ensure the funds spent on cleanup efforts are maximized to achieve the greatest benefit to human health and the environment.

In sum, MWPAAC asks the U.S. Environmental Protection Agency and the Washington State Department of Ecology (department) to apply the adaptive management approach using the most cost effective approach to cleanup the LDW. Any selection of an alternative, as part of the cleanup plan, that prescribes what activities will occur without some flexibility does not allow for adequate review following cleanup of the most contaminated sites or recognize the importance of new information as the cleanup progresses.

MWPAAC is also concerned that further remedial cleanup efforts may occur in advance of the department's source control program that is aimed at reducing contaminants entering the LDW. It is imperative to implement the source control program so that its impact enhances the success of any remediation efforts in the LDW. MWPAAC is pleased to offer its comments on the Draft FS and looks forward to future stakeholder involvement on the cleanup of the LDW.

Sincerely,

Dave Christensen
Vice-Chair

cc: MWPAAC Members
The Honorable Kurt Triplett, King County Executive
Regional Water Quality Committee Members
Christie True, Director, Wastewater Treatment Division,
King County Department of Natural Resources and Parks

KLICKITAT COUNTY
BOARD OF COUNTY COMMISSIONERS

205 S. COLUMBUS AVENUE, ROOM 103, MS-CH-04, GOLDENDALE WASHINGTON 98620 • FAX 509 773-6779 • VOICE 509 773-4612
REX F. JOHNSTON, DISTRICT #1
DAVID M. SAUTER, DISTRICT #2
RAY THAYER, DISTRICT #3

June 25, 2009

The LDWG Public Outreach Central Database
info@ldwgoutreach.org

Re: ***Contaminated Sediment Disposal at Roosevelt Regional Landfill in Klickitat County, WA***

To Whom It May Concern:

Klickitat County, as the host jurisdiction to Allied Waste's Roosevelt Regional Landfill (RRL, is supportive of contaminated dredge sediment disposal from the Duwamish Waterway. RRL is currently permitted by the Klickitat County Health Department and Washington Department of Ecology to place dredged spoils containing free liquids on municipal solid waste (MSW) disposal areas that have been lined with an 80-mil HDPE geomembrane and 2-feet of low permeability soil as a moisture enhancement demonstration project.

The moisture in dredged spoils accelerates the biodegradation of municipal solid waste in the landfill. Acceleration of the biodegradation process has the following benefits:

- waste will be stabilized in a shorter period of time and the post-closure care time period should be able to be decreased because of this;
- landfill gas generation rates will be increased and will enable the green power produced by the landfill gas-to-energy plant to increase;
- waste densities within the landfill will be increased and less lined area will be required to dispose of an equivalent amount of waste; and
- the period of time during which organics within the waste are a threat to human health and the environment will be significantly reduced.

Under the demonstration project, since 2003 RRL has accepted more than 1,500,000 tons of dredged spoils from the Puget Sound area. Allied Waste's team of experienced professionals, in cooperation with the BNSF, has efficiently, safely and cost effectively moved this material via rail to Roosevelt, where the material can be placed in one of the most secure solid waste disposal facilities in the country.

Their system allows the generation of dedicated trains, reducing fuel consumption and associated emissions while creating a much more efficient transportation scenario than traditional over the road trucking alternatives. It is one of the largest disposal facilities in the country, and the efficiency gained from their transportation infrastructure and RRL's ideal location, minimize impacts to the public and environment.

Klickitat County has enjoyed a productive and cooperative working relationship with Allied Waste over the 18 years of landfill operations. Their staff of professionals are diligent stewards of our environment and their facilities utilize state-of-the-art and proven technologies.

We are proud to partner with Allied Waste and the Klickitat Public Utility District (KPUD) in the industry leading H. W. Hill Energy Recovery Facility project, located at the landfill. This energy recovery facility has been in operation for more than 10 years and now continually produces enough renewable energy to power more than 7,000 homes. KPUD has begun construction on an expansion of the project that will more than triple our electrical generating capacity. The amount of renewable energy produced will continue to grow with the landfill and will continue to be a viable energy resource for decades after landfill closure. The moisture contained in dredged spoils will enhance landfill gas generation and increase the renewable energy output for the project. The facility's longevity, track record of consistent renewable energy production and commitment to continually increase the realized environmental benefits make it a leader in the land fill gas to energy field.

The RRL energy recovery facility and rail haul system provide an essential environmental service and asset to our collective region. The stringent siting process for the landfill insured that it would be one of the most environmentally secure disposal facilities in operation. They have demonstrated a commitment to enhancing that security by exceeding the regulatory requirements for other like facilities. In 2007 the energy recovery facility was awarded the Washington State Refuse and Recycling Association Sustainability Award.

Disposal of dredged spoils at RRL is a great example of an opportunity to further regional cooperation through responsible environmental planning and management by providing a safe and efficient eastern Washington based solution to support the state's commitment to restoring the pristine natural beauty and health of the Puget Sound. We believe that we share a common regional environment to manage, protect and to preserve for future generations.

Klickitat County, through its agreement with Allied Waste, is proud to offer the Roosevelt Regional facility as a responsible, secure, cost-effective dredged spoils management option. Please feel free to contact any of the Board members at (509) 773-4612, or Klickitat County's Solid Waste Director, Tim Hopkinson, at (509) 773-4295, to discuss any questions you may have.

Sincerely,

BOARD OF COUNTY COMMISSIONERS
Klickitat County, Washington

David Sauter, Chairman

Ray Thayer, Commissioner

Rex Johnston, Commissioner

CC: Renee Dagseth, US EPA Region 10 Outreach Manager, dagseth.renee@epa.gov
Kevin Burrell, ECOSS, Kevin@ecoss.org
Pat Serie, EnviroIssues, info@ldwgoutreach.org
Thea Levkovitz, DRCC, contact@duwamishcleanup.org
Tim Hopkinson, Klickitat County
Matt Henry, Allied Waste, mhenry@republicservices.com

June 29, 2009

United States Environmental Protection Agency (U.S. EPA)
Attn.: Renee Dagseth, E.S. EPA District 10 Outreach Manager
1200 Sixth Ave., Ste. 900
Seattle, WA 98101-3140

Dear Ms. Dagseth:

Thank you for this opportunity to comment on the Lower Duwamish Waterway Group's "Draft Feasibility Study" which provides five alternative methods for cleaning up contaminated sediments along a 5-mile portion of the Duwamish industrial area. The area sustains employment for more than 80,000 people and serves as a vital hub of regional economic activity, commercial navigation and commerce. It is also provides habitat for various species including salmon and steelhead, so environmental restoration in this area is an important piece of our larger effort to improve the health of Puget Sound. Therefore, it is important that we move forward with a balanced plan that sustains economic activity and job creation at the same time that it supports environmental preservation and a healthy Puget Sound.

In reviewing these options, we encourage you to recognize science and modeling that shows how natural recovery plays a key role in the preservation of the Lower Duwamish ecosystem. As a depositional river, the Lower Duwamish continues to repair itself and we would be wise to support this natural recovery. Rather than engaging in more expensive options that may do more harm than good over time, we encourage you to adopt an adaptive management approach that involves removing the worst materials first and then determining next steps based on diligent scientific monitoring.

This adaptive management approach would not only be environmentally responsible, but would be fiscally responsible as well. As we look at the enormous task of cleaning up waterways in King County and the entire Puget Sound Basin, it is essential that we balance our finite resources of time, labor and money in the most efficient way possible. As your feasibility study shows, these efforts can become extremely expensive and it would be easy to spend an enormous portion of our limited restoration resources on a single project, even though we know Puget Sound will need additional restoration in other areas as well.

We appreciate your careful consideration of our suggestions and concerns and look forward to working with you as this process continues.

Sincerely,

Eric Johnson
Executive Director

cc: Pat Serie, EnviroIssues (representing Lower Duwamish Waterway Group)

WATER RESOURCE INVENTORY AREA 9 (WRIA 9) WATERSHED ECOSYSTEM FORUM

GREEN / DUWAMISH AND CENTRAL PUGET SOUND WATERSHED

Algona
Auburn
Black Diamond
Burien
Covington
Des Moines
Enumclaw
Federal Way
Kent
King County
Maple Valley
Normandy Park
Renton
SeaTac
Seattle
Tukwila

King Conservation District
Vashon/Maury Island Community Council
Covington Water District
Port of Seattle
Tacoma Public Utilities
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington Department of Natural Resources
U.S. Army Corps of Engineers

Washington Environmental Council
Green/Duwamish Watershed Alliance
Trout Unlimited/Mid-Sound Fisheries Enhancement Group
Save Habitat and Diversity of Wetlands (SHADOW)

The Boeing Company
Master Builders Association
King County Agricultural Commission

June 26, 2009

Renee Dagseth
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Re: Comments on April 24, 2009 Draft Feasibility Study for the Lower Duwamish Waterway

Thank you for the opportunity to comment on the Draft Feasibility Study for the Lower Duwamish Waterway.

The following comments are offered on behalf of the WRIA 9 Watershed Ecosystem Forum, a broad-based partnership of governments, businesses, and non-profit groups working on watershed health and salmon habitat recovery in the Green/Duwamish and Central Puget Sound Watershed.

Four of our partners – King County, the City of Seattle, the Port of Seattle, and The Boeing Company – comprise the Lower Duwamish Waterway Group. In addition, several of our partners are likely to offer their own individual comments on the Draft Feasibility Study. Consequently, our comments will focus on general salmon-related considerations that we think should be a factor in decision making rather than addressing the specific merits of individual alternatives.

Importance of Timely and Enduring Cleanup for Watershed Salmon Habitat Recovery

Successful recovery of Chinook salmon in Puget Sound under the Endangered Species Act requires the restoration/rehabilitation of estuarine ecosystems throughout the region, including the Duwamish River. Timely and enduring clean-up of contaminated sediments and stormwater in the Lower Duwamish River are critical to achieving recovery of Chinook salmon populations in our watershed.

The Lower Duwamish is a critical link in the string of aquatic habitats that make up the Green/Duwamish Watershed. Transition zone habitat – where juvenile Chinook, chum, and other salmonids transition from freshwater to saltwater – is believed to represent a "bottleneck" in the life history of salmon in the Green/Duwamish Watershed. In other words, this habitat likely constrains the viability of this population. Increasing its quality and quantity will have a large positive impact on the health of the population. Most of the Lower Duwamish Superfund area provides or could provide transition zone habitat and the stretch from River Mile 3.0 to 5.5 –

Financial support provided by signers of Watershed Planning Interlocal Agreement for WRIA 9 including: Algona, Auburn, Black Diamond, Burien, Covington, Des Moines, Enumclaw, Federal Way, Kent, King County, Maple Valley, Normandy Park, Renton, SeaTac, Seattle, Tacoma, Tukwila

the upper part of the Superfund area – is likely to be a core area for transition zone habitat.

This perspective provides the basis for our comments below:

I. Coordination of Superfund Cleanup with NRDA Restoration

The WRIA 9 Salmon Habitat Plan: Making Our Watershed Fit for a King (2005) recommends:

> ***Policy DU2:*** *Encourage the Natural Resource Trustees to develop Natural Resources Damages Assessment (NRDA) approaches that allow habitat creation/restoration concurrent with Superfund cleanup of the Lower Duwamish Waterway. This will accelerate the rate at which mitigation occurs and be more efficient.* (page 7-78)

We understand that the Draft Feasibility Study does not currently discuss the relationship between cleanup and NRDA mitigation. However, given the importance of cleanup to salmon habitat recovery and the possibility that the duration of cleanup could range from 15 to 30 years, we ask that the impacts of alternatives on opportunities for mitigation be evaluated to identify any opportunities for expedited resource recovery. Specifically, we ask the regulatory agencies to weigh the following in evaluating alternatives and selecting a preferred alternative:

- The extent to which cleanup alternatives are conducive to timely habitat mitigation. For example, alternatives relying more heavily on dredging may require that nearby habitat creation be postponed to avoid potential recontamination during the dredging process.
- Within the overall approach of cleaning the "worst first," prioritization for cleanup *within* groups of similarly-contaminated sites should go to:
    - Sites that are exclusively or largely shallow water habitat, which are favored over deeper water habitats by juvenile salmonids.
    - Sites farthest upstream, which are more likely to provide transition zone habitat for juvenile salmonids.

II. Impacts of Cleanup Alternatives on Recovery of Salmonids

We encourage EPA and Ecology to evaluate the impacts of the various cleanup alternatives on salmonids when making the decision about a preferred alternative.

The varying time frames and varying intrusiveness of the alternatives are likely to have differing impacts on salmonids, not least the Endangered Species Act-protected Chinook salmon, bull trout, and steelhead trout. The potential impacts on juvenile and/or adult fish include but probably are not limited to:

- Dredging creating turbidity and short-term higher concentrations of bio-available chemicals in the water column and prey species.
- Dredging activities (noise, light, dredging equipment) altering migration patterns.

- The cumulative impacts of the activities described in the preceding two bullets for a period of 15-30 years for a period of up to 120 days each year.
- The differing durations of availability of bio-available chemicals in the food web depending on the alternative selected.

We also urge a careful examination of the assumption that the construction "fish window" available for dredging will remain at 120 days. Juvenile salmonids likely make use of at least the more brackish waters of the Lower Duwamish throughout the year because part of this area is functionally marine nearshore. Outmigrating Green River juvenile fish migrate and rear in the area from January to June. Adult fish are found in the Duwamish from August through November. The Feasibility Study should note the time of year when dredging is expected to occur (presumably October 16 -- February 15, which is the current construction "fish window").

Thank you for the opportunity to comment. We are hopeful that timely and enduring cleanup of the Lower Duwamish – both sediments and pollution source control of stormwater – will contribute to a healthier Duwamish estuary for the benefit of both people and fish.

Please contact WRIA 9 staff Dennis Clark, 206-296-1909, dennis.clark@kingcounty.gov with any questions and regarding future comment opportunities.

Sincerely,

Dow Constantine, Co-Chair
Councilmember, King County

Bill Peloza, Co-Chair
Councilmember, City of Auburn

Cc: WEF Members

A comment from ldwg.org.

Name:
David Williams

E-mail:
davew@awcnet.org

Address:
Association of Washington Cities, 1076 S. Franklin St.

Address 2:

City:
Olympia

State:
Washington

Zip:
98501

Comment:
Thanks for the opportunity to comment and thanks to all the work conducted by the City of Seattle, King County, the Port of Seattle and Boeing Company in compiling the DRAFT Feasbility Study for the Lower Duwamish Waterway.

The City of Seattle is one of the two hundred and eighty-one cities in Washington State. All are members of the Association of Washington Cities (AWC). Although by far the largest city, the issues and challenges it and its partners face in cleaning up and protecting an urban waterway, are ones faced by numerous other communities throughout our state.

I am not qualified, nor am I prepared at this point to provide detailed comments about the various alternatives. I am in a position to offer the following observations and hope that they are useful:

* It is critical that contaminated sites be cleaned up and protected.

* AWC wants to see "good" clean-ups - ones that can be accomplished!

* Urbanized areas containing contaminated sites are unlikely able to be brought back and manintained in a natural state.

* Clean-up alternatives need to recognize this and identify ones that can be achieved.

* Public resources are strained to meet a variety of demands - and in particular in urban Washington, within which these communities must meet the challenge of providing more densely developed cities as required by our Growth Management Act. They need to spend whatever clean-up funds they have in a "smart" way - getting the most value possible.

* Most cities and towns in Washington State also must plan for and manage our Shorelines under the Shorelines Management Act. Opportunities to manage and protect shorelines present opportunities (helping to protect and revive natural attributes along shorelines) as well as challenges (development and redevelopment along urban shorelines is an allowed use).

AWC will be closely following the next DRAFT Feasibility Study development process and welcomes the opportunities it will present to help educate this Association and our diverse membership about the ways to best proceed with clean up of urban contaminated sites.

Thanks for the opportunity to provide comments.

Appreciatively,

David Williams
Municipal Policy Associate
Association of Washington Cities

ASH GROVE CEMENT COMPANY

11011 CODY
OVERLAND PARK, KS 66210
PHONE 913 / 451-8900 FAX 913 /451-1686

CURTIS D. LESSLIE, PE
DIRECTOR OF ENVIRONMENTAL AFFAIRS

WRITER'S DIRECT LINE – 913/319-6065

June 26, 2009

Via Federal Express

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Ash Grove Cement Company Comments
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This letter provides Ash Grove Cement Company's (Ash Grove) comments on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at Draft FS community briefing sponsored by the U.S Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA LLC. Anchor QEA is assisting us with review of the LDW documents and attends the EPA Stakeholder meetings on our behalf. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

Ash Grove has owned and operated the facility located at 3801 East Marginal Way South in Seattle, Washington (Facility) since 1984, although the plant has been used for cement production since 1920. The Facility has supported the South Seattle business community for approximately 89 years and currently generally employs approximately 81 people. The facility includes several large silos, storage domes, truck loading equipment and storage sheds that support the production of Type I, Type II and Type III portland cement. We operate two berthing areas in the LDW that are permitted to -25 feet mean lower low water elevation (MLLW) to support navigational needs for facility operations.

Based on our history and involvement with the community, we have a strong understanding of the role of existing and future waterfront businesses have on the local and regional economy and supportive of the need for improvement of the Lower Duwamish Waterway. Ash Grove is generally supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making progress has been limited to the agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront property owner perspective and likely does not reflect a balanced view of the entire community.

Significant discussions needs to occur with other businesses identified as additional potentially liable parties (PLP's) to gain their input and understand the concerns raised by PLP's who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance feasibility, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term adaptive

management. The Draft FS summarizes the detailed technical information necessary for the reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to PLPs who perform the initial cleanups.
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.
6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The ROD must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frame extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition (DRCC), and the Tribes:

1. SMA-2 and SMA-3 were defined based on surface and subsurface sediment screening level exceedances for chemicals that are not associated with our historical or current operations and can likely be attributed to waterway-wide source loadings [PCB's, hexachlorobenzene, BEHP, arsenic, cPAHs].
2. The permitted berthing areas will likely be dredged within the next 10 years to maintain our permitted depths (-25 feet MLLW) and we expect to perform this work under the Dredged Material Management Program (DMMP) process.
3. We feel that it is absolutely necessary that source control activities be completed in the slightly upstream Duwamish Diagonal Early Action Area and associated drainage basin prior to any potential initiation of sediment cleanup actions within the SMA's adjacent to the Facility to avoid iterative cleanup work that is costly and ineffective.
4. Additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
5. It is absolutely necessary that source control activities be completed prior to initiation of sediment cleanup actions to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.
6. The iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.
7. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the LDW

Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.

8. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.
9. We understand that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative. However, we believe the ultimate remedy for the LDW will be a combination of alternatives applied to distinct areas that balance water dependent uses, habitat improvements, and public access.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the development of a remedy that addresses all of the stakeholder's input. Please do not hesitate to contact me at (913) 319-6065 if you have any questions concerning these comments.

Sincerely,

Curtis D. Lesslie, P.E.
Director of Environmental Affairs
Ash Grove Cement Company

Cc David Templeton and Ryan Barth, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle
Craig Puljan, Ash Grove Cement Co., Seattle Plant
Eileen Flink, Ash Grove Cement Co.

JORGENSEN FORGE CORPORATION

ALUMINUM – TITANIUM – SPECIALTY STEELS

8531 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108

PHONE (206) 762-1100 FAX (206) 763-0848

June 26, 2009

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Comments
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This letter provides the Jorgensen Forge Corporation's (Jorgensen Forge) comments on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at Draft FS community briefing sponsored by the U.S Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA, L.L.C. Anchor QEA, L.L.C. is assisting us with review of the LDW documents and attends the EPA Stakeholder meetings on our behalf. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and

impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

The Jorgensen Forge Corporation has owned and operated the facility located at 8531 East Marginal Way in Seattle, Washington (Facility) since 1992. The Facility was purchased from the previous owner and operator Earle M. Jorgensen Company (EMJ). The Facility has supported the South Seattle business community for approximately 68 years and currently generally employs approximately 250 people. The Facility includes an integrated forge shop with melting, forging and machining operations that produces custom steel and aluminum parts forged and machined to high precision specifications for various industrial clients. Jorgensen Forge is an active member of the Washington Business Association, support the efforts of local organizations that improve environmental quality in the business community (e.g., Environmental Coalition of South Seattle), and supports other local businesses and utilities through our ongoing operations. Our annual multi-million dollar revenue continues to help maintain a strong local economy through the goods and services we purchase and the employment we provide.

Jorgensen Forge has a long track record of responsible participation in site investigation and cleanup at its Facility and has been proactively engaged with the EPA and Ecology in connection with the LDW Site. Jorgensen Forge entered into an Agreed Order (AO; Number DE 4127 dated July 12, 2007) with Ecology to evaluate whether the upland portion of the facility is a potential ongoing source of chemicals to the Site with the potential to cause adverse effects to sediment quality. To date, under the AO process we have submitted a number of source control evaluation documents and conducted data gaps sampling at the Facility. The final deliverable required under the AO is the *Source Control Evaluation Addendum Report* which will document whether additional source control implementation is required at the Facility to protect sediment quality. If necessary, any additional controls would be implemented under a separate Order or Decree with Ecology. All sources will be controlled prior to initiation of the sediment cleanup activities adjacent to the Facility to minimize the potential for sediment recontamination.

Concurrent with the source control evaluation, we are working with the EMJ to prepare an Engineering Evaluation/Cost Analysis (EE/CA) under their Amended Administrative Order on Consent (AOC) with EPA (EPA Docket No. CERCLA-10-0111, 2008 dated April 15, 2008). The EE/CA addresses a non-time critical removal of contaminated sediments and associated bank soils within the removal action boundary (RAB) in the LDW adjacent to the Facility (Figure 1). The RAB is located within a portion of Early Action Area 4 (EAA-4), one of the seven Early Action Areas identified by EPA and Ecology as an area that contains sufficient chemical concentrations in sediments to warrant a removal action. The Draft EE/CA was submitted to EPA on March 13, 2009. EMJ is currently awaiting receipt of comments from EPA.

Based on our history and involvement with the community and participation in the EPA and Ecology regulatory processes, we have a strong understanding of the role existing and future waterfront businesses have on the local and regional economy and support the need for Site cleanup. We are generally very supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making process has been limited to the Agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront business perspective and likely does not reflect a balanced view of the entire community.

Significant discussions need to occur with other businesses identified as additional potentially liable parties (PLP's) to gain their input and understand the concerns raised by PLP's who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance implementability, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term adaptive management. The Draft FS summarizes the detailed technical information necessary for the reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to PLPs who perform the initial cleanups. Legal protection is paramount to Jorgensen Forge since the removal action of contaminated sediments and associated bank soils within the RAB in the LDW will likely be conducted in advance of the Record of Decision (ROD).
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly

4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.
6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The ROD must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frames extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition (DRCC), and the Tribes:

1. EAA-4 was initially identified by LDWG as the combined areas adjacent to the Jorgensen Forge Facility and the Boeing Plant 2 Facility. We request that the Draft FS figures be revised to show the Boeing/EMJ-Jorgensen

2. Sediment Management Area (SMA)-38 is driven by polychlorinated biphenyl exceedences at depth adjacent to the Plant 2 facility some distance downstream from the Boeing/EMJ-Jorgensen Forge cleanup boundary. The Draft FS provides no chemical data supporting extending this SMA south adjacent to the Jorgensen/EMJ RAB. We request further technical rationale supporting the southern aerial extents of this SMA.
3. We believe that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
4. The AOC between EMJ and EPA incorporates the MOU that administratively requires the coordination and cooperation of the aforementioned parties during design and implementation of the cleanup remedies. Therefore, we feel that it is absolutely necessary that source control activities be completed prior to initiation of sediment cleanup actions within the RAB adjacent to the Facility and adjacent to the Boeing Plant 2 Facility to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.
5. We believe that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.
6. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.
7. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.
8. We believe that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the remedy selection process for the LDW.

Sincerely yours,

Ron Altier

Vice President Administration
Environmental officer

Attachment: Figure 1 - Proposed Removal Action Boundary

Cc Josh Lipsky, Cascadia Law Group
Bill Joyce, Salter Joyce Ziker, P.L.L.C.
Gil Leon, Earle M. Jorgensen Company
David Templeton and Ryan Barth, Anchor QEA, L.L.C.
Amy Essig Desai and Peter Jewett, Farallon Consulting, L.L.C.
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

MUCKLESHOOT INDIAN TRIBE
Fisheries Division
39015 - 172nd Avenue SE • Auburn, Washington 98092-9763
Phone: (253) 939-3311 • Fax: (253) 931-0752

29 June 2009

Ms. Allison Hiltner
Office of Environmental Cleanup, ECL-111
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, WA 98101

re: Comments on the draft Feasibility Study, Lower Duwamish Waterway (draft dated 4/24/09)

Dear Ms. Hiltner,

The Muckleshoot Indian Tribe Fisheries Division (MITFD) has conducted a technical review of the above-referenced draft report. As you know, the Muckleshoot Indian Tribe's Usual and Accustomed Fishing Grounds includes all of the aquatic area that is the focus of the Lower Duwamish Waterway Superfund Site. These are important locations where the Tribe exercises its federally-adjudicated fishing rights. Adequate cleanup of this site is a necessary step for the protection of the health of tribal fishers exercising their treaty rights in these areas and for the protection of the aquatic ecosystem, which contributes to the health of the fishery itself.

Our comments on this draft Feasibility Study focus primarily on structural and scoping-related issues. Since this is the first of at least two public comment drafts, we feel it is most important to focus initially on whether an adequate breadth of cleanup alternatives are presented, whether the Remedial Action Levels are appropriate, whether the amount of time cleanup alternatives take to meet Remedial Action Objectives is appropriate, and whether other important uncertainties, such as background concentrations of key contaminants in the River are properly considered. Since we expect that there will be significant changes to the report between this draft and the next draft, we are electing not to provide line-by-line comments at this time. Therefore, we reserve the right to provide those more detailed comments at a later date, and our lack of comments on specific discussions in the current draft report should not be construed to imply that we are in agreement with the text.

Please find the attached, more detailed discussion of technical comments on the above-referenced report. We request the opportunity to meet with EPA to discuss these issues further. The Tribe looks forward to an expeditious and adequate cleanup of the Duwamish River sites to protect its

current and future uses. Thank you for the opportunity to comment on this very important activity. Please feel free to contact me at (253) 876-3130 with any questions or concerns.

Sincerely,

Glen R. St. Amant
Habitat Program Manager

Technical Comments on
Draft Feasibility Study
Lower Duwamish Waterway (draft dated 4/24/09)

General Comments-

1. *Need for Ongoing Consultation.* This draft Feasibility Study clearly identifies many issues of direct concern to the Tribe. In fact, many of the scenarios considered in this document specifically focus on either current or future use of the Duwamish River by the Muckleshoot Indian Tribe. Hence, it is fundamentally important that EPA and Ecology closely consult with the Muckleshoot Indian Tribe during the next critical cleanup planning phases, in order to assure that the unique impacts to the Tribe are appropriately remedied. We reserve the right to provide additional comments during that process.

