# SEDIMENT MANAGEMENT

# ANNUAL REVIEW MEETING

***FINAL***

**MEETING MINUTES**

**JUNE 2014**

## *Prepared by DMMP Agencies:*

*United States Army Corps of Engineers*
*Washington Department of Ecology*
*United States Environmental Protection Agency*
*Washington Department of Natural Resources*

# Table of Contents



# Appendices

# List of Acronyms and Abbreviations

| | |
|---|---|
| AFDW | ash free dry weight |
| BMP | best management practice |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CSL | Cleanup Screening Level |
| CSMP | Cooperative Sediment Management Program (Washington State) |
| CWA | Clean Water Act |
| DEQ | Oregon Department of Environmental Quality |
| DMMO | Dredged Material Management Office |
| DMMP | Dredged Material Management Program |
| DNR | Washington State Department of Natural Resources |
| DY14 | Dredge Year 2014 |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| FCR | fish consumption rate |
| FPM | Floating Percentile Method |
| LEKT | Lower Elwha Klallam Tribe |
| MTCA | Model Toxics Control Act |
| NEP | National Estuary Program |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| PCB | polychlorinated biphenyl |
| PLP | Potentially Liable Party |
| PNWA | Pacific Northwest Waterway Association |
| PQL | practical quantification limit |
| PRG | Project Review Group |
| PSDDA | Puget Sound Dredged Disposal Analysis |
| PSEP | Puget Sound Estuary Program |
| PSET | Portland Sediment Evaluation Team |
| QA/QC | quality assurance/quality control |
| RDT | Regional Dredging Team |
| RI/FS | Remedial Investigation/Feasibility Study |
| RSET | Regional Sediment Evaluation Team |
| SEF | Sediment Evaluation Framework |
| SL | Screening Level |
| SMARM | Sediment Management Annual Review Meeting |
| SMS | Sediment Management Standards |
| SQS | Sediment Quality Standards |
| SQV | Sediment Quality Value |
| SRM | Sediment Reference Material |
| TEQ | toxic equivalence |
| TOC | total organic carbon |
| TSS | total suspended solids |
| USACE | United States Army Corps of Engineers |
| WAC | Washington Administrative Code |
| Ecology | Washington State Department of Ecology |

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The 26th annual review of sediment management issues in the Pacific Northwest region was held on May 7, 2014 by the Cooperative Sediment Management Program (CSMP). The Sediment Management Annual Review Meeting (SMARM) was hosted by the Washington State Department of Natural Resources (WDNR), at the Salish Sea Conference Room, in the new Seattle District Oxbow Headquarters Building in Seattle, Washington. Comments from the public were welcomed, with prior invitation to submit issues for consideration and discussion.

The Dredged Material Management Program (DMMP) is an interagency cooperative program that includes the U.S. Army Corps of Engineers (USACE), Seattle District; the Environmental Protection Agency (EPA), Region 10; the Washington Department of Natural Resources (DNR); and the Washington Department of Ecology (Ecology). These minutes include the DMMP's response to public issues raised at this year's SMARM meeting (Appendix I), meeting agenda (Appendix II), list of attendees (Appendix III), the speaker's presentation slides (Appendix IV), and the 2014 SMARM Clarification Papers (Appendix V).

## WELCOME AND OPENING REMARKS

***Justine Barton (Moderator, EPA)***, welcomed everyone to the 26th consecutive annual SMARM meeting. She briefly reviewed the history of the DMMP, stressing the collaborative process of the DMMP and its important role in the state's goal of cleaning up Puget Sound by 2020. According to Justine, a hallmark of the program is the civil discourse among all parties. She briefly summarized the 25th anniversary historical summary that was held last year. Justine introduced the members of the head table, including Christine Reichgott (EPA, Manager, Environmental Review and Sediment Management Unit), Erika Shaffer (DNR, Manager, Aquatic Resources Division), and Jim Pendowski (Ecology, Manager, Toxic Cleanup Program). This is the second meeting in the new Corps Building and Salish Sea Conference Room. Justine advised everyone to please sign in at the table outside the door if they haven't already. She addressed a few "housekeeping" issues. She reminded everyone that the 30 day public comment period was June 6, 2014 to provide input on the SMARM topics and/or proposed changes to the program. The host for these meetings rotates each year, and this year the host is Washington State Department of Natural Resources. The meeting location continues to remain at the Corps because of free parking.

**LTC Andrew Park (Deputy District Engineer).** Justine then introduced LTC Andrew Park, Deputy District Engineer, who welcomed those in attendance at the 26th consecutive SMARM to the 2nd meeting in the new Corps headquarters building. He then provided opening remarks and a brief summary of why the DMMP has been so successful over the past twenty-six years. He indicated that he wished it the same success for the next twenty-six years.

Justine then asked David Kendall and Wayne Wagner to come up to the front of the room. David then read a brief summary acknowledging the many contributions that Wayne Wagner (Seattle District Chief, Technical Support Branch) has provided to the Dredged Material Management Program over the years. Wayne is scheduled to retire this year and this will be his last SMARM. The DMMP agencies wanted to acknowledge their respect for all the support he has provided over the years, and wanted to wish him the very best in his well earned retirement.

Justine Barton.

PP-1 Panel Best

***Justine Barton (Moderator),*** introduced the first agency speaker, Chance Asher, Ecology.

## SMS RULE IMPLEMENTATION UPDATES

## 1. Ecology/TCP, Chance Asher, Ivy Anderson

***Chance Asher (Ecology/TCP).*** Ecology's presentation on the Sediment Management Standards (SMS) rule included updates on the progress implementing the newly adopted rule. The focus of the SMS implementation updates was the Sediment Cleanup Users Manual II (SCUM II) and establishment of sediment regional background. The update on SCUM II included a high level summary of the public comments received to date, Ecology's plans to convene technical workshops to work with stakeholders to resolve issues raised in the public comments, and the timeline for completing the final SCUM II document. The SCUM II technical workshops will be convened on July 17, July 31, and August 6 at Ecology's NWRO Bellevue office from 9 AM - 1 PM. The update on establishment of regional background included a high level summary of how Ecology has responded to comments received over the past year on the Port Gardner Bay and Port Angeles regional background work. This included presenting the supplemental sampling design and framework for Port Gardner Bay in response to comments, the timeline for establishing regional background in Port Gardner Bay and Port Angeles, as well as a brief update on the outreach Ecology will conduct in 2014 for the regional background work in the Lower Duwamish Waterway.

**Chance Asher**

PP1.1 Sediment Policy Updates Toxi cs Cleanup Program

PP1.2 Goals for Today, Provide Updates On:

PP1.3 Revised Sediment Cleanup Users Manual II:

PP1.4 Acknowledgements

PP1.5 A Tale of Two SCUMs

PP1.6 Draft SCUM II – Summary of Content

PP1.7 Draft SCUM II – Summary of Content (Continued)

PP1.8 Appendices

PP1.9 Public Comments – Big Picture Topics

PP1.10 Public Comments – Big Picture Topics (Continued)

PP1.11 Public Comments – Big Picture Topics (Continued)

PP1.12 SCUM II Technical Workshops

PP1.13 SCUM II Timeline & Next Steps

PP1.14 SCUM II – Future Opportunities for Revisions

PP1.15 Now for Something completely different…

PP1.16 Regional Background Updates

PP1.17 Background & SMS rule – Establishing Cleanup Levels

PP1.18 Intent of Regional Background

PP1.19 Regional Background – What it is Not

PP1,20 Ecology's Regional Background Engagement process

PP1.21 How Ecology Considered Comments

PP1.22 Why Did We Conduct Supplemental Sampling?

PP1.23 Changes to the Port Gardner Supplemental SAP

PP1.24 These Changes Resulted In:

PP1.25 Conceptual Bay Model, Evaluation of Sources, Sites, and Areas of Influence

PP1.26 % Total Organic Carbon & Grain Size Distribution

PP1.27 Existing Sediment Concentrations: cPAHs & Dioxins/Furans

PP1.28 Existing Sediment Concentrations: Cadmium & Arsenic

PP1.29 Port Gardner Revised Sampling Area

PP1.30 Phase II Baseline & Secondary Sampling Locations

PP1.31 Regional Background/SCUM II Timeline

**Comments and Questions**

Q: Deborah Williston (King County) - Please clarify your statement saying that the SAPA would become obsolete.

A: Chance Asher (ECY) - SAPA information has been folded into SCUM II and old information updated. All the SAPA information has been captured, just in a different document. Once SCUM II is final, the SAPA will be taken off the web site. SAPA had a lot of old and outdated sections. ECY saw no sense in having two documents, one updated and one outdated.

Q: Joyce Mercuri (ECY) - Will SCUM II be web based or will future changes be incorporated into a new document or via SMARM documentation?

A: Chance Asher (ECY) - SCUM II will be web based in terms of being posted on internet but there will be an actual document for printing as well. As we make future revisions, changes may be indicated as redline in a given chapter as a SMARM Issue or Clarification Paper or could be reflected in an additional appendix. ECY still not sure how to track changes. Alternatively, appendix B (past SMARM Issue and Clarification Papers) could house the updates plus they could be folded into SCUM II where sensible. ECY would appreciate hearing ideas on how to make the updates more user-friendly. In any event, there will be a date change on front of document to show its updated status. Any changes will be presented at SMARM for public comment before inclusion.

Q: Alan Chartrand (SFS) - What is the schedule for developing natural/regional background for other embayments?

A: Chance Asher (ECY) - Other embayments are being considered by ECY and we have some funds but the agency isn't ready yet to announce which ones. Remember that ECY is paying for all this expensive work. ECY will let people know more about this in the next few months.

Q: Tad Deshler (Coho Environmental) - Can you give more information on how stormwater outfalls were modeled?

A: Chance Asher (ECY) - King County has described their extensive work on modeling outfalls (mostly by Bruce Nairn - KC) on their website. There is a link to the presentation King County gave at the September 2013 Ecology workshop to discuss regional background for Elliott Bay and the Lower Duwamish on our website:

(http://www.ecy.wa.gov/programs/tcp/smu/EB_LDW_2013_SAP_Workshop_Presentations.pdf)

Their studies have shown that depositional zones area for CSOs and stormwater outfalls is more limited than originally thought. This may not be case for large wastewater outfalls with diffusers, however. This information has informed ECY's decision to move the supplemental sampling for regional background to locations that are closer to storm water outfalls.

Q: Roger McGinnis (Hart Crowser) - These embayments are dynamic systems. Have you thought about updating the information for Regional Background? I also have noticed that Port Gardner Regional Background values are greater than SLs used by the COE to determine sediment suitability for open water disposal. If this true, won't more dredged material have to go upland?!

A: Chance Asher (ECY) - We've been thinking about how often regional background values will need to be updated. The answer will be specific to the area and its sediment deposition rate. We don't anticipate dramatic change in any of the current embayments we're working on over

timeframes of less than 10 yrs. Decisions to resample will also depend on whether there are funds available.

Port Gardner regional background values do not conflict with open water disposal criteria, if the CSL is considered. We are paying close attention to both sets of values because we don't want open water disposal at designated sites to create cleanup sites.

Q: Kathy Godfredtsen (Windward Environmental) - You've done a great job with making adjustments to the sampling for regional background at Port Gardner. Are you planning to apply similar adjustments to Port Angeles?

A: Chance Asher (ECY) - Right now we're just focusing our revised sampling framework on Port Gardner to see what happens. If the new data make a big difference than we may rethink other regional background datasets in the future. I can't say whether this will apply to Port Angeles as we would need to see the data before answering that question.

A: Teresa Michelsen (Avocet) - Remember that developing Regional Background for large river systems like the Lower Duwamish may rely more on particulate data and modeling as opposed to using bedded sediment data as was done for Port Gardner and Port Angeles. This should be kept in mind during stakeholder deliberations in the future.

## 2. DMMP Issue: Adoption of Chemistry Freshwater Guidelines, Laura Inouye

**Laura Inouye (Ecology):** The SMS benthic criteria only account for chemical toxicity to benthic invertebrate communities and may not be protective of sensitive fish species and other organisms. This presentation presents a proposed approach of screening level overlays for the new freshwater benthic screening levels (FW benthic SLs) for dredging projects, which includes the FW benthic SLs, water quality-based screening levels (WQ-based SLs) and background for metals. Fish and bioaccumulative SLs are still under development. The SMS benthic criteria will be adopted with the exception of ammonia and sulfides, which will only be used to inform bioassay testing and water quality monitoring. WQ-based SLs are based on the SEF Chapter 10 elutriate testing approach. For background, Washington proposes adopting state soil background for nickel at this time, due to lack of statistically robust freshwater sediment background datasets. Tiered testing for benthic SL exceedances relies on bioassays, and a wide range of tests for WQ-based SLs exceedances including elutriate tests, development of site-specific SLs and/or WQ criteria, or modeling. Impact analysis indicates that PCP detection limits may be an issue for the WQ-based SLs. DMMP will not require special analytical methods unless there is a reason to believe that PCP may be present at the dredge location. Instead, data must be reported down to the MDL and only detected exceedances will trigger tiered testing. Since fish and bioaccumulative SLs are still under development, when ESA-listed species are present, the Federal action agency may need to contact NMFS and/or USFWS (as appropriate) to discern whether

additional analyses are needed, and whether those analyses should be done as part of an ESA consultation.

***Laura Inouye***.

PP2.1 Implementation of Revised Freshwater Sediment Screening Values

PP2.2 Introduction: a bit of history

PP2.3 Introduction: Benthic standards and the SMS rule:

PP2.4 Introduction

PP2.5 Problem Statements

PP2.6 Approach

PP2.7 Benthic FW screening levels

PP2.8 Benthic freshwater screening levels (continued)

PP2.9 Benthic freshwater screening levels (continued)

PP2.10 Benthic freshwater screening levels (continued)

PP2.11 Water-Quality Criteria-based SLs

PP2.12 Water-Quality Criteria-based SLs (Continued)

PP2.13 Water-Quality Criteria-based SLs (Continued)

PP2.14 Background Based SLs

PP2.15 Background Based SLs (Continued)

PP2.16 Background Based SLs: Washington Sediment Data

PP2.17 Background Based SLs

PP2.18 Background Based SLs: Washington Soil data

PP2.19 Background Based SLs

PP2.20 The FW Screening Level Table

PP2.21 Using the FW Screening Level Table

PP2.22 Using the FW Screening Level Table (Continued)

PP2.23 Using the FW Screening Level Table (Continued)

PP2.24 Using the FW Screening Level Table, Tiered Testing Option

PP2.25 Using the FW Screening Level Table (Continued)

PP2.26 Impact Analysis

PP2.27 Impact Analysis (Continued)

PP2.28 Questions?

**Comments and Questions**

Q: Allan Chartrand (SFS) - This is a great use of the EPA toxicity database. I know that there is tons of data there for PAHs and dioxin. Why are these not represented in your FW values?

A: Laura Inouye (ECY) - We're working with Lyndal Johnson (NOAA) to develop a PAH fish screening level. The value is approx. 2000 ppb, but we are still deliberating on this. As for Dioxins – toxicity to benthos and fish are much less sensitive than bioaccumulation.

Q: Roger McGinnis (Hart Crowser) – I understand that your Water Quality-based SLs used a default hardness of 18.9. The calculations are meant to be used for hardness between 25 – 400. If < 25 default to 25 mg/L.