2. *Remedial Action Levels.* The approach taken to develop the proposed Remedial Action Levels (RALs) is critical to the development of appropriate Remedial Alternatives. Development of RALs must be consistent with all applicable or relevant and appropriate requirements (ARARs). We do not believe that all of the RALs are consistent with the Washington State Sediment Management Standards (SMS), which is a primary ARAR to consider in this circumstance. The SMS calls for the development of remedial alternatives that meet all cleanup objectives within a period of zero to ten years following the completion of the cleanup action. Therefore, all RALs evaluated in this draft FS should be designed to achieve all of the Remedial Action Objectives within zero to ten years following completion of the remedial action. Since several of the Remedial Action Objectives (RAOs) for the site involve achieving background concentrations of four risk-driving chemicals (PCBs, carcinogenic PAHs, arsenic, and dioxin) in the river, RALs that allow concentrations above background levels for a period of greater than 10 years following cleanup should be excluded. Please revise the methodology to develop RALs to enable all RAOs to be met within zero to 10 years following cleanup. This comment primarily relates to Chapter 6 of the draft Feasibility Study, but is significantly integrated into much of the rest of the document.

   The discussion of RALs for PCBs as they pertain to the State Sediment Management Standards is potentially misleading. The document seems to infer that 240 ppb dry weight was used as a surrogate for the State SQS value. Only the 12 ppm TOC or 130 ppb LAET value should be used in discussions of whether the PCB SQS was met or exceeded. The document also carries this inference through

when developing RALs to address the PCB Cleanup Screening Level (CSL). Please revise these specific RALs to only refer to the actual SMS values.

3. *Development of Remedial Alternatives.* We believe that the proposed Remedial Alternatives should be reformulated. Several important issues underlie this recommendation. As mentioned in our comments regarding the Remedial Action Levels, it is important that the Remedial Alternatives are designed to achieve all Remedial Action Objectives (RAOs) no later that ten years following cleanup. Therefore, all of the Action Alternatives (excluding Alternative 1, which is the "No Further Action Alternative"), must, at a minimum, achieve this objective. We further believe that more alternatives should be developed that achieve all of the RAOs immediately following cleanup. Therefore, considering paired alternatives for each set of remedial technologies or approaches seems logical—one alternative that achieves all of the RAOs at year zero and one alternative that achieves all of the RAOs by year ten.

   It is also important that all alternatives utilize the same set of assumptions regarding long-term background concentrations of chemicals in the River. To accomplish this, it may be necessary to further subdivide each alternative, so that it either achieves the high-end or the low-end of the estimated long-term background concentration of contaminants in the River. Currently, Alternative 5 uses a different set of background assumptions as compared to the other Action Alternatives. The values used for all alternatives should be those provided previously to the Lower Duwamish Waterway Group from EPA and Ecology.

   Alternative 5 is inappropriately screened out from further consideration. Currently, it is the only Remedial Alternative that is designed to achieve background concentrations for all of the risk-driver chemicals at year zero.

4. *Bed Composition Model (BCM) updates and input parameters.* It is unfortunate that the draft Feasibility Study failed to incorporate the EPA written guidance on this issue transmitted to the Lower Duwamish Waterway Group from EPA via Memorandum on Sept. 11, 2008. By reference, this comment requests incorporation of the sediment post remediation replacement values and other background-based values referenced in that memorandum. This omission is potentially significant, since these numbers are critical in determining long-term chemical trends in the river sediments, and, hence, in evaluating how the river will respond to different remedial alternatives. As an example of this, the draft FS uses a sediment post remediation value for PCBs of 75 parts per billion (ppb), which is 50% higher than the value referenced in the EPA Memorandum (50 ppb).

5. *Depth of Contamination.* This document should lay out specific criteria for remedial action levels for contaminants found deeper than in the top 10 cm of surface sediments. Additional RALs should be developed for other sediment depth horizons (e.g., the top 45 cm), when cleanup of contaminants at depth is warranted to protect certain resources. These RALs shouldn't replace any RALs developed for the top 10 cm, but, rather, should be used in addition to those RALs.

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Environmental Cleanup Office

Northshore Utility District

ADDRESS
6830 NE 185th Street
Kenmore WA 98028-2684
PO Box 82489
Kenmore WA 98028-0489

TELEPHONES
Engineering: (425) 398-4401
Administration: (425) 398-4402
Operations: (425) 398-4403
Information: (425) 398-4400

FAX NUMBERS
Administration: (425) 398-4430
Operations: (425) 398-4432
Purchasing: (425) 398-4434
Website: www.nud.net

June 2, 2009

Mr. Bob Warren
NW Regional Office Section Manager
Washington State Department of Ecology
Northwest Field Office
1440 - 10th Street
Suite 102
Bellingham, WA 98225

Ms. Sheila Eckman
Cleanup Unit Manager
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Suite 900
Seattle, WA 98 101

Re: Lower Duwamish Draft Feasibility Study

Dear Mr. Warren and Ms. Eckman:

Northshore Utility District has received a copy of the Draft Feasibility Study of the Lower Duwamish Waterway Superfund site released on April 24, 2009 (Draft FS). We recognize the importance of improving sediment quality in the Lower Duwamish Waterway (LDW) and believe the recommendations contained in the Draft FS are grounded in good science.

We support the adaptive management approach described in the Draft FS of starting with the most contaminated areas first. Following remediation of the most contaminated sites, we agree with the Draft FS approach of progressively remediating the next most contaminated areas as necessary to achieve remedial action objectives. The decision to remediate any of the next most contaminated sites should be made based on the results of the methods used to remediate the most contaminated sites and the benefits of ongoing natural sediment recovery processes.

On behalf of the 60,000 people that we are elected to represent, Northshore Utility District requests that the U.S. Environmental Protection Agency and the Washington State Department of Ecology (department) apply the adaptive management approach contained in the Draft FS to cleanup the LDW.

Sincerely,

Margaret K Wiggins

Margaret Wiggins
President, Board of Commissioners

c: Honorable Kurt Triplett, King County Executive
Christie True, Director, Wastewater Treatment Division, King County Department of Natural Resources and Parks

Accountable Management - Responsible Usage

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DOUGLAS MANAGEMENT

June 26, 2009

Douglas Management Co
P.O. Box 3757
Seattle, Washington 98124-3757
(206) 241-8778
(800) 426-3201
Fax: (206) 243-8415

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Comments
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This letter provides Douglas Management Company's (DMC) comments on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at Draft FS community briefing sponsored by the U.S Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA LLC. Anchor QEA is assisting us with review of the LDW documents and attends the EPA Stakeholder meetings on our behalf. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront

businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

DMC owns the property located at 7100 First Avenue S. in Seattle, Washington (Property) having purchased it from Swan Bay Holdings, Inc. The Property is currently used by Alaska Marine Lines and other companies for mooring barges, transferring gravel and other cargoes, storage of shipping containers and other equipment, and other purposes. The Property's moorage along the LDW is actively used. There are no known direct discharges from the Property to the south adjacent Trotsky Inlet, which has been designated by Ecology as source control Early Action Area 2.

Based on our history and involvement with the community, we have a strong understanding of the role of existing and future waterfront businesses have on the local and regional economy and support the need for Site cleanup. We are generally supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making progress has been limited to the agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront property owner perspective and likely does not reflect a balanced view of the entire community.

Significant discussions needs to occur with other businesses identified as additional potentially liable parties (PLP's) to gain their input and understand the concerns raised by PLP's who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance implementability, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term adaptive management. The Draft FS summarizes the detailed technical information necessary for the

reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to PLPs who perform the initial cleanups.
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.
6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial

approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The ROD must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frames extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition (DRCC), and the Tribes:

1. Sediment management area (SMA)-23 was identified within the LDW adjacent to the Property based on a limited number of surface and subsurface sediment exceedances for polychlorinated biphenyls (PCB's). As indicated our response to the EPA's 104(e) request, DMC has not had any operations on the Property involving PCB's.
2. We feel that it is absolutely necessary that source control activities be completed in Trotsky Inlet (i.e., source control Early Action Area 2) prior to any potential initiation of sediment cleanup actions within the SMA adjacent to the Property to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.
3. We believe that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
4. We believe that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive

management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.

5. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.

6. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.
7. We believe that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the remedy selection process for the LDW.

Sincerely yours,

DAVID R. DEWALT

Rod DeWalt, President

Cc David Templeton and Ryan Barth, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

1017-DFS-B-O

Earle M. Jorgensen Company
10650 Alameda Street
P.O. Box 640
Lynwood, CA 90262
Tel: 323.567.1122
Fax: 323.567.1034

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Cleanup Office

June 24, 2009

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Comments
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

Earle M. Jorgensen Company (EMJ) has prepared this letter to provide comments on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at the Draft FS community briefing sponsored by the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA. Anchor QEA is assisting us with review of the LDW documents. These comments are provided on the Draft FS and are independent of any ongoing comments or issues associated with current source control, site investigation, or remedy selection work at the EMJ property. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. Opportunities to provide input from waterfront businesses in the development of the Draft FS directly to regulatory agencies has been very limited to date.

EMJ previously owned and operated the Jorgensen Forge Corporation facility located at 8531 East Marginal Way South in Seattle, Washington (Facility), which supported the South Seattle business community for approximately 68 years. EMJ sold the Facility to Jorgensen Forge Corporation in 1992.

EMJ has a long track record of responsible participation in site investigation and cleanup at its Facility and has been proactively engaged with the EPA in connection with the LDW. EMJ entered into a First Amendment to the Administrative Order on Consent (AOC) U.S. EPA Docket No. CERCLA-10-0111, 2008 with EPA on April 15, 2008, which required EMJ to prepare an Engineering Evaluation/Cost Analysis (EE/CA) for a non-time critical removal of contaminated sediments and associated bank soils within the removal action boundary (RAB) in the LDW adjacent to the Facility (Figure 1). The RAB is located within a portion of Early Action Area 4 (EAA-4), one of the seven Early Action Areas, identified by EPA and Ecology as an area that contains sufficient chemical concentrations in sediments to warrant a removal action. The Draft EE/CA was submitted to EPA on March 13, 2009. EMJ is currently awaiting receipt of comments from EPA.

Based on our history and involvement with the community and participation in the EPA and Ecology regulatory processes, we have a strong understanding of the role existing and future waterfront businesses have on the local and regional economy and support the need for Site cleanup. We are generally very supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making process has been limited to the Agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront business perspective and likely does not reflect a balanced view of the entire community.

Significant discussions needs to occur with other businesses identified as potentially liable parties (PLPs) to gain their input and understand the concerns raised by PLPs who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance implementability, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term adaptive management. The Draft FS summarizes the detailed technical information necessary for the reader to understand and evaluate the key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to parties who perform the initial cleanups. Legal protection is paramount to EMJ since the removal action of contaminated sediments and associated bank soils within the RAB in the LDW will likely be conducted in advance of the Record of Decision (ROD).
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering

the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.

5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.
6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly not inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The ROD must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frame extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within 20 years.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition, and the Tribes:

1. EAA 4 was initially identified by LDWG as the combined areas adjacent to the Facility and the Boeing Plant 2 Facility. We request that the Draft FS figures be revised to show the Boeing/EMJ-Jorgensen Forge cleanup boundary identified in the EPA-approved Memorandum of Understanding (MOU) between Boeing and

EMJ/Jorgensen Forge (dated August 2007) so the public is clear what area will be remediated by Boeing and Jorgensen Forge/EMJ.

2. Sediment Management Area (SMA)-38 is driven by polychlorinated biphenyl exceedences at depth adjacent to the Plant 2 facility some distance downstream from the Boeing/EMJ-Jorgensen Forge cleanup boundary. The Draft FS provides no chemical data supporting extending this SMA south adjacent to the Jorgensen/EMJ RAB. We request further technical rationale supporting the southern aerial extents of this SMA.

3. We believe that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.

4. The AOC between EMJ and EPA incorporates the MOU that administratively requires the coordination and cooperation of the aforementioned parties during design and implementation of the cleanup remedies. Therefore, we feel that it is absolutely necessary that source control activities be completed prior to initiation of sediment cleanup actions within the RAB adjacent to the Facility and adjacent to the Boeing Plant 2 Facility to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.

5. We believe that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in a timely fashion.

6. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.

7. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.

8. We believe that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the remedy selection process for the LDW.

Sincerely yours

E. Gilbert Leon Jr.
Earle M. Jorgensen Company

cc: Josh Lipsky, Cascadia Law Group
Bill Joyce, Salter Joyce Ziker, P.L.L.C.
David Templeton and Ryan Barth, Anchor QEA, L.L.C.
Amy Essig Desai and Peter Jewett, Farallon Consulting, L.L.C.
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

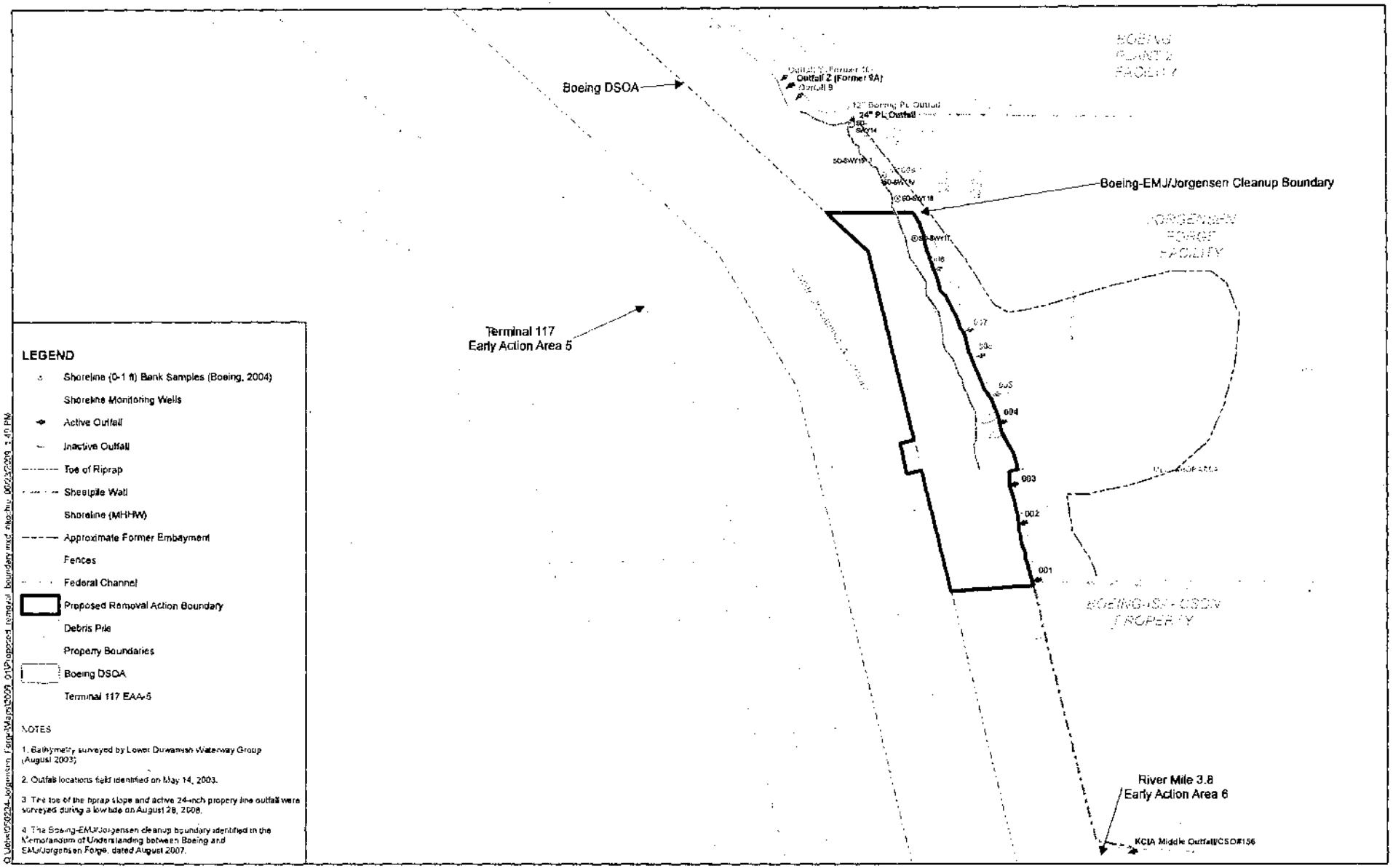

Figure 1
Proposed Removal Action Boundary
Early Action Area 4 EE/CA

1018-DFS-B-0
JUN 29 2009

CROWLEY®

June 26, 2009

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Comments of Crowley Marine Services, Inc.
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This letter provides the comments of Crowley Marine Services, Inc. ("Crowley") on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at the Draft FS community briefing sponsored by the U.S Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA LLC. Anchor QEA is assisting Crowley with the review of the LDW documents and attends the EPA Stakeholder meetings on our behalf. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

Crowley has been a responsible participant in site investigation and cleanup at its Facility over a considerable period of time, and has been proactively engaged with the EPA and Ecology in connection with the LDW Site. Crowley operated at 7400 8th Avenue South and the adjacent Slip No. 4 property in Seattle, Washington as a lessee since 1987, and purchased the properties (the Slip No. 4 parcel through the Crowley entity Pacific Terminals, Inc. and its successor by name change 8th Avenue Terminals, Inc.) in 1992. Since Crowley's involvement at the property and Slip 4, its operations and those of its tenants have been strictly related to marine transportation and short term storage of materials to be transported. In 1996, with approvals from Ecology and the Corps of Engineers, Crowley arranged for the dredging of the northwest side of the adjacent Slip 4, removing approximately 12,000 cubic yards of silt, sand, and materials from Slip No. 4. Crowley contracted for the recycling of approximately 11,000 tons of this dredged material for the use and manufacture of Portland cement. In 2007 Crowley sold the inner portion of the Slip 4 parcel to the City of Seattle (the "City"). The City of Seattle will perform the remediation of sediments in the inner portion of the Slip as well as adjacent bank materials, under the City's Administrative Order on Consent with EPA.

In June and July of 2008, Crowley voluntarily conducted a source control investigation of the 8th Avenue property, including a review of potential pathways of contamination to LDW sediments. The investigation found no reasonable potential for a release of hazardous substances from the Crowley property to the LDW via any of the potential discharge pathways. Crowley's successor at the property and a related entity, 8th Avenue Terminals, Inc., is in the process of negotiating an Agreed Order with Ecology to formally complete the source control investigation process, and identify potential source control or other cleanup actions that may be necessary, if any.

Through its operations, Crowley has supported the South Seattle business community for over five decades, in recent years employing as many as 100 workers in and around South Seattle. Our annual revenue continues to help maintain a strong local economy through services we provide.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

Based on our history and involvement with the community and participation in the EPA and Ecology regulatory processes, we have a strong understanding of the role of existing and future waterfront businesses have on the local and regional economy and support the need for Site cleanup. We are generally supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making progress has been limited to the agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront property owner perspective and likely does not reflect a balanced view of the entire community.

Significant discussions needs to occur with other businesses identified as additional potentially liable parties (PLP's) to gain their input and understand the concerns raised by PLP's who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance ability to implement, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term

adaptive management. The Draft FS summarizes the detailed technical information necessary for the reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to PLPs who perform the initial cleanups.
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.
6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The Record Of Decision ("ROD") must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frames extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition (DRCC), and the Tribes:

1. The portions of sediment management area (SMA)-31 and SMA-33 adjacent to the Property include exceedances of polychlorinated biphenyls that are not associated with our historical or current operations, as evidenced by a recent source control investigation that did not identify any reasonable potential pathways for releases of contaminants from the Property to Duwamish sediments or Slip 4. In addition, the most recent data (2006) collected in SMA-33 show only low level surface sediment PCB exceedances adjacent to the Slip 4 Early Action Area. This suggests the exceedances are due to migration of contaminated sediments within the Early Action Area and/or source loadings from the Early Action Area drainage basin.
2. We feel that it is necessary that known sources of contamination to Duwamish sediments be controlled in the Slip 4 Early Action Area drainage basin prior to any potential initiation of sediment cleanup actions within the SMA's adjacent to the Property to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.
3. We believe that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
4. We believe that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.
5. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.
6. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.

7. We believe that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the remedy selection process for the LDW.

Sincerely yours,
Crowley Maritime Corporation

R. Stephen Wilson
Director, Environmental, Safety & Quality Assurance

Cc David Templeton and Ryan Barth, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

ALASKA MARINE LINES

June 26, 2009

P.O. Box 3757
Seattle, WA 98124-3757
(206) 241-8778
(800) 426-3201
Fax: (206) 243-8415

Allison Hiltner
Remedial Project Manager
Mailcode: ETPA-081
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington State Department of Ecology
Toxics Cleanup Program
3190 160th Avenue SE
Bellevue, WA 98008

Re: Comments
Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This letter provides Alaska Marine Line's (AML) comments on the Draft Feasibility Study (FS) for the Lower Duwamish Waterway (LDW) Superfund Site (Site) dated April 24, 2009. The comments below are based on our review of the Draft FS, information provided at Draft FS community briefing sponsored by the U.S Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) on May 27, 2009, and information provided by Anchor QEA LLC. Anchor QEA is assisting us with review of the LDW documents and attends the EPA Stakeholder meetings on our behalf. Submittal of these comments is not intended as an admission of responsibility or liability for any aspect of the LDW site. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We recognize the challenges that EPA and Ecology have in managing a complex LDW cleanup that is protective of human health and the environment and considers the needs of

P.O. Box 578
Sitka, Alaska 99835
(907) 747-6625
Fax: (907) 747-6433

3205 Tongass
Ketchikan, Alaska 99901
(907) 225-7660
Fax: (907) 225-6291

P.O. Box 349
Wrangell, Alaska 99929
(907) 874-3314
Fax: (907) 874-3315

P.O. Box 1609
Haines, Alaska 99827
(907) 766-2221
Fax: (907) 766-2639

P.O. Box 788
Petersburg, Alaska 99833
(907) 772-9278
Fax: (907) 772-9278

P.O. Box 355
Skagway, Alaska 99840
(907) 983-2581
Fax: (907) 983-2581

150 Mount Roberts Road
Juneau, Alaska 99802
(907) 586-3700
Fax: (907) 463-3929

P.O. Box 309
Ketchikan, Alaska 99689
(907) 764-3382
Fax: (907) 764-3382

P.O. Box 707
Craig, Alaska 99921
(907) 826-3389
Fax: (907) 826-3389

all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

AML is the current owner/operator of a containerized freight barge terminal located at 5600-5610 West Marginal Way SW (Property) on the west bank of the LDW. We purchased the property in 1989 and began operations at this location in December 1993. AML has supported the South Seattle business community for approximately 26 years, and we currently employ approximately 102 people at the Property. The main operations at the facility include loading of barges and transportation/storage of containerized freight cargo. We maintain a single berthing area in the LDW at -17 feet mean lower low water elevation (MLLW) to support navigational needs for Property operations.

Based on our history and involvement with the community, we have a strong understanding of the role of existing and future waterfront businesses have on the local and regional economy and support the need for Site cleanup. We are generally supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS. However, to date, the decision-making progress has been limited to the agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, composed of the Port of Seattle (Port), King County, the City of Seattle (City), and The Boeing Company (Boeing). This process has not adequately incorporated the waterfront property owner perspective and likely does not reflect a balanced view of the entire community.

Significant discussions needs to occur with other businesses identified as additional potentially liable parties (PLP's) to gain their input and understand the concerns raised by PLP's who may be responsible for funding a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance implementability, short- and long-term effectiveness, potential for recontamination, cost effectiveness and long-term adaptive management. The Draft FS summarizes the detailed technical information necessary for the reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. We support the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first to achieve the greatest initial risk reduction followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the Agencies must provide incentives and legal protection (Consent Decrees) to PLPs who perform the initial cleanups.
3. We generally support the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, we agree that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedance factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. We recommend the development of remedial action levels that account for documented ongoing upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. We support additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation to more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. We support the use of the monitored natural recovery (MNR) and enhanced natural recovery (ENR) in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe as active remediation.

6. We support the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites so that protection of human health and the environment is achieved in the most implementable but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging given each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (i.e., wide scale removal identified in Alternative 5) is clearly inappropriate for this complex Site, as shown by the detailed analysis of alternatives.

The ROD must provide a process and contain incentives for waterfront businesses to conduct cleanup, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal protection.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frames extending beyond 20 years is not feasible given the Draft FS identifies a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, Duwamish River Cleanup Coalition (DRCC), and the Tribes:

1. Sediment Management Area (SMA)-14b located adjacent to the Property is driven by a single surface sediment sample low level exceedance of the polychlorinated biphenyl screening level that is indicative of waterway-wide source loadings, not releases from the Property.
2. We believe that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
3. We feel that it is absolutely necessary that source control activities be completed within the Glacier Bay source control Early Action Area prior to initiation of sediment cleanup actions adjacent to the Property to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.

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4. We believe that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the Agencies and involved stakeholders to learn from previously completed cleanup action results which will increase future remedy effectiveness, and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.
5. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas in the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging or ongoing source control activities coordinated with Ecology.
6. We generally support the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation so that accurate timeliness for remedies including removal are established.
7. We believe that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS and look forward to ongoing discussions with you throughout the remedy selection process for the LDW.

Sincerely yours,

Kevin Anderson

Kevin Anderson, President
By Garett Bilhiplea, corporate Secretary

cc David Templeton and Ryan Barth, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

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
Hiltner.Allison@epa.gov

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 Nontidal Freshwater	No	No	2002 and 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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J&A

JOHANNESSEN & ASSOCIATES, P.S.
ENVIRONMENTAL, LAND USE & REGULATORY LAW

RECEIVED
JUL 01 2009
Environmental
Cleanup Office

June 30, 2009

Via Facsimile & By Regular Mail

Allison Hiltner, Remedial Project Manager
U.S. Environmental Protection Agency
Mailcode ETPA-081
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington Department of Ecology
Toxics Cleanup Program
3190 160th Avenue S.E.
Bellevue, WA 98008

Re: Comments on Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

This firm represents Duwamish Shipyard, Inc. ("DSI"). We are submitting the following comments on behalf of DSI, whose property is located within the Glacier Bay Source Control Area. DSI has been negotiating an Agreed Order with the Washington Department of Ecology ("Ecology") for a Remedial Investigation/Feasibility Study ("RI/FS") that will address the upland and nearshore sediments adjacent to its former shipyard property. All shipyard operations at the property formally ceased as of April 1, 2007. The property is currently being used by Alaska Marine Lines for equipment and container storage.

The Agreed Order is expected to be out for public comment in mid July. Therefore, it is critical that DSI understand how the Lower Duwamish Waterway ("LDW") process will be integrated with an Ecology RI/FS process in order to avoid any regulatory disconnects and inefficiencies. DSI formally requests that Ecology and the U.S. Environmental Protection Agency ("EPA") provide consistent comments and directions to DSI as the RI/FS process moves forward.

DSI, through its consultant Anchor QEA, has reviewed and wishes to comment on the Draft Feasibility Study ("FS") dated April 24, 2009 for the LDW Superfund Site ("Site"). The comments below are based on a review of the Draft FS, information provided at a Draft FS community briefing sponsored by EPA and Ecology on May 27, 2009, and other information.

5413 Meridian Ave. N., Suite C · Seattle, WA 98103-6138
Phone: (206) 632-2000 Fax: (206) 632-2500

Submittal of these comments is not intended as an admission of any responsibility or liability for any aspect of the Site or in connection with the DSI property. Additional comments on the FS and remedy selection process may be provided as more information becomes available.

We are mindful of and recognize the challenges that EPA and Ecology have been facing in managing a complex LDW investigation, and in developing remedies that are not only protective of human health and the environment, but also considers the needs of all stakeholders, including the local community and businesses that provide important jobs and tax revenue. Our future vision of the LDW is one that both supports local waterfront businesses and the jobs they provide, as well as a safe resource for the community and environment within the context of a working waterfront. We also believe that the cleanup costs and impacts to local waterfront businesses are potentially so significant that there needs to be a careful balance between a practical cleanup process and reasonable cleanup objectives. To date, opportunities to provide input directly to the regulatory agencies from waterfront businesses during the development of the Draft FS have been very limited.

Based on our 66-year history on the LDW and involvement with the community, we have a strong understanding of the role that existing and future waterfront businesses have on the local and regional economy. We also support the remediation of the LDW, having negotiated an Agreed Order that will lead to an identification and evaluation of remedial options for our property as well as nearshore sediments. We are generally supportive of a cooperative decision-making framework led by Ecology and EPA, which should balance all stakeholders' input and provide the foundation for the adaptive management approach proposed in the Draft FS.

However, to date, the decision-making process has been limited to the agencies (EPA and Ecology), Tribes, community advisory groups (i.e., Duwamish River Cleanup Coalition), and the Lower Duwamish Waterway Group, comprised of the Port of Seattle, King County, the City of Seattle, and The Boeing Company. This process has not adequately incorporated the waterfront property owners' perspectives and likely does not reflect a balanced view of the entire community.

Significant discussions need to occur with other businesses, whether or not they have been identified as additional potentially liable parties ("PLPs"), to solicit their input and gain a better understanding of their concerns. This is especially important given that those businesses may well be the parties who may be responsible for funding (or who will be asked to fund) a portion of the cleanup. To facilitate this outreach, we request additional opportunities to participate and offer input into the decision-making process, including attending future meetings with the other stakeholders and receiving technical information as it becomes available.

The final remedy selected for the LDW must balance implementability, short- and long-term effectiveness, potential for recontamination, cost effectiveness, and long-term adaptive management. The Draft FS summarizes the detailed technical information necessary for the

reader to understand and evaluate these key issues. We offer the following general comments on the Draft FS:

1. The document generally presents detailed technical information in a manner that is understandable to the public and employs sound technical rationale in the detailed evaluation of cleanup alternatives using the appropriate federal and state evaluation criteria.
2. DSI supports the "adaptive management framework" that identifies active remediation in areas with the highest chemical concentrations first, in order to achieve the greatest initial risk reduction, followed by an assessment of the progress of natural recovery to determine what, if any, additional active remediation is necessary in less contaminated areas to achieve the remedial action objectives. In order for this framework to be successful, the agencies must provide incentives and legal protection (i.e., Consent Decrees) to PLPs who perform the initial cleanups.
3. DSI generally supports the assumptions used to evaluate the restoration timeframes and costs associated with each of the cleanup alternatives. Further, DSI agrees that attempting to actively manage all areas currently showing chemical concentrations above the screening levels, regardless of the exceedence factors, will result in lower overall benefits, grossly disproportionate costs (approximately $500 million to greater than $1 billion), and significantly longer restoration timeframes (from 25 to 43 years) relative to the remedy identified in the adaptive management framework.
4. DSI recommends the development of remedial action levels that account for documented, ongoing, upstream urban background sources. Simply stated, none of the identified cleanup alternatives will likely be able to clean up and maintain the Site at concentrations below upstream anthropogenic background concentrations entering the Site. DSI supports additional and complete evaluation of background data upstream of the Site and incorporation of this data into the FS alternatives evaluation. This will more accurately assess the potential for recontamination and restoration timeframes associated with each cleanup alternative.
5. DSI supports the use of the monitored natural recovery ("MNR") and enhanced natural recovery ("ENR") in areas where these technologies can result in short- and long-term protection of human health and the environment in a reasonably comparable timeframe.
6. DSI supports the selection of a waterway-wide remedy that incorporates all applicable, proven technologies at individual sites. This will ensure that protection of human health and the environment is achieved in the most implementable, but cost-effective, manner possible. To this end, the alternatives evaluation should continue to include MNR, ENR, capping and dredging, given that each of these proven remedial approaches/technologies may be most applicable under differing conditions. A uniform remedy (e.g., wide scale removal identified in Alternative 5) is clearly not appropriate for this complex Site, as shown by the detailed analysis of alternatives.

Any Record of Decision ("ROD") must provide a process and contain incentives for waterfront businesses to conduct cleanups, such as:

1. How the ROD framework will determine the selected waterway-wide remedy and in what timeline and under what type of legal mechanisms. Those legal mechanisms must offer contribution protection and preserve a party's right to pursue cost recovery and/or contribution claims or other remedies against uncooperative or non-participating parties.
2. The ROD needs to provide clear incentives for businesses to consider active remediation, provide legal protection against ongoing sources of contamination to cleanup areas from offsite sources within the Site, and account for ongoing anthropogenic background sources from areas and properties upstream of the Site.
3. The ROD needs to identify the remediation sequencing and timeframes. An EPA-selected remedy that includes a restoration time frame extending beyond 20 years is not feasible. This is demonstrated by the Draft FS' identification of a number of protective cleanup alternatives that can achieve the remedial action objectives within this timeframe.

Finally, on behalf of DSI, we also offer the following specific comments and concerns regarding the Draft FS and associated supporting communications provided by EPA, Ecology, the Duwamish River Cleanup Coalition, and the Tribes:

1. DSI believes that additional outreach to persons and businesses who may ultimately be responsible for Site cleanup actions is necessary to avoid a litigious process and to ensure that the Site is remediated expeditiously.
2. DSI feels that it is absolutely necessary that source control activities be completed prior to initiation of sediment cleanup actions to avoid iterative cleanup work (e.g., Duwamish Diagonal, Slip 4, Terminal 117 Malarkey) that is costly and ineffective.
3. DSI believes that the iterative, worst-first approach suggested by the Draft FS will reduce the recontamination potential, will allow the agencies and involved stakeholders to learn from previously completed cleanup action results (thus increasing future remedy effectiveness), and will facilitate an appropriate adaptive management framework that achieves waterway-wide cleanup objectives in the most effective, timely fashion.
4. The Draft FS does not clearly present a summary of the large number of cleanup activities currently in progress. The Draft FS should identify areas within the Site that are already identified for cleanup beyond the Early Action Areas either as part of planned maintenance dredging, ongoing source control activities coordinated with Ecology, or under Agreed Orders with Ecology.
5. DSI generally supports the detailed evaluation of removal implementation provided in the Draft FS. The evaluation of removal rates, offload rates, and transportation and disposal issues needs to continue to be carried through the alternatives evaluation. This will ensure that accurate timeliness for remedies, including but not limited to removal, are established.
6. DSI believes that Alternative 5 (complete removal) needs to be carried through the detailed alternatives evaluation to more fully evaluate the overall incremental benefit, restoration timeframes, and costs associated with this alternative.

We appreciate the opportunity to comment on the Draft FS. DSI looks forward to ongoing discussions with the agencies throughout the remedy selection process for the LDW.

Kindly add our firm to your mailing list and e-mail listservs so that we can continue to be included in your outreach efforts to businesses, who operate within the boundaries of the LDW and who will be most directly affected by future cleanup efforts. My associate, Tracy Williams, and I can be reached at (206) 632-2000 or via e-mail at kmj@johanassocs.com or tyw@johanassocs.com.

Very truly yours,

Kim Maree Johannessen

/kmj

cc: Duwamish Shipyard, Inc.
Kelly-Ryan, Inc.
Boyer Towing, Inc.
Boyer Halvorsen
Kirsten Halvorsen Stahl
Maia Halvorsen
David Templeton, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

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Caring for
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June 24, 2009

Allison Hiltner
Office of Environmental Cleanup
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

RE: Comments on the Draft Feasibility Study for the Lower Duwamish Waterway CERCLA Site

Dear Ms. Hiltner:

The Washington State Department of Natural Resources (DNR) appreciates the opportunity to comment on the April 24, 2009 Draft Feasibility Study for the Lower Duwamish Waterway CERCLA site.

DNR manages 2.6 million acres of aquatic lands, a small portion of which is located within the waterway. Though the Lower Duwamish Waterway is owned and managed by the Port of Seattle, the Lower Duwamish Waterway CERCLA site contains lands, both upland and aquatic, that are owned and managed by other entities, including the Department of Natural Resources. It must be recognized, as well, that the operation of that waterway impacts State Owned Aquatic Lands in East Waterway and West Waterway, as well as portions of the Lower Duwamish CERCLA site not within the waterway. CERCLA sites are located within east and west waterways, and any remedial action within the Lower Duwamish Site may result in their recontamination. DNR is concerned that the potential contamination / recontamination of those downstream CERCLA sites has not been adequately considered in the evaluation of alternatives.

DNR is concerned that this report relies on previous documents by merely citing them, and is not a stand alone document. It would be appropriate for the report to add a paragraph or two with those citations to grasp fully the flow of information.

Executive Summary, ES-4; Chapter 2, Section 2.1.3, page 2-6: Even though the executive summary mentions the salt water wedge influence on the Duwamish Waterway, and chapter 2 identifies the salt water wedge as affecting the hydrology of the Duwamish Waterway Site, that process is not modeled within the Sediment Movement and Recovery Model presented in Chapter 5. The effect of tidal influence on sediments should be considered as part of the model since "vertical mixing over the length of the saltwater wedge is almost non-existent," and that the salt water wedge extends at high tide to the navigation channel. How this phenomenon would

AQUATIC RESOURCES DIVISION ▪ 1111 WASHINGTON ST SE ▪ MS 47027 ▪ OLYMPIA, WA 98504-7027
TEL (360) 902 1100 ▪ FAX (360) 902 1786 ▪ TTY (360) 902-1125 ▪ TRS 711 ▪ WWW.DNR.WA.GOV
EQUAL OPPORTUNITY EMPLOYER

effect the movement of bottom sediments, and thus natural recovery, or enhanced natural recovery, or even capping needs some discussion.

Chapter 4, Section 4.2.1, page 4-8 (and Chapter 9, Section 9.4.2, page 9-23 to 9-24): the Sediment Standards are not only promulgated under MTCA, but also under the Clean Water Act. DNR disagrees that surface waters impaired following the remedial action should be addressed through a separate regulatory program. EPA will have to make a determination in the Record of Decision whether water quality standards, and thus sediment management standards, will be met during and after the remedial action. The statement that releases resulting from remediation activities should be addressed through a separated regulatory program under the clean water act does not factor in the requirement that EPA must meet all substantive requirements of the ARARs. The RoD clean water act determination will have to include downstream impacts to water quality resulting from remedial actions at a minimum. The DNR remains concerned that the source control measures being undertaken are ineffective and that in the absence of effective control measures the cleanup sites will become recontaminated.

Chapter 4, Section 4.3.4, page 4-3 and Table 4-5: The ten reference areas to estimate natural background are primarily Puget Sound embayments selected for various undefined purposes. All of the ten reference areas appear to be marine environments, and do not include estuarine areas. DNR also does not necessarily agree that these reference sites are outside the influence of localized activity, and believes that the feasibility study should use upstream sediment of the Duwamish River to estimate natural background (see Chapter 5, Section 5.6, page 5-36).

Chapter 4, Section 4.3.5.3, page 4-19 to 4-21: DNR does not believe that portions of the Lower Duwamish contaminated site (RM 4.0 to RM 4.75) should be used for calculation of background estimations. Natural background must mean nonanthropogenic background. Natural background must be assessed in an estuarine environment not severely impacted by the activities of man. This is a fundamental condition that requires a thorough discussion with all stakeholders.

Table 4-4, page 4-38: Clarification: Aquatic Land Management Act and applicable rules apply only if the aquatic lands are State Owned. Most of the Lower Duwamish Site is aquatic land owned by the Port of Seattle, and is not State Owned Aquatic Land as statutorily defined.

Table 4-4, page 4-39: Clarification: the Aquatic Land Management Act applies only to State Owned Aquatic Lands.

Chapter 5, Section 5.1.2 states that 50% of sediment flowing into the LDW is deposited there, while it is implied that the remainder would flow into East and West Waterway. It is uncertain whether the salt water wedge was included when this estimate was made. Figure 5-10a DNR is also concerned that East and West Waterways are not included in the 10 year model simulation—especially given the acknowledgement of the salt water wedge. The report does not reflect the uncertainty associated with the model. All interpretations that are based upon the model must show the uncertainty with those interpretations.

Chapter 5, Section 5.6, page 5-36(and Section 8.2.4 and Figure 2-5): The statement that ship induced bed scour has been incorporated into the LDW sediment bed structure should be more fully developed. Many of the remedial action alternatives, such as enhanced natural recovery and capping, will be impacted by propeller scour. Any existing scour areas should be collocated with SMAs, since such scour will be an element effecting remedial design and cost.

Chapter 7, Section 7.2.4.1, page 7-24 (Washington State Department of Natural Resources (WDNR) Aquatic Lease. This sub-section appears to be misstitled. Except for very small segments of the LDW CERCLA Site, the Port of Seattle owns the aquatic lands in the Duwamish Waterway. These lands were obtained from Commercial Waterway District No. 1 of King County in 1963. These aquatic lands are not State Owned Aquatic Lands subject to Title 79 RCW, but rather to Title 53 RCW—or statutes relating to the powers and authorities of Port Districts. This section needs to be entirely reworked, and references to Port Ownership and Management authorities to implement institutional controls within the waterway should reference Title 53 RCW, including authorities to regulate anchorage areas above and beyond U.S. Coast Guard requirements; to control of vessel speed and wakes; to enter into restrictive covenants; to enter into proprietary documents other than leases (i.e. easements; and to restrict access to the beds of the waterway.

Sincerely

John A. Bower, Jr.
Historical Geographer
Aquatics Resources Division

JOHANNESSEN & ASSOCIATES, P.S.
ENVIRONMENTAL, LAND USE & REGULATORY LAW

June 30, 2009

Via Facsimile & By Regular Mail

Allison Hiltner, Remedial Project Manager
U.S. Environmental Protection Agency
Mailcode ETPA-081
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Brad Helland
Washington Department of Ecology
Toxics Cleanup Program
3190 160th Avenue S.E.
Bellevue, WA 98008

Re: Comments on Lower Duwamish Waterway Draft Feasibility Study (April 24, 2009)

Dear Ms. Hiltner and Mr. Helland:

Our firm represents Boyer Towing, Inc. and Boyer Logistics, Inc. (collectively "Boyer Towing"), Boyer Halvorsen, Kirsten Halvorsen Stahl, and Maia Halvorsen (collectively, "the Halvorsens"),[1] and Kelly-Ryan, Inc. ("Kelly-Ryan"). Kelly-Ryan is former owner and current lessee of three parcels of property located upland of the Lower Duwamish Waterway ("LDW"). Boyer Towing now owns those parcels, together with several other waterfront and non-waterfront parcels. The parcels owned by Boyer Towing, including the three parcels leased by Kelly-Ryan, have been included in a much larger area designated by EPA as Early Action Area 2. Most of the parcels have been and continue to be used to store construction materials (such as lumber and foundation materials), construction equipment (such as excavators, front-end loaders, bulldozers, and cranes), and shipping containers, prior to being shipped to Alaska.

Boyer Towing, the Halvorsens and Kelly-Ryan wish to join in and support the written comments submitted by Duwamish Shipyard, Inc. ("DSI") on the draft Feasibility Study for the LDW Superfund Site. DSI's five-page comment letter dated June 30, 2009 was submitted to you via fax and by regular mail today.

[1] Our firm does not represent Mary Catherine (or "M.C.") Halvorsen.

5413 Meridian Ave. N., Suite C - Seattle, WA 98103-6138
Phone: (206) 632-2000 Fax: (206) 632-2500

Thank you for the opportunity to comment on the Draft Feasibility Study. Our clients look forward to ongoing discussions with the agencies throughout the remedy selection process for the LDW.

Very truly yours,

Kim Maree Johannessen

/kmj

cc: Kelly Ryan, Inc.
Boyer Towing, Inc.
Boyer Halvorsen
Kirsten Halvorsen Stahl
Maia Halvorsen
David Templeton, Anchor QEA LLC
Thea Levkovitz, Duwamish River Cleanup Coalition
Kevin Burrell, Environmental Coalition of South Seattle

FISHERIES DEPARTMENT
360/598-3311
Fax 360/598-4666

THE SUQUAMISH TRIBE
P.O. Box 498 Suquamish, Washington 98392

July 17, 2009

Allison Hiltner
U.S. EPA, Region 10
1200 Sixth Avenue
Seattle WA 98101

Re: Draft Feasibility Study
Lower Duwamish Waterway – April 24, 2009

The Suquamish Tribe has reviewed the document referenced above and offers the following comments. These comments are in addition to those previously submitted on various portions of this document. These comments are preliminary (due to the size and complexity of the document and we reserve the right to provide additional comments as information becomes available and we continue our review). If we do not comment on an issue or item it should not be taken as concurrence. Please note that some of our comments are similar to those previously submitted and have not been addressed to date.

General Comments

Organization of the document made review challenging. Not only was it difficult to follow what information applied to each clean up option but changes in format/text between documents made review an arduous task when trying to reference previous comments to ensure that issues have been adequately addressed.

The FS document minimizes potential ecological and human health impacts in the LDW, especially to affected Tribes. It oversimplifies the decisions that need to be made and seeks to steer the reader into accepting that natural recovery will be enough to reduce chemical concentrations in surface sediments by up to 50% within 5-10 years (assuming local sources are controlled and "hotspots" are remediated). The Tribe requests an FS that includes appropriate background values, PRGs that reflect appropriate background levels, and remedial alternatives that achieve PRGs on acceptable scales and within an acceptable timeframes (without reliance on CAD/CDFs, extended MNR, or institutional controls that limit treaty rights).

Specific Comments

1. (ES – 4) The LDW lies with the U&As of the Muckleshoot and Suquamish Tribes. Tribes have treaty protected rights to access and harvest all types of fish and shellfish at subsistence levels. The way it is stated it sounds as if only the Muckleshoot have fishing rights in the LDW (this comment was submitted previously and was not addressed).

2. (ES – 16) RAO's and SMS numbers need to be added to Table ES-2.

3. (ES – 30) The assumption that because the Duwamish is a depositional system and clean up alternatives other than natural recovery are not needed should be deleted. It has been 10 years since this process started and the waterway is not clean.

4. (page 2-9) The fish windows have changed as of April 09. Are the dates included in the FS current? My understanding is that for the Duwamish system the work window is August 1 – August 31. These dates do need to be verified with the local habitat biologist as they are sometimes adjusted depending on the specifics of a project.

5. (page 2-9) Under primary activities of Tribes add "gathering" (previously submitted comment).

6. (page 2-9) Flooding implies the system is not functioning properly. Prior to the 20th century "channel migration" was a common occurrence. Channel migration is a natural function of stream/river systems.

7. (Section 2.6 and Section 9.3) EAAs: There needs to be an in-depth discussion of how EAAs are being incorporated in the FS.

8. (Section 3.2.2) **All** COPCs that present an excess cancer risk of 1 X 10 -6 or an HQ greater than 1 for any scenario, **including** Suquamish seafood consumption, should be identified as COCs.

9. (Tables 3-3a and 3-3b) Suquamish data needs to be included.

10. (page 3-5) Although the Suquamish survey is not limited to just the Duwamish system it is most certainly applicable. The Suquamish survey represents the Suquamish Tribe, a specific people who have traditionally harvested and consumed fish and shellfish from the LDW and who will do so in the future. Risk management decisions should be protective of tribal rights to access and harvest and should not limit or restrict future expression of those rights based on current contaminated conditions. The Suquamish Tribe does not agree with the EPA policy decision to use the Tulalip survey in place of the Suquamish survey. The consumption survey states consumption rates for Suquamish Tribal members and those should be used when determining the level of clean up in the Duwamish River. In addition, when considering existing versus future conditions, EPA has a trust responsibility to preserve resources for the Tribes. The Suquamish Tribe does not intend to compromise treaty-reserved rights or give up on resources, and has been working diligently to restore resources and habitat throughout the U&A. The Suquamish survey is relevant to the Suquamish Tribe and is the preferred survey within the Suquamish U&A.

11. (page 3-5) Delete the last paragraph on this page (it extends on to the next page). The tribe objects to the use of "considerable" uncertainty and the references to quality and quantity of shellfish habitat currently present. The report does not adequately or accurately represent the importance of the LDW to the tribes who retain treaty-reserved rights to harvest. Risk management decisions should be protective of tribal rights to

access and harvest and should not limit or restrict future expression of those rights based on current contaminated conditions.

12. (Section 4.1.1) RAO 1 relates to human health impacts via seafood consumption. Although a PRG will need to be established for sediment concentrations, there should also be a tissue-related remediation goal.

13. (Section 4) The draft FS assumes that SWACs are the appropriate measure for the RAO 1: Reduce human health risks associated with the consumption of resident LDW seafood by reducing surface sediment concentrations of COCs to protective levels, with surface sediment defined using the SMS definition of the top 10 centimeters as the biologically active zone for benthic organisms.

14. (Section 4) SWACs are not an appropriate measure of indirect exposure via organisms that do not use the entire LDW over their lifetimes. The FS should be revised to propose additional PRGs that are more "point-based" for such resources. In addition, the exposure interval for clams should be at least 18 inches, rather than 10 centimeters.

15. (Section 4) Ideally, RBTCs would form the basis of appropriate PRGs for RAO 1. The LDWG maintains that RBTCs cannot be developed for dioxin/furans, arsenic or cPAHs because of a lack of tissue data (for dioxin/furans) and because the relationships are complex and not well understood (arsenic and cPAHs). For these 3 contaminants, PRGs revert to background levels. The 10^{-4} PCB risk-related sediment concentration also drives the PCB PRG to background levels.

16. (Section 4) Although it is stated that the relationships will be assessed through long-term monitoring of the remedial actions, there should be a discussion of how PRGs can be modified as new information on sediment/tissue relations becomes available, or as background values improve.

17. (Section 4) In the draft FS, although a range of anthropogenic background values is provided, PRGs are set at the high end of the range. Natural background values are presented, but are not carried through the evaluation in a meaningful way. LDWG also introduces a concept referred to as "light" urban (see page 4-15), including sediment samples from RM 4.1 – 4.75 as an anthropogenic data set, and states that concentrations closer to the more industrialized areas of the site should be considered as background so as not to "under represent" background levels, and concludes that only anthropogenic background levels need to be considered in the FS.

18. (Section 4) No agreement has been reached to date regarding the use of urban values as background for the LDW, or what range of background values will be used as PRGs for achievement of RAOs related to seafood consumption. The Tribe regards upstream Green River data to represent an appropriate upstream/background for the LDW site, rather than sample data collected from within the site boundaries. CERCLA and MTCA guidance and requirements do not prescribe that only anthropogenic values be considered in the FS.

19. (Section 4) After all outstanding data sets are finalized, the results should be presented for review and discussion. Setting PRGs equal to the upper end of a “light” urban background level is not considered to meet the intent of RAO 1. EPA should consider a range of background values that includes both natural and area background data.

20. (Sections 4.3.5.3/4.3.6) The report states "This segment of the LDW does not contain any EAAs or Ecology Tier 1 area and, with the exception of Slip 6, no Ecology Tier 2 areas." and "this segment of the LDW is within the highly industrialized portion of the South Seattle area and is therefore more geographically representative (i.e., in terms of land use) than land area surrounding the Green/Duwamish River. Thus localized or small-scale variations in anthropogenic background associated with the urban-industrial land use along the LDW can best be discerned by considering this source of information.” This area does contain Slip 6, Rhone Poulenc and may also be influenced by the Norfolk CSO and the marina and should not be considered as any part of a background data set.

21. (Pages 4-17 and 4-20) Outliers are typically defined by analytical data quality concerns. Data that passes QA/QC review and is accepted should be considered in data evaluation. It is unclear how LDWG is using the term "outlier" and the effect on the evaluation. Please provide clarification.

22. (Section 4.3.6) The discussion of background levels for dioxins/furans relies too heavily on values from areas that are likely to be influenced by contamination, including the DMMP disposal sites and sites characterized as Greater Seattle. The proposed range of values is much higher than what is being considered to be natural background based on the 2008 BOLD data.

23. (Section 4.3.6.2/Table 4-29) Although EPA's preliminary background values are presented, they are not considered in any meaningful way in the evaluation of anthropogenic background values or PRGs.

24. (page 4-33 - as an example): It does not seem appropriate to focus the establishment of PRGs at the high end of anthropogenic background because it would result in a "higher probability of actually achieving the PRG in practice." PRGs should reflect the remediation goals necessary to meet RAOs, not what LDWG thinks they might be able to do.

25. (Section 5.2.2) The underlying assumptions of the BCM that lead to the conclusion that "redistribution of existing sediments that exceed PRGs is not a significant process, and future bed sediment chemistry can be estimated as a mass balance between present bed sediment and incoming sediment loads from the Green/Duwamish River and lateral sources" do not account for ongoing dredging and construction projects within the LDW.

26. (Section 5.2.3) The post-remedy bed sediment replacement values are higher than EPA's proposed anthropogenic background levels and upstream Green River values. The report also states that the lines of evidence used to calculate replacement values included surface sediment concentrations from urban bays in Puget Sound and sediment concentrations in sediment traps deployed near Harbor Island. Bed replacement values should more accurately reflect the incoming sediment load from the Green/Duwamish River as the predominant source of incoming material.

27. (Section 5.2.4) SQS is point by point and contaminant-specific. The assumption that one chemical represents the potential impacts of all COCs is not protective. Sediment toxicity tests may be used as a measure of cumulative impact (and trump SQS criteria); however, sediment toxicity tests are location specific and do not represent "SWACs", which are generally not considered protective for benthic organisms in any case.