A: Laura Inouye (ECY) – I'm not sure of how/why the equations in Chapter 10 auto default. If standard procedure is to do that for fresh water, then we will. Remember that these values are for adoption by a greater regulatory community and IDEQ is questioning some of the default parameters. This may need more discussion. For now we've agreed to these defaults in order to have some sediment guidelines rather than to have nothing or under-protective values

Q: Teresa Michelsen (Avocet) – Mark Sippola (formerly COE), if he were here, would say that sediment nickel is elevated on the Oregon coast. Are you concerned about that issue? On that basis, I would caution against using Portland Harbor data to represent background for sites on the coast.

A: Laura Inouye (ECY) - That's why the WA background evaluation was done. Results did show that some COCs in Washington freshwater sediments were higher than in the Williamette.

Q: Teresa Michelsen (Avocet) – The difference between SL1/SL2 does not represent toxicity associated with acute vs chronic exposures. Why would one apply a chronic endpoint to a dredging project (whose direct water quality effects are short-lived)? Why not use acute endpoints which would be more applicable to the short-term nature of dredging projects?

A: Laura Inouye (ECY) – If you look at the defined time-frame associated with acute and chronic Water Quality criteria, they are 1-day and 4-days. Since the criteria definitions include these time frames, the chronic criteria can be applied to dredging projects (which typically last longer than 4-days).

Q: Teresa Michelsen (Avocet) – Why is the WQ Criteria approach only being used to develop fresh water sediment guidelines? Why not develop similar guidelines for the marine/estuarine context as well?

A: Laura Inouye (ECY) – Because fresh water SLs are priority for the RSET group. We are working our way through the process in RSET to determine guidelines that will be acceptable to all the agencies. Lessons learned from this process will inform future efforts.

Q: Deborah Williston (King County) – Was the EPA copper criteria value back calculated using the Biotic Ligand model? Would that require steady-state data on hardness?

A: Laura Inouye (ECY) – We used an EPA 2007 document that used a species sensitivity distribution approach; not the Biotic Ligand model. An acute to chronic ratio was also used. *[Post SMARM clarification from Ecology: While not discussed in the meeting, development of a site-specific WQ-based SL could use biotic ligand model for metals, rather than the spreadsheet. Again, it would be proponent-developed and would require agency approval.]*

Q: Tim Thompson (SEE) –A clarification paper for the future should elaborate on the procedure to be used to conduct a modified dredge elutriate test.

A: Laura Inouye (ECY) – We agree that this will be needed. *[Post SMARM clarification from Ecology: This will be discussed within RSET and an approach presented in the fall RSET meeting.]*

Q: Jennifer Sutter (OR DEQ) – Clarify if/how these new freshwater values will affect cleanups.

Laura Inouye (ECY) – Actually, the process has gone the opposite way. The tiered approach being used is similar to what was developed for the cleanup rule. WQ-based values are new, though.

A: Chance Asher (ECY) – We want to hear feedback on this approach before we put it into SCUM II and apply it to cleanups

**Morning Break**

## 3. DMMP Clarification: Freshwater Bioassays, Laura Inouye

***Laura Inouye, Ecology:*** The current Sediment Evaluation Framework (SEF 2009) requires only 10-day bioassays for tiered testing when exceedances of freshwater screening levels (FW SLs) occur. This is inconsistent with the new Sediment Management Standards (WAC 173-204-563), which requires at least one chronic exposure and one sublethal endpoint. Additionally, the new proposed FW SLs are often based on chronic exposures and sublethal endpoints, so it makes sense that tiered testing should require one of the more sensitive bioassays. The proposed required suite of freshwater bioassays will be aligned with WAC 173-204-563. When bioassays are triggered, they will include:

- Two different test species (*Hyalella* and *Chironomus*)
- Three endpoints
- One chronic test; and
- One sublethal endpoint

Test protocols, control and reference QAQC, and 1-hit/2-hit definitions for 10 and 20-day *Chironomus* growth and mortality bioassays and 10 and 28-day *Hyalella* bioassays were presented (see slides for details).

**Laura Inouye**

PP3.1 Freshwater Bioassays

PP3.2 Introduction

PP3.3 Problem Statement

PP3.4 Proposed Modifications

PP3.5 Proposed Modifications (Continued)

PP3.6 Proposed Modifications (Continued)

PP3.7 Proposed Modifications – Bioassay Performance Standards

PP3.8 Proposed Modifications – Hit definitions: 2-hit and 1-hit interpretive criteria (*Hyalla azteca*)

PP3.9 Proposed Modifications – Hit definitions: 2-hit and 1-hit interpretive criteria (*Chironomus dilutus*)

PP3.10 Questions?

**Questions and Answers.**

There were no questions

## DMMP Updates

## 4. DMMP Project Testing Summary, David Fox (Corps)

**David Fox (Corps):** David Fox (Corps) presented the DMMP project evaluation activities for DY2014. DMMP activities are documented in memoranda that get posted to the DMMO website, including suitability determinations, recency extensions, tier 1 evaluations, volume revisions, design modifications and antidegradation determinations. There were eleven suitability determinations and fifteen other completed actions in DY14. Project locations were distributed throughout the State of Washington.

Twelve projects required chemical testing, with nine of these tested for dioxins/furans. Only two projects ran bioassays. There was no bioaccumulation testing. Six projects included antidegradation testing. Projects with DMMP chemical guideline exceedances (excluding dioxins/furans) included Duwamish Yacht Club, Kittitas County Boat Ramp, Port of Seattle T5 and T91, USACE Hylebos and USACE Snake/Clearwater Rivers. Six projects had failures based on dioxins/furans or partially due to dioxins/furans, including Duwamish Yacht Club, MJB Properties, Port of Olympia berthing area, Port of Seattle T5 and T91, and USACE Hylebos.

The two projects subjected to bioassays were Kittitas County Boat Ramp (cadmium) and USACE Snake/Clearwater Rivers (phenol and 4-methylphenol). Freshwater bioassays were used for both projects. There were no hits in any of the bioassays.

Five projects had material found unsuitable for open-water disposal, including Duwamish Yacht Club, MJB Properties, Port of Seattle T5 and T91, and USACE Hylebos. A total of 70,835 cubic yards were determined to be unsuitable out of a total of 920,644 cubic yards (7.7% unsuitable). This compares to a 5.4% unsuitable rate over the last eight years and 4.6% over the last 26 years. The volume of material tested in DY14 was well below the average tested volume of 2.1 million cubic yards over the last 26 years.

Antidegradation testing resulted in failures or partial failures in five of the six projects tested. Overdredging with subsequent placement of a sand cover is required at Duwamish Yacht Club, Port of Olympia berthing area and Port of Seattle T5 to address the degraded nature of the sediment surface exposed by dredging. The remedy at the Port of Seattle T91 is yet to be determined as additional sediment evaluation is ongoing at that site. The Hylebos Waterway will not be dredged, so the degraded subsurface sediment will not be exposed.

USACE Hylebos had unexpectedly high concentrations of dioxins/furans in the five shoals that were tested. The five shoals spanned the length of the waterway. None of the material tested met the dioxin/furan evaluation guidelines for open-water disposal. Concentrations were highest in Shoal D, located at approximately the midpoint of the waterway.

**David Fox**

PP4.1 DMMP Evaluation Activities, Dredging Year 2014

PP4.2 Dredging Year Actions

PP4.3 DY14 Completed Actions

PP4.4 DY 2014 Project Locations

PP4.5 DY14 Testing

PP4.6 Projects with guideline exceedances (excluding dioxin)

PP4.7 Dioxin Testing DY14

PP4.8 Biological Testing DY14

PP4.9 Projects with Unsuitable Dredged Material

PP4.10 Suitability of Volume Tested

PP4.11 Multiyear Comparison

PP4.12 DMMP Testing History

PP4.13 Antidegradation Testing

PP4.14 USACE Hylebos – Dioxin

PP4.15 Projects underway, but incomplete

PP4.16 DMMO Website

PP4.17 Questions?

**Comments and Questions**

There were no questions.

## 5. DMMP Clarifications and Updates, Lauran Warner (Corps)

**Lauran Warner (Corps):** presented a brief summary of DMMP clarifications and DMMP program updates. Clarifications are modifications to existing DMMP guidance that do not substantively change program or policy. But important nonetheless: they may or may not be adopted as proposed based on comments received from stakeholders and public.

Clarification: Recency Guideline Modifications. Two modifications proposed:

1. Change the recency period for high-ranked areas from 2 years to 3 years.
2. Discontinue the use of the "frequency" term; roll "frequency" concept into recency.

The caveat for all projects under recency guidelines is that they are guidelines ONLY. If there are changes to the proposed dredge area that could alter the usefulness of collected data, the DMMP may request additional testing.

Five updates to previous DMMP programs or interests were highlighted:

1. Puget Sound SRM is now in its third year and performing well. Those using the SRM are required to submit data per guidance on the DMMP website.
2. Ammonia/Sulfides in bioassays. This is an example of a DMMP clarification that will NOT be implemented based on stakeholder feedback. Proposals for programmatic modifications of bioassays to control for ammonia and sulfides will not be implemented. They may be used on a project-specific basis if requested by the proponent.
3. DAIS to EIM transition is almost entirely finished, largely due to extra work by David Fox of the DMMO. DAIS is no longer used for DMMP data; all data is submitted via the DMMO project manager to EIM.
4. A new EPA document on dioxin validation is now available: *Data Validation and Review Guidelines for Polychlorinated Dibenzo-p-Dioxin and Polychlorinated Dibenzofuran (PCDD/PCDF) Data Using*

*Method 1613B and SW846 Method 8209A.* For copies, contact Ginna Grepo-Grove at grepo-grove.gina@epa.gov

5. ESA Rockfish listings: larval rockfish were collected in the area of Puget Sound disposal sites during 2012 as part of a study to determine whether there are disposal effected on listed rockfish species. Preserved larval rockfish will be genetically identified to species to determine whether any collected were listed species.

Finally: the DMMP User Manual will be updated with SMARM modifications after the SMARM comment period.

**Lauran Warner**

PP5.1 DMMP Clarifications & Updates

PP5.2 Clarification: Recency/Frequency

PP5.3 Recency/Frequency (definitions)

PP5.4 Recency

PP5.5 Frequency

PP5.6 Updates, Puget Sound SRM, Ammonia/Sulfides in bioassays, Status of EIM transition

PP5.7 Puget Sound SRM

PP5.8 Puget Sound SRM (Continued)

PP5.9 SRM: Required Deliverables

PP5.10 Ammonia/Sulfides in Bioassays

PP5.11 DAIS to EIM transition

PP5.12 To be updated after SMARM comment period – Dredged Material Evaluation and Disposal Procedures User Manual July 2013 (version)

PP5.13 Corps Website Address for Dredged Material Management Office

PP5.14 Questions?

**Comments and Questions**

Kathy Taylor (ECY): I'd like to introduce Hugo Froyland – a new coordinator and analyst at ECY.

Tuan Vu (U.S. EIM) – Good job to Dave Fox for EIM migration.

Q: Joyce Mercuri (ECY) – Where are EPA's Dioxin validation guidelines published?

A: Justine Barton (EPA) –You will need to talk with Ginna Greppo-Grove about that. The report does not have an official EPA # yet nor has it been peer reviewed. Probably best to email her (greppo-grove.gina@epa.gov) to get a final copy. I also assume will be posted on the R10 EPA web site.

Q: Maria Peeler (CHB) - How long do we have to submit comments and questions on SMARM presentations?

A: Lauran Warner (COE) - There is a 30 day comment period (due June 6th).

Q: Joyce Mercuri (ECY) – Is there an official public notice for the comment period? How does general public know about the comment period? What's the formal process?

A: Lauran Warner (COE) - The SMARM is the public notice and the mailing list announcing the SMARM amounts to public notification. The comment period starts today and goes for 30 days. We will consider extensions on that period if requested.

## Afternoon Lunch Break

## 6. DNR Update & Disposal Site Monitoring Results, Celia Barton (DNR) and David Fox (Corps)

**Celia Barton (DNR) and David Fox (Corps).** Celia Barton and David Fox provided updates on monitoring conducted during the past year. Monitoring occurred at 3 disposal sites in Puget Sound in Dredge Year 2014: multibeam hydrographic survey (multibeam) and sediment profile imaging (SPI) at Commencement Bay (CB) and Elliott Bay (EB), partial monitoring at EB, and multibeam at Anderson/Ketron (A/K). In addition, there was disposal modeling at A/K and targeted disposal at EB. Near future plans include a crab and shrimp trawl study at the A/K site.

The EB site had received 603,000 cubic yards (cy) of material since the last full monitoring event in 2002, exceeding the soft monitoring trigger of 500,000 cy. A decision was made to conduct a partial monitoring event at EB in the summer of 2013 to address the first two monitoring questions. Partial monitoring was determined to be sufficient due to the relatively low volume of disposal and a 25-year history of monitoring in Elliott Bay; partial monitoring also resulted in a considerable cost savings over full or tiered-full monitoring. Commencement Bay site had received 433,000 cy of material since the last monitoring event and was not used last year for disposal. However, it had been 6 years since the shift in disposal coordinates and multibeam and SPI surveys were warranted to check performance of the new coordinates.

The multibeam survey at the CB site showed a slight flattening and elongation of the disposal mound, indicating that the shift in disposal coordinates was having its intended effect. The SPI results corroborated the multibeam data, with the 3-cm dredged material accumulation boundary clearly shifted southeast of the center of the site. A minor quantity of dredged material (less than 1 cm in depth) extended outside of the disposal site to the southeast, indicating that the shift in disposal coordinates had not resulted in inordinate movement of material offsite in the direction of the disposal

coordinate shift. A larger lobe of dredged material extended north from the site beyond the disposal site boundary. However, the depth of offsite deposition was less than 1 cm. This pattern of offsite movement to the north had been documented in previous monitoring events at CB.

The multibeam survey at the EB site showed a much less pronounced mound when compared to CB, reflecting the smaller volume that has been deposited over the years. The center of the disposal mound is near the disposal coordinates for the site, which had been shifted 300 feet to the south of the center of the site in the early 90's to prevent material from moving into the submarine canyon to the north of the site. The SPI survey showed a well-defined deposition pattern, with the 3-cm accumulation boundary completely encircling the disposal zone. All recently-placed material remained onsite.

Partial monitoring was conducted at EB in 2013 by Integral Consulting Inc., with significant funding assistance from the Department of Ecology. Sampling occurred August 5-14, 2013 at 19 EB stations and two Carr Inlet reference stations, including seven random onsite stations for dioxin testing. The first two PSDDA Monitoring Framework questions were answered by addressing four testable hypotheses. It was concluded that dredged material was not moving offsite and onsite biological effects conditions were being met.

The DMMP agencies established revised dioxin guidelines in 2010. The site management objective was set to four parts-per-trillion toxic equivalents (pptr TEQ). The monitoring design for non-dispersive sites was modified to include ten onsite stations. The dioxin results for EB indicated that dioxin concentrations within the dredged material footprint were meeting the site management objective, although some stations outside the footprint were still above the objective. Of most concern was station EBS04, which had a concentration of 30 pptr TEQ. This same station had a concentration of 17 pptr TEQ in 2007. Since the dredged material footprint did not extend as far as EBS04, the difference between the 2007 and 2013 concentrations is likely attributable to spatial heterogeneity.

Data from the partial monitoring event at EB are available in EIM, and the monitoring report will be finalized and posted sometime after SMARM.

One of the recommendations from the report was to adjust the disposal coordinates to cover the elevated dioxin levels at EBS04. This was accomplished by the Corps at the end of 2013 with the placement of 20 barge loads of clean material from navigation dredging in the Duwamish turning basin.

The A/K Shoreline permit expires in September 2014. The process of securing a new permit involves an extensive public process. The Corps and DNR received many comments on the use of this site over the last 2 years. The Corps conducted work in 2013, including a multibeam survey and fate/transport modeling study to begin to address these comments. The multibeam survey indicated that the hydrodynamics responsible for development of sand waves in the Nisqually delta appear to have no effect on material placed at the A/K disposal site. The fate and transport modeling supported the conclusions that had been reached during the siting study in the late 80's. Approximately 95% of the dredged material placed at the site comes to rest within the site boundary within 2 hours of disposal. Half of the 5% that remains in suspension after two hours eventually comes to rest within the site boundary as well. The remaining 2-3% of material does move offsite but is constrained to the very deep

water between Anderson and Ketron Islands. It does not move into shallower subtidal areas or into the Nisqually delta where biological resources are more abundant.

The Corps will also conduct a four-season beam trawl study starting in July 2014 with a focus on Dungeness crab and Pandalid shrimp densities. The DMMP agencies are working with the Washington Department of Fish and Wildlife, the agency responsible for the management of these resources, to investigate any resource changes since the original 1987 siting work. Two additional transects have been added through the disposal site to increase definition. Use of this site is not anticipated in the next two years, and DNR will not apply to renew the Shoreline permit until late 2015, when this study is expected to be completed.

The DNR managed disposal volumes for Puget Sound continue to decline, while Grays Harbor continues to require maintenance dredging. These uses provide revenue for the Dredged Management Account which pays for management and monitoring of the disposal sites. The combined revenue for DY 2014 is slightly over $36,000. DNR is developing a plan to take to the co-managers and user groups as we work toward a solution to the Dredged Management Account decline.

**Celia Barton**

PP6.1 Disposal Site Monitoring Results

PP6.2 Highlights of 2014

PP6.3 Puget Sound, Grays Harbor and Willapa Disposal Sites

PP6.4 Site Monitoring

PP6.5 Cumulative Volumes Since Last Monitoring, Elliott Bay

PP6.6 Cumulative Volumes Since Last Monitoring, Commencement Bay

PP6.7 Monitoring in DY14

PP6.8 2013 Commencement Bay Multibeam Survey, Corps of Engineers

PP6.9 Commencement Bay SPI

PP6.10 2013 Elliott Bay Multibeam Survey, Corps of Engineers

PP6.11 Elliott Bay SPI

PP6.12 Elliott Bay Partial Monitoring

PP6.13 PSDDA Monitoring Framework

PP6.14 2013 Sediment Sampling

PP6.15 2013 Sediment Analyses

PP6.16 2013 Results – Chemistry

PP6.17 Chemical Tracking System (CTS) Evaluation

PP6.18 2013 Results – Bioassays

PP6.19 2010 Dioxin Guidelines

PP6.20 Elliott Bay Dioxin Results, highlighting S4 results

PP6.21 2013 Monitoring Conclusions, Hypothesis No. 1

PP6.22 2013 Monitoring Conclusions, Hypothesis No. 2

PP6.23 2013 Monitoring Conclusions, Hypotheis No. 3

PP6.24 2013 Monitoring Conclusions, Hypothesis No. 4

PP6.25 Recommendations

PP6.26 Target Disposal at Dioxin Hotspot

PP6.27 Shoreline Permit

PP6.28 Anderson/Ketron Disposal Site

PP6.29 A-K Fate and Transport Modeling

PP6.30 A-K Fate and Transport Modeling

PP6.31 Anderson/Ketron Disposal Site

PP6.32 DNR Managed Disposal

PP6.33 Grays Harbor DNR volumes

PP6.34 Questions?

**Comments and Questions:**

There were no questions.

## CERCLA / SMS / MTCA Cleanup Updates

## 7. Lower Duwamish Waterway Update, Allison Hiltner (EPA)

***Allison Hiltner (EPA),*** presented an update on cleanup activities at the Lower Duwamish Waterway Superfund site, including:

- Boeing Plant 2 cleanup – 2 seasons of dredging completed and habitat project built; cleanup will be completed in 2015
- Terminal 117 cleanup nearly complete. Some additional cleanup and habitat restoration will be completed in 2015.

- Jorgensen Forge cleanup to start in 2104.
- Fishers Study to learn more about who is consuming fish from the LDW is underway.
- Clam arsenic laboratory study completed.
- Carbon amendment pilot study is in initial stages.
- Numerous source control activities and studies underway (Ecology lead).
- EPA is considering public comments on Proposed Cleanup Plan and developing draft Record of Decision. We anticipate Record of Decision will be released by the end of this year.

**Allison Hiltner**

PP7.1 Lower Duwamish Waterway Update

PP7.2 Lower Duwamish Waterway

PP7.3 Key parts of the Duwamish cleanup

PP7.4 Lower Duwamish Waterway – What's new

PP7.5 Lower Duwamish Waterway Project Team

PP7.6 Lower Duwamish Early Action Areas

PP7.7 Lower Duwamish Early Action Activity

PP7.8 Boeing Plant 2 Progress

PP7.9 Boeing Plant 2

PP7.10 Boeing Plant 2 Dredging Overview

PP7.11 Backfilling with clean sand

PP7.12 Boeing Plant 2, Construction Season 2 Production Summary

PP7.13 Boeing Plant 2 Project Status

PP7.14 New fish & Wildlife Habitat

PP7.15 New Fish & Wildlife Habitat

PP7.16 Terminal 117 project status

PP7.17 T-117 uplands/sediments cleanup, looking east

PP7.18 T-117 uplands/sediments, looking NE to Boeing Plant 2

PP7.19 T-117 uplands/sediments cleanup, looking north to south Park bridge

PP7.20 Jorgensen Forge

PP7.21 LDW Early Action Overview

PP7.22 Protecting Fish Consumers in EPA's Superfund Cleanup – the LDW Fishers Study

PP7.23 Do Advisories Work?

PP7.24 Why don't advisories work?

PP7.25 What's Next

PP7.26 Activated Carbon Pilot Study

PP7.27 Evaluation of Exposure to Arsenic of the Eastern Soft Shell Clam

PP7.28 Lab-Based Questions

PP7.29 Sediment Collections Fractions

PP7.30 Exposure Methods

PP7.31 Tissue Results Comparison (mg/kg WW)

PP7.32 Source Control

PP7.33 Site Cleanup & Inspections: Ecology, EPA

PP7.34 Site Cleanup & Inspections Compliance Assurance

PP7.35 Source Control Studies

PP7.36 Record of Decision

PP7.37 For More Information

**Comments and Questions:**

Q: Jennifer Sutter (OR DEQ) – Can you give more details on the activated carbon study? Are the results of the workshop available to public?

A: Allison Hiltner (EPA) – Currently, we're working on developing a Scope of Work (SOW). So this project is still in the early stages. We don't yet know what activated carbon product will be used. Meeting notes from the February 2012 activated carbon workshop are EPA's web site.

Q: Maria Peeler (CHB) – Is EPA going to give presentation on this work to the University of Washington CAFÉ meetings? This is a W. Seattle forum where UW and EPA provide information on the Lower Duwamish project in W Seattle.

A: Allison Hiltner (EPA) – I've never heard of these meetings. Let's talk.

Q: James Keithly (ERM) – What is the overall schedule for the LDW cleanup? How long is it expected to take?

A: Allison Hiltner (EPA) – It will take a long time. After we sign the Record of Decision we will negotiate a cleanup agreement with potentially responsible parties. The proposed active remediation timeframe is 7-yrs. It may take 20-yrs for the whole thing if you include 10-yrs allowed for natural recovery.

Q: Jeff Stern (KC) – Why does the Jorgensen early action project have to be out of the water by Sept 7?

A: Allison Hiltner (EPA) – I don't know. You will have to ask the Project Manager, Becky Chu.

## 8. SMS/MTCA Cleanup Projects Update, Kathy Taylor (Ecology)

***Kathy Taylor (Ecology/Toxics Cleanup Program).*** Kathy Taylor presented an update regarding Ecology's sediment cleanup sites focused in Puget Sound. The presentation included an overview of the work conducted in Bellingham Bay, Fidalgo and Padilla Bays, Port Gardner and the Snohomish River Estuary, Seattle, Commencement Bay, Port Angeles, and Port Gamble. Additional detail was provided regarding the Custom Plywood cleanup in Anacortes and Ecology's cleanup and restoration activities in Port Gamble Bay. In-water cleanup work at Custom Plywood involved the removal of marine decaying structures, debris and pilings, sediment remediation for dioxin and wood waste, and habitat restoration and shoreline protection. The Port Gamble Bay cleanup is on schedule to begin implementation in July 2015. It involves removal of creosote and overwater structures, excavating intertidal sediments, removing and isolating wood waste, thin layer capping of moderate wood waste impacts, and long term monitoring of recovery after removing creosote sources from the bay. Ecology's other work in Port Gamble Bay includes providing funding for the recent acquisition of the western shoreline of Port Gamble Bay for ownership by Kitsap County. Ecology is also working with partners to conduct studies on pacific herring (with WDFW), restore eelgrass (with DNR), enhance native oyster populations (with the Puget Sound Restoration Fund), remove debris, derelict vessels and an unused pier from the bay (with the Port Gamble S'Klallam Tribe) and acquire additional land with surface water connections to Port Gamble Bay (with Kitsap County). In summary, many sediment cleanups are underway and Ecology is using innovative approaches, where possible, to restore and protect habitat on cleanup sites. Additional details are available at https://fortress.wa.gov/ecy/tcpwebreporting/Default.aspx.

**Kathy Taylor**

PP8.1 SMS/MTCA Cleanup Projects Update

PP8.2 Sediment Cleanup Sites

PP8.3 Major sediment cleanup areas in Puget Sound

PP8.4 Map depicting cleanup areas

PP8.5 Map depicting Bellingham cleanup sites

PP8.6 Map depicting all cleanup areas

PP8.7 Map depicting Anacortes cleanup sites

PP8.8 Anacortes cleanup sites

PP8.9 Map depicting Anacortes cleanup sites

PP8.10 Anacortes: Custom Plywood cleanup site

PP8.11 Anacortes: Custom Plywood cleanup site (Continued)

PP8.12 Anacortes: Custom Plywood, In-water Cleanup Work

PP8.13 Picture of cleanup area

PP8.14 – pp8.18 Picture of cleanup area (Continued)

PP8.19 Custom Plywood, Pete Adolphson (sediments) and Hun-Seak Park

PP8.20 Picture of cleanup area

PP8.21 – pp8.33 Picture of cleanup area (Continued)

PP8.34 Map of Cleanup areas

PP8.35 Port Gardner Cleanup areas

PP8.36 Map of cleanup areas

PP8.37 Map of Seattle cleanup sites

PP8.38 Seattle Cleanup Sites

PP8.39 – pp8.40 Seattle Cleanup Sites (Continued)

PP8.41 Map of cleanup areas

PP8.42 Map of Tacoma Cleanup sites

PP8.43 Tacoma Cleanup sites

PP8.44 Map of cleanup areas

PP8.45 Map of Port Angeles Cleanup sites

PP8.46 Port Angeles Cleanup sites

PP8.47 Map of cleanup areas

PP8.48 Map of Port Gamble cleanup sites

PP8.49 Port Gamble historical figure

PP8.50 Port Gamble historical figure (Continued)

PP8.51 Port Gamble Bay Cleanup Actions, Russ McMillan

PP8.52 – pp8.54 Port Gamble Figure (Continued)

PP8.55 Port Gamble Bay Proposed Cleanup

PP8.56 Proposed Site Cleanup Mill Site North

PP8.57 Proposed Site Cleanup Mill Site South

PP8.58 Proposed Site Cleanup Central Bay

PP8.59 Proposed Site Cleanup Former Lease Area

PP8.60 Proposed Cleanup Background Area

PP8.61 Port Gamble Bay Source Control, Habitat Preservation and Cleanup Sustainability (Celina Abercrombie)

PP8.62 Restoration and Preservation Projects:

PP8.63 Land Acquisition and Preservation, Western Shoreline block

PP8.64 Pacific Herring Studies

PP8.65 Eelgrass Restoration

PP8.66 Olympia Oyster Enhancement

PP8.67 Debris and Derelict Gear and Vessel Removal

PP8.68 Upcoming Restoration and Preservation Projects

PP8.69 Summary

**Comments and Questions:**

Q: Allan Chartrand (SFS): Is any of the Port Gamble wood waste being disposed of in open water? How about wood waste from other cleanups?

A: Kathy Taylor (ECY) – They haven't done the testing yet for disposal of Port Gamble sediments. Material from the Custom Plywood cleanup has gone to upland disposal sites only. *[Post SMARM clarification from DMMP: Sediments from some wood waste projects have been evaluated and allowed to be disposed at open water disposal sites. Examples are Manke Lumber (2005) and more recently, a restoration project in Thatcher Bay (2009). Currently, wood waste material from the Port Gamble cleanup is being evaluated for open water disposal options. See DMMP guidance on wood waste for evaluation protocols.]*
http://www.nws.usace.army.mil/Portals/27/docs/civilworks/dredging/Updates/1997-arm_wood.pdf

Q: Janet Knox (PGG): Is Sinclair Inlet on Ecology's map of cleanup projects? If so what role does Ecology have there?

A: Adam Harris (ECY) – Yes, Ecology is involved but the cleanup in Sinclair Inlet (PSNS) is an EPA CERCLA site.

Q: Ken Pelton (APEX Labs): Is TCP doing any work on ocean acidification?

A: Kathy Taylor (ECY) – Ecology's Toxics Cleanup Program is not studying it but there is lots of work on this topic being conducted by others.

A: Joyce Mercuri (ECY) – For example, Taylor Shellfish is doing a lot of research on ocean acidification as it affects oysters.

## Break and Poster Session

## 9. Sediment Characterization Core Sampling Issues, James McMillan (Corps)

***James McMillan (Corps)*** presented a summary of sediment characterization sampling issues.
**Introduction:** The Washington Dredged Material Management Program (DMMP) and the Portland Sediment Evaluation Team (PSET) review dozens of dredging projects annually. Under the auspices of the Clean Water Act and Ocean Dumping Act, the regulatory decisions made regarding the fate of dredged material depend on representative sediment characterization data.

Core sampling is often required to adequately characterize the physical and chemical makeup of the dredge material and in-situ residuals (aka, the new surface material, Z-layer, leave surface, or post-dredge surface). To adequately characterize the dredging project, core samples must be collected on-station, in thickest parts of the dredge prism. High core recovery helps ensure that samples/subsamples are collected from the target depths.

Staff from the DMMP and PSET met on 4 December 2013 to discuss core sediment sampling issues as they pertain to dredged material characterization. The DMMP and PSET agencies identified a wide range of core sampling issues and core sampling error caused by human negligence. The agencies also discussed potential guidelines and contingencies for these core sampling issues. The DMMP's/PSET's findings are the subject of this presentation.

**Low Core Recovery:** Percent core recovery is calculated by dividing the length of core sample retrieved by the depth the core barrel is advanced into the sediment profile (multiplied by 100). For example, if 5.25 ft. of sediment is collected from a core advanced 7.0 ft. into the sediment profile, then the core recovery is 75%.