28. (Section 5.3.1) It is misleading to state that "vessel power high enough to scour sediment deeper than 10 cm is infrequently used", considering tug operations in berthing areas that occur on a routine basis.

29. (Section 5.3.2) The evaluation of the applicability of ENR relies on a thicker than normal sand layer and uses replacement values that are not reflective of upstream sediment values. ENR may be considered as part of some remedial actions, but should not be considered in areas subject to ship scour.

30. (Section 5.3.3.1) The purpose of this scenario is unclear and the conclusion that "it is unlikely that remediated areas will be recontaminated by unremediated areas unless the areas are adjacent to each other" does not seem particularly useful. There needs to be a real, detailed discussion of how EAAs are going to be included in this FS.

31. (Section 5.4.1.2) Given recent data from the Boeing Plant 2 EAA, assumptions regarding vertical PCB concentrations trends are going to need to be revisited.

32. (Section 6.1) The report states that the AOPC "represents the area of surface sediment that has potentially unacceptable risk" and will likely require remediation. The definition assumes contaminated subsurface sediments (below 10 centimeters) do not present potentially unacceptable risk, if the contaminated area is not subject to scour. This definition is not protective of human exposures via clamming, or of resources that use a deeper sediment profile.

33. (Section 6.1.1) The AOPC includes areas previously identified as EAAs. Given that investigations regarding sources and extent of contamination are ongoing at the EAAs, it is likely that the AOPC delineation is inaccurate and likely under-represents contaminated areas requiring remediation. In addition, it is unclear what assumptions have been made regarding the level of expected clean up at EAAs, and how that compares to PRGs for the LDW. (Are they assuming replacement values for EAAs?).

34. (Section 6.1.2.2) EPA's request that a larger, more conservative remedial footprint be evaluated that would achieve the low end of the anthropogenic background range with active remediation has not been fully evaluated or carried through the FS. The LDWG argues that low end background cannot be achieved due to dredging residuals and because background for the LDW is higher than background based on the Green/Duwamish River. Neither of these arguments is considered relevant. Dredging residuals should be managed through the process and should not be considered as a source of contamination; the Green/Duwamish River is background for the LDW.

35. (Section 6.2.1.2) To be conservative, partial grid cells should be included in an SMA boundary, rather than excluded if there is less than 50% overlap with the AOPC. Additionally, grid cells should not be excluded for human health concerns based on sediment toxicity data.

36. (Section 7.1.1 and 8.3.3.1) Dredging: The assumptions that only partial dredging (and capping) will be necessary when contamination is over four feet thick and that the maximum volume that may require active management is determined by depth to native alluvium (which assumes native alluvium is clean and that will not act as an ongoing source of contamination) should be re-evaluated in light of the Boeing Plant 2 findings

37. (Section 7.1.3.1 and) CAD/CDF: The Tribe and other stakeholders have expressed significant concern with the inclusion of one or more CAD/CDFs in the LDW, and it was our understanding that these had been (and should be) eliminated from consideration in the FS. In addition to impacting tribal treaty rights, these options do not remediate contamination, they concentrate contamination. Also, regarding the CAD option, the FS gives the impression that with a CAD, dredging production rates will not be constrained. This type of approach is guaranteed to result in contamination of areas outside of the CAD. Any costs saved by pushing production and placement rates during the dredging will be lost or offset in remediating adjacent areas. If Alternative 2 is to be carried through, it should be revised to include upland disposal rather than a CAD/CDF, and should achieve background/SQS levels rather than CSLs.

38. (Section 7.1.4 and 8.3.3.2) Capping: In areas where capping (or ENR) is proposed, potential impacts to the nature of the substrate and to the benthic community must be considered. At the least, design should include a cover of material that is the appropriate grain size, etc. Composite or reactive caps: The use of composite or reactive caps should be more fully explored as an implementable technology. It may be appropriate to propose several pilot projects.

39. (Section 7.1.5 and 8.3.3.5) MNR: Allowing an additional 10 years for recovery after remediation construction, in areas that are already in the process of natural recovery, is not appropriate. If an area is designated for MNR, the recovery period should be 10 years at most, with the baseline monitoring as year 0. In addition, it is likely that any adaptive management decisions will be administratively difficult, depending on what wording in used in the ROD.

40. (Section 7.1.6 and 8.3.3.3) ENR: If the success of ENR depends on a thickness great enough to "armor" the substrate, the area should be considered for dredging/capping rather than ENR. ENR should not be considered for beaches or areas subject to scour.

41. (Section 7.2.4 and 8.3.3.7)Institutional controls: Institutional controls which limit or restrict treaty rights, such as fishing and consumption restrictions, are generally not acceptable to tribes as permanent or long-term solutions. The Suquamish Tribe has invested considerable time and resources to the recovery of valuable habitat and treaty-reserved resources within the LDW. RAOs have been established for the site which emphasizes remediation to levels protective of human health and the environment.

42. (Section 7.2.4) Zoning: The tribes should be consulted regarding changes in land/waterway use or activities that may impact the LDW remedy (i.e. future stormwater), as well as state and federal agencies.

43. (Section 7.2.4.4) Information devices are not considered effective or practical for subsistence harvesters and are also not protective of ecological receptors.

44. (Section 8.3.1) More discussion is needed on the issue of recontamination/source control (i.e. Boeing Plant 2, Jorgensen, Rhone Poulenc). It is understood that a lot of this information will be discussed during source control, however, some information needs to be included in the FS (background was discussed without having a final determination).

45. (Section 8.3.3.6 and 8.3.4.4) Verification Monitoring: Verification monitoring is not a "remedial alternative" element. If it's done in remedial design, it's part of the baseline monitoring; if it's done after action, it's performance or long-term monitoring.

46. (Section 8.3.4.5) Long-term Performance Monitoring: Sediment and tissue chemistry need to be evaluated relative to RAOs, rather than in relation to anthropogenic background values.

47. (Section 10.2.1.2) There is no discussion of post clean up monitoring (appendix documents were not distributed to all stakeholders that received copies of the main body of the document). If the document is not stand alone (which apparently it is not) then ALL information for review needs to be provided with adequate time for review.

48. (Section 11.4.2) Adaptive management triggers for contingency actions need to be identified upfront.

If you have any questions regarding the comments provided please contact Denice Taylor dtaylor@suquamish.nsn.us or Alison O'Sullivan at aosullivan@suquamish.nsn.us.

Sincerely,

Denice Taylor
Environmental Scientist, Suquamish Tribe

Alison O'Sullivan
Biologist, Suquamish Tribe

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Assessment and Restoration Division
7600 Sand Point Way NE
Building 1
Seattle, Washington 98115

June 29, 2009

Ms. Allison Hiltner
US EPA Region X
1200 Sixth Avenue
Seattle, WA 98101

Re: Draft Lower Duwamish Waterway Feasibility Study (dated April 24, 2009)

Dear Allison:

NOAA appreciates the opportunity to provide comments on the Draft Lower Duwamish Waterway Feasibility Study (dated April 24, 2009) prepared by AECOM. NOAA is a trustee for aquatic habitats, fish and other aquatic species in the coastal areas of the United States. The Lower Duwamish provides important habitat as well as migration access to and from the Duwamish/Green River watershed for juvenile salmonids, including ESA listed Chinook. Therefore, NOAA is very interested in participating in the feasibility study process on the Lower Duwamish Waterway to ensure that the remedy selected is protective of NOAA trust resources.

General Comments

Site delineation
Determining achievement of PCB RAOs/PRGs by averaging (or doing other statistical analyses) over the entire 5 miles of LDW, allows clean upstream areas that were never contaminated to "compensate" for contaminated areas downstream. Averaging over the entire length of the LDW to establish compliance is not consistent with most of the exposure scenarios for both human and ecological receptors:

a.) Exposure locations for beach play and clamming are specific locations, each of which should achieve PRGs.

b.) Forage fish, e.g., blennies and sculpins; (and shellfish) that are prey both for larger fish consumed by humans and for the selected ecological receptor (river otter, *Lutra canadensis*) do not generally range over 3 or 4 miles of river, so it is inappropriate to average contaminant concentrations over this length to estimate food chain exposure.

c.) Research using radio-telemetry by the University of Alaska, Fairbanks, demonstrated that denning female river otters do more than 50% of their foraging within a 4 km (2.5 miles) stretch of shoreline (Blundell et al, Wildlife Life History, pgs 325-333, Table 2). Thus, averaging exposure over the entire LDW length would not be appropriate for estimating the exposure of denning female otters, a critical lifecycle consideration for PCB exposure.

The STM results indicate LDW sediment dynamics generally divide into three similar reaches. We recommend the "site" be divided into the three reaches identified by the STM for compliance and remediation, referred to as Areas of Potential Concern (AOPC). In addition, remediation and compliance should be completed from upstream to downstream. The most upstream reach, AOPC 3 (RM 4.0 – 5.0) had only very small areas of contamination even during the R.I. sampling: the immediate area of the Norfolk CSO and the Rhone Poulenc RCRA site. Fish from this reach had consistently lower concentrations than the other two reaches. The Norfolk CSO remediation was completed prior to the CERCLA listing. Rhone Poulenc is in the process of being addressed. This river reach was included in the STM as the upstream boundary for stability of the hydrodynamic model and to include the turning basin as a sediment source. All stakeholders agree that the cleanest sediment entering the system comes from the river upstream, and that much of this sediment is deposited in RM 4.0 to 5.0. The STM indicates all of this reach, including Slip 6, has an average net annual sediment accumulation of >2 cm (Figure 5-15, pg 5-64). Thus, according to the STM, all areas of RM 4.0 -5.0 will have accumulated more than 20 cm [8 inches] of "background" sediment between years 2000 and 2010. This upstream reach is likely to easily meet compliance with any and all RAOs.

The five unremediated early action areas (EAAs) are all in the middle reach (AOPC 2), RM 2.0 to 4.0. Clean-up of the three sponsored EAAs should begin immediately, without waiting for the ROD, in accordance with EPA's principle of source control first. Because remedial actions may disturb and redistribute some of the contaminated sediment, and because the highest contaminant concentrations are within the EAAs, it is preferable to complete the EAAs before resampling to determine where additional remediation is appropriate. Once the EAAs are complete, sampling and remedy design for any remaining areas in RM 2.0 to 4.0 that exceed RALs can begin, in accordance with the ROD for the remainder of the LDW.

Figures 6-2-a,-b,-c,-d,-e (pgs 6-33 to 6-37) show significant areas of surface contamination in the navigation channel only in the downstream reach (AOPC 1, RM 0.0 to 2.0), suggesting that upstream sources contribute contaminants downstream. This downstream reach has most of the CSOs and SDs (Figures 5-10-a,-b,-c, pgs 5-57,-58,-59), so leaving remediation of the downstream reach until last provides more time to address the complex, but relatively minor, CSO/SD sources of contaminated sediment. Delaying remediation of the downstream reach until the middle reach is addressed also provides the greatest opportunity for natural recovery in the downstream reach. (The STM demonstrates that the CSO's and other drains are minor contributors to contamination of LDW sediment, thus it is reasonable to begin remediation of sediment even without complete control of all the CSO/SD's.)

Unknown impacts of sediment transport from the site

The net mass transport of sediment is downriver, which the sediment transport model represents (the STM estimates 107K metric tons average net annual sediment discharge from LDW) but the STM can not accurately represent the net transport of PCBs, because a disproportionate amount of the PCBs are associated with fine organic-based particulates that do not readily settle from the water column. Thus, the particulates that are most concentrated with PCBs (and the other COCs) are the particulates that are most likely to be transported

farther downstream than the average sediment particle, and are more likely to be exported from the LDW to receiving waters (See Figure 5-14, page 5-63).

The sediments at Boeing Plant 2 should be remediated before other downstream areas to reduce the risks of recontamination.

The most significant potential current source of PCBs to the LDW, with respect to both PCB concentration and contaminated area, is Boeing Plant 2 (See for example, Figure 2-7, pg. 2-70). During high river flows, the Sediment Transport Model (STM) estimates extensive mobilization of LDW sediment within the river reach dominated by Plant 2 (Figure 2-4, pg. 2-67). Thus, Plant 2 likely continues to export PCBs adsorbed to sediment to other parts of the LDW, with some of this contaminant load migrating downstream (See Figure 4-8, pg. 4-82). The STM further indicates Plant 2 sediment is unlikely to be buried by cleaner sediment from upriver (Figure 5-9, pg. 5-56). During the past 15 years, Plant 2 has completed numerous RCRA actions to control contaminant migration from the adjacent upland, greatly reducing the risk of recontamination from upland sources. It is time that the sediment in front of Plant 2 is remediated to remove this massive potential source of PCBs in the LDW (source control first, in accordance with *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*, EPA 2002).

Remedial Action alternative

A major concern is the duration of time that the public perceives the LDW as still being contaminated, during which the site remains a continuing source of PCBs to Elliott Bay. Remediation of other contaminants also should proceed with alacrity; spending decades in studies and discussions is a detriment to the environment equivalent to never having listed the site. Natural resource trustees are obligated under CERCLA to make the public whole by seeking compensation from responsible parties for injury to trust resources. The amount of injury will continue to accrue until a protective remedy is implemented.

"Monitored natural recovery" in the LDW is predominantly burial with cleaner sediment, generally derived from the upstream river, which occurs regardless of any remedial action. MNR may not be effective for reducing contaminant concentrations at all locations due to hydrodynamic effects from pilings, islands, bridge abutments, piers, sinuosities, dolphins, propeller wash, boat wakes, and bed irregularities. Relying on MNR after the remedial actions to attain PRGs means waiting 10+ years to determine whether the remedy is complete and risks have been reduced to PRGs; means having to intensively sample specific areas again, with the added expense of that monitoring; and having to negotiate and mobilize for an appropriate action if the MNR does not occur as predicted. EPA guidance requires designing sampling plans as part of the remedial design. Thus, including MNR as part of the remedy also delays all of the remedial actions while the MNR sampling and analysis plan is negotiated. The plan also includes contingencies if there are areas that do not meet the expected PRG. Thus, if MNR is not part of the remedy (except for the natural recovery that occurred between the 2001 CERCLA listing and 2011 pre-design sampling), remedial actions can begin sooner. In addition, monitoring to determine whether MNR met the PRGs a decade after remedial action completion, and any contingent remedial actions, is eliminated.

Removing MNR from the equation will reduce significant cost, time, and energy in the outyears.

In summary, 10+ years of natural recovery has already elapsed since the baseline sampling that demonstrated significant contamination and risks in the LDW, waiting another 10 years following the completion of upcoming remedial actions means waiting 25 - 30 years for the site to be remediated to PRGs. This delay is insupportable. We recommend that the next sampling of each AOPC (3 reaches) be intensive enough to establish areas that do not meet PRG/RALs, and design for active remediation of these areas should then expeditiously commence. In the absence of MNR as a remedy component, RALs are equal to PRGs.

Alternative 3
Alternative 3 is characterized as 'emphasizing containment', but the primary emphasis is ENR. ENR is not containment or isolation and may be more aptly described as sediment dilution. The description of Alternative 3 and text throughout should not imply that ENR is a form of containment.

Recommendations for suitable remedial action technology
The surroundings and uses of each area needing remedial action will generally dictate what technology is most appropriate:
a.) Clamming sites and play beaches can be expected to experience disturbance and mixing of sediment to depths greater than the assumed 10 cm (4 inch) biologically active zone. Furthermore, the elevation of these areas relative to tides is essential to their continued resource use, along with clean sediment of the appropriate texture for the intended use. Thus, enhanced natural recovery (ENR) of 6 inches would not be adequately protective in these areas. Containment capping is not feasible because it would make a significant change in elevation. Since these areas are along the shoreline, excavation can generally be accomplished from onshore; but if not, a small, shallow-draft barge could be used. Shoreline areas are ideal for shallow, precise land-based excavating on a low tide and backfilling. Because children (and dogs) dig holes in beaches, and because clams burrow to depths of 45 cm or more, beach and clamming areas need to meet RALs to this depth, or greater. [Note also, pg 2-15 reports that intertidal elevations above -4MLLW "may be subject to relatively low deposition".]

b.) The navigation channel must be maintained at the appropriate depth, which discourages containment capping. Dredging is problematic because the USACE does not like to leave dredged depressions which may become traps for (contaminated) sediment. The navigation channel may be the best location for ENR, as the navigation channel is generally depositional. ENR also can be done relatively quickly, reducing the duration of construction interference with waterway use.

c.) Remedial actions in many of the remaining areas are complicated by the presence of over-water structures along about 24% of the shoreline (pg. 2-36), berthing facilities for ships, and/or pilings, dolphins or other structures. Locations where the STM predicted annual net sedimentation, and corresponding sediment core samples did not demonstrate sediment

accumulation, were often associated with pilings, piers, dolphins, or bridge abutments (Figure 5-15, pg 5-64; SC-5, SC-24, SC-29, SC-48). This incongruity demonstrates that the presence of in-water obstructions impedes sediment deposition, and may be associated with scour. ENR would not be appropriate due to the uncertainty whether sediment would remain uniformly distributed over these areas. Dredging to remove contaminated sediments, or dredging followed by hard surface capping, if contaminants remain *in situ*, are the remedial actions with the best long-term reliability in these areas. Dredging around obstructions is difficult with a conventional dredge, but can be accomplished using a diver-directed hydraulic dredge.

d.) Dredging to remove sediments contaminated above RALs, or containment capping, or a combination of dredging and containment capping are options for remaining areas needing remedial action.

Dredging alternatives

The approach in determining dredging areas for the RA alternatives should be revised. Currently existing sediment samples are interpolated to determine dredging footprints. In some cases, large dredging footprints may be based on 3 sample locations. This conservative approach may significantly overestimate the footprints and associated cost. This approach will make dredging appear to be much more expensive than less active options. However, these footprints could be reduced during remedial design with more extensive sampling. The interpolation methods should be revised to develop more realistic footprints based on available data.

PRGs

The PRGs put forward relate to sediment concentrations. It's important to address contamination in the sediment. However, risk is also tied to elevated contaminant concentrations in tissue. If sediment concentrations are reduced, but tissue remains elevated, the site has not been cleaned up to address risk. There are multiple reasons why reducing sediment concentrations may not sufficiently address risk. For example, the Sediment Transport Model and BCM may overestimate natural recovery and the depositional nature of the waterway. The FWM model may not be adequately calibrated to determine the relationship between sediment and tissue. For these reasons, the PRGs should also state goals related to concentrations in tissue, not just sediment.

Mixing Depth

Underestimation of mixing depth will result in overestimation of rate of recovery. In a sensitivity analysis of mixing depth for their PCB fate model for the Upper Hudson River, QEA (1999) found that increasing the depth of mixing from 10 cm to 15 cm in cohesive sediments improved the prediction of observed values. QEA also noted that because of the non-linear relationship between the volume of the surface mixed layer and the rate of dilution with deposited solids, their model is more sensitive to a reduction in mixing depth than to an increase in mixing depth. We recommend using a minimum mixing depth of 15 cm, which is consistent with the findings in Ecology's SPI report that more than half of the stations had evidence of biological activity at depths greater than 10 cm.

Natural Recovery
Natural recovery predictions are based on the BCM. The BCM is a simplistic model that uses the output of the STM and makes estimates of contaminant concentrations in the surface sediment based on predicted rate of net deposition, the proportion of depositing sediment from upstream and lateral sources, and the concentrations of contaminants in the sediment source material. Two types of primary empirical information are used to support the predicted rates of natural recovery: surface concentrations in nominally co-located cores collected more than 5 years apart and vertical segmentation of concentrations in sediment cores. As discussed in our specific comments, both of these "lines of evidence" are extremely limited and have insufficient resolution to support model predictions. If predictions of natural recovery (MNR or ENR) are expected to play an important role in the selected remedial alternatives, NOAA recommends that EPA develop a sediment sampling plan to objectively assess temporal changes in surface sediment concentrations in the LDW.

Rate of Natural Recovery
The rates of natural recovery (sediment "burial") derived from the BCM are extremely optimistic. For example, in Alternative 3b/4b an RAL PCB concentration of 700 ppb is projected to reach 240 ppb in 10 years. This corresponds to a rate of decline of approximately 10% per year. If a similar rate of recovery was taking place in the past, 700 ppb in 2009 would have been 15000 ppb in 1980. Overestimation of the rate of natural recovery results in underestimation of the relative benefits of more active remedies (Field et al 2009).

Appendix H
The proposed methods for estimating the 95% upper confidence limit (UCL95) for the average contaminant concentration in surface sediments are likely to understate risks, due to a biased estimation procedure using smoothed (i.e. less variable) interpolated values to estimate the population standard deviation. These methods are proposed for use as-"… one line of evidence for evaluating the effectiveness of remedial alternatives" and as a benchmark to evaluate how well the alternatives are achieving the preliminary remediation goals. Simulations using statistical distributions similar to those commonly encountered at contaminated sediment sites demonstrate that variance estimates based on the proposed methods understate the population variance in 95% of simulations and by more than a factor of 2 in 67% of simulated samples. As a result, risks due to exposure to contaminants in the surface sediments are likely understated and the benefit of proposed remedial actions are likely overstated.

General Comments on Chapter 9:

Chapter 9, Figures 9-2, 9-3, 9-4, 9-5 and 9-6: The expected year-by-year progression of natural recovery following each remedial alternative should be graphed and provided for RA comparisons. Showing each year is necessary for a fair comparison, because some remedies will reach full compliance at 8 years, and others will reach it at 15 years and others at 28 years (for example). Graphing each year would develop curves with real inflection points,

rather than the artificial inflection points that appear because of the arbitrary 10-year and 30-year time steps. Because the STM has already been run to a 30-year duration, the STM output is available for every year. The only additional work is to apply the BCM.

Ideally, a series of randomly generated hydrographs would be used for the projections of future recovery, because the timing of floods can greatly influence these results. If a Monte-Carlo type simulation isn't feasible, the 30 year hydrograph, or a table with the maximum flows for each year in the model run, should be provided as context for the STM/BCM projections.

A discussion is needed differentiating the permanence and reliability between a 3 ft thick containment cap and a 6 inch ENR layer. A 6 inch ENR layer should not be confused with containment capping. Since the STM only mixes the top 10 cm (4 inches) of sediment, and has no provision for contaminant migration through a cap, the STM will equate ENR with containment capping. This is a significant uncertainty (and bias) that should be noted in discussion of the model projections.

A discussion should be included that provides an explanation of how the 100 sample locations were selected for estimating the UCL95 following remedial action. Are the same locations sampled each time? How are they distributed, eg., how many are in the navigation channel, or in the beaches/clamming areas? Are different locations sampled each time, selected randomly, or by a stratified random design? Also, please explain why ProUCL95, a peer-reviewed public domain software package, could not be used for the calculating the UCL95 based on these 100 samples.

The figures in Sec. 8 show SMAs extending to RM 5.0, but the Sec. 9 detailed analyses of remedial alternatives and subsequent natural recovery extend only to RM 4.75, eliminating changes related to remediation of the Norfolk EAA and SMA 48, significant PCB sources during the RI.

Sec. 9.1.1.2 discusses the threshold criterion of "compliance with ARARs" but seems to overlook chemical specific AWQC, protective concentrations in water that have regulatory compliance requirements for the remedial actions, and for considering a remedy successful.

Pg. 9-5: The assumption of a 3 year post-construction recovery period for fish and shellfish tissue concentrations is not warranted. Recent data from several sites including the Grasse River (Connolly et al 2007), Kalamazoo River (Kern et al 2009), the Queensbury site on the Upper Hudson River (Field et al 2007), and the Duwamish River (Figure 1) indicate that any increases in fish PCB concentrations are short-term and reduction in fish tissue PCB concentrations often occurs in Year 1 post-removal or sooner.

Pg. 9-16*: …uncertainty in the point-in-time estimates suggests that interval or range of times is a more appropriate way to represent restoration time frames. ….Therefore, for each risk-driver chemical and each exposure scenario, the evaluation of alternatives designates a 5- or 10-year interval ….For example, a point-in-time estimate of 16 has an estimated*

restoration time frame of 15-20 years. Similarly,a point-in-time value of 19 years corresponds to the same range, 15 to 20 years. While we agree that the point-in-time estimates have considerable uncertainty (especially for any one location or grid cell), the estimates of restoration time among the various remedial actions should be distinguishable. Forcing these estimates into rigid intervals eliminates our capacity to identify relatively small differences in time to restoration among remedies that are quite similar. In the example, restoration time estimates of 16 years and 20 years (a four year difference) would both be reported as 15 to 20 years, but an estimate of 21 years (only one year different from 20) would be reported as 21 to 25 years. Please provide the exact estimate of point-in-time to restoration, so that we can evaluate the incremental improvement between remedial alternatives.

Specific Comments and Concerns:

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ES-14, The figure illustrating remedial technologies should be revised. Enhanced natural recovery is not containment. Rather, it's an accelerated version of monitored natural recovery. NOAA recommends replacing the MNR category with a Natural Recovery category. MNR and ENR should be options within this category. ENR should not be confused with containment.

Pg. 2-10: *The STM was calibrated over a 21-year period (1960 to 1980) using upstream river flow data to set initial bed conditions. Boundary conditions (i.e., upstream inflow) were then calculated over a 30-year period (1960 to 1989) to model the movement of suspended and bed load sediment into the LDW from upstream and through the LDW*. It also is reported that the Howard Hansen dam was constructed in 1961 and that it is located "approximately 65 miles upstream of the LDW" (pg. 2-2). As noted previously, NOAA is concerned that the sediment load released below the dam and potentially reaching the LDW has decreased over the last two decades. During this time clear-cutting of forest was all but eliminated and the Green River valley was converted from farmland to warehouses and parking lots. Both of these land-use changes would impact the river hydrograph and also would significantly reduce the sediment loading to the River. However, rather than continuing to argue with this aspect of the FS/STM, we recommend completing remedies at the EAAs and resampling the LDW to determine whether natural recovery *in situ* is consistent with the projections of the model.

Pg. 4-89, Figure 4-15, Dioxin/Furan TEQs in Surface Sediment Samples Used as Line of Evidence for Anthropogenic Background: Samples 5a and 5b at the south end of Lake Washington are likely affected by a creosote CERCLA site (Quendall) in this vicinity. Similarly, samples 9a and 9b (and the sample at 54) are likely to be areas affected by the former coal gasification plant at Gas Works Park (also a CERCLA site). Because these samples are in proximity to intense sources of contaminants that contain dioxins/furans, they are not representative of ambient urban background.

Chapter 5:

Pg. 5-1: "*Predict contaminant fate and recovery potential for risk-driver chemicals over periods of time (e.g., 10 years) via the primary mechanisms of burial and source control*". Other goals for the modeling efforts that should be addressed include the potential for contaminant re-distribution within the LDW and export from the LDW to Elliott Bay.