Low recovery is typically caused by substrate limitations; material may be lost from the core if there is wood debris present in the profile, or if the profile is composed of coarse-grained (sandy) sediment. If the substrate contains gravelly or cobbly material, the core may not penetrate at all; this is referred to a core refusal.

Two types of phenomena that can lead to low core recoveries (and uncertainty in sediment sample collection) include: 1) sample shortening and 2) stratigraphic bypass. Sample shortening can be linear or non-linear, and most practitioners assume the former. Stratigraphic bypass is rarely assumed to occur. When core recovery is high, the occurrence of shortening and/or bypass is likely minimal. However, as

core recovery decreases, it is unclear whether shortening, bypass, or a combination of both, contributed to the low recovery (McGuire et al., 2012).

If recovery is low and it is unclear if the correct dredge prism and Z-layer intervals were characterized, then the DMMP and PSET will err on the side of the resource. The DMMP and PSET agencies propose the following guidelines to minimize potential sampling error that may result from low core recovery:

1. Samplers must attempt to achieve 75% minimum core recovery. Multiple attempts must be made to attain 75% recovery.
2. If core refusal or low core recovery may be an issue, or if site conditions are unknown, then the practitioner should bring a grab sampler as a contingency.
3. If subsurface dredge prism units or the Z-layer cannot be sampled, or if the location of the interval in the core is uncertain, then post-dredge grab sampling may be required to characterize post-dredge conditions.
4. To minimize the core length and potential for sampling error, the DMMP and PSET agencies also recommend advancing the core nose no more than 1 ft. below the maximum depth of characterization.

**Human Sampling Error:** In recent years, the DMMP and PSET agencies have observed an increase in poorly executed sediment sampling events. Poor methodology, field notes, and core logging practices have contributed to mischaracterization of multiple dredging projects in both Washington and Oregon. Examples of human error include:

- Not correcting for tides or river levels
- Not measuring the depth to mudline
- Not measuring the depth of core penetration
- Not calculated core recovery (or assuming 100% recovery without measuring depth of penetration)
- Incomplete and/or incorrect field records and data reporting

The DMMP and PSET agencies are proposing the following preventive measures to address human-related core sampling error:

- Pre-sampling meetings w/ DMMP/PSET
- Standardize fields in sediment core (and grab) sample logs
- Develop a field checklist for samplers

When sampling team negligence is evident, the DMMP and PSET agencies will always err on the side of the resource. Poorly executed core sampling events will take longer to review, because the agencies must determine which data are usable. If the project is incorrectly sampled, portions of the data may be rejected, and additional sampling and analysis may be required. Post-dredge characterization may also be required if the Z-layer was not characterized.

The DMMP and PSET are seeking technical recommendations from the public to better inform the DMMP and PSET agencies and enhance/improve the proposed core sampling guidelines. After full consideration of public comments, these guidelines will be incorporated into local and regional dredged material evaluation guidance.

**Reference:** McGuire, C., P. McGuire, D. Richardson, & J. Holmstadt. 2012. Core sampling: influence on sediment profile interpretation. *Presentation by* TetraTech staff at the PIANC-COPRI Dredging 2012 Conference, 24 October 2012, San Diego, CA. http://dredging12.pianc.us/agd_detailss.cfml?ssid=166

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***James McMillan***

PP9.1 Sediment Characterization: Core Sampling Issues

PP9.2 Sampling Objectives

PP9.3 Core Sampling Objectives

PP9.4 Presentation Objectives

PP9.5 Issue No. 1: Low Core Recovery

PP9.6 Low Recovery: substrate Limitations

PP9.7 Low Recovery: Sample shortening

PP9.8 Low Recovery: Stratigraphic bypass

**PP9**.9 Low Recovery – the Regulatory perspective

PP9.10 Core Sampling guidelines

PP9.11 Core Sampling guidelines (Continued)

PP9.12 Issue No. 2: Human Error

PP9.13 Human Error

PP9.14 Core Sample Log (depicting errors)

PP9.15 Human Error (Continued)

PP9.16 Human Error: What We're Going to Do About it

PP9.17 We Need Your Help

PP9.18 Reference

PP9.19 Questions?

**Comments and Questions:**

Q: Roger McGinnis (Hart Crowser) – If your dredge prism extends into native material would you still have some of these concerns about core sampling? There are some areas where you can collect 20 cores and not get 75% recovery no matter what you do.

A: James McMillan (Portland COE) – It really depends on the project. If it involves new work dredging and it's on the Columbia River, then you are likely to get into native sand. Generally, when you can't get good recoveries no matter what technologies you use, the agencies may then require collection of the z after the dredge event.

Q: Tim Thompson (SEE) – I'm very surprised that you are asking if 75% is a reasonable minimum recovery; it's more than reasonable. Here in Puget Sound, we have this as a minimum plus we typically will try collection 3 times and then only move the station after checking in with the agencies. I'm surprised that others think that 75% recover isn't achievable. As for core logs, "gINT" software has standardized format logs that may work well and can be edited to add features. The upshot is, that standardized log forms shouldn't be a problem to implement.

A: James McMillan (Portland COE) – I don't think we want to standardize the forms, just the information that's collected. Regardless of the agency or contractor doing the work, each form should have the same fields. I really don't want to impose the use of gINT core logs & database on everyone.

Q: Jeff Stern (KC) – Since It's difficult to know if you are really sampling the z-layer, why not just always require post dredge z sampling? When we sample beforehand, we don't really know if we've characterized the z layer; we're just guessing.

A: Laura Inouye (ECY) – The reason we typically characterize the z-layer before dredging is that many agencies and applicants need/want to know beforehand if the z-layer fails. When the z-layer fails, it may require different construction depth/volumes to accommodate over dredging. The planning and placement and time needed will change as a result. Furthermore, a different type of permit could be required.

A: James McMillan (Portland COE) – In addition, the Services want to see this information before the project is permitted. Anti-degradation policy requires it.

Q: Matt Childs (American Construction) – Do you envision pre-sampling meetings to be over the phone or must they be a face-to-face meeting?

A: James McMillan (Portland COE) and Laura Inouye (ECY) – We are thinking that a phone call will usually be sufficient.

## 10. Results of PCB Homologue Studies, Laura Inouye (Ecology) and Kelsey Van der Elst (Corps)

***Laura Inouye (Ecology):*** Two studies (Corps, Ecology) on alternative PCB analysis were discussed. Aroclor analysis has issues with weathering, high detection limits, and inability to determine dioxin-like PCB-TEQs. These studies investigated the potential of low resolution GC-MS methods (LRMS) as a lower

cost surrogate for total PCBs and for calculating dioxin-like PCB-TEQs. The Corps dataset, which had higher concentrations of PCBs as compared to the Ecology dataset, showed that PCB-Aroclor over-estimated total PCBs, while the Ecology dataset showed Aroclor PCBs slightly lower than that calculated by GCMS methods. Both studies had excellent, almost 1:1 correlation between high resolution MS (HRMS) and LRMS methods, even when different LRMS methods were used. The second part of the study, the development of homolog TEFs, was based on Ecology's dataset only, since the approach could not be conducted with the Corps dataset due to elevated detection limits. All the dioxin-like PCB congeners fall into four of the homolog groups. Using the HRMS data, TEF's were calculated for each sample by:

1) summing the congeners into homolog groups,
2) summing the HRMS congener TEQs in each homolog group, and
3) dividing the HR-MS homolog TEQ by the HR-MS homolog concentrations.

All 10 samples were analyzed and the resulting TEFs averaged. The average homolog TEF was then used to calculate HRMS sum homolog TEQ and LRMS sum homolog TEQ, which were compared to the HRMS sum congener TEQs (calculated by using the standard congener specific TEF approach). The LRMS homolog sum TEQ correlated well with both HRMS homolog sum TEQs and HRMS congener sum TEQ. A single sample what was analyzed by both studies (PS-SRM), and application of the homolog TEFs indicated that the LRMS homolog approach likely provides a better estimate of PCB-TEQ than Kaplan Meier sum TEQ when detection limits are elevated.

Due to new sediment regulations, the DMMP agencies may need to evaluate new guidance for PCBs, depending on regional background results, which are still being developed. While there are no proposals at this time, a summed PCB and dioxin TEQ approach may be appropriate for the disposal sites. What little data is available for samples with both HRMS PCBs and dioxins indicates that in typical samples away from known PCB sources, about 4-11% of the total TEQ is due to PCBs, the rest to dioxins. Although the LRMS TEQ approach is promising, more studies are needed prior to application of the approach for dredging.

**Laura Inouye**

PP10.1 PCB Alternative Analysis, Comparison of Aroclor to low and high-resolution GCMS

PP10.2 Introduction

PP10.3 Approach

PP10.4 USACE Study, Total PCBs

PP10.5 USACE Total PCB Results

PP10.6 Ecology Study, Total PCBs

PP10.7 Combined Studies, Total PCBs

PP10.8 Ecology Study, Total PCBs

PP10.9 Comparison of Studies, Total PCBs

PP10.10 Combined Studies, Total PCBs

PP10.11 Total PCB Summary

PP10.12 Developing PCB Homolog TEFs

PP10.13 TEQ definition

PP10.14 Homolog-TEF derivation

PP10.15 Sample-specific homolog TEF calculations: ECY HRMS data

PP10.16 Sample-specific homolog TEF calculations: ECY HRMS data (Continued)

PP10.17 Sample-specific homolog TEF calculations: ECY HRMS data (Continued)

PP10.18 Average homolog TEF: ECY HRMS data

PP10.19 $TEF_{homo}$ Analysis

PP10.20 HR-GCMS congener sum TEQ vs sum TEQ from homolog TEF

PP10.21 How Robust is the Homolog TEF?

PP10.22 Homolog TEF and PS-SRM results:

PP10.23 Homolog TEF Summary

PP10.24 So What?

PP10.25 So What? (Continued)

PP10.26 Next Steps

PP10.27 Comments? Questions?

**Comments and Questions:**

Q: Susan McGroddy (Windward) – Homologue analysis is a great approach for measuring total PCBs. ARI says that the homologue method costs approximately $300. But I would urge extreme caution in using homologue data to estimate PCB TEQ. Have you performed pattern analysis? Have you looked at the different distributions of congeners? East Waterway has tons of PCB data. There are other sites too.

A: Laura Inouye (ECY) – I've done a lot of analyses with this data that I don't have time to present here. And there appears to be very little HRMS data out there with good enough detection limits. *[Post SMARM clarification from Ecology: Laura was referring to available data within Ecology's EIM database, which was the data being used in this analysis].* What I did find was that some the data sets I had gave the same data pattern. Other datasets had an odd split with some of the data having a 1:1 correlation

between High Res congener TEQ and homolog TEF-calculated TEQ results, and some data having a different correlation between the two methods (falling off the 1:1 relationship). Identifying these may be the way to determine if PCBs are from a specific source or characterized by ambient patterns. I will follow up on getting more data for future presentations.

Q: Roger McGinnis (Hart Crowser) – The congener composition of each Aroclor is different. Do you know what Aroclor(s) you had in your samples? My concern with your approach to developing homologue TEFs is as you change predominant Aroclor, the congener compositions will change. You could be comparing different data sets with different predominant Aroclor patterns.

A: Laura Inouye (ECY) - We have some Aroclor info on these samples but the different labs disagreed on which Aroclors were present. I have tried this comparison with some data sets where the relationship held – these were samples with PCBs from mixed sources.

Q: Roger McGinnis (Hart Crowser) - PCB TEFs are low compared to dioxin. Will the PCB contribution really make a difference if your dioxin concentrations are close to 4 pptr TEQ?

A: Laura Inouye (ECY) – Agreed. For most projects to date, if data approaches or exceed the 4 pptr TEQ based on dioxin concentrations, then data (especially volume-weighted averages) are typically already over the threshold. In that case, PCB contribution to TEQs won't be the make-or-break element.

Tim Thompson (SEE) – Is this data available for public review? Did you correct for Axys' diff homologue method?

A: Laura Inouye (ECY) – My analysis and homologue TEF calculations aren't available at this point. The raw data is all available in an ECY publication. *[Post SMARM clarification from Ecology: the report can be found at:*

*https://fortress.wa.gov/ecy/publications/SummaryPages/1403009.html*

## 11. Bioavailability Assessment Using Passive Porewater Samplers, Mandy Michalsen (Corps)

***Mandy Michalsen (Corps).*** Passive samplers permit direct measurement of freely dissolved contaminant concentrations in sediment porewater, which provide a better proxy for contaminant bioavailability. Results of three passive sampler field demonstrations were presented. Solid-phase microfiber extraction (SPME) fiber samplers were used to quantify depth-discreet porewater concentrations of PAHs at two creosote-contaminated sediment sites to assess performance of sediment cap remedies. Polyethylene (PE) samplers were used similarly to quantify porewater concentrations of PCBs in sediment. In all demonstrations, the passive samplers permitted direct, in situ measurement of freely dissolved contaminant concentrations at the ng/L level. Each passive sampler was sectioned into depth-discreet sections, which permitted an assessment of concentration gradients at each location, thereby permitting an assessment of both compliance with surface water quality critera near the sediment surface, as well as evidence of bottom-up contaminant recontamination through sediment caps.

**Mandy Michalsen**

PP11.1 Sediment Bioavailability Assessment Using Passive Porewater Samplers

PP11.2 Bulk Sediment Concentrations are Poor Predictors of Toxicity

PP11.3 Estimating Bioavailability from Bulk Sediment has limitations

PP11.4 Measuring Porewater Contaminants

PP11.5 Porewater Sampler Demonstration, Lower Duwamish Waterway Superfund Site, EPA Region 10

PP11.6 Polyethylene (PE) Porewater Sampler Field Demonstration Objective

PP11.7 PE Deployment Locations in Lower Duwamish Waterway

PP11.8 Sampling/Analysis Program Schematic

PP11.9 PE Sampler visuals

PP11.10 Results by Key Congeners

PP11.11 Pacific Sound Resources (PSR) Superfund Site

PP11.12 Solid-Phase Microextraction (SPME)

PP11.13 SPME Fiber Field Demonstration at PSR

PP11.14 SPME Fiber Results

PP11.15 SPME Fiber Results

PP11.16 SPME Porewater Sampler Demonstration at Wyckoff/Eagle Harbor Superfund Site

PP11.17 SPME Fiber Demonstration at Wyckoff/Eagle Harbor

PP11.18 Corrections for Steady State

PP11.19 Concentration Depth Profiles Allow Assessment of Through-Cap Migration

PP11.20 Bulk Sediment Estimated Porewater vs. Measured Porewater

PP11.21 Take Home Message

PP11.22 Standard Methods and Laboratories

**Comments and Questions:**

Q: Are these methods published?

A: Mandy Michalsen – The standard method document has not yet been released. It will contain field and analytical information. Method scientific information is also in the recently published SETAC journal

*[Post SMARM clarification from COE: The journal is titled Integrated Environmental Assessment and Management and can be found at:*
*http://www.onlinelibrary.wiley.com/doi/10.1002/ieam.v10.2/issuetoc*
*This issue has 6 "free" articles describing scientific consensus on methods and applications for passive sampling. A second manual is coming out in the next year that will give information on the relevance and application of the results of passive porewater sampling. The reference for this is ER-201216 Sediment Bioavailability Initiative (SBI): Development of Standard Methods and Approaches for the Use of Passive Samplers in Assessment and Management of Contaminated Sediment and can be found at:*
http://www.serdp.org/Program-Areas/Environmental-Restoration/Contaminated-Sediments/ER-201216/ER-201216/(language)/eng-US

*Some key URLs to find out more are:*

- *http://www.serdp.org/Program-Areas/Environmental-Restoration/Contaminated-Sediments/ER-200915*
- *http://www.serdp.org/Program-Areas/Environmental-Restoration/Contaminated-Sediments/ER-201216/(language)/eng-US*
- *http://www.serdp.org/content/download/16022/182923/file/Sediment%20Workshop%20Report_October%202012.pdf ]*

Q: Alan Chartrand (SFS) – Have correlations been made with standard bioaccumulation test organisms?

A: John Wakeman (COE) – There is a large body of information both from the lab and the field showing a high level correlation between porewater and tissue for lots of species (both freshwater and marine). There is also information from the Feb 2012 Lower Duwamish Waterway meetings on Activated Carbon (some of which is on the LDW web site).

*[Post SMARM clarification from COE: Additional information on Activation Carbon can be found in the following articles:*

- http://www.serdp.org/Program-Areas/Environmental-Restoration/Risk-Assessment/ER-1552
- *Millward RN. Bridges TS, Ghosh U, Zimmerman JR, Luthy R. 2012. Addition of Activated Carbon to Sediments to Reduce PCB Bioaccumulation by a Polychaete (Neanthes arenaceodentata) and an Amphipod (Leptocheirus plumulosus)Lampert, DJ, WV Sarchet, DD Reible. 2011. Assessing the Effectiveness of Thin-Layer Sand Caps for Contaminated Sediment Management through Passive Sampling. Environ. Sci. Technol. 2011, 45, 8437–8443*

*Lu, X.; Skwarski, A.; Drake, B.; Reible, D. Predicting Bioavailability of Polycyclic Aromatic Hydrocarbons and Polychlorinated Biphenyls with Pore Water Concentrations Measured by Solid-Phase Micro-Extraction Fibers. Environ. Toxicol. Chem. 2011, 30, 1109–1116.*

Q: Alan Chartrand (SFS) – How did you measure porewater?

A: Mandy Michalsen – Porewater was measured directly from the sampler, which was secured within a perforated protective stainless steel casing and inserted directly into the sediment. The sampler polymer is deployed for a period of time (typically weeks) required to reach equilibrium with the freely dissolved contaminants present in the porewater. Following retrieval, the polymer sampled is sectioned into discreet intervals, the polymer is extracted in solvent, and then the extract analyzed using standard analytical methods. This approach is not new – SPME fibers have been used in the laboratory for years

to obtain low-level detection limits in aqueous samples. This commonly used laboratory method was simply modified for use directly in the field for exposure *in situ*, i.e. SPME deployment directly in sediment using the protective stainless steel samplers. Otherwise, we used a standard extraction process. Afterwards you convert the result to a porewater concentration using known partition coefficients specific to the polymer.

Q: Joyce Mercuri (ECY) – Pore water concentrations were back-calculated from bulk concs in sediment, right?

A: Mandy Michalsen – No. The porewater concentrations were derived from the sorbed PCBs directly quantified using polymer extracts, then adjusted for progress towards equilibrium using deuterated Performance Reference Standards pre-loaded into the sampler polymer. In the case of the Pacific Sound Resources site, the first one illustrated for PAHs, another calibration method was used (association rates with thicker and thinner fibers).

Q: Roger McGinnis (Hart Crowser) – where did you get Passive Sampler association constants for PCBs?

A: Tim Thompson (SEE) – The SETAC paper referenced above has 40 different people (Pellston workshop), and gives consensus partition coefficients for SPMES. They standardized the process. Phil Gschwend and Danny Reible also compared methods in 2011 paper. They compared porewater measurement from a sample and the SPME methods. Upshot is that there is good science backing this methodology up.

## 12. Public Issue Papers.

There were no public issue papers presented prior to or during the 26th SMARM.

## SUMMARY AND CLOSING

**Justine Barton,** thanked everyone for coming to the 26th SMARM. She concluded the 26th annual SMARM by announcing that the clarification and issue papers were currently on the website and that the SMARM presentations will be posted to the website soon. She reminded everyone that the deadline for submitting comments on the SMARM topics and Ecology SMS/MTCA topics is June 6, 2014.

## Meeting Adjourned

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# APPENDIX I

# DMPP Response to Public Issues

Appendix I:  DMMP responses to the  two comment letters received following the SMARM will be provided here when completed.

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# APPENDIX II

# Meeting Agenda

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# 2014 Sediment Management Annual Review Meeting

Corps of Engineers, Seattle District May 7, 2014

| | | |
|---|---|---|
| 8:30 | REGISTRATION AND COFFEE | |
| 9:00 | Welcome | Moderator, Justine Barton, EPA |
| 9:05 | Opening Remarks | Lt. Col. Andrew Park, Deputy Commander, Seattle District Corps of Engineers |
| 9:15 | SMS Rule Implementation Updates (Regional Background, Draft Sediment Cleanup Users Manual II, etc.) | Chance Asher, Ecology |
| 10:00 | DMMP Issue: Adoption of Chemistry Freshwater Guidance | Laura Inouye, Ecology |
| 10:30 | BREAK | |
| 10:45 | DMMP Clarification: Freshwater Bioassay Requirements & Interpretation | Laura Inouye, Ecology |
| 11:15 | DMMP Project Testing Summary | David Fox, Corps |
| 11:35 | DMMP Clarifications and Updates | Lauran Warner, Corps |
| 11:45 | LUNCH | |
| 12:45 | DNR Update & Disposal Site Monitoring Results | Celia Barton, DNR & David Fox, Corps |
| 1:15 | Lower Duwamish Waterway Update | Allison Hiltner, EPA |
| 1:45 | SMS/MTCA Cleanup Projects Update | Kathy Taylor, Ecology |
| 2:15 | BREAK | |
| 2:35 | Sediment Characterization: Core Sampling Issues | James McMillan, Corps |
| 2:55 | Results of PCB Homologue Studies | Laura Inouye, Ecology |
| 3:15 | Bioavailability Assessment Using Passive Porewater Samplers | Mandy Michalsen, Corps |
| 3:45 | Public Issues and Discussion | |
| 4:30 | SUMMARY & CLOSING | |

Comments on SMARM issues accepted through June 6, 2014

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# APPENDIX III

# List of Attendees

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# APPENDIX IV

# PowerPoint Slides for Each Speaker

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pp-1

# SMARM

## Sediment Policy Updates
## Toxics Cleanup Program

Chance Asher
May 7, 2014

pp-1-1

## Goals For Today
## Provide Updates on:

- Sediment Cleanup Users Manual II (SCUM II)
  - Public comments – what we've heard so far
  - Technical workshops.
  - Finalization of document.
- Regional Background Implementation.
  - Port Gardner
  - Port Angeles
  - Lower Duwamish Waterway

pp-1-2

## Revised Sediment Cleanup Users Manual II:

Guidance for Implementing **Part V**

"Sediment Cleanup Standards" of the SMS

pp-1-3

## Acknowledgements


- Laura Inouye, Ecology
- Russ McMillan, Ecology
- Dave Bradley, Ecology
- Pete Adolphson, Ecology
- Pete Kmet, Ecology
- Craig McCormack, Ecology
- Teresa Michelsen, Avocet Consulting
- Chris Waldron, Pioneer
- Lorraine Read, TerraStat Consulting
- Mike Ehlebracht & Roger McGinnis, Hart Crowser
- Taku Fuji, Anchor QEA
- Lon Kissinger, EPA
- Sediment Management Standards Advisory Group Members




## A Tale of Two SCUMs

- **SCUM I**
  - Source Control Users Manual.
  - Published in 1993.
  - In need of updating.

- **SCUM II**
  - Sediment Cleanup Users Manual.
  - Published in 1991.
  - 2013 revised version includes:
    - Process of sediment cleanup from “start” to “finish”.
    - Focused mainly on implementation of Part V of the 2013 SMS rule.
    - Includes the information in the Sediment Sampling and Analysis Plan (SAPA).
    - The SAPA will become obsolete once SCUM II is final.

## Draft SCUM II – Summary of Content

- Incorporated newer science, reorganized to follow the cleanup process from site identification to compliance monitoring, and reflects the 2013 SMS rule revisions.
- **Chapter 1**: SMS rule framework & guidance document organization.
- **Chapter 2**: Site identification of sites, screening CoCs, development of a conceptual site model.
- **Chapter 3**: Remedial investigation, sampling guidance.
- **Chapters 4 - 6**: Updated tests, lab analysis and QA/QC procedures, data analysis and reporting.



## Draft SCUM II – Summary of Content

- **Chapter 7**: Cleanup standards framework
  - **Chapter 8**: Benthic criteria.
  - **Chapter 9**: Human health criteria.
  - **Chapter 10**: Higher trophic level criteria.
  - **Chapter 11**: Natural and regional background.
  - **Chapter 12**: Practical quantitation limits.
- **Chapter 13**: Sediment cleanup units.
- **Chapter 14**: Feasibility study & remedy selection:
- **Chapter 15**: Sediment recovery zones.
- **Chapter 16**: Compliance monitoring.
- **Chapter 17**: Applicable laws and authorizations required.

## Appendices

- **Appendix A** Ecology Contact List
- **Appendix B** Sediment Management Annual Review Meeting (SMARM) papers
- **Appendix C** Marine Microtox Sediment Porewater Toxicity Assessment
- **Appendix D** Freshwater Microtox Sediment Porewater Toxicity Assessment
- **Appendix E** Conducting Bioassays on Sediments w/ PAHs Exposed to UV Radiation
- **Appendix F** Analytical Methods PQLs for Sediment and Tissue
- **Appendix G** Statistics for Addressing Non Detects and Evaluating Compliance
- **Appendix H** Human Health and Ecological Risk Information
- **Appendix I** Remedy Selection Case Studies
- **Appendix J** Determining Toxicity of Natural Chemicals
- **Appendix K** Elutriate Testing
- **Appendix L** Natural Background Data
- **Appendix M** Summing TEQs using Kaplan Meier and ProUCL



## Public Comments – Big Picture Topics

- **Remedial Investigation:**
  - Sufficiency of data
  - How to screen CoCs

- **Statistics:**
  - Metric for establishing natural and regional background concentrations.
  - Determining compliance – metric and process:
    - Area weighted averaging
    - 95$^{th}$ UCL on the mean

- **Recontamination:**
  - How to settle with PLP for recontamination
  - How to address non PLP sources responsible for recontamination

## Public Comments – Big Picture Topics

- **Bioavailability:**
  - Use of tissue data to:
    - Determine cleanup levels
    - Determine compliance with cleanup levels
  - Incorporate into assessment for selecting the preferred remedy

- **Remedy Selection:**
  - Alternative ideas for conducting the disproportionate cost analysis.
  - More emphasis on remedial technologies "preference" based on:
    - Bioavailability: bioaccumulation vs. acute/chronic benthic impact
    - Adverse environmental impacts from dredging

- **Sediment Recovery Zones:** How and what to monitor



## Public Comments – Big Picture Topics

- **Human Health:**
  - Exposure parameters:
    - Fish consumption rate – more detail on how to establish
    - Site use factor – how this can or should be incorporated
    - Fish diet fraction – inclusion of salmon or other pelagic fish

- **QA / QC:**
  - Laboratory methods for bioaccumulative chemicals
  - Use of non approved methods

- **Regional Background:**
  - Conservative framework results in values below recontamination potential

## SCUM II Technical Workshops

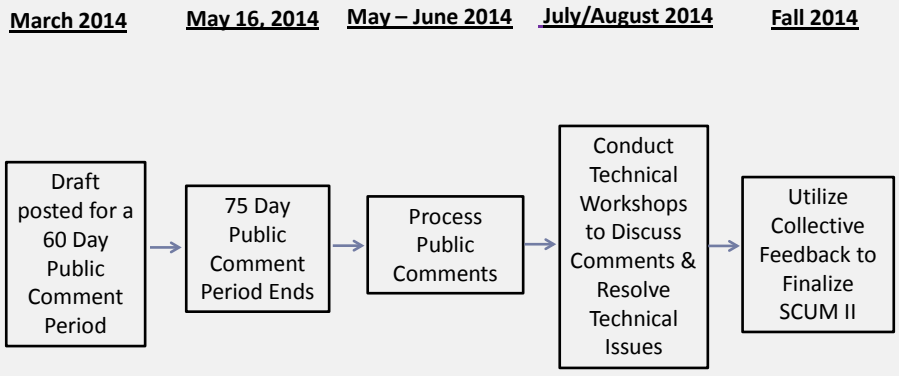
- **Purpose.** Provide an opportunity for Ecology to collaboratively work with people to resolve key issues to finalize SCUM II.

- **Logistics:** Workshops will be held at the Ecology Bellevue Office from 9 AM – 1 PM.

| July 17, 2014 | July 31, 2014 | August 6, 2014 |
|---|---|---|
| Screening CoCs | Remedial Investigations | Establishing Cleanup Levels |
| Natural/Regional Background | Human/Ecological Health Risk Assessments | Remedy Selection |
| Compliance Monitoring | Bioavailability | Sediment Recovery Zones |

pp-1-12

## SCUM II Timeline & Next Steps




pp-1-13

## SCUM II – Future Opportunities for Revisions

- SCUM II is intended to be a “living” guidance document.
- Regular and focused revisions will be made through SMARM to:
  - Reflect newer science as appropriate
  - Correct errors as they are discovered
  - Update policy
  - Incorporate lessons learned from experience as the SMS rule and SCUM II are implemented





## Now for something

## completely different……

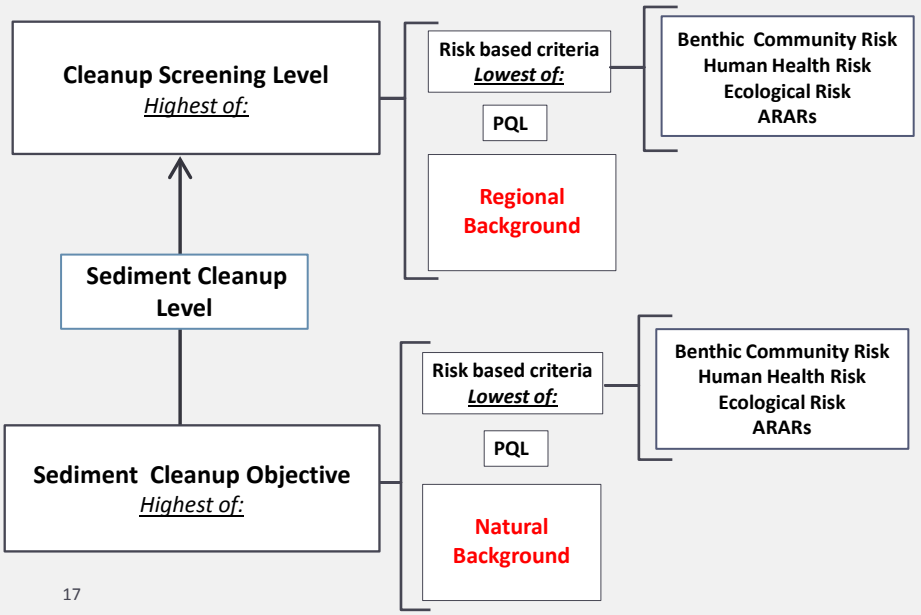
# Regional Background Updates

- Briefly describe the regional background concept.
- Provide context for how and why we're conducting supplemental sampling for Port Gardner based on feedback received.
- Communicate next steps and our timeline for:
  - Completing the Port Gardner regional background work.
  - Completing the Port Angeles data report.
  - Completing the initial development of the LDW SAP.