Pg. 5-1: "*Compare model results to empirical measurements to show convergence of information. Both the modeling results and empirical data have some measure of uncertainty;…*" The analyses presented in this chapter (and Appendix F) would be more useful if uncertainty associated with the model predictions and empirical data and analysis was quantitatively addressed in the evaluation.

Pg. 5-7: "BCM Assumptions. "*The surface sediment that erodes, moves, and redeposits within the LDW is primarily of Green/Duwamish River origin*." Implicit in this assumption is that sediment of Green River origin does not change concentration within the LDW.

Pg. 5-8: "*Adherence to these assumptions means that redistribution of existing sediments that exceed PRGs is not a significant process, and future bed sediment chemistry can be estimated as a mass balance between present bed sediment and incoming sediment loads from the Green/Duwamish River and lateral sources*." Significant PCB mass exists in the surface and shallow subsurface sediment of Reach 2, an area described by the STM as mixed deposition and erosion, so it is likely that contaminant redistribution from this Reach will continue to be an important process. Rather than strict adherence to assumptions, the uncertainty associated with these assumptions should be considered.

Pg. 5-8: "*The biologically active zone for most of the LDW is 10 cm or less, and therefore the top 10 cm model layer represents exposure concentrations for benthic organisms…. The 10-cm depth is also consistent with the STM and BCM assumptions of the active mixing layer*." In the Ecology (2007) report, the median maximum void depth was 10.4 cm, which implies that more than half of the LDW locations evaluated with SPI had evidence of biological activity at depths below 10 cm. In addition, benthic organisms within any area exposed to scour (even if net depositional) would likely be exposed to layers deeper than 10 cm. Using assumptions to support assumptions seems like a stretch.

Pg. 5-12: "*These lines of evidence included data from upstream Green/Duwamish River inflows, surface sediment concentrations from urban bays in Puget Sound (in areas not listed as contaminated sites and not in dredged material disposal sites), and sediment concentrations in sediment traps deployed near Harbor Island*." Please explain why sediment traps near Harbor Island, downstream of the LDW, would provide useful post-remedy bed sediment replacement values.

Pg. 5-17: "*Natural recovery over longer periods may still be occurring in areas with localized propeller scour. Propeller scour temporarily resuspends bed sediment, after which a portion of that material resettles in the same footprint*." The heavier material will be more likely to re-settle within the area, while finer-grain material will be more likely to travel greater distance. Since most of the contamination is likely associated with fine-grained

sediment, this emphasizes the importance of these areas as sources of contaminant loading to other areas.

Pg. 5-25: "*Of the 157 cores included in the analysis, 110 cores (70%) had peak total PCB concentrations at depths equal to or greater than the estimated depths, consistent with the STM's estimated net sedimentation rates. Forty-seven cores (30%) had maximum total PCB concentrations that were shallower than the estimated depth range based on net sedimentation rates from the STM, or the concentrations were too diffuse to detect a significant peak at depth. Thirty-two of these 47 cores were located in EAAs with either very low net sedimentation rates or in areas where source investigations have suggested the potential for ongoing releases of PCBs.*" This analysis includes 33 cores with the highest concentrations in the surface segment as supporting the STM predictions, where it is impossible for the data to contradict the model according to the evaluation framework. Using an alternative evaluation framework, more than 50% of the cores (80 of the 157) had the highest concentrations in segments that were shallower than the model estimates or were in the surface core segment. Because there is no discussion of the actual PCB peak concentrations, except to state that many of the cores that had peak concentrations shallower than the STM predictions had "relatively" high PCB concentrations, the reader has no way of knowing whether the concentration differences are meaningful (for example, greater than a factor of 2). If the STM predictions are less reliable for areas of elevated concentrations (e.g., EAAs), what does that say about the potential use of the STM in estimating natural recovery?

Pg. 5-25: Chemical Trends at Resampled Surface Sediment Stations. The analysis presented here and in more detail in Appendix F should include analyses of spatial heterogeneity in nominally co-located samples in order to define what could be considered to be a meaningful difference among samples.

Tables 5-5 and 5-6: Why were early action areas excluded from evaluation of temporal change in "co-located" surface sediment samples? Given the limited amount of data for this evaluation, it would make sense to include all of the data and then evaluate differences.

Table 5-6: estimated half-life for bed composition change: " [a] *Stations with increased surface sediment concentrations in the re-occupied samples were excluded from rate calculations, but included in total sample coun*t." Please explain why these data were excluded from the analysis.

Pg. 6-6: …*anthropogenic background for the LDW is likely higher than that for the Green/Duwamish River due to the higher level of urbanization in the contributing drainage basin.* At a minimum, this assertion should be documented by maps showing the respective drainage basins and the locations of the background samples. More significantly, the FS several times notes the STM shows sediment loading from urban drainages (delivered to the LDW by CSOs/SDs) is negligible in comparison to the sediment loading from the upper Duwamish River, except for a few model cells located at CSO/SD discharges. "*Overall, at*

year 10, only 2% of site-wide bed composition is derived from lateral sources" (Appendix D, Sec. D.3.1, first paragraph following equations).

Pg. 6-13: "*Finally, even given the above factors by which a grid cell was included or excluded, a grid cell was generally excluded if sediment toxicity test data were available for that area, and the sample(s) passed (except areas with high PCB concentrations were retained for the protection of RAOs 1, 2, and 4).*" Please clarify the decision process/criteria and provide a table showing which SMAs were excluded based on toxicity test results. Is it possible that one sample below the toxicity threshold was sufficient to exclude an SMA even if other samples showed high chemistry?

Pg. 6-15, footnote: *Potential vessel scour areas were identified based on the 2003 bathymetry survey sun illumination maps. Physical signs of vessel disturbance were mapped, based primarily on significant ridges and furrows on the order of 1-2 ft thick/deep in the sediments*. These observations of erosion and mixing (1-2 ft or 31-63 cm) are significantly greater than the depth of scour/erosion used in any other part of the analysis. A one-time snapshot of the sediment bed showing furrows of this magnitude indicates LDW sediment is subject to <u>deep</u> scour and mixing by vessel passage, and/or other forces that create valleys and ridges of 1-2 ft magnitude. These observations also indicate a soft, unconsolidated sediment bed that is vulnerable to erosion, mixing and transport, not just within SMAs, but in many areas of the LDW, for example east of the navigation channel at RME 0.2thru0.5, and RME 1.2thru1.4, RME2.55-2.8, and RME 3.9-4.1 (Figure 2-5, pg 2-68).

Pg. 7-19, Sec. 7.2.1 Barge Dewatering: "*Dewatering mechanically dredged sediment on transfer barges prior to additional handling is an important interim management step…the water is then released back to the water body within the defined limits of the dredge operating area.*" Why isn't this method permissible for hydraulic dredging, if it is allowed for mechanical dredging? Is the return water, or the edge of the dredge operating area, monitored for COC concentrations, as well as for turbidity? Has there been a study of the LDW sediment to demonstrate that contaminant concentrations correlate with water column turbidity? How is it demonstrated that these discharges comply with AWQC? (Contrast this with Sec. 7.2.2: "*…alternatives that involve removal and handling of (contaminated) sediment invariably generate wastewater that must be managed, treated and discharged in a manner consistent with ARARs*."

Table 7-2b, Monitored Natural Recovery and Enhanced Natural Recovery. This table fails to indicate the costs associated with the "intense" monitoring needed to demonstrate consistent MNR. It incorrectly equates the costs of MNR to those in Table 7-2a, No Action and Institutional Controls.

Table 7-2c, Containment Process Options should note the conflict of armored capping, composite capping and reactive capping with the use of inter-tidal areas for clamming and/or recreational beaches. This table should also note that use of a shotcrete cap reduces the habitat value of the intertidal sediment bed.

Table 7-2e, pg 7-38, Physical Solidification using lime or another solidification agent. The addition of lime to (wet) sediment causes an exothermic (heat generating) chemical reaction which has been shown to volatilize PCBs, transferring them to the air. This is phase transfer, not treatment.

Table 7-3, pg. 7-40: Summary Assessment of Effectiveness, Implementability and Cost….: For the process option named, Access/Deed Restrictions the "Disadvantages" column should contain the same language for ecological receptors as it does for the Fish and Shellfish Consumption Advisories, i.e., "Not effective for ecological receptors because COPCs remain in place".

Table 7-3, pg. 7-41: For the process option named Resuspension and Transport, the disadvantages should be revised to indicate (2)"facilitates PCB contamination of the marine foodchain".

Table 7-3, pg. 7-42: For the process option named Composite Cap, the disadvantages should include a requirement for institutional controls.

Table 7-3, pg. 7-43: For the process option named Spray Cap, the disadvantages should include requirements for institutional controls, for long-term monitoring and maintenance, and a potential requirement for replacement habitat.

Table 7-3, pg. 7-43: For the process option named Reactive Caps, the disadvantages should note: "probably not acceptable in beach areas".

Table 7-3, pg. 7-43 and 7-44: For the process option named Hydraulic Dredging, the last disadvantage, "*limited experience with mechanical dewatering and water treatment facilities*" is hard to believe, since one of the RPs is the agency that operates all of the wastewater treatment facilities for Seattle and King County. It is particularly difficult to believe in contrast this comment with the Soil Washing advantages column on the following page, which states: "*mobile units available for quick set-up and take-down time*". Mobile dewatering and wastewater treatment plants also are available from numerous vendors, and have the potential to be barge mounted. Numerous engineering firms have the ability to operate these "package" wastewater treatment plants.

Table 7-3, pg. 7-44: For the process option Dry Excavating, it is difficult to understand the following disadvantage (2), "*Runoff water may contain high concentrations of TSS and COPCs*". What run-off water? The excavated material can be directly loaded into lined trucks, railroad tankers or settling containers; or loaded onto a shallow-draft barge, as would be done for a water-based dredge. Why is this a problem for a land-based excavator and not for a water-based excavator?

Figure 7-7, pg. 7-56: Surface Sediment PCB Trends at Slip 4 EAA. The graphical treatment of these data is very misleading. Careful analysis indicates there are only 6 samples in 2006,

4 of which are clustered outside the EAA and none of which were located near previous samples. This analysis is disingenuous and should be removed from the document.

Pg. 8-2, Sec. 8.1.1: *In the case of the LDW, five Early Action Areas have been identified…for the purposes of this FS… the no further action alternative acknowledges that the EAAs will be cleaned up,…* While this indicates "cleanup of the EAAs", in fact, only the cleanup of the five sponsored EAAs is included in alternative 1 (34 acres). It is confusing to have two additional areas shown as EAAs on the figures (at RMW 2.2 and RME 3.8, eg., Figures 2-13b, 2-13d, 6-2b and 6-2d) and general statements like the quote, above, when actually only three of the unremediated EAAs are included in Alternative 1.

The FS Workplan (Windward, 2007) notes that the FS will include proposals for addressing the two EAAs that "are not sponsored", but little information is provided in the draft FS. The information about the EAA at RM 3.8E, is very limited, although it is shown on Figures 2-13d and 6-2d.

Pg. 8-5: What is the CSL? Is this the same as the MCUL? If not, please explain how they are related and the rationale for using a screening level as a goal for 10 years post remedial action.

Pg. 8-5, Sec. 8.1.5.3, Alternative 3 notes that "*active remediation extends laterally to the RAL boundary…the remainder of the SMA also receives ENR consistent with the engineering constraints of the technology.*" No engineering constraints were noted for ENR in Table 7-2b or Table 7-3.

Pg. 8-28, Short-term monitoring during implementation: "*Water quality and residuals monitoring generally consists of collecting water samples and turbidity measurements.*" How does a turbidity measurement demonstrate compliance with AWQCs for toxic contaminants? Has there been a correlation of water column turbidity *in situ* with the water column COC concentration, showing that turbidity is a good surrogate for toxic contaminant concentrations? This is particularly critical in areas contaminated with PCBs, which are known to both bioconcentrate and biomagnify in the foodchain.

Pg. 8-34 to 8-35, Description of Alternative 2 CAD at Harbor Island: A construction complication not mentioned is the historic subsurface contamination of Harbor Island, particularly with NAPL. Dredging to construct a CAD in proximity to this industrial site could encounter concentrated contaminants requiring additional remedial actions.

Pg. 8-41, Alternative 4: "*Capping and ENR are applied only when removal is technically impractical or administratively unacceptable (eg. potential tribal clamming areas).*" Please explain why dredging (and backfilling) would not be acceptable in a clamming area.

Pg. 8-44, describing the treatment train for soil washing (Alternative 4d), bullet 2: "*For FS purposes, assume use of the following treatment train: collect and settle, flocculate, filter, analyze and discharge.*" Why doesn't this include GAC treatment, as is noted for hydraulic

dredging? [Its unlikely GAC treatment is needed for either technology, especially if it is acceptable to dewater mechanically dredged sediment loaded on a barge by filtration through geotextile and/or overflows.] These inconsistencies bias the analysis toward mechanical dredging.

Pg 8-45, Alternative 5a and 5b. Why isn't there an alternative with comparable RALs, but that is parallel to series 3? That is, low RAL concentrations, but only implement to the edge of the RAL, not the entire SMA; and rely on capping and ENR where feasible?

Pg. 8-47, Sec. 8.5.1, Source Control. The STM is unequivocal that the biggest sources of persistent, bioaccumulative contaminants in the LDW are the contaminated sediments in the LDW: "*The STM output for year 10 indicated that the site-wide average bed composition is expected to be about 23% original bed, 75% upstream source, and 2% lateral source.*" (Appendix D, Sec. D.3.1). The most effective source control action is the removal or containment of contaminated sediment at Boeing Plant 2. The STM demonstrates that this area is one more of scour rather than deposition. Continuing delay unnecessarily adds contaminant loading to the foodchain of the LDW and its receiving waters: Elliott Bay and, ultimately, Puget Sound.

Pg. 8-48, Sec. 8.5.2.2: "*The area and volume uncertainty are likely to be smaller for higher RALs, and greater for lower RALs*." The analysis in Table 6-2 contradicts this statement by showing the interpolated footprint with the lowest percentage of false values was a PCB RAL of 240 ug/kg dw. The statement and subsequent discussion should be deleted.

Table 8-4, Engineering Constraints and Generalized Assumptions for Implementation…: Land-based excavation can certainly be controlled with greater precision than the 3 ft assumed here as a minimum cut. Especially because we recommend excavation and backfilling (rather than ENR) for beach and shellfishing areas, this is an important refinement for land-based excavation.

Pg. 9-11, Tables 9-3a and 9-3b, bullet 3: "*The BCM grid cells in Beach 7 receive a large proportion of sediment from Hamm Creek that discharges to this beach. As a result, the BCM predicts concentration increases over time.*" What is confusing about this is that only Alternative 5 shows a need for active remediation at this location, and then only in a very small section of the beach. All of the Alternative 3 series and Alternative 4 series (as shown on Figures in Sec. 8) propose only verification monitoring, indicating an expectation that the area is already meeting the lowest RALs. Please correct this apparent discrepancy.

Pg. 9-15: "*Fish and shellfish tissue concentrations are not assumed to decrease from baseline concentrations during dredging operations and are assumed to require a post-construction recovery period of roughly 3 years to equilibrate to post-remedial conditions.*[9] [[9] *Elevated contaminant concentrations in fish tissue during and for multiple years following dredging operations are well documented (Floyd Snider 2007b; BBL 1995a and 1995b; Bauman and Harshbarger 1998)*]." The assumption of a 3-year post-construction recovery time for fish and shellfish tissue concentrations is not warranted based on the documentation

cited. The Floyd|Snider 2007b report addresses Year 0 monitoring for remediation conducted in 2006 and appears to provide no relevant tissue data. BBL 1995a (Grasse River) and 1995b (Sheboygan River) both were pilot projects that only addressed a portion of the overall contaminated sediment. Recent studies on the Grasse River (Connolly 2007) and Bryant Mill Pond in the Kalamazoo River (Kern, personal comm.) show reductions in Year 1 post-removal fish tissue concentrations. English sole fillet data from the Lower Duwamish in the vicinity of Duwamish Diagonal dredging project demonstrate concentration reductions in Year 0 (2004) and additional reductions following additional remediation in 2005 and 2007 (see Figure 1).

Pg. 9-15: *The rules adopted for restoration time frames differ depending on the RAO and are as follows:…* In all cases, the estimated LDW concentration is compared to the <u>higher</u> estimated urban background concentration, when the site would be expected to revert to the mid-range background concentration. This erroneous assumption that natural recovery processes will stop at a calculated upper range background concentration eliminates any further analysis and causes all the alternatives to reach the same, artificially inflated, endpoint. [Over time, all the overall concentration will drift toward the most expected value, which is the mean of the distribution, not the upper UCL. See Table F-3 for confirmation.]

Table 9-2a: Please see comment on Appendix H.

Appendix D: It is difficult to track the "unsponsored" EAAs at RM 3.8E and RM 2.2W. The one at RM 2.2 is included in Table D-1 (Trotsky, SMA 26 on Figure 6-2b), but the EAA at RM 3.8E doesn't seem to be in Table D-1 or D-2, and it does not have an SMA designation in Figure 6-2d, although it is identified as an EAA, and is shown as an EAA in Figure 2-13d. If there are commitments to cleanup these two EAAs, they should be noted. Since they seem to be evaluated similar to other SMAs, why are they identified as EAAs on the Figures? This gives the impression that they are part of the baseline remedy, Alternative 1.

Appendix F: The analyses presented in this section attempt to make the best of very limited data of the type needed to assess temporal changes in sediment concentrations. The interpretation of these data appears biased to support the authors' hypothesis that natural recovery is taking place throughout the LDW at a rapid rate. Alternative ways of looking at the data are ignored and observations that do not support the hypothesis are explained away. The information supporting natural recovery is particularly sketchy for the STM middle reach (RM 2.2 - 4.0), the area with 5 un-remediated EAAs and identified by the STM as an area of mixed deposition and erosion.

Table F-3: This table would be more useful if the STM predicted annual deposition rate was included.

Pg. F-4: "*…the human health risk drivers (total polychlorinated biphenyls [PCBs], arsenic, carcinogenic polycyclic aromatic hydrocarbons [cPAHs], and dioxins/furans), are largely conserved in surface sediment and do not significantly desorb into the water column or volatilize*." It's not clear what is meant by "significantly desorb", but data from other sites

indicate that PCBs are released from the sediment to the water column at rates greater than predicted by equilibrium partitioning.

Pg. F-15, Analysis of nominally co-located samples: *"It is important to consider the analytical accuracy and precision when comparing two sample results. Combined analytical variability between two samples can commonly be as high as 20 to 50%, even between two analyses of the same sample. Thus, location-specific conclusions when comparing two sample results from one location that were collected at different times and potentially by different parties, must be used cautiously. In contrast, comparing populations of resampled data is a more statistically powerful analysis; but this analysis (evaluation of the entire LDW-wide population) can only lead to conclusions regarding large spatial areas. Therefore, this appendix evaluates recovery at two scales: site-wide trends and station-by-station trends."* Although the report acknowledges the importance of analytical variability and spatial heterogeneity, how is this taken into account in the analysis? Many of the re-sampled locations were selected to re-visit samples with SQS exceedances-what is the probability of re-sampling elevated concentrations from a lognormal distribution? Because of the major differences in deposition and erosion identified by the STM among the three reaches, rather than conducting a site-wide analysis, complete separate analyses by Reach are recommended.

Table F-2 shows lack of chemical data from Reach 2 in anything other than 1-2 foot cores, which are too coarse to provide useful resolution. Since this area is identified by the STM as an area of mixed deposition and erosion, this is an important data.gap.

Appendix F: Table F-3, Percent Change in Resampled Surface Sediment Location PCB Concentrations Ordered by Original Total PCB Concentration, pgs F-58 -59: The PCB sample concentrations for approximately co-located samples are compared to estimate a half-life for PCBs, one line of evidence for natural recovery. It is interesting that when the data are ordered from the highest initial concentration to the lowest, the 12 highest concentrations all decrease (all but one by 50% or more), and <u>six of the lowest 12 concentrations</u> **increase**, **three by 50% or more**. That is, the highest <u>and lowest</u> concentrations in the dataset all are closer to the mean when resampled. This suggests mixing of sediment within the LDW, rather than uniform burial with sediment at background concentrations.

F-21, footnote 5: *"Sometimes, lower resolution data would indicate that the peak concentration was in the surface interval; however, when the high resolution data were considered, the peak was found to be below the surface. For example, 5 of 7 cores having both high and low resolution data had peaks in the subsurface using the 0.5-ft (high) resolution data, but the lower resolution data led to the conclusion that the peak was in the surface interval. The low resolution data (i.e., 1- to 2-foot intervals) was not fine enough to reveal the true depth of the peak."* Almost all of the information used to support the conclusions in this section is based on cores downstream of River Mile 2. Excluding cores from the navigation channel and within slips, only 3 cores from upstream of RM 2.0 show higher concentrations at depth (Table F-5a), while 9 cores show no pattern with depth (Table F-5b) and 5 cores showed higher concentrations in the surface (Table F-5c).

F-25 Tissue Concentrations: *"It is noted that short-term PCB releases associated with more recent contaminated sediment dredging projects (e.g., Duwamish/Diagonal EAA, East Waterway, Lockheed, and Todd Shipyards) may have resulted in a temporary increase in fish tissue PCB concentrations in 2004, returning fish tissue PCB levels back to historical levels (Patmont 2008). However, more recent monitoring data indicate that fish tissue total PCB concentrations have since declined to close to pre-dredging levels (Windward 2008)."* As NOAA and others have repeatedly pointed out, presenting PCB concentrations in fish on a wet weight basis for trend analysis, particularly when comparing fish collected in the spring with very low lipid content (pre-2004) with fish collected in late summer (2004-7) with much higher lipid content, is misleading at best. If the data are presented on a lipid-basis, the apparent trend is a reduction in English sole fillet concentrations post-dredging, including fish collected later in the same year dredging was completed. [see Figure 1].

Figure F-16 Trends in English Sold Muscle Tissue Total PCBs in LDW and Nisqually/Carr Reference Area: There appears to be in error in the wet weight concentration for English sole fillet in 2004-the highest measured concentration in English sole fillet in 2004 was 2010 ng/g wet wt., much lower than the approximate 3500 ng/g shown in the figure.

F.5.1 Uncertainty in Resampled Surface Sediment Locations: *"The FS manages this uncertainty by setting a minimum number of years between sampling events (at least 5 years) to detect temporal changes in the areas and to minimize the influence of spatial variability*." The importance of spatial heterogeneity is acknowledged, but no analysis is presented to evaluate the potential influence of the uncertainty. It is not clear how setting a minimum number of years between sampling events minimizes spatial variability. Samples with less than 5 years between sampling events could be used to evaluate the uncertainty associated with re-sampling a location (nominally within 10 feet).

F-36: *"Finally, the LDW surface sediments have a degree of spatial heterogeneity. The RI has shown that chemical gradients can be steep and that hot spots may be isolated and well contained, such that moving several feet off station can yield different results, even during the same sampling event. These random errors can mask actual recovery (or concentration increases) occurring in the LD*W." Such "random errors" are commonly observed small-scale spatial heterogeneity at contaminated sediment sites. An analysis conducted for the Portland Harbor Superfund site indicated that "variation between replicate samples typically averages 40% relative percent difference for most chemicals." (Integral and Anchor 2007) A study designed to address the uncertainty associated with co-located samples concluded that "concentration differences measured in same-day pairs approximately equals or exceeds the range measured in samples collected up to 3000 days apart"and that spatial heterogeneity was greater than temporal differences (Integral et al 2007). A similar study should be conducted for the LDW to quantify this uncertainty before data from nominally co-located samples can be used to support natural recovery estimates.

F-46: *"However, elevated fish tissue levels have been recently documented in the LDW (relative to other years) likely caused by exposure to dredge residuals during removal*

operations (see Section 9). The state-of-art dredging operations have much improved over the past several years as it relates to precision dredging and containment, but a small portion of resuspended, fine-grained material will always escape downstream from the dredging operations. Therefore, although natural recovery is occurring, fish tissue concentrations may not always reflect these improvements, because dredging residuals affect fish tissue over the short term." As discussed above, the data indicate that any short-term effects were over within the first year. Lipid-normalized results for English sole indicate recovery 7 months post-dredging and continued decline in subsequent years.

Appendix H: Computing Halls Upper Confidence Limit for IDW-Interpolated Data.
Pg. H-2: *The IDW dataset has over 182,000 interpolated values based on the 10x10 grids.*
Pg. H-3: The LDW RI datasets have 1,327 samples for PCBs, 828 for cPAHs and 852 for arsenic. **Comment:** This means that less than 0.75% of the values used in the statistical analyses are actual measurements, and over 99.25% are interpolated estimates of the variation between these (few?) samples. Statistics based on such an overwhelmingly fabricated dataset are difficult to accept. The overwhelming number of interpolated values in the dataset probably explains why the results are all so similar in Table 9-2a: the great majority of values used as the basis for the statistics don't change (all 10x10grids in any area not affected by a remedial action.)

Appendix H: see Attachment 1.

Appendix K: LDW Conceptual Monitoring Program

Although Appendix K is only meant to provide a "conceptual" monitoring program, the plan lacks detail in several critical areas.

Objectives: Appendix K lists four primary objectives for the monitoring program, yet there is little or no detail regarding how data is to be linked to these objectives. The plan should specify the particular parameters that are of interest and the scale at which they will be evaluated—river segments, whole river, point locations etc. Without this information it is impossible to evaluate whether the proposed sampling plan will be adequate to support the stated objectives.

- *Monitoring of potential short-term risks due to dredging (implementation monitoring)*
- *Monitoring that the remedial action has achieved its immediate target cleanup levels (post-construction confirmation monitoring)*
- *Monitoring to determine whether remedial action objectives (RAOs) have been or are likely to be achieved in the expected time frame(s) (SMA compliance and long-term performance monitoring).*
- *Baseline monitoring to characterize pre-remedial conditions for comparison with post-remedial conditions*

Justification for the number of sampling locations: The report indicates that 100 sediment locations will be sampled prior to remediation and again at 5 year intervals post remediation. Without precisely stated objectives it is difficult to determine an adequate number and spatial configuration of sampling locations. Importantly, the problems identified in SWAC calculations (see Appendix H comments) should be explicitly avoided for the proposed sediment monitoring. This should be accomplished by ensuring that sample inclusion probabilities are completely specified for each sampling location, so that subsequent efforts to estimate surface averages can be specified precisely without a lot of experimentation.

Description of the spatial layout of the sampling plan: It is not clear what is intended when a "stratified" plan is described. We recommend that the project team identify specific polygons of interest, such as the early removal areas, the areas between specific removal areas, and any areas expected to see intense human or ecological uses. Those areas should then be sampled with an adequate number of samples to conduct statistical analyses within each stratum and that can be later combined into reach and river wide statistical summaries, including confidence intervals. This would include unbiased sampling designs within identified stratum polygons, and may include higher sampling intensity within some strata perceived to be of greater "value" or known to poses more variable contaminant concentrations. This would undoubtedly lead to stratum sample sizes of 30 or more locations, given our understanding of the degree of skewness of typical data from these areas.