16

pp-1-16

# Background & SMS rule - Establishing Cleanup Levels




17

pp-1-17

## Intent of Regional Background

- To address the reality of ubiquitous contaminants continuously entering the environment .
- To provide a technically implementable structure to meet and maintain cleanup standards given the potential for recontamination from diffuse and uncontrollable sources.
- Can include some influence from definable sources such as piped stormwater, but not the direct influence (that is, the primary contributor).

18

pp-1-18

## Regional Background - What it is NOT

- Not primarily influenced by definable sources (e.g. a cleanup site).
- Not defined by "recontamination potential" that is primarily from definable sources (e.g. a stormwater discharge from a pipe).
- Cannot solely sample within an area of relatively elevated concentrations due to the direct impact of a definable source. For example:
  - Within the depositional zone of an outfall, if a clear depositional zone exists.
  - Within an established cleanup site (that hasn't been cleaned up).
- Not natural background – if there's a statistically significant difference between regional and natural background.

19

pp-1-19

## Ecology's Regional Background Engagement Process

Port Gardner:

- 2013 Draft SAP reviewed by stakeholders/tribes & discussed at a workshop.
- 2013 data package (data and summary statistics) reviewed by stakeholders.

Port Angeles:

- 2013 Draft SAP reviewed by public & discussed at public meetings.
- 2013 data made available to public.

Elliott Bay / Lower Duwamish Waterway:

- September 2013: Technical workshop to discuss establishing regional background and SAP sampling design options due to feedback received for Port Gardner and Port Angeles work.

20

pp-1-20

## How Ecology Considered Comments

- We considered the collective comments received over the past year on our regional background approaches and decided to re-focus our efforts on **Port Gardner Bay**.
- We analyzed the usefulness and technical feasibility of:
  - Developing a conceptual bay model to guide a more appropriate selection of sampling stations representative of regional background.
  - Conducting alternate types of sampling (sediment traps).
  - Using bay-specific data to define the appropriate distance from the shoreline and historic, current, and potential sources.

21

pp-1-21

## Why Did We Conduct Supplemental Sampling?

- Port Gardner is essentially our “pilot” embayment – it was our first attempt at establishing regional background.
- Your comments and feedback were very helpful. We realized there was room for improvement with this work.
- You helped us rethink the sampling framework and design as well as the intent and SMS rule definition of regional background.
- We want to get this right to see how the lessons learned can be applied to future regional background work.
- This can be the starting template for future work, with the acknowledgement that bay or area specific flexibility is necessary.

22

pp-1-22

## Changes to the Port Gardner Supplemental SAP

- Development of a Conceptual Bay Model to guide the appropriate selection of sampling stations which include: Hydrology, bathymetry, known sites and sources, use of all existing chemistry data and other existing information such as modeling.
- Analyzed all historical data, total organic carbon and grain size distributions to:
  - Exclude areas from sampling.
  - Determine distance from shoreline for sampling locations.
  - Identify potential sources and direct areas of influence.

23

pp-1-23

## These Changes Resulted In:

- Refined sampling area by adding nearshore areas potentially influenced by diffuse urban sources but excluding areas primarily influenced by sites or sources.
- Exclusion of approximately ½ of the original 2013 sampling area (Phase I) to avoid sampling in areas primarily influenced by natural background sources as opposed to the urban environment.
- Combined the remaining Phase I sampling area with the new Phase II sampling area in a statistically appropriate manner.

24

pp-1-24

## Conceptual Bay Model
## Evaluation of Sources, Sites, and Areas of Influence

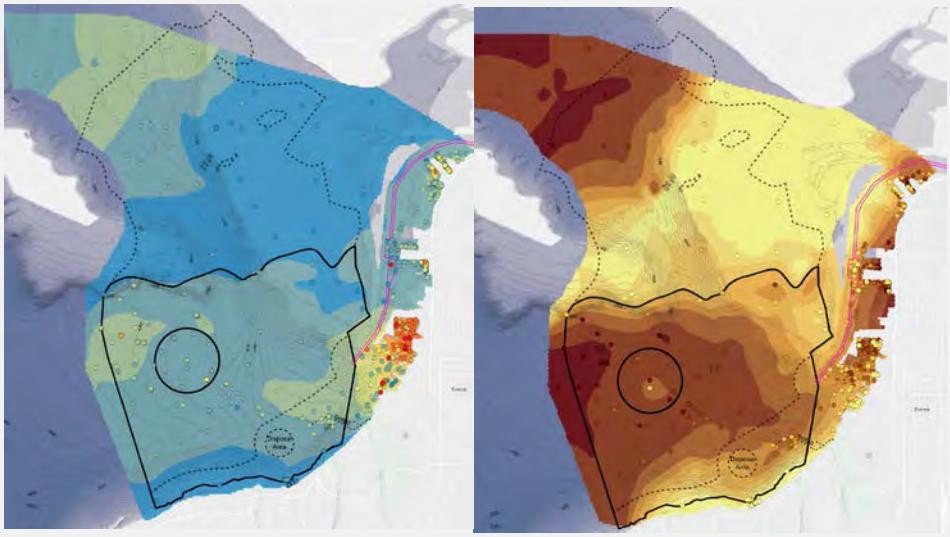
- Ecology is currently focusing on cleaning up ten identified contaminated sites. The influence of these sites was considered.
- Three additional areas of potential influence were further evaluated:
  - Deep water diffuser outfall southwest of Weyerhaeuser Mill A.
  - Historical disposal area (1954 – 1966) - had not been used.
  - Dredged Material Management disposal site - currently active.

25

pp-1-25

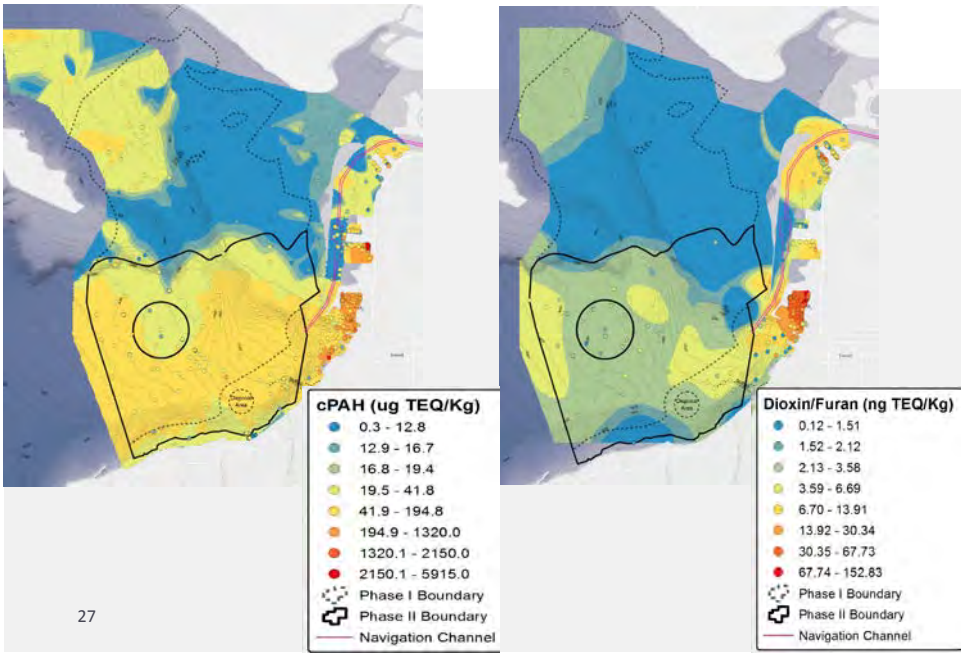
## % Total Organic Carbon & Grain Size Distributions

**Sampling area guided by < 30% fines and < 1% TOC contours (solid line)**
**Original sampling area (dotted line)**



pp-1-26

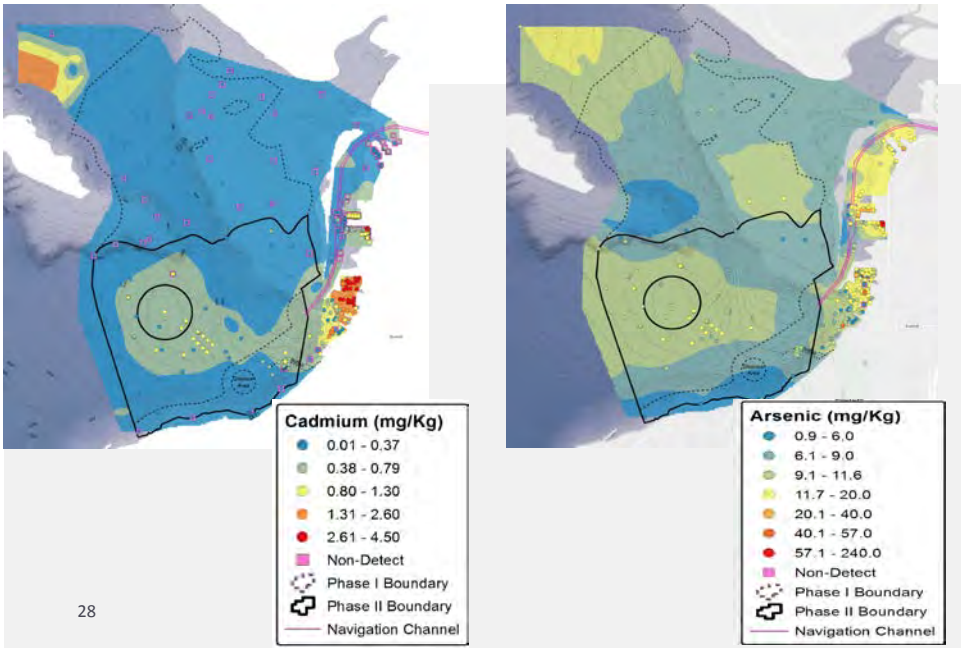
## Existing Sediment Concentrations: cPAHs & Dioxins/Furans




27

pp-1-27

## Existing Sediment Concentrations: Cadmium & Arsenic



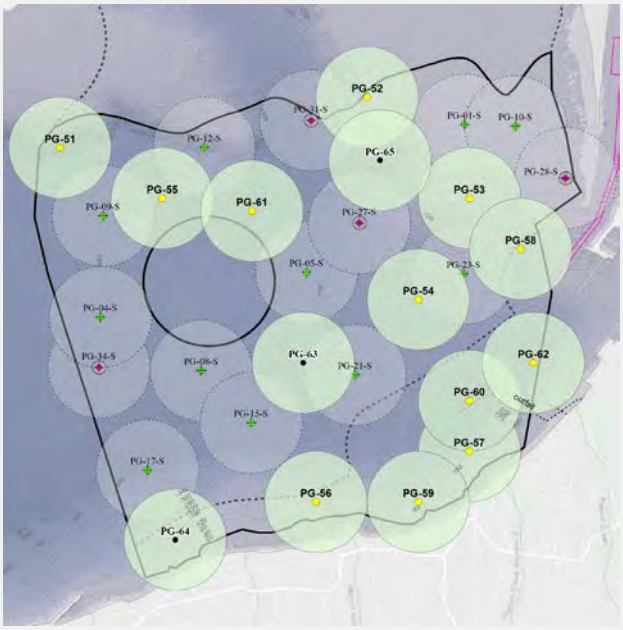

pp-1-28


## Port Gardner Revised Sampling Area

**Original Study Area (White Dotted Line)**

**Revised Study Area (Yellow Solid Line)**

pp-1-29




## Phase II Baseline & Secondary Sampling Locations

**Phase II:**
**12 Baseline Samples**
**3 Secondary Samples**

**Phase I:**
**15 original samples**

30

pp-1-30

## Regional Background/SCUM II Timeline

**Spring 2014** | **Summer 2014** | **Fall / Winter2014**

**Port Gardner**: Supplemental SAP& Field Sampling → Draft Data Report Public Review & Conduct Technical Workshops to Discuss Comments → Finalize Data Report

**Port Angeles**: Draft Data Report Public Review & Public Meetings to Discuss Comments → Finalize Data Report

**Lower Duwamish**:
- **2014** - Continue stakeholder engagement to plan and inform development of the SAP.
- **2015** - Begin SAP development – completion dependent on Green River studies results and complexity of the SAP.

Ongoing in 2015 →

**Draft SCUM II** Public Comment Period → SCUM II Technical Workshops to Discuss & Resolve Comments → Finalize SCUM II

31

pp-1-31

# Implementation of Revised Freshwater Sediment Screening Values

Laura Inouye (Ecology) and the DMMP and RSET agencies

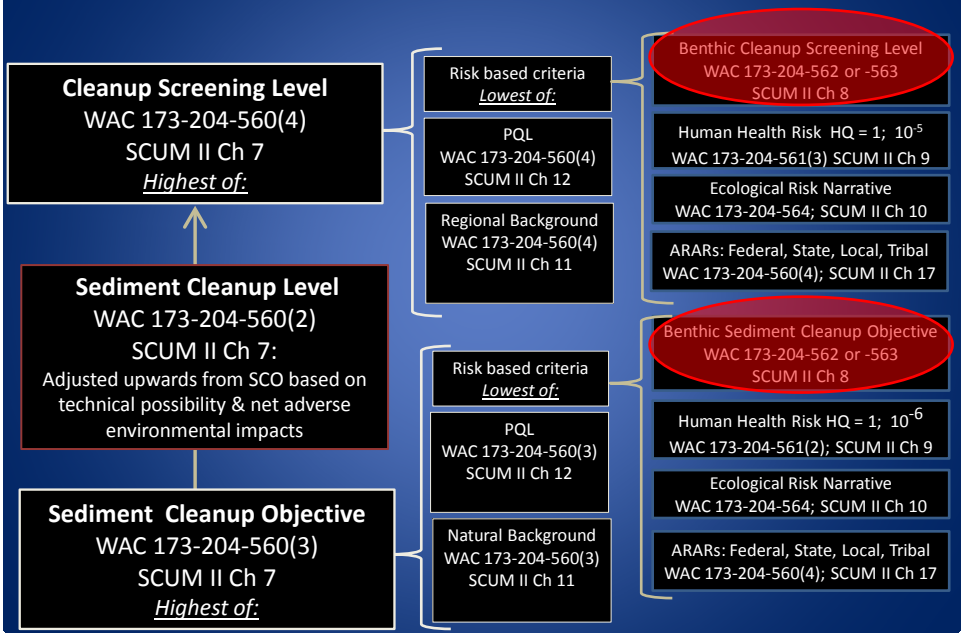
May 7, 2014



## Introduction: a bit of history

- 2002: Ecology evaluated existing freshwater (FW) screening values
- 2003: Ecology published report using the Floating Percentile Method (FPM) to generate FW benthic screening levels
- 2007: RSET freshwater group responded to comments by gathering more data for input into the model (greater geographical coverage and more biological endpoints).
- 2011: Ecology published the final FPM report
- 2013: Ecology adopts the freshwater FPM-derived benthic SQS and CSL values in part V of the SMS rule.

# Introduction: Benthic standards and the SMS rule:




pp-2-3

# Introduction

- Benthic standards and dredging- need to have similar overlays as the rule
- 2013: The RSET Freshwater Technical Working Group intended to propose a multi-tiered approach to address toxicity to other species (fish) and bioaccumulative issues.
  - Use the elutriate test trigger approach (SEF, Chapter 10) to develop water quality-based sediment screening values
  - fish and wildlife-based screening values (including bioaccumulative compounds)
  - background-based screening values (for selected metals).

pp-2-4

# Problem Statements

- The SMS benthic criteria only account for chemical toxicity to benthic invertebrate communities and may not be protective of sensitive fish species and other organisms.
- The water quality criteria-derived SLs described later in this presentation were developed using typical values for water quality parameters (hardness, pH, and TOC). Procedures for site-specific use of SLs needed to be developed.
- The Pacific Northwest region is known to have naturally elevated metals concentrations in large part due to the volcanic nature of this region. In some cases, sediment background concentrations should be taken into consideration.

pp-2-5

# APPROACH

- Multiple SLs
  - Benthic SLs
  - Background
  - WQ-based SLs
  - Fish and bioaccumulative SLs still under development
- Tiered testing procedures for exceedances
  - Based on what SL was exceeded
  - Biological testing
  - Elutriate testing
  - Modeling
  - Development of site-specific SL or background (required agency approval)

pp-2-6

# Benthic FW screening levels

- Benthic screening level development described in in Ecology's publication #11-09-05, "Development of Benthic SQVs for Freshwater Sediments in Washington, Oregon, and Idaho" (Avocet, 2011).
- The development and evaluation of these SLs have been presented in previous SMARMs and will not be covered in this presentation.

pp-2-7

# Benthic freshwater screening levels

| Analyte | ECY BENTHIC SLs | |
|---|---|---|
| | SQS/SL1 | CSL/SL2 |
| *Metals (mg/kg)* | | |
| Arsenic | 14 | 120 |
| Cadmium | 2.1 | 5.4 |
| Chromium | 72 | 88 |
| Copper | 400 | 1200 |
| Lead | 360 | >1300 |
| Mercury | 0.66 | 0.8 |
| Nickel | 26 | 110 |
| Selenium | 11 | >20 |
| Silver | 0.57 | 1.7 |
| Zinc | 3200 | >4200 |

">" values: > "Greater than" value indicates that the toxic level is unknown, but above the concentration shown. If concentrations above this level are encountered, bioassays should be run to evaluate the potential for toxicity.

pp-2-8

# Benthic freshwater screening levels

| Analyte | ECY BENTHIC SLs SQS/SL1 | CSL/SL2 |
|---|---|---|
| *Organic contaminants (ug/kg)* | | |
| 4-Methylphenol | 260 | 2000 |
| Benzoic acid | 2900 | 3800 |
| beta-Hexachlorocyclohexane | 7.2 | 11 |
| bis(2)-Ethylhexyl)phthalate | 500 | 22000 |
| Carbazole | 900 | 1100 |
| Dibenzofuran | 200 | 680 |
| Dibutyltin | 910 | 130000 |
| Dieldrin | 4.9 | 9.3 |
| Di-n-butyl-phthalate | 380 | 1000 |
| Di-n-octyl-phthalate | 39 | >1100 |
| Endrin ketone | 8.5 | ** |
| Monobutyltin | 540 | >4800 |
| Pentachlorophenol | 1200 | >1200 |
| Phenol | 120 | 210 |
| Tetrabutyltin | 97 | >97 |
| DDDs | 310 | 860 |
| DDEs | 21 | 33 |
| DDTs* | 100 | 8100 |
| PAHs | 17000 | 30000 |
| PCB Aroclors | 110 | 2500 |
| Tributyltin | 47 | 320 |
| Bulk Petroleum Hydrocarbons (mg/kg) (NW-TPH method) | | |
| TPH-Diesel | 340 | 510 |
| TPH-Residual | 3600 | 4400 |

pp-2-9

# Benthic freshwater screening levels

Ammonia and Sulfides, listed below, are used only to inform bioassay testing.

| *Conventionals (mg/kg)* | | |
|---|---|---|
| Ammonia | 230 | 300 |
| Total sulfides | 39 | 61 |

- Ammonia and sulfides will not be used to determine suitability of the material for open water disposal or in-water placement.
- Sulfide and ammonia SLs will be used to inform bioassay testing (e.g. special handling to remove ammonia/sulfides prior to bioassays) and water quality monitoring requirements at the dredging site.

pp-2-10

# Water- Quality Criteria-based SLs

- It was recognized that SLs were needed to protect other species
- In the absence of other SLs, it was proposed to use the "Elutriate Trigger" approach in Chapter 10 of the SEF.
- WQ-based SLs are based on equilibrium partitioning, EPA water quality criteria, and reasonably protective assumptions of WQ parameters
  - pH 7
  - Hardness 18.9 mg/L
  - TOC 1%
  - Total suspended solids 100 mg/L

pp-2-11

# Water- Quality Criteria-based SLs

| | ECY BENTHIC SLs | | WQC-BASED SLs (EPA) | |
|---|---|---|---|---|
| *Analyte* | SQS/SL1 | CSL/SL2 | chronic | acute |
| *Metals (mg/kg)* | | | | |
| Arsenic | 14 | 120 | 1900 | 3400 |
| Cadmium | 2.1 | 5.4 | 3.9 | 20 |
| Chromium | 72 | 88 | 2380 | 18330 |
| Copper | 400 | 1200 | 110 | 140 |
| Lead | 360 | >1300 | 160 | 4030 |
| Mercury | 0.66 | 0.8 | 150 | 280 |
| Nickel | 26 | 110 | 510 | 4550 |
| Selenium | 11 | >20 | | |
| Silver | 0.57 | 1.7 | | 15 |
| Zinc | 3200 | >4200 | 3630 | 3600 |

pp-2-12

# Water- Quality Criteria-based SLs

| Analyte | ECY BENTHIC SLs | | WQC-BASED SLs (EPA) | |
|---|---|---|---|---|
| | SQS/SL1 | CSL/SL2 | chronic | acute |
| *Organic contaminants (ug/kg)* | | | | |
| 4-Methylphenol | 260 | 2000 | | |
| Benzoic acid | 2900 | 3800 | | |
| beta-Hexachlorocyclohexane | 7.2 | 11 | | |
| bis(2)-Ethylhexyl)phthalate | 500 | 22000 | | |
| Carbazole | 900 | 1100 | | |
| Dibenzofuran | 200 | 680 | | |
| Dibutyltin | 910 | 130000 | | |
| Dieldrin | 4.9 | 9.3 | 90 | 380 |
| Di-n-butyl-phthalate | 380 | 1000 | | |
| Di-n-octyl-phthalate | 39 | >1100 | | |
| Endrin ketone | 8.5 | ** | | |
| Monobutyltin | 540 | >4800 | | |
| Pentachlorophenol | 1200 | >1200 | 39 | 50 |
| Phenol | 120 | 210 | | |
| Tetrabutyltin | 97 | >97 | | |
| DDDs | 310 | 860 | | |
| DDEs | 21 | 33 | | |
| DDTs* | 100 | 8100 | 7 | |
| PAHs | 17000 | 30000 | | |
| PCB Aroclors | 110 | 2500 | 33 | 4720 |
| Tributyltin | 47 | 320 | 18 | 110 |

pp-2-13

# Background Based SLs

- RSET proposed Willamette upstream data for background (LDWG 2012). However, background varies over geographic areas.
- Data from Ecology's publication #09-03-032 ("Baseline characterization of nine proposed freshwater sediment reference sites, 2008") was used to evaluate Washington sediment metals background

pp-2-14

# Background Based SLs

| Metal (lowest risk-based SL in parentheses) | Willamette sed bkg (95th %ile) | WA sed (90/90UTL) |
|---|---|---|
| **Arsenic (14)** | ~~3.8~~ | **17** |
| Cadmium (2.1) | 0.2 | 0.7 |
| Chromium (72) | 32.7 | 60 |
| **Copper (110)** | ~~38.0~~ | **146** |
| Lead (360) | 14.3 | 53 |
| Mercury (0.66) | 0.1 | 0.22 |
| **Nickel (26)** | ~~26.1~~ | **57** |
| Selenium (11) | 0.4 | 2 |
| **Silver (0.6)** | **0.7** | 0.19 |
| Zinc (459) | 105.0 | 110 |

Metals background appears to be higher in Washington compared to that of Willamette.

To determine which metals may need background based SLs, soil and sediment background data was compared to the benthic and WQ-based SLs.

pp-2-15

# Background Based SLs: Washington Sediment data

- Sediment data for the metals were looked at more closely to determine if they could be used as background.
- Non-normal distribution
- Apparent outliers were present in all but nickel datasets
- In absence of other data, outliers removed and the 90/90 UTL calculated
- Only nickel had background higher than SLs.
- Statistical evaluation indicated that more data is needed for all metals to establish reliable background sediment values.

pp-2-16

# Background Based SLs

| Metal (lowest risk-based SL in parentheses) | Willamette sed bkg (95th %ile) | WA sed (all data) (90/90UTL) | WA sed (outliers removed) (90/90UTL) |
|---|---|---|---|
| Arsenic (14) | 3.8 | 17 | 6.5 |
| Cadmium (2.1) | 0.2 | 0.7 | 0.5 |
| Chromium (72) | 32.7 | 60 | no outliers |
| Copper (110) | 38.0 | 146 | 49 |
| Lead (360) | 14.3 | 53 | 12 |
| Mercury (0.66) | 0.1 | 0.22 | 0.14 |
| **Nickel (26)** | **26.1** | **57** | **no outliers** |
| Selenium (11) | 0.4 | 2 | 0.6 |
| Silver (0.6) | 0.7 | 0.19 | 0.13 |
| Zinc (459) | 105.0 | 110 | no outliers |

pp-2-17

# Background Based SLs: Washington Soil data

- Ecology's publication #94-115 (Natural Background Soil Metals Concentrations in Washington State) was evaluated to determine if it could provide an interim SL
- 90th percentile = 38 ppm
- Soil data will be adopted until sufficient sediment data is available to develop statistically supported sediment background.

pp-2-18

# Background Based SLs

| Metal (lowest risk-based SL in parentheses) | Willamette sed bkg (95th %ile) | WA sed (all data) (90/90UTL) | WA sed (outliers removed) (90/90UTL) | WA soil (90th %ile) |
|---|---|---|---|---|
| Arsenic (14) | 3.8 | 17 | 6.5 | 7 |
| Cadmium (2.1) | 0.2 | 0.7 | 0.5 | 1 |
| Chromium (72) | 32.7 | 60 | no outliers | 42 |
| Copper (110) | 38.0 | 146 | 49 | 36 |
| Lead (360) | 14.3 | 53 | 12 | 17 |
| Mercury (0.66) | 0.1 | 0.22 | 0.14 | 0.04 |
| **Nickel (26)** | **26.1** | **57** | **no outliers** | **38** |
| Selenium (11) | 0.4 | 2 | 0.6 | na |
| Silver (0.6) | 0.7 | 0.19 | 0.13 | na |
| Zinc (459) | 105.0 | 110 | no outliers | 85 |

pp-2-19

# The FW Screening Level Table

| Analyte | ECY BENTHIC SLs | | WQC-BASED SLs (EPA) | | WA-specific metal background |
|---|---|---|---|---|---|
| | SQS/SL1 | CSL/SL2 | chronic | acute | |
| *Metals (mg/kg)* | | | | | |
| Arsenic | 14 | 120 | 1900 | 3400 | |
| Cadmium | 2.1 | 5.4 | 3.9 | 20 | |
| Chromium | 72 | 88 | 2380 | 18330 | |
| Copper | 400 | 1200 | 110 | 140 | |
| Lead | 360 | >1300 | 160 | 4030 | |
| Mercury | 0.66 | 0.8 | 150 | 280 | |
| Nickel | 26 | 110 | 510 | 4550 | 38 (*interim*) |
| Selenium | 11 | >20 | | | |
| Silver | 0.57 | 1.7 | | 15 | |
| Zinc | 3200 | >4200 | 3630 | 3600 | |

SL is the lowest risk-based value (benthic or WQ-based SL) unless background is higher than risk (nickel)

SL2 or acute WQ-based SL: used primarily for antidegradation evaluations

pp-2-20

## Using the FW Screening Level Table

- If project sediment data are below all SLs, then the material is suitable for open water disposal or in-water placement and passes antidegradation evaluation.
- If project sediment data exceed one or more screening levels, then the material is considered unsuitable unless further evaluation is conducted.

pp-2-21

## Using the FW Screening Level Table

- Tiered testing options based on which SL was exceeded
- Benthic SL:  Bioassays
  - Details covered in next talk!

pp-2-22

# Using the FW Screening Level Table

- Tiered testing options based on which SL was exceeded
- Water Quality-based SL
  - Elutriate tests: details of testing may differ depending on informational needs (whether WQ criteria are based on whole water or dissolved phase).
  - Development of site-specific water quality criteria and SLs based on site specific pH, hardness, and/or TOC
    - Spreadsheet available
    - Subject to approval by the agencies
  - Site specific modeling to determine if water quality criteria will be met at the point of compliance

pp-2-23

# Using the FW Screening Level Table

- Tiered Testing Options

| comparison | CoCs | If the SL is exceeded, material is unsuitable for open water disposal/placement* unless the appropriate tiered testing listed below passes | Pass SL |
|---|---|---|---|
| Benthic SL | all compounds | Bioassay testing- must use both species (*Hyalella* and *Chironomus*), at least one chronic exposure, and at least one sub-lethal (growth) endpoint. | If a sample is at or below all SLs, then the material is suitable for dredging/disposal/in-water placement and meets the antidegradation standard. However, when ESA-listed species are present, the Federal action agency may need to contact NMFS and/or USFWS (as appropriate) to discern whether additional analyses are needed, and whether those analyses should be done as part of an ESA consultation. |
| WQC-based SL | metals, dieldrin, PCP, sum DDT, PCB Aroclors, TBT | WQC-based testing options- elutriate tests show WQC will be met; develop and pass site- specific WQC SL; or model to show standards will be met at the point of compliance. | |

pp-2-24

# Using the FW Screening Level Table

- Antidegradation
  - DMMP 2008 clarification paper
  - Both benthic and WQ-based SLs would be considered

pp-2-25

# Impact Analysis

- 12 projects between 2009 and 2013
- 43 DMMUs evaluated
- Columbia River, Lake Washington and Lake Union

| | All COCs are less than or equal to proposed SLs | One or more detected exceedance of proposed SLs | One or more non-detects exceed proposed SLs |
|---|---|---|---|
| All COCs are less than or equal to 2006 SLs | 6 | 2 (Ni) | 12 (5 Ag, 5 PCP, 2 PCB) |
| One or more detected exceedance of 2006 SLs | 0 | 16 | 3 (PCP) |
| One or more non-detects exceeded 2006 SLs | 0 | 1 (2006 Hg, proposed Ni) | 3 |