Decision points and criteria used to evaluate data: Decision points and precision requirements need agreement by the agencies and LDWG so that minimum sample sizes necessary to meet minimum power and precision requirements can be met. As the plan currently stands, it is difficult to discern what analysis is planned and whether the proposed 100 samples will be adequate to meet the objectives. It is clear from the SWAC simulations conducted for review of Appendix H that 100 sample locations including a mix of biased and unbiased sampling are likely to lead to poor statistical performance and ambiguous conclusions. A rigorous sampling design with known statistical properties and associated estimation procedures should be developed.

Description of anticipated statistical analyses: Correct statistical analyses are determined by the sampling design. Failure to adequately specify the sampling design will result in poor statistical performance and ambiguous results.

K-3: "*Protection of ecological receptors – RAO 4, site-wide*." Monitoring to address protection of ecological receptors should include sampling from specific sub-areas.

K-3: "*Baseline data: Establish a point of reference for assessing long-term remedy effectiveness and achievement of RAOs*." While it may be reasonable to establish a point of reference for sediment sampling, baseline data for biota (especially fish) requires multiple years of sampling to account for interannual variability. Because the remediation (including both active and passive components) will be taking place over a protracted time period, baseline conditions for biota will need to be updated on a regular basis to make it possible to assess recovery.

K-4: "*The pronounced rates at which sediment from the Green/Duwamish River system deposit in the LDW (as estimated by the Sediment Transport Model (STM) and discussed in Section 5.1) suggest that conditions may be improved through natural recovery by the time the Record of Decision (ROD) is issued. This argues for a new temporally and spatially consistent LDW-wide dataset.*" It also argues for a sediment sampling design to specifically to address temporal changes that can be used to evaluate the assumptions in the BCM and the predictions of the rate of natural recovery in the three reaches of LDW.

K-5: "*Tissue samples are assumed to be collected to assess LDW-wide reductions in fish and shellfish tissues*." The tissue sampling program for shellfish and fish should be assumed to focus on specific subareas within the LDW. The tissue sampling program should be designed to distinguish between the remedial effectiveness of MNR areas and areas of active remediation.

"*These samples would be analyzed for the risk-driver chemicals (RAOs 1 and 4), with the analysis focusing on PCBs, arsenic, and cPAHs in particular.*" The analysis should include polychlorinated dioxins (PCDDs), dibenzofurans (PCDFs) and coplanar PCBs, which are important risk drivers. The limited characterization in the sediment and the absence of information on PCDD/Fs in tissue needs to be addressed in baseline and long-term monitoring to evaluate the remedial effectiveness in addressing risk from dioxin-like compounds to human health and ecological receptors via the foodweb pathway.

"*Water quality testing includes daily turbidity monitoring, with periodic collection of downstream surface water samples for laboratory testing (e.g., turbidity and select chemicals)*." Water quality testing should include regular monitoring of PCBs in the water column, since turbidity has not been found to be a good surrogate for PCB releases during removal actions at other sites.

Table K-1: tissue "*PCBs as congeners – 20% of samples*." Based on the significant problems with Aroclor quantification in recent LDWG tissue monitoring (overestimation of total PCBs in 2004 and underestimation in 2007), we recommend complete congener analysis for at least one-third of the samples. We also recommend that the congener analysis include high resolution analysis for coplanar PCBs, PCDDs, and PCDFs.

Thank you for the opportunity to submit these comments. One of NOAA's most significant concerns is the treatment of the site as one unit, which allows for too much averaging over a significant stretch of waterway. Risk due to fish consumption by humans and river otters is one of the main drivers for the cleanup. In order to reduce risk, areas where fish forage need to be remediated. Therefore, we suggest that the cleanup target areas outside the navigation channel, as fish are much more likely to feed along the shoreline and benches. Areas along the shoreline tend to have much higher contaminant concentrations compared to the navigation channel. In addition, the LDW Superfund site should be divided into three AOPCs, generally corresponding to the three "reaches" identified by the sediment transport

model. Compliance with PRGs should be attained within each of the three areas of potential concern (AOPC). Remediation of the three large EAAs in AOPC2 should begin immediately as source control actions in accordance with EPA's *Principles for Managing Contaminated Sediment at Hazardous Waste Sites* (EPA, 2002). Each of these areas should meet the RALs/PRGs independent of the others. Remediation of the AOPCs generally should proceed from upstream to downstream in order to take advantage of the site sediment transport regime (as documented in the STM), allowing cleaner sediment from upstream areas to contribute to natural remediation of downstream areas. Please let me know if you have any questions.

Sincerely,

Marla Steinhoff
Regional Resource Coordinator, NOAA

Cc: (by email): Mary Baker, NOAA Randy Carman, WDFW

Jay Field, NOAA
Rebecca Hoff, NOAA
John Kern, NOAA/NOS
Jeff Kraussman, USFWS
Laurie Lee, GCNR, NOAA
Thea Levkowitz, DRCC
Jim Meador, NOAA
Craig O'Connor, GCNR, NOAA
Allison O'Sullivan, Suquamish Tribe
Ben Shorr, NOAA
Glen St. Amant, Muckleshoot Tribe
Denice Taylor, Suquamish Tribe
Heather Trim, People for Puget Sound

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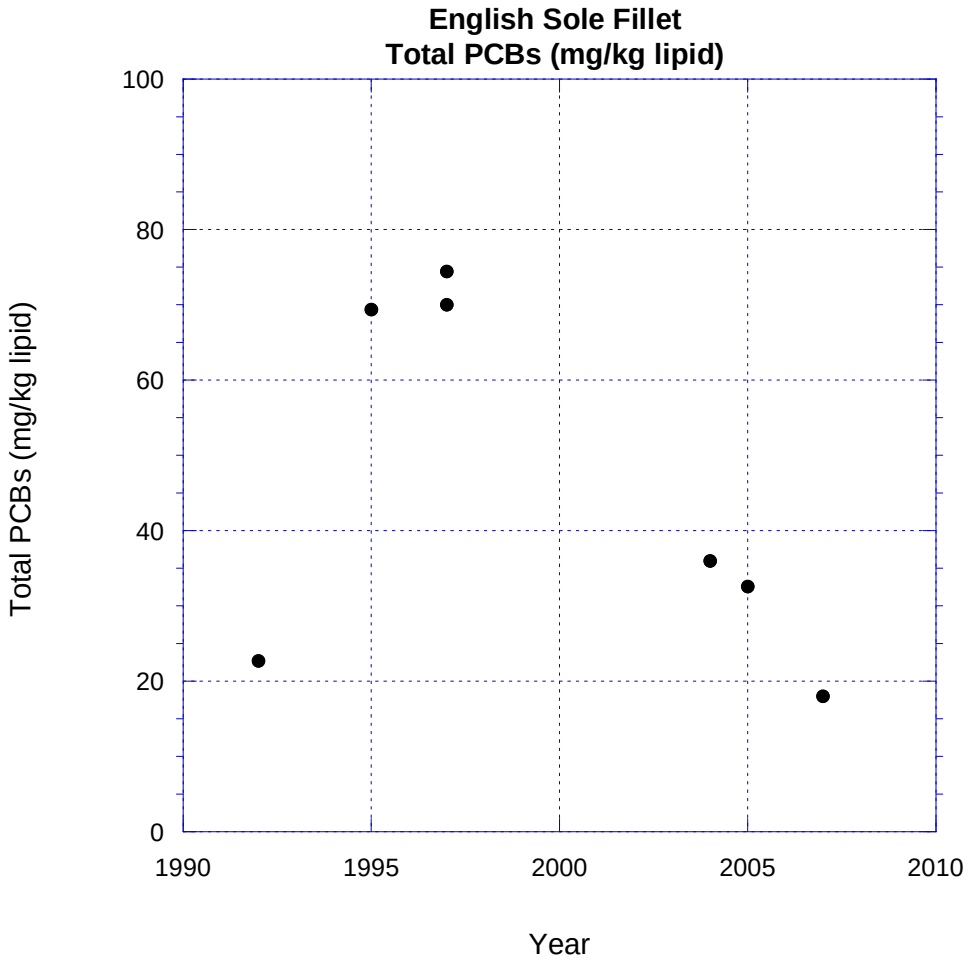


Figure 1. Total PCBs (mg/kg lipid) in English sole fillet. Data from 2004-7 were from English sole collected in fish area T1 to be comparable to the earlier data. Aroclor total PCBs from 2004 and 2007 were adjusted by 0.7 and 1.8 to account for differences between Aroclor totals and 209 congener totals (Draft Final Remedial Investigation Fig. 4-12, p. 229).

REVIEW OF APPENDIX-H:

HALL'S UPPER CONFIDENCE LIMIT FOR IDW-INTERPOLATED DATA DRAFT FEASIBILITY STUDY

LOWER DUWAMISH WATERWAY SEATTLE, WASHINGTON

Prepared for:
Assessment and Restoration Division
Office of Response and Restoration,
National Oceanic and Atmospheric Administration
7600 Sand Point Way NE
Seattle, WA

Prepared By:
Kern Statistical Services, Inc.
5175 NE River Rd.
Sauk Rapids, MN 56379

Executive Summary

Appendix H – Computing Hall's Upper Confidence Limit (UCL) for IDW-Interpolated Data, Draft Feasibility Study (AECOM, 2009) referred to herein as Appendix-H. The objective of this review is to evaluate the proposed methods for estimating the 95% upper confidence limit (UCL95) for the arithmetic average contaminant concentration in surface sediments -- which is proposed for use as-"… *one line of evidence for evaluating the effectiveness of remedial alternatives*" and as a benchmark to evaluate how well the alternatives are achieving the preliminary remediation goals. This method has also been used to derive exposure point concentrations (EPC) for risk assessment for the Housatonic River site (Weston 2005).

The proposed methods are based on methods proposed in Weston (2005) for the human health risk assessment at the GE/Housatonic River Site—and the authors of Appendix H justify the proposed method based on the GE/Housatonic River site reported in Attachment 4 of the Housatonic risk assessment. According to the authors of (Appendix-H page H-2), the Housatonic methods were developed by Applied Biomathematics, Inc., serving as EPA contractors, and that developers of the EPA funded ProUCL© package also contributed to the efforts. ProUCL© is a software package that EPA promotes for estimation of upper confidence limits for risk assessment. Because Appendix-H provides limited description of the proposed UCL methods this review focuses on the detailed derivations provided in Weston (2005).

Findings and Recommendations

1. UCL Estimation Method

1.1. Simulations conducted as part of this review demonstrate that the proposed UCL methods are likely to understate risks, due to a biased estimation procedure using smoothed (i.e. less variable) interpolated values to estimate the population standard deviation.

1.1.1. As a result, risks due to exposure to contaminants in the surface sediments have likely been understated.

1.1.2. The benefit of the proposed remedial action may also be overstated.

1.1.3. Variance estimates based on the proposed methods understate the population variance in 95% of simulations.

1.1.4. The population variance was under estimated by more than a factor of 2 in 67% of simulated samples.

1.2. The proposed method was justified based on simulations used to validate the procedure for the Housatonic River Site. However, those tests were based on data that were much less variable than typical contaminant distributions found in sediments at many sites. This may have

resulted in favorable evaluations that are not applicable to the Duwamish River Site. The test population also may have been less variable than data from the Housatonic River.

1.3. It is recommended that additional simulations based on data from the Duwamish River be conducted to identify appropriate UCL methods that are directly applicable to the Duwamish River.

1.3.1. Candidate UCL methods should be selected from the peer reviewed statistical literature. Including Student's T, Cox's T, unmodified Hall's and Thiessen-weighted T methods.

1.3.2. Methods should be verified with test populations consistent with the statistical characteristics of the Duwamish--including the mean, variance, sample histogram and semivariogram.

1.3.3. The semivariogram should be calculated in straightened coordinates to insure that spatial correlations are matched with the long- and cross-flow directions.

1.3.4. Simulations should be conducted in these "straightened" coordinates so that simulated surfaces also incorporate reasonable relationships to geomorphic processes expected to control spatial distributions of contaminants.

1.4. Because the sample size is large for estimating the UCL for current conditions, errors in the UCL estimation procedure may not be exceedingly large. However this would not justify application of the method when other statistically derived methods are available and appear to outperform the proposed methods.

1.5. In this review, the proposed modified Hall's method was tested using statistical distributions similar to those commonly encountered at contaminated sediment sites. These tests showed that the proposed method actually performed worse than the standard Hall's method and other standard UCL estimators available in ProUCL©.

1.6. EPA should not recommend this approach because other methods from the peer reviewed statistical literature (e.g. unmodified Hall's Method) that apparently outperform the proposed method are available and more easily calculated.

1.7. It may be necessary for EPA to reevaluate data from other sites where EPCs were estimates with the modified Hall's method.

2. SWAC Reduction Forecasting

2.1. Uncertainty in SWAC reduction is sensitive to the strength of spatial correlation in contaminant concentration distributions. Methods used in Appendix-H do not account for to correlation in the contaminant distributions.

2.1.1. If substantial small scale variability is present in the data the benefits of remediation of small discrete areas supported by a small number of samples has likely been overstated--

particularly where individual high concentration samples represent large remedial polygons of influence.

2.1.2. An understanding of the semivariogram and the percentage of variance due to nugget effect is important qualitatively when interpreting such samples, and can also be used quantitatively to estimate the potential value of remediating such areas.

2.2. Data from the site should be subjected to a thorough geostatistical evaluation, including coordinate transformation to long and cross flow directions, careful de-trending if necessary, semivariogram analysis including tests for anisotropy and development of a rigorous statistical model.

2.3. The geostatistical model should then be used to develop valid estimates of SWAC reduction and to forecast changes in SWAC with rigorous testing and validation. The geostatistical model would provide a mechanism to integrate the spatial information into the analysis through methods based on sound theoretical statistical underpinnings. The IDW interpolation may provide an adequate picture of the spatial distribution of sample values, but in and of itself does not provide a mechanism to integrate uncertainty from the sample data through to the estimation of SWAC reduction needed for remedy selection.

Introduction

The objective of this review is to evaluate the proposed methods for estimating the 95% upper confidence limit (UCL95) for the arithmetic average contaminant concentration in surface sediments -- which is proposed for use as-"… *one line of evidence for evaluating the effectiveness of remedial alternatives*" and as a benchmark to evaluate how well the alternatives are achieving the preliminary remediation goals. This method has also been used to derive exposure point concentrations (EPC) for risk assessment for the Housatonic River site (Weston 2005).

As one line of evidence for evaluating the effectiveness of remedial alternatives, the UCL95 serves as both a relative gauge of remedial alternative effectiveness (i.e., the lower the UCL95, the more effective the alternative) and a benchmark to evaluate how well the alternatives are achieving the preliminary remediation goals. The proposed methods are based on methods proposed in Weston (2005) for the human health risk assessment at the GE/Housatonic River Site—and the authors of Appendix H justify the proposed method based on the GE/Housatonic River site reported in Attachment 4 of the Housatonic risk assessment. According to the authors of (Appendix-H page H-2), the Housatonic methods were developed by Applied Biomathematics, Inc., serving as EPA contractors, and that developers of the EPA funded ProUCL© package also contributed to the efforts. ProUCL© is a software package that EPA promotes for estimation of upper confidence limits for risk assessment. Because Appendix-H provides limited description of the proposed UCL methods this review focuses on the detailed derivations provided in Weston (2005).

Background

The United States Environmental Protection Agency (USEPA 1992) coined the term "exposure point concentration" (EPC) to describe the interaction between the spatial distribution of contaminants and organism use. The EPC is an upper confidence limit for the arithmetic mean intended to represent exposure for risk assessment.

Based on the works of Singh et al 2002 and 2003 and others over the years, EPA has recommended the use of Pro-UCL© (USEPA 1992) for estimation of the EPC at contaminated sites. Increasingly, at large contaminated sediment and floodplain soil sites such as the Housatonic, Fox, and Kalamazoo Rivers, EPCs have been estimated using what is termed surface weighted average concentration (SWAC). Reible et al. (2003) described SWAC as a useful surrogate risk metric, representing the average contaminant concentration in the biologically active portion of sediment. In this sense SWAC is used in place of an EPC for quantifying exposure, yet SWAC is routinely applied without measures of uncertainty (i.e. the confidence limit aspect of an EPC is commonly ignored).

SWAC approaches typically ignore uncertainty in favor of the perceived precision of interpolated concentrations, whereas the EPC provides a margin of safety (upper confidence limit). Practitioners and project managers at most sites appear to be unaware of methods for estimation of the spatial averages that have their roots in geostatistics (e.g. Journel and Huijbregts 1978). Although Kern et al. (2001) and Thayer et al. (2001) introduced the application of standard geostatistical methods (de-clustering, global block kriging and conditional simulation) for estimation of spatial averages and their confidence limits,

these methods have not been widely adopted. Recently, ad-hoc procedures lacking mathematical statistical justification have been proposed, in efforts to estimate confidence limits for SWACs (Strauss et al, 2005 and Ferson 2005 and 2007 and Sinha et al 2007). These continuing efforts and EPA's apparent endorsement of the modified Hall's method applied at the Housatonic River, lead to confusion and inconsistency among sites with regard to selection of reliable estimators of spatial averages and their confidence limits.

Weston (2005) estimated the population variance from smooth interpolated values, rather than the original sample data. Because the variance of the interpolated values is less than that of the sample data, it is expected that this approach would underestimate the population variance. To evaluate the practical consequences of this theoretical problem, a small simulation study was conducted as part of this review. The results of this simulation study are particularly important because most of the results provided in Appendix-H depend upon this method for calculating UCLs.

UCL Methods

Approximately 15 UCL estimation methods are available in ProUCL©. Based on simulation studies conducted by Singh et al (2002 and 2003) it is clear that for moderate and large sample sizes from populations with skewed distributions, the bootstrap methods tend to be relatively robust for a range of distributions, yet there remains no clear guidance suggesting a single UCL method. Recognizing this situation, a small number of UCL methods were selected for testing in this study in order to provide a basis for comparison with the proposed method.

Student's T Method

The standard Student's T procedure for constructing confidence limits available in any elementary statistics text book is tested. This method was derived for independent random samples from a normal distribution.

Modified Student's T Interpolation Method

Figure 1, excerpted from Weston (2005) provides a summary of the modified Student's T Method intended to compensate for spatial weighting. As can be seen in Figure 1, the method is the same as that for a typical Student's T interval except that the mean and variance are calculated from the interpolated grid of values, rather than the original sample data.

Box 9: Computing the Student UCL for Spatially Weighted Data

Let $X_1, X_2, \ldots, X_n$ represent the n interpolated concentrations that were obtained by spatially weighting the m originally sampled concentrations $Y_1, Y_2, \ldots, Y_m$.

STEP 1: Compute the mean of the interpolated data $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$.

STEP 2: Compute their standard deviation $s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}$.

STEP 3: Use a table of quantiles of the Student's t distribution to find the $(1-\alpha)^{th}$ quantile of the Student's t distribution with $m-1$ degrees of freedom. For example, the value at the 0.05 level with 40 degrees of freedom is 1.684. A table of Student's t values can be found in Gilbert (1987, page 255, where the values are indexed by $p=1-\alpha$, rather than α level). The t value appropriate for computing the 95% UCL can be obtained in Microsoft Excel with the formula TINV((1-0.95)*2, $m-1$).

STEP 4: Compute the one-sided $(1-\alpha)$ upper confidence limit on the mean accounting for spatial weighting $UCL_{1-\alpha} = \overline{X} + t_{\alpha,m-1}s/\sqrt{m}$.

Figure 1. Modified Student's T procedure for interpolated data excerpted from Weston (2005). The procedure differs from the standard Student's T in that the sample mean and variance are calculated from the smooth interpolated surface rather than from the original data.

Bootstrap Interpolation Method

Ferson (2006) modified the Housatonic Student's T method by incorporating a bootstrapping step where the interpolated surface is repeatedly sampled with replacement followed by construction of a standard Student's T interval based on each bootstrap sample. These bootstrap confidence intervals are then averaged to form the UCL estimate. This method is similar to the method proposed for the Duwamish.

Hall's Method

Hall (1982) proposed a bootstrapping method specifically designed to compensate for skewed distributions without the parametric assumptions of the lognormal distribution.

Hall's Interpolation Method

Weston (2005) proposed modification to the Hall's method that incorporated a smoothing step where an interpolated surface is created from the sample data followed by application of Hall's method to the smooth interpolated values, rather than the original data. This is the procedure that has been proposed for the Duwamish and is of particular interest for this simulation study. Figure 2 is an excerpt from Weston (2005) describing the calculations.

Student's T With Thiessen Polygon Declustering

The Thiessen polygon declustering method is well known in the geostatistics literature (Isaaks and Srivastava 1989) and is based on a simple weighted average of the data where weights are proportional to the area of the Thiessen polygons associated with each sample. Variance formulas for weighted

Box 11: Computing the Hall UCL for Spatially Weighted Data

Let $X_1, X_2, \ldots, X_n$ represent the n interpolated concentrations that were obtained by spatially weighting the m originally sampled concentrations $Y_1, Y_2, \ldots, Y_m$.

STEP 1: Compute the mean of the interpolated data $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$.

STEP 2: Compute the associated (biased) standard deviation $s = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}$.

STEP 3: Compute the associated skewness $k = \frac{1}{ns^3}\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^3$.

STEP 4: For $b = 1$ to B (a very large number) do the following six steps:

- 4.1: Generate a bootstrap sample data set of size m by random sampling with replacement from the interpolated data; i.e., for $i = 1$ to m let j be a random integer between 1 and n and add the datum X_j to the bootstrap sample data set.
- 4.2: Compute the arithmetic mean $\overline{X}_b$ of the data set constructed in Step 4.1.
- 4.3: Compute the associated standard deviation s_b of the constructed data set.
- 4.4: Compute the skewness k_b of the constructed data using the formula in Step 3.
- 4.5: Compute the Studentized mean $W = (\overline{X}_b - \overline{X})/s_b$.
- 4.6: Compute the statistic $Q = W + k_b W^2/3 + k_b^2 W^3/27 + k_b/(6m)$.

STEP 5: Sort all the Q values computed in Step 4 and select the lower α^{th} quantile of these B values. It is the $(\alpha B)^{th}$ value in an ascending list of Q's. This value is from the *left* tail of the distribution.

STEP 6: Compute $W(Q_\alpha) = \frac{3}{k}\left(1 - \left(1 + k\left(Q_\alpha - \frac{k}{6m}\right)\right)^{1/3}\right)$.

STEP 7: Compute the one-sided $(1-\alpha)$ confidence limit on the mean accounting for spatial weighting $UCL_{1-\alpha} = \overline{X} + W(Q_\alpha)s$.

Figure 2. Modified Hall's method using interpolated surfaces to estimate the 95% UCL for the population mean excerpted from Weston (2005).

averages are straight forward for this method. The confidence limit is estimated using the standard Student's T formula with the slight modification that the mean and variance are based on weighted averages, rather than the unweighted averages typically used in the Student's T procedure. For this method, the estimated mean is similar to the proposed method, but the variance estimate is based on the original data rather than smoothed values.

Cox's T

Cox's T was proposed by Remington (2003) and is a small modification from Cox's original method derived for skewed distributions (Zhou and Gao, 1997). This method is designed for skewed distributions, but does not include any corrections for biased sampling.

Modified Cox's T

The modified Cox's method incorporates declustered estimates of the sample mean and variance as described in the modified Student's T method. This is intended to counter the effects of biased sampling.

Simulation Procedure

A one sided confidence limit is a number providing an upper bound for the true population mean with a stated level of confidence, such as 95%. This percentage is defined to mean that if one were to repeat the sampling and analysis many times, the UCL would exceed the true population mean in 95% of samples. Accurate coverage requires characterization of the sampling distribution of the estimator of the mean. Singh et al (2002 and 2003) evaluated coverage rates of common UCL methods using Monte Carlo simulation procedures. The Monte Carlo procedure for performance evaluation is to; 1) simulate samples from a known statistical population, 2) calculate the UCL for the simulated sample, 3) compare the estimated UCL with the true population mean, and 4) repeat the process many (1000+) times. The percent of simulated samples for which the UCL is greater than the true known population mean is defined as the coverage probability (coverage rate). When a UCL procedure is operating properly, the coverage rate should match or exceed the stated confidence level—the coverage rate for a 95% UCL should equal or exceed 95%. For the most part, published studies of UCL performance have not considered spatially correlated populations or biased sampling designs.

In this investigation, we follow the Monte Carlo procedure described above, with the exception that samples are derived from both biased and unbiased designs from a positively spatially correlated population. This is the situation for which the modified Hall's bootstrap method was intended.

Spatial Correlation

Positive spatial correlation means that samples collected in proximity are less variable than those separated by greater distances—on average, dissimilarity increases with increasing distance between sample locations. Selection of a spatially correlated population from which to simulate test samples requires identification of a model for spatial correlation that is consistent with site data. In geostatistical terms spatial correlation is characterized by a function called the semi-variogram which summarizes the relationship between variance of the variables of interest, and the distance among locations. When a

population is positively spatially correlated, variance increases with distance. Intuitively this means that samples collected in close proximity are expected to be more similar than those collected at greater separation distances. A parameter of the semivariogram called the *range of influence* is the distance at which values can be considered statistically uncorrelated. In addition to this functional relationship between variance and distance, there is also frequently small scale (close proximity) heterogeneity that would appear to contradict the basic premise that nearby samples are expected to be similar. This small scale heterogeneity is usually termed *nugget effect* in the geostatistics literature. This term was motivated from the gold mining exploration roots of geostatistics where abrupt changes in concentration were usually due to the occasional collection of a nugget of pure gold. In environmental samples, nugget effect may be due to unusually high (low) concentration material within a matrix of generally lower (higher) nearby values. Figure 3 illustrates the functional form of a semivariogram, including the nugget effect and the range of influence.

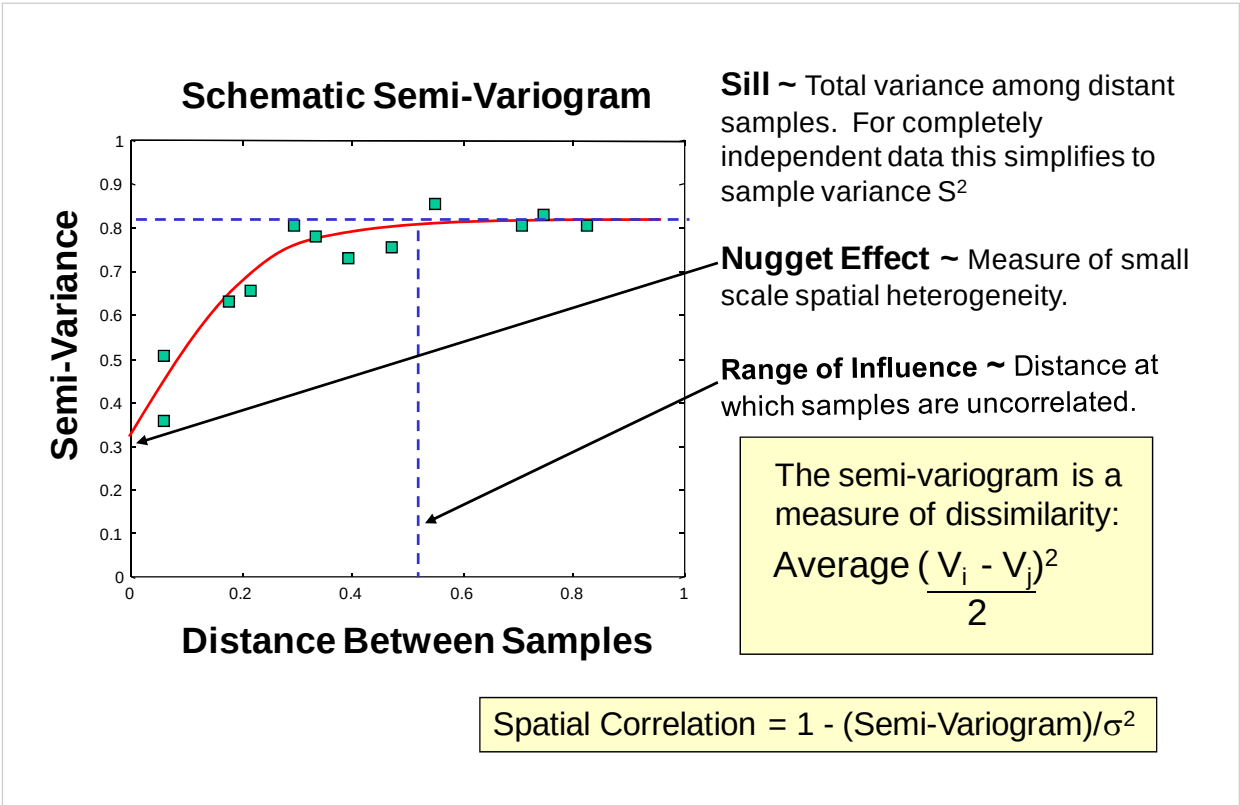


Figure 3. Schematic of a typical sample semivariogram and fitted model. The sill is the total variance of spatially uncorrelated locations. The range of influence is the distance beyond which values are uncorrelated, and the nugget effect is the magnitude of small scale heterogeneity.

Test Populations

If the proposed method is to be applied at sites other than the Housatonic, it should be tested with data from those prospective sites or at least with the types of statistical populations that can be generally

expected. For this short review, actual site data were not available, so a statistical distribution was selected that can be expected to share the characteristics of typical contaminated sediment data.

In general, PCB contaminated sediment data in rivers exhibit several common features; 1) sample data are generally spatially correlated; 2) small scale heterogeneity (nugget effect) is common; 3) spatial continuity (correlation) is typically stronger along than across flow direction; and 4) the sample histogram is generally right skewed.

Two test populations were developed for testing the modified Hall's, and for comparison, other UCL methods. The two populations were related in that Population-I was lognormally distributed and Population-II was the normal distribution corresponding to the natural log transform of Population-I. Test Population-I was selected to be consistent with general characteristics of sediment data from the Kalamazoo and Hudson Rivers.

For example Figure 3, excerpted from Kern (2009) illustrates the statistical distribution of surface PCB concentration in over 300 samples from formerly impounded sediments at the Kalamazoo River Superfund Site. The sample histogram in Panel A illustrates that the data are right skewed, much like the lognormal distribution. Panel C shows the semivariogram of the normal scores transformed data. The normal scores transform is an alternative to the natural log transform for obtaining normally distributed distributions. In practice the general characteristics of the semivariogram in normal score transform is similar to that for log transforms. The nugget effect (y-intercept) is approximately 32% of the sill (horizontal asymptote). Similarly, a semivariogram for normal score transformed surface total PCB in the Hudson River also indicates a nugget effect that is nearly 50% of the sill. The point is that at these two sites and others with which the author has had extensive experience, nugget variance is a characterizing element of spatial correlation in surface PCB data. Additionally, the range of influence across flow is often approximately 50% of the river width or less, with long-flow range of influence typically at least twice the cross flow range of influence. Test populations were selected in such a way that these important real world characteristics seen at the Kalamazoo and Hudson Rivers were maintained.

Simulations reported in Weston (2005) assumed no nugget effect and also that spatial variation was smooth—described by a polynomial function.

Test Population-I was selected to be *lognormally* distributed with log-mean and log-variance of 0 and 1.0 respectively, so Population –II was *normally* distributed with mean 0 and variance 1. Both populations were spatially correlated with range of influence of 250 units in the long-flow direction and 125 units in the cross flow direction (i.e. 2:1 ratio of anisotropy). The nugget effect was selected to be approximately 15% of the sill and the simulated study area was 250 by 250 units in size. Examples of simulated maps of concentration derived from this statistical distribution can be seen in Figures 6 and 7. It should be noted that concentrations at proximate locations are similar, but there are also discontinuities in concentration due to nugget effect.

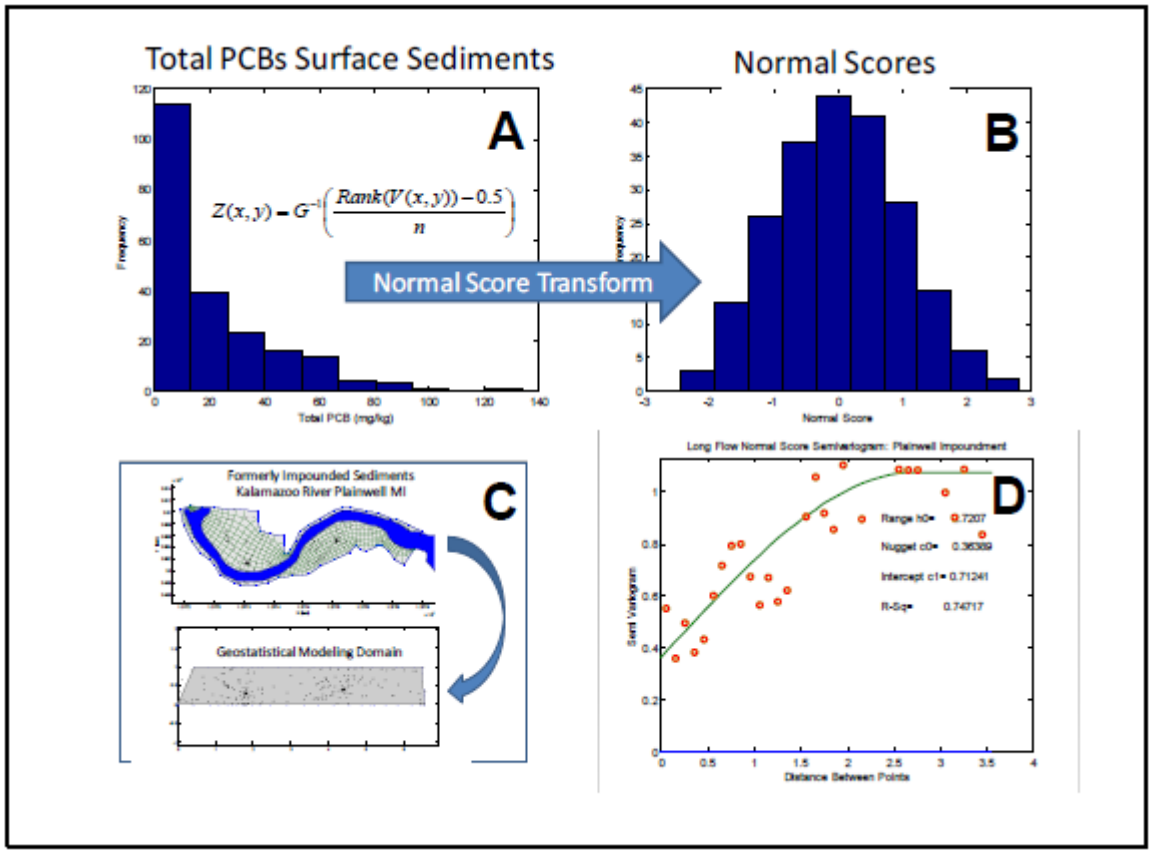


Figure 4. Statistical distribution of total PCB concentration in surface sediments at Plainwell Impoundment. The right skewed data (Panel A) were normal score transformed (Panel B) and geographic coordinates were transformed to a long and cross flow coordinate system (Panel C). The semivariogram exhibited approximately 37% small scale heterogeneity (Panel D). Figure excerpted from Kern (2009).

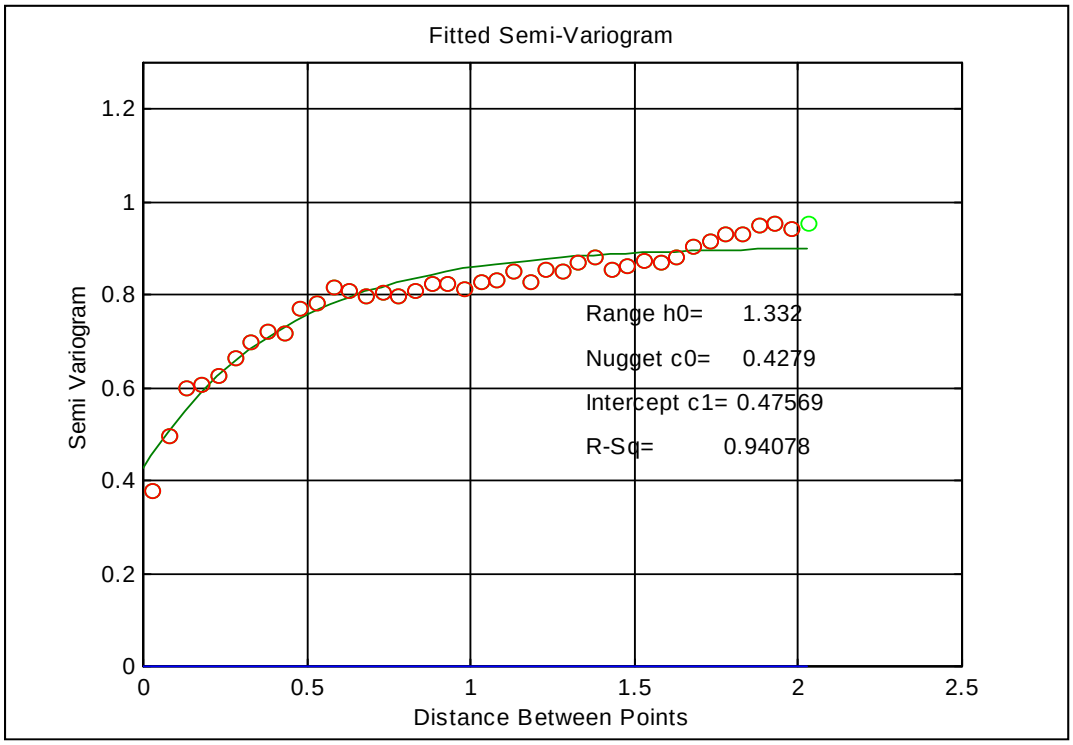


Figure 5. Long-flow semivariogram for surface total PCB for the Lock-5 to River-Mile-189 area at the Hudson River, New York. The nugget effect is approximately 50% of the sill.

Fast Fourier Transform Simulation Algorithm

Typical simulation studies for evaluating confidence limits require simulation of independent samples directly from the equations that define distributions. However, to simulate performance for spatially correlated populations, the simulated data must also be constrained to agree with the sample variogram in order to reinforce the required spatial correlations. The fast Fourier transform method (Borgman et al 1984) was used to simulate equally likely maps sampled from a spatially correlated random function model with the parameters described above. Other methods are available for these simulations, but none are as efficient and accurate as the FFT approach. The underlying population was normally distributed with mean 0, variance 1.0, 15% nugget effect and range of influence 250 units and 125 units in the long and cross flow directions respectively. Five thousand maps with these characteristics were simulated using the Fast Fourier Transform algorithm on a grid with 256 rows and 256 columns with 1 by 1 unit cell sizes.

A sample of three such maps can be seen in the left column of Figure 4. The corresponding interpolated maps based on random samples of size 20 are shown in the right column. Figure 5 shows 3 additional simulated maps with corresponding biased samples and resulting interpolated concentrations. To implement the interpolation based UCL methods, each of the 5000 sets of sample data was interpolated

using the natural neighbor interpolation algorithm from the National Center for Atmospheric Research. This interpolation algorithm was selected because it is fast and computationally efficient and is commonly used by EPA as part of their Fields tools. It is recognized that IDW interpolation was used at the Duwamish and was the basis for the modified Hall's method so would have been preferred for direct comparison, but it would not be expected to provide substantively different results. Findings of this review are associated primarily with use of interpolation to estimate variability, and because all interpolators smooth the data, it is unlikely that nuances in the different interpolation algorithms would cause substantively different results. This could be verified through additional simulations.

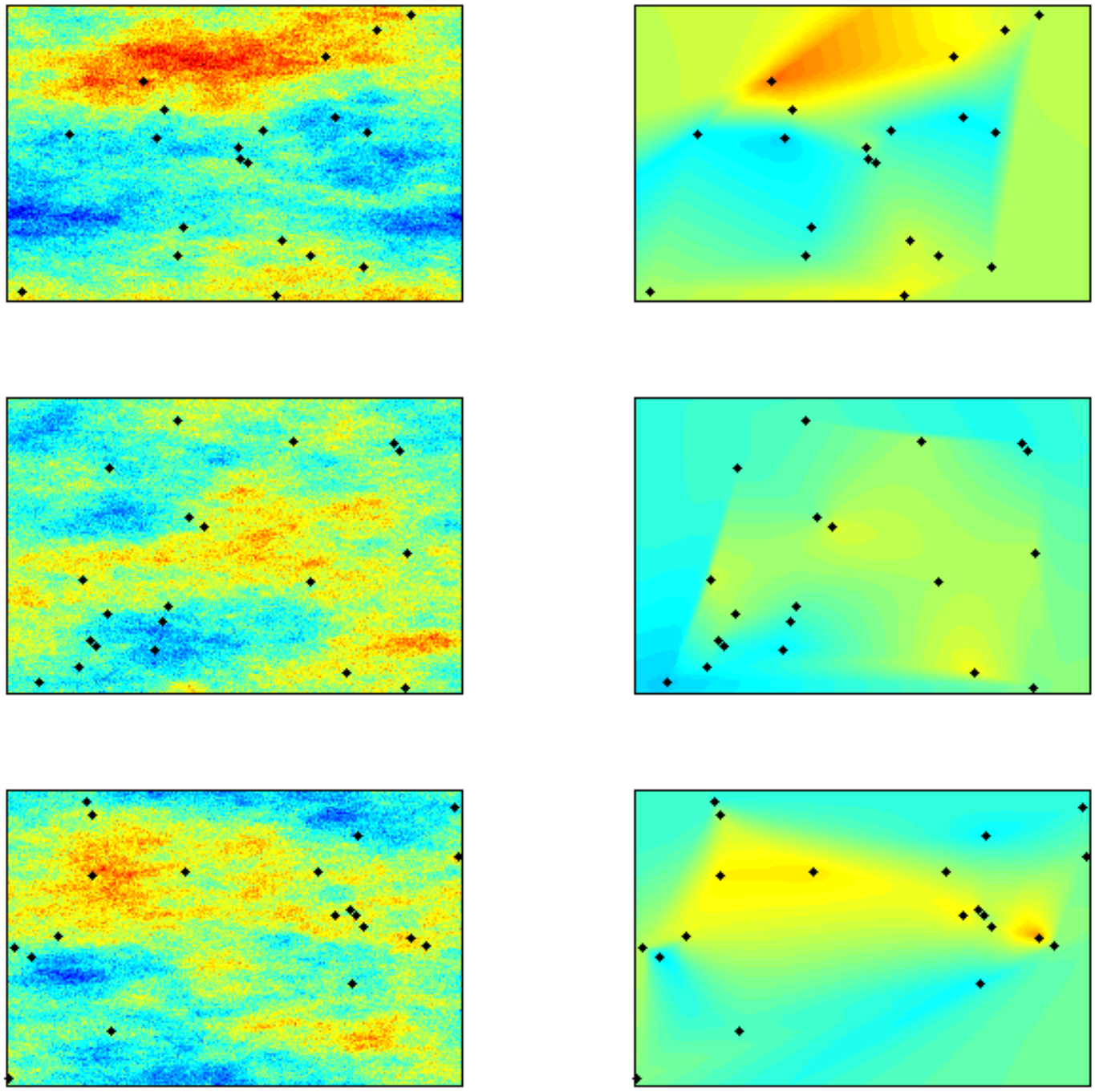


Figure 6. Simulated spatially correlated normally distributed random variables (Left Column) random sampling locations (black dots) and corresponding interpolated maps based on sample data.

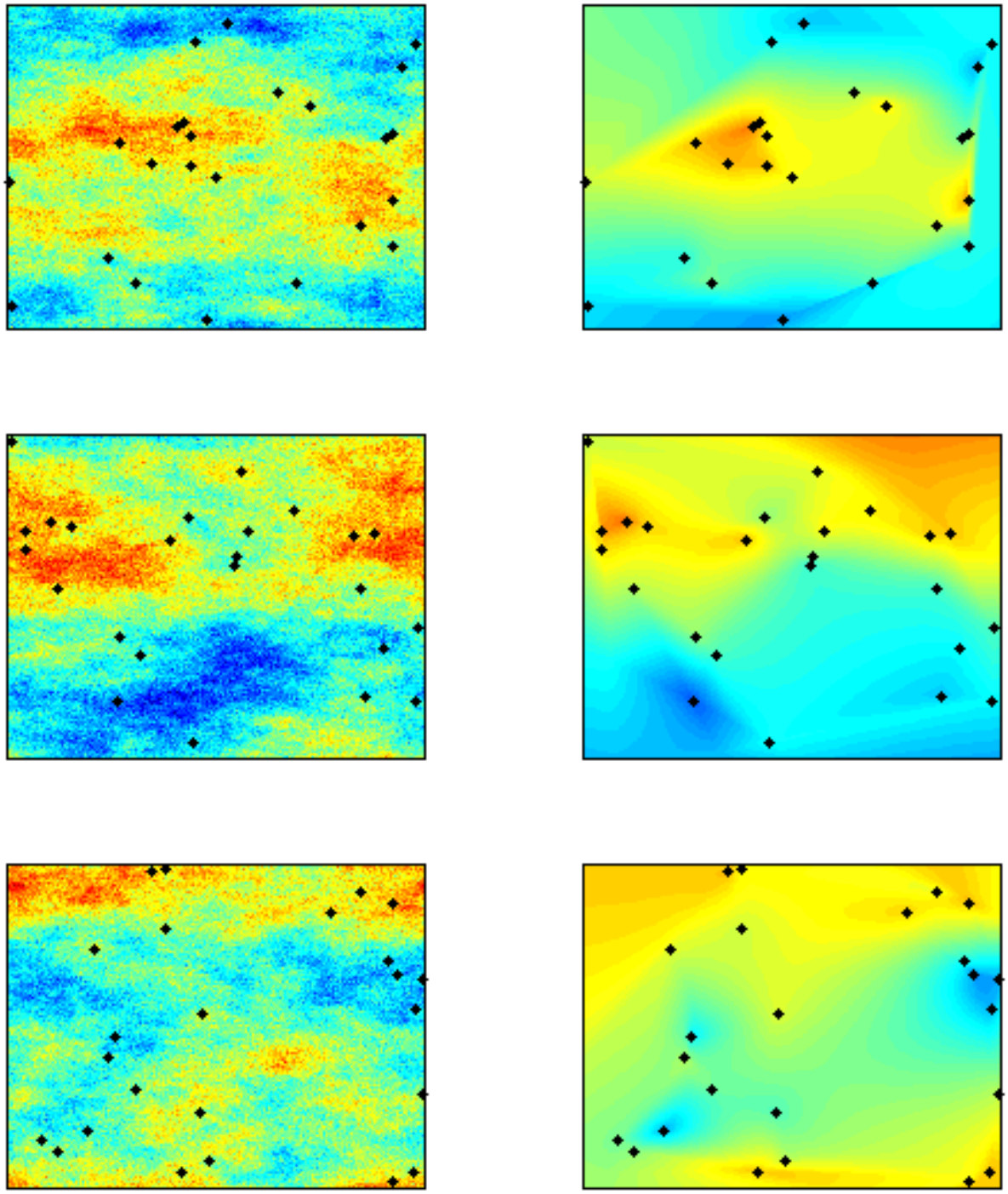


Figure 7. Simulated spatially correlated normally distributed random variables (Left Column) random sampling locations with 20% biased samples (black dots) and corresponding interpolated maps based on sample data.

Results

Bias of Variance Estimate

The modified Hall's method proposed in Appendix-H uses smooth interpolated concentrations to estimate the sample variance. This is a critical term in the UCL estimation procedure that would adversely affect UCL coverage rates if improperly estimated. Figure 6 provides a histogram of the estimated variance from 5000 simulated unbiased samples from Population-II of size N=20. The vertical red line represents the true population variance of 1.0. It can be seen that the proposed estimation technique underestimated the true variance substantially, with 95% of estimates less than the true value, and 67% of values underestimated by more than a factor of 2.

Coverage Rates

Figures 7 and 8 summarize the performance of the 8 UCL methods for normal and lognormal distributions with biased and unbiased sampling designs. Estimated coverage rates are summarized in Table 1.

Unbiased Sampling-Lognormal

Panel A of Figure 7depicts results for the unbiased sampling design for the spatially correlated lognormal distribution (Population-I). It can be seen that the Cox T method provided slightly less than 95% coverage for all sample sizes as is desired. For sample sizes of 100 and 800, the unmodified Hall's method provided slightly better coverage, while for sample sizes of 20 and 50, coverage was slightly lower. The three methods using the interpolated surface to estimate the sample variance were the worst performers with coverage ranging from less than 75% for samples of size 20, but also over covering for samples of size 800. The method that provided the best coverage rate across all sample sizes is indicated with a triangle symbol.

Biased Sampling-Lognormal

Panel B of Figure 7 depicts the situation of greatest interest--when a biased sampling design is applied to a spatially correlated lognormal distribution. In this case, it can be seen that for samples of size 20, 50 and 100, Hall's unmodified method the best coverage rates, but did poorly for N=800, falling to slightly greater than 90% coverarge. For samples of size 50, 100 and 800, the Thiessen weighted T interval performed reasonably well, particularly for N=800.

Again, the three methods proposed for the Housatonic and Duwamish Rivers substantially under covered the true mean with coverage ranging from less than 75% to no better than approximately 88% coverage.

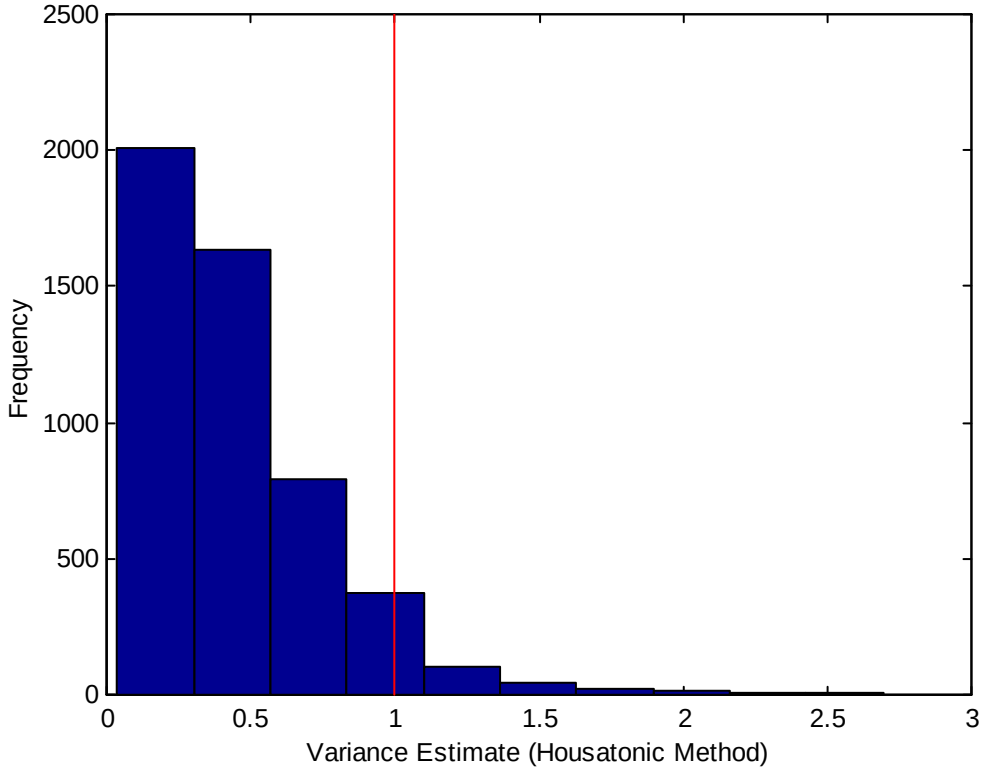


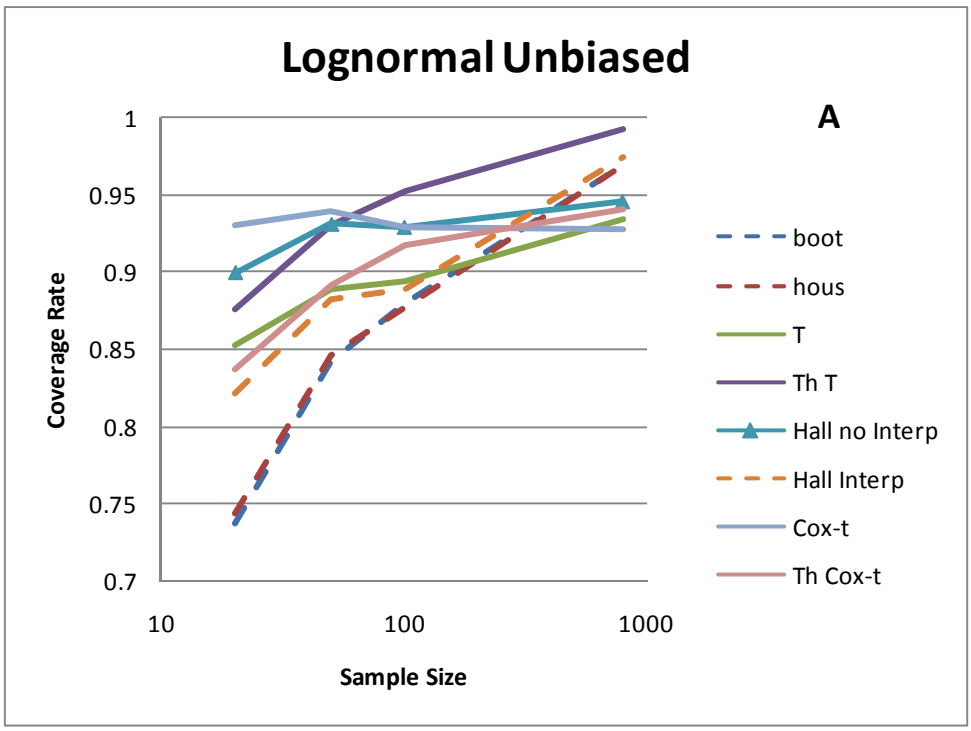
Figure 8. Estimated variance based on the Housatonic Method when true population variance is 1.0. Note 95% of variance estimates were lower than the true parameter.

Unbiased Sampling-Normal

Panel A of Figure 8 illustrates the performance of 6 of the 8 UCL methods. The Cox's methods were not included in these plots, because the method is only applicable to positive values. It can be seen that for unbiased sampling from a spatially correlated random process, the Student's T and unmodified Hall's method provided near perfect coverage probabilities across all sample sizes. For the Student's T method this reflects the fact that the method is designed for independent normally distributed random variables, and for the unmodified Hall's method it indicates that its sample dependent measure of skewness performed approximately correctly in the case when there is no skewness. In other words the method properly degenerates to approximately the Student's T method when data are not skewed.

Biased Sampling-Normal Distribution

Panel B of figure 8 summarizes method performance for biased samples from a normal distribution and it can be seen that the unmodified Hall's method tended to over cover slightly for samples of size 20, 50 and 100, and under-cover slightly for samples of size 800. The T and Thiessen weighted T performed similarly, while the modified methods with uncertainty based on smooth interpolated surfaces performed poorly across all sample sizes with coverage rates less than 88%.



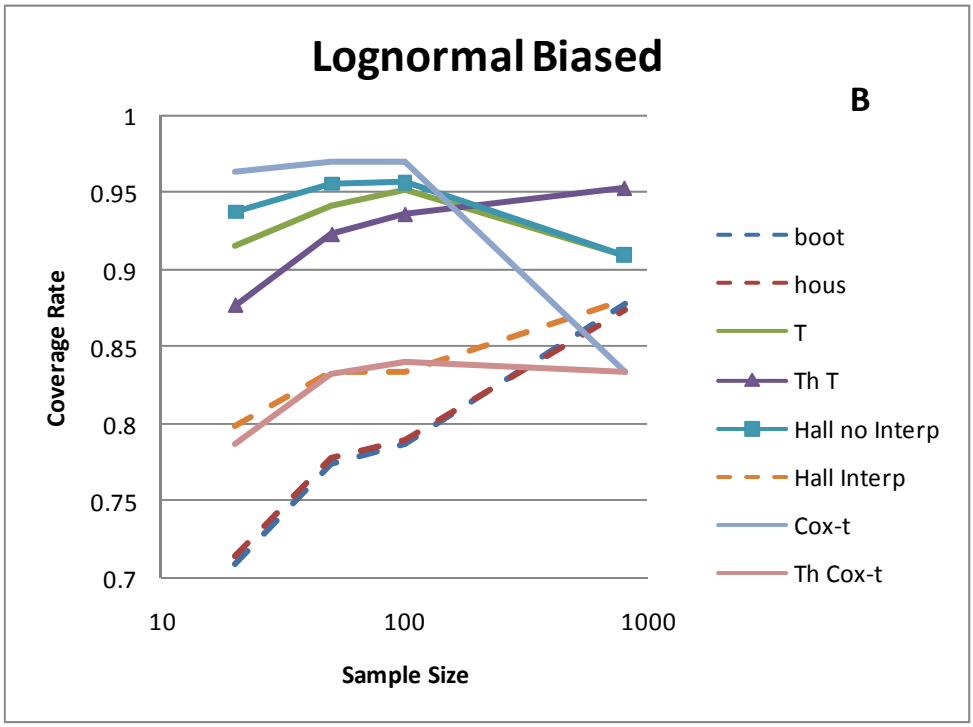
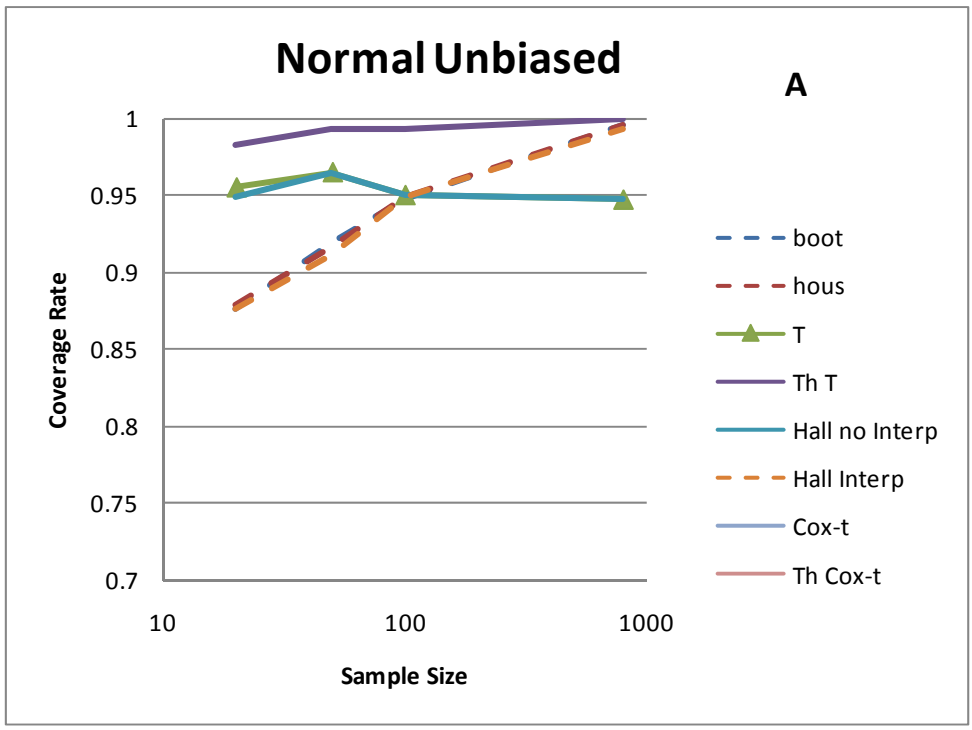


Figure 9. Interval coverage for 8 UCL methods for spatially correlated lognormal distribution (Population-I) based on unbiased sampling (Panel A) and biased sampling (Panel B). Unbiased sampling was a simple random design, and biased sampling was based on 80% from a simple random sample and the remainder selected proximate to the highest 20% of the sample values.



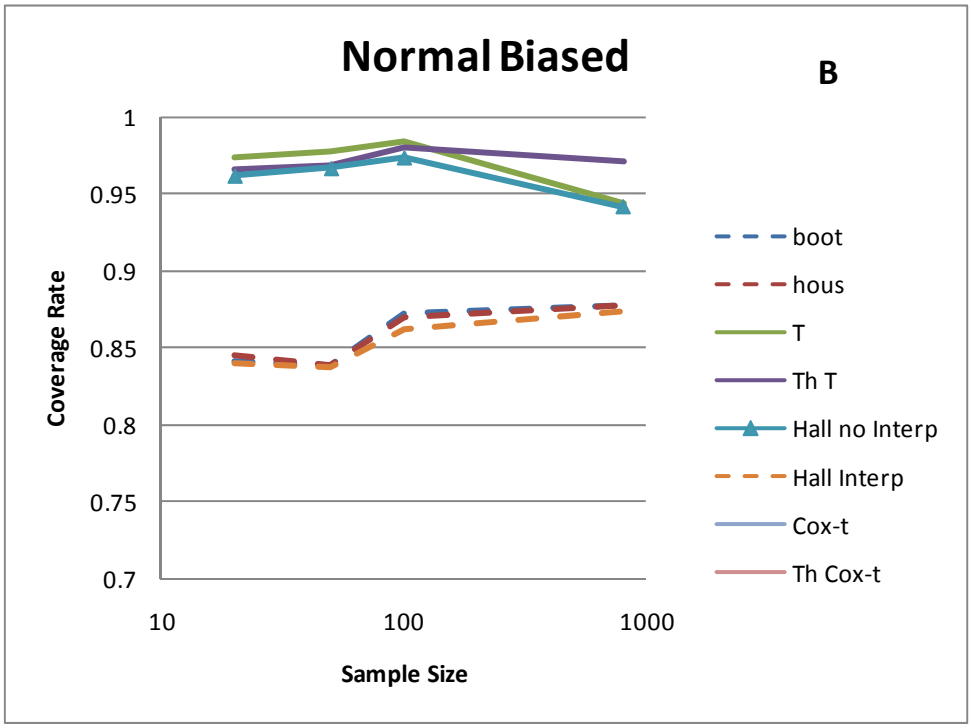


Figure 10. Interval coverage for 8 UCL methods for spatially correlated normal distribution (Population-II) based on un biased sampling (Panel A) and biased sampling (Panel B). Unbiased sampling was a simple random design, and biased sampling was based on 80% from a simple random sample and the remainder selected proximate to the highest 20% of the sample values.

Table 1. Coverage rates for selected 95% upper confidence limit estimators with normal and lognormal populations, sampled with biased and unbiased sampling designs. The Cox methods were not implemented for the normal population because the method requires positive data.

Sampling	Distribution	n	Boot	Housatonic	T	Th T	Hall no Interp	Hall Interp	Cox-t	Th Cox-t
Biased	lognormal	20	0.71	0.715	0.915	0.877	0.938	0.799	0.963	0.787
Biased	lognormal	50	0.775	0.778	0.942	0.923	0.956	0.834	0.97	0.832
Biased	lognormal	100	0.787	0.79	0.952	0.936	0.957	0.834	0.97	0.84
Biased	lognormal	800	0.878	0.874	0.909	0.953	0.91	0.881	0.834	0.833
Unbiased	lognormal	20	0.737	0.743	0.852	0.876	0.899	0.821	0.93	0.837
Unbiased	lognormal	50	0.842	0.846	0.888	0.93	0.931	0.882	0.94	0.891
Unbiased	lognormal	100	0.88	0.877	0.893	0.952	0.929	0.888	0.929	0.917
Unbiased	lognormal	800	0.969	0.969	0.934	0.992	0.946	0.974	0.928	0.941
Biased	normal	20	0.842	0.845	0.973	0.966	0.961	0.84	NA	NA
Biased	normal	50	0.839	0.838	0.977	0.968	0.966	0.837	NA	NA
Biased	normal	100	0.873	0.869	0.984	0.98	0.973	0.861	NA	NA
Biased	normal	800	0.878	0.877	0.943	0.971	0.941	0.873	NA	NA
Unbiased	normal	20	0.876	0.879	0.955	0.983	0.948	0.876	NA	NA
Unbiased	normal	50	0.919	0.916	0.965	0.994	0.965	0.911	NA	NA
Unbiased	normal	100	0.948	0.949	0.95	0.994	0.95	0.949	NA	NA
Unbiased	normal	800	0.996	0.995	0.947	1	0.947	0.993	NA	NA

Discussion

Appendix H includes estimates of SWAC under current as well as future conditions. Most of the investigations reported above focus on evaluation of how these estimates were developed and the likelihood that they are accurate and provide the stated nominal levels of confidence. It was found that the proposed methods did not perform as well as other currently available methods for estimating UCLs. In addition to estimates for current condition, a great deal of Appendix H also focuses on forecasting SWAC levels for a range of remedial alternatives. These alternatives involve delineation of the remedial footprint and selecting areas for remediation based on this remedial footprint and the estimated reduction in SWAC. In the following, findings for the UCL estimation procedure are discussed in the first section, and the methods for estimating change in SWAC are discussed in the second section.

Current SWAC Estimation

These investigations demonstrated that for biased and unbiased sampling from the right skewed test population, the modified Hall's method proposed in Appendix-H and at the Housatonic River underestimated the UCL and that existing commonly available UCL methods provided better estimates. Even for sample sizes as large as 800, the proposed methods understated the UCL substantially.

The UCL is a function of the estimated mean and sampling variance of then mean. Proper performance of an estimated UCL requires that both parameters are estimated accurately. Kern (2009) showed that interpolation can be used to reduce bias in the estimated mean (i.e. the SWAC), but these investigations showed that using interpolated concentrations caused substantial underestimation of the variance, causing the resultant UCL to also be underestimated.

Simulations conducted for this review indicated that several commonly available standard methods performed well for data with characteristics similar to those found at the Kalamazoo and Hudson Rivers. It is not known how these simulated data might compare with actual data distributions from the Duwamish or Housatonic Rivers, so it is recommended that additional simulations be conducted with standard UCL methods and data from these rivers for selection and application of a UCL method for risk assessment. In any case, it is very likely that the synthetic data used for this study are much more like actual site data than that used in Weston (2005) to test the proposed methods.

Because more standard methods are readily available, easier to implement and performed better, it is recommended that the Modified Hall's method of Weston (2005) be discouraged from further application. EPA should not adopt any new methods that do not perform substantively better than the larger number of existing methods. Additionally, any methods under consideration should be tested thoroughly and test results should be published in applied statistics journals before they are adopted.

Efforts by Singh and Singh (2002 and 2003) illustrate the difficulty of developing satisfying UCL methods for identically distributed independent samples from right skewed distributions. Recently Kern (2009 unpublished data) has found that methods recommended in ProUCL© based on Singh's work also may not perform particularly well when underlying populations deviate from the standard lognormal and gamma probability models. Simulation work conducted for this review has shown that biased sampling

from skewed distributions exacerbates these difficulties. It can be seen from these results that estimation of a reasonable UCL is greatly simplified with unbiased samples. It is recommended that EPA require that all Remedial Investigations and Feasibility Studies include a large percentage of unbiased data that can be identified for estimation of global parameters such as contaminant mass, volume and surface average concentration. Additionally confidence limits should be provided for each of these parameters. Kern (2009) and this study show that biased sampling is counterproductive for estimation of these global parameters.

These studies also show that the perceived need to interpolate sample data as an intermediate step to arrive at estimates is unnecessary particularly when sampling designs are unbiased, but also for biased sampling designs. Interpolation is only required for delineation of deposits. These results are consistent with (Cochran 1977; pages 22-23) who shows that the nature of the underlying population, correlated or not, is of no concern when random sampling methods are applied. In particular, Cochran shows that the sample mean and variance are unbiased to the population parameters independent of the underlying statistical distribution. Performance of UCL methods is much more robust when unbiased sampling designs are implemented, and sample sizes necessary to achieve reasonable precision are lower than when biased samples are mixed with unbiased samples to estimate global parameters.

If insistence on use of biased samples continues, EPA should require that RI/FS investigations implement true unequal probability designs with known probabilities of inclusion so that rigorous procedures for unequal probability sampling (Horvitz and Thompson 1952) can be correctly applied.

The approach described in Appendix H for forecasting future SWAC values, fails to incorporate the uncertainty associated with the scale of identified removal polygons and their proximity to sample data. Uncertainty associated with these factors, particularly in isolated polygons supported by a small number of samples is a function of the strength of spatial correlation. The following section describes the relationships between removal area and SWAC reduction and a method for evaluating uncertainty for selected remedial alternatives.

SWAC Forecasting

Calculation methods proposed in Appendix-H, and statistical methods used to estimate UCLs are designed for estimation of the overall SWAC at *"global"* scale. Forecasting SWAC reduction for a particular remedy requires estimation of contaminant values at unsampled locations (interpolation) so that deposits can be delineated. Because of this intermediate step, forecasting future SWAC is less certain than global estimation, because of the uncertainty associated with this delineation step. This is because for global estimation one only needs to know the frequency distribution of sample values, whereas for delineation one most also know how concentrations are distributed across the landscape.

Because of this added resolution necessary to delineate remedial boundaries, methods for forecasting SWAC reduction and the associated uncertainty differ from those that are applicable to global estimation. In particular, uncertainty of SWAC forecasts must incorporate uncertainty associated with delineation of deposits and the data densities within and outside delineated areas.

For example if concentrations exhibit substantial small scale heterogeneity simple "*cookie-cutter*" or "*hill-topping*" analyses that fail to incorporate delineation uncertainties will overstate remedial effectiveness because interpolated values tend to smooth the original data and overstate the degree of separation of high and low concentration areas. Calculations reported in Appendix-H do not incorporate these components of uncertainty in predictions of SWAC reduction and may overstate remedial effectiveness.

Reliable forecasts of remedial effectiveness require that the characteristics of the underlying population are understood and incorporated into forecasting calculations. These are model-based analyses that depend heavily on proper characterization of the semivariogram and the use of geostatistical tools to estimate uncertainty. Failure to adequately quantify uncertainty is likely to result in over-statement of remedial performance and understatement of the size of the remedial footprint. Following is a sketch of the relationships governing SWAC forecasting and uncertainty and ultimately determining remedial performance.

Consider two areas A_1, targeted for remediation and A_2, not targeted for remediation. Treating A_1 and A_2 as strata in a stratified design, the average concentration over the full area can be written as the area weighted average (i.e. SWAC) within areas A_1 and A_2, $\overline{X} = \left(A_1 \times \overline{X}_1 + A_2 \times \overline{X}_2\right) / \left(A_1 + A_2\right)$.

Define $\overline{X}_{residual}$ to be the post remediation average concentration. The overall post remediation contaminant concentration is given by $\overline{X}_{post} = \left(A_1 \times \overline{X}_{residual} + A_2 \times \overline{X}_2\right) / \left(A_1 + A_2\right)$, and the reduction in SWAC between pre- and post-remediation average sediment concentration is

$$SWAC\ reduction = \frac{A_1}{\left(A_1 + A_2\right)} \times \left(\overline{X}_1 - \overline{X}_{\mathrm{Re}\,sidual}\right) = \begin{pmatrix} proportion \\ remediated \end{pmatrix} \times \begin{pmatrix} dredging \\ efficiency \end{pmatrix}$$

where the means may be estimated using kriging, conditional simulation, or other interpolation methods.

The reduction in SWAC is a function of the pre-remedial SWAC in the remediated areas, the residual concentrations, and the proportion of the overall area remediated. This indicates that the uncertainty in the global pre-removal SWAC is actually unimportant when evaluating remedial alternatives—rather uncertainty in reduction is driven by uncertainty in estimates of SWAC within the removal areas, which frequently contain small numbers of samples and are therefore uncertain.

The sampling variance of the expected SWAC reduction is also a function of the variance of the SWAC within the proposed remedial footprints

$$\mathrm{var}(SWAC\ reduction) = \left(\frac{A_1}{(A_1 + A_2)}\right)^2 \times \left(\mathrm{var}(\overline{X}_1) + \mathrm{var}(\overline{X}_{\mathrm{Re}sidual}) + 2 \times \mathrm{cov}(\overline{X}_1, \overline{X}_{\mathrm{Re}sidual})\right)$$

Assuming that data are positively spatially correlated, each of these terms is a function of the covariance among sample locations as well as the proximity of samples to removal areas. In practice, these terms can be estimated as functions of the semivariogram, using global block kriging formulas and the mean squared prediction error, or conditional simulation procedures.

If the remediation areas are small or if they contain only a small number of pre-remediation sample points, the uncertainty in the effectiveness estimates are likely to be very high. If there are areas planned for remediation that appear as bulls-eyes on maps surrounding single high concentration samples, it is likely that their effect on SWAC will be negligible, in spite of their high influence on pre-remedial SWAC estimates. Further evaluations of expected reduction in SWAC should explicitly consider the scale of the proposed remedial areas and the uncertainty of the SWAC reduction term as described above.

Conflicting Results

All three methods that used the interpolated surface to estimate the UCL were tested in Weston (2005) or by Ferson (2006) and apparently performed well in those trials, yet all performed poorly in this simulation study. One must naturally question why the dramatic difference in results. Review of the testing conducted showed that these methods were tested on underlying populations that do not reflect realistic conditions found in typical samples from contaminated sediment sites. Figure 9 is an excerpt from Weston (2005) showing that the test population used in the study was a smooth polynomial function of the spatial coordinates.

Effectively, the test was a tautological exercise in which it was shown that the variability of a smooth interpolated surface was approximately the same as the smooth polynomial data generating function. Effectively this test was unable to fail for all but the crudest estimation techniques.

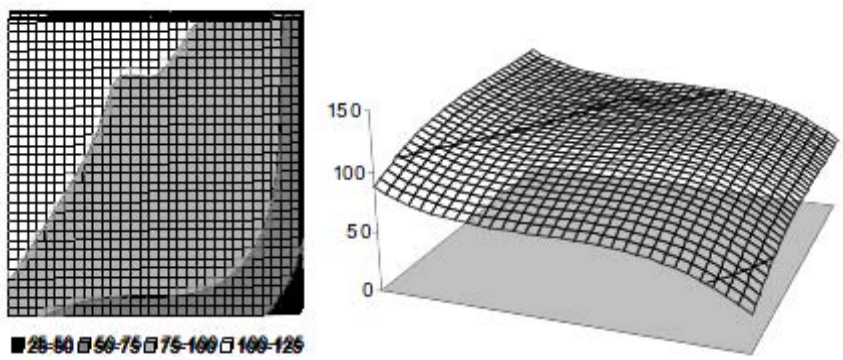


Figure 8 Two Displays of Spatial Variation in the Hypothetical Data Set Used to Test the Modified UCL Formulas for Spatial Weighting

Figure 9. Excerpt from Weston (2005) Attachment 4 illustrating the underlying population used to test the proposed UCL methods. The surfaces are reported to be smooth polynomial functions of coordinate locations with equation $Z=1900-0.0025[(x-10)^3+(y-20)^2+3(x-5)^2+3(y-15)^3]$.

Recommendations

1. We recommend replacing the proposed procedure with a more robust estimation procedure for EPCs.

2. Data from the site should be subjected to a thorough geostatistical evaluation, including coordinate transformation to long and cross flow directions, careful detrending if necessary, semivariogram analysis including tests for anisotropy, and development of a rigorous statistical model of first and second order statistics.

3. A geostatistical model should then be used to develop valid estimates of SWACs and to forecast changes in SWAC with rigorous testing and validation. The geostatistical model would provide a mechanism to incorporate the spatial information into the analysis through methods based on sound theoretical statistical underpinnings.

4. The geostatistical procedures would also provide a basis to properly account for the various scales of selected remedial options. In particular the uncertainty associated with various remedial options should vary with the lateral extent of those options. Smaller more refined options are more uncertain and would require greater amounts of data to execute as confidently as remedial options that are more laterally extensive.

5. Methods from the peer reviewed statistical literature should be selected for application and should be rigorously and extensively tested using methods similar to those descrived in this review.

6. Any newly developed methods should be published in rigorously peer reviewed applied statistics journals before application to the calculation of EPCs at contaminated sites.

Detailed Comments

Comment 1. Page H-1. Second paragraph states: *Use of interpolated, spatially-weighted chemical concentrations accounts for the fact that receptors can move around the exposure area, and partially corrects for non-random sampling within the site.*

The UCL95 is intended to estimate the upper bound of exposures to which organisms are exposed within a given area. This is by definition the integral of the concentration surface within the exposure area. Cochran (1977) shows that independent of the underlying distribution, the sample arithmetic average is a consistent and unbiased estimator. There is no implicit need to interpolate in order to estimate SWAC unless data are collected using biased sampling techniques. The interpolation is introduced in efforts to utilize biased sample data. It should be noted that other methods to counter the effects of biased sampling are also available, such as polygonal declustering (Isaaks and Srivastava 1989). Kern (2009) found that polygonal declustering and interpolation based methods were comparable for populations similar to the distribution of PCBs at the Kalamazoo River.

Comment 2. Footnote page H-1. The footnote states that "*…insufficient dioxin/furan data exist site wide to generate spatially-interpolated data sets…..(SWACS are not derived).*

As described above in Comment 1, it is not necessary to construct an interpolated surface in order to estimate the UCL95 for the mean. The interpolation based estimator of SWAC is merely a device for handling biased data. If data are too sparse to support this device, an alternative approach should be applied.

Comment 3. Section H.2 page H-1. UCL95 estimates were provided for future conditions at year 0, year 10 and year 30 post remediation. How was uncertainty in the forecasting of future concentrations incorporated into the estimates.

Comment 4. Section H.4.1 This section states that the bias was evaluated by verifying that results from the new program were consistent with the software program developed for the Housatonic River. This does not imply that the proposed UCL95 method provides an unbiased estimator.

Comment 5. Section H.4.2 This section states: *"The Hallbig2 program was determined to have acceptable coverage for the Housatonic project (Weston 2005). For purposes of the LDW FS, a qualitative assessment of coverage was conducted by comparing the UCL95 estimates with the SWAC estimates for post-remediation surface sediment conditions "*

The method development conducted for the Housatonic River was based on the assumption that true contaminant distributions follow smooth mathematical functions. Contaminants in sediments are typically much more variable than the test population used to justify the Housatonic method. The Housatonic results should not be extrapolated to the Duwamish River data without verifying that the

data are consistent with the assumptions of the population used to test the Housatonic. This could be easily accomplished by conducting a careful semivariogram analysis to test the hypothesis that the underlying population is nearly perfectly smooth and has not small scale variability.

Tests conducted in this review show that the proposed method will not perform well for distributions with even a moderate amount of small scale heterogeneity. The proposed method can be expected to underestimate the UCL, which will result in understatement of risks and overstatement of the benefit of proposed remedial alternatives.

Comment 6. Section H.4.2. This section points out that the UCL was less than the estimated sample SWAC for alternative 5 for PCBs. This condition is asserted to support the idea that the method provides proper coverage rate. On the contrary, this situation illustrates that the method is not internally consistent. Note that a typical Student's T UCL is of the form X+kS, where k and S are both positive numbers. It is impossible for the UCL to be less than the parameter estimate. This situation illustrates some form of instability in the HallBig2 software program, or shows that resampling from the interpolated surface provides an inconsistent estimator of the mean.

Comment 7. Section H.4.3 This section states: *"The FS is conservative because it assumes the smaller sample size of 100; the trueUCL95 could be lower".*

The degrees of freedom evaluation shows that the proposed UCL method is insensitive to variation in the assumed sample size, so selection of the smaller sample size is not really convincing argument that the selected method is conservative. Underestimation of the standard deviation, which appears likely, will cause risks to be understated, and most likely reverse any tendency toward conservatism. Based on the tests conducted for this review it is much more likely that the UCL lacks protectiveness.

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