pp-2-26

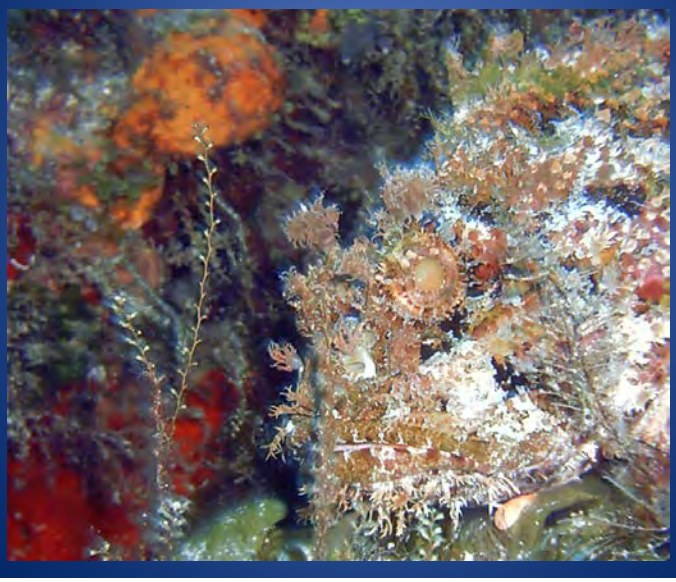
| Analyte | ECY BENTHIC SLs | | WQC-BASED SLs (EPA) | | WA-specific metal background |
|---|---|---|---|---|---|
| | SQS/SL1 | CSL/SL2 | chronic | acute | |
| *Organic contaminants (ug/kg)* | | | | | |
| 4-Methylphenol | 260 | 2000 | | | |
| Benzoic acid | 2900 | 3800 | | | |
| eta-Hexachlorocyclohexane | 7.2 | 11 | | | |
| bis(2)-Ethylhexyl)phthalate | 500 | 22000 | | | |
| Carbazole | 900 | 1100 | | | |
| Dibenzofuran | 200 | 680 | | | |
| Dibutyltin | 910 | 130000 | | | |
| Dieldrin | 4.9 | 9.3 | 90 | 380 | |
| Di-n-butyl-phthalate | 380 | 1000 | | | |
| Di-n-octyl-phthalate | 39 | >1100 | | | |
| Endrin ketone | 8.5 | ** | | | |
| Monobutyltin | 540 | >4800 | | | |
| Pentachlorophenol | 1200 | >1200 | 39 | 50 | |
| Phenol | 120 | 210 | | | |
| Tetrabutyltin | 97 | >97 | | | |
| DDDs | 310 | 860 | | | |
| DDEs | 21 | 33 | | | |
| DDTs* | 100 | 8100 | 7 | | |
| PAHs | 17000 | 30000 | | | |
| PCB Aroclors | 110 | 2500 | 33 | 4720 | |
| Tributyltin | 47 | 320 | 18 | 110 | |
| Bulk Petroleum Hydrocarbons (mg/kg) (NW-TPH method) | | | | | |
| TPH-Diesel | 340 | 510 | | | |
| TPH-Residual | 3600 | 4400 | | | |

* Elutriate-based DDT value is based on the sum of sum of o,p'- and p,p'-DDXs
** no SL2 available

- Unless there is a reason to believe that PCP may be present at the dredge location, standard analytical method should be used.
- Data must be reported to MDL.
- Only detected exceedances will trigger tiered testing.

pp-2-27

# QUESTIONS?



pp-2-28

# Freshwater Bioassays

Laura Inouye (Ecology), for the RSET and DMMP agencies

May 7, 2014

pp-3-1

# Introduction

- The floating percentile model (FPM) used to develop the new Washington State freshwater sediment standards (WAC 173-204-563) used input from both acute (10-day *Chironomus* and *Hyalella*) and chronic (28-day *Hyalella*) tests.
- The resulting standards were based on the most sensitive test, which was often the chronic 28-day *Hyalella* growth bioassay.

pp-3-2

# Problem Statement

- Currently, the Sediment Evaluation Framework for the Pacific Northwest (SEF 2009) and the DMMP User Manual (DMMP 2013) require only short-term bioassays (10-day) using either *Hyalella* or *Chironomus.*
- The SEF and the DMMP User Manual should be consistent with the standards in requiring at least one chronic exposure measuring a sublethal endpoint

pp-3-3

# Proposed Modifications

Requirements for freshwater sediment:

- Two different test species
- Three endpoints
- One chronic test; and
- One sublethal endpoint

Typical combination:

- One 10-day mortality test
- One chronic test with mortality and growth

| Species, biological test, and endpoint | Acute effects biological test | Chronic effects biological test | Lethal effects biological test | Sub-lethal effects biological test |
|---|---|---|---|---|
| Amphipod: *Hyallela azteca* | | | | |
| 10-Day mortality | X | | X | |
| 28-Day mortality | | X | X | |
| 28-Day growth | | X | | X |
| Midge: *Chironomus dilutus* | | | | |
| 10-Day mortality | X | | X | |
| 10-Day growth | X | | | X |
| 20-Day mortality | | X | X | |
| 20-Day growth | | X | | X |

pp-3-4

# Proposed Modifications

Bioassay protocols

Acute Effects Tests

- Hyalella azteca 10-day mortality: ASTM E1706-05 (2010)/EPA Method 100.1 (US EPA, 2000)
- Chironomus dilutus 10-day mortality: ASTM E1706-05 (2010)/EPA Method 100.2 (US EPA, 2000)
- Chironomus dilutus 10-day growth: ASTM E1706-05 (2010)/EPA Method 100.2 (US EPA, 2000)

Chronic Effects Tests

- Hyalella azteca 28-day mortality: EPA Method 100.4 (US EPA, 2000)
- Hyalella azteca 28-day growth: EPA Method 100.4 (US EPA, 2000)
- Chironomus dilutus 20-day mortality: EPA Method 100.5 (US EPA, 2000)
- Chironomus dilutus 20-day growth: EPA Method 100.5 (US EPA, 2000)

pp-3-5

# Proposed Modifications

Bioassay protocols

- Unlike marine biological criteria, the freshwater biological criteria are based on a comparison to control treatments

- Due to the lack of established freshwater reference sites in Washington.

- Not necessary to collect reference sediments for freshwater bioassays.
  - Dredging projects wishing to use reference sediments must have the reference location approved prior to collection of the reference sediments.

pp-3-6

# Proposed Modifications

## Bioassay Performance Standards

| Biological Test/ Endpoint | Performance Standard | |
|---|---|---|
| | Control* | Reference |
| *Hyalella azteca* | | |
| 10-day mortality | $M_C \leq 20\%$ | $M_R \leq 25\%$ |
| 28-day mortality | $M_C \leq 20\%$ | $M_R \leq 30\%$ |
| 28-day growth | $MIG_C \geq 0.15$ mg/individual | $MIG_R \geq 0.15$ mg/individual |
| *Chironomus dilutus* | | |
| 10-day mortality | $M_C \leq 30\%$ | $M_R \leq 30\%$ |
| 10-day growth | $MIG_C \geq 0.48$ mg/individual | $MIG_R/MIG_C \geq 0.8$ |
| 20-day mortality | $M_C \leq 32\%$ | $M_R \leq 35\%$ |
| 20-day growth | $MIG_C \geq 0.60$ mg/individual | $MIG_R/MIG_C \geq 0.8$ |

M = Mortality; C = Control; R = Reference; T = Test; F = Final; MIG = Mean Individual Growth at time final; mg = milligrams.

* ASTM is currently considering updating performance standards. Ecology will adopt the new performance standards once they are released.

pp-3-7

# Proposed Modifications

## Hit definitions: 2-hit and 1 hit interpretive criteria

| Biological Test/ Endpoint | Sediment Cleanup Objective for each biological test (2 hit criteria) | Cleanup Screening Level for each biological test (one hit criteria) |
|---|---|---|
| *Hyalella azteca* | | |
| 10-day mortality | $M_T - M_C > 15\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 28-day mortality | $M_T - M_C > 10\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 28-day growth | $(MIG_C - MIG_T)/MIG_C > 0.25$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.40$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |

M = Mortality; C = Control; R = Reference; T = Test; F = Final; MIG = Mean Individual Growth at time final; mg = milligrams; SD=significant difference.

pp-3-8

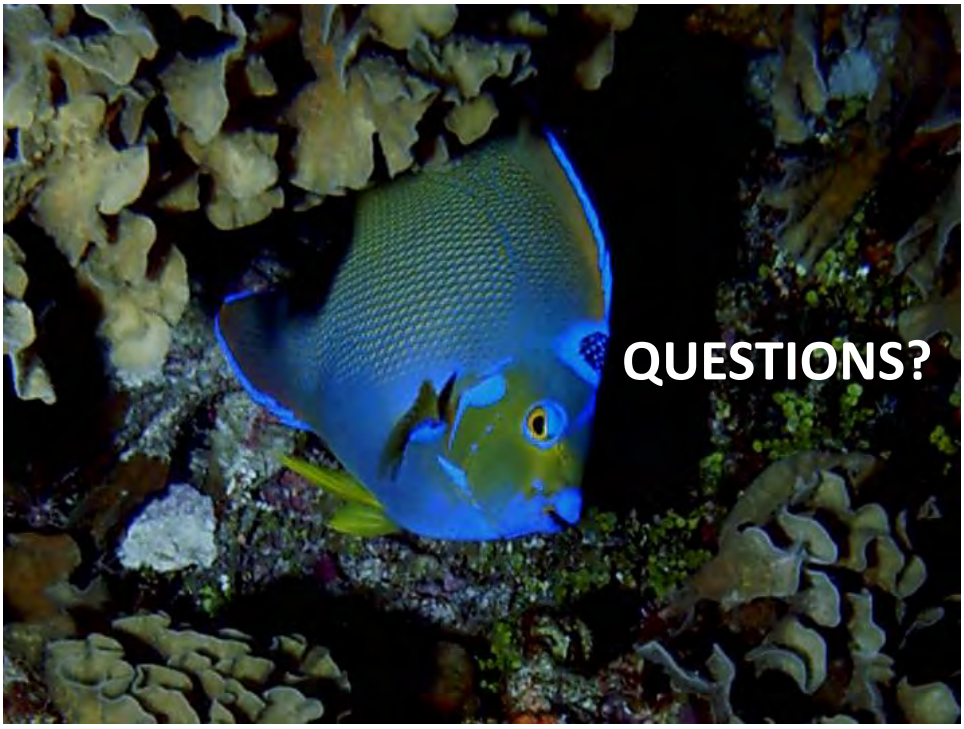
# Proposed Modifications

## Hit definitions: 2-hit and 1 hit interpretive criteria

| Biological Test/ Endpoint | Sediment Cleanup Objective for each biological test (2 hit criteria) | Cleanup Screening Level for each biological test (one hit criteria) |
|---|---|---|
| *Chironomus dilutus* | | |
| 10-day mortality | $M_T - M_C > 20\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 30\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 10-day growth | $(MIG_C - MIG_T)/MIG_C > 0.20$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.30$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |
| 20-day mortality | $M_T - M_C > 15\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 20-day growth | $(MIG_C - MIG_T)/MIG_C > 0.25$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.40$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |

M = Mortality; C = Control; R = Reference; T = Test; F = Final; MIG = Mean Individual Growth at time final; mg = milligrams; SD=significant difference.

pp-3-9




pp-3-10

# DMMP Project Evaluation Activities

Dredging Year 2014

David Fox, P.E.
US Army Corps of Engineers
Seattle District

pp-4-1

# Dredging Year Actions

- DY 2014:
  16 June 2013 to 15 June 2014
- Decision Documents:
  - Suitability Determinations
  - Others:
    - Recency Extensions
    - Tier 1 Evaluations
    - Volume Revisions/Design Modifications
    - Antidegradation Determinations

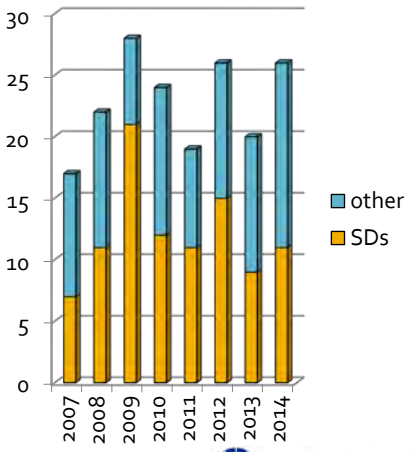
pp-4-2

# DY14 Completed Actions

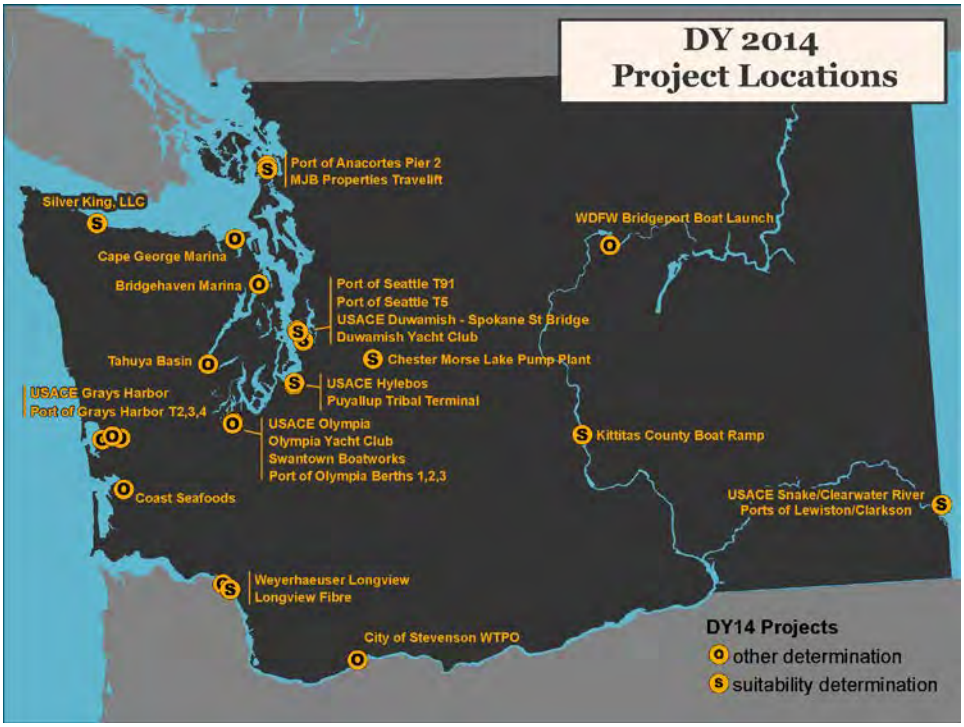
Suitability Determinations (11)

Others (15):

- Volume Revision/Design Modification (2)
- Recency Extensions (4)
- Antidegradation (1)
- Tier 1/No Test (6)
- Dioxin Re-evaluation (2)




pp-4-3




pp-4-4

# DY14 Testing

- Out of 26 completed actions:
  - 12 projects - chemical testing
  - 9 projects - dioxin testing
  - 2 projects - bioassays
  - *No* bioaccumulation testing
  - 6 projects – antidegradation testing

pp-4-5

# Projects with guideline exceedances
## (excluding dioxin)

| Project | Chemicals |
|---|---|
| Duwamish Yacht Club | diethyl phthalate, butyl benzyl phthalate, total chlordane |
| Kittitas County Boat Ramp | cadmium |
| Port of Seattle T5 | TBT, PCBs, mercury |
| Port of Seattle T91 | TBT, PCBs, PAHs, mercury |
| USACE Hylebos | TBT, PCBs; 2,4-dimethylphenol, hexachlorobenzene, hexachlorobutadiene, dieldrin |
| USACE Snake/Clearwater | phenol, 4-methylphenol |

pp-4-6

# Dioxin Testing DY14

- 6 projects had failures based on dioxin or partially due to dioxin
  - Duwamish Yacht Club
  - MJB Properties Travelift – Anacortes
  - Port of Olympia Berths 1,2,3 (AD testing only)
  - Port of Seattle T5
  - Port of Seattle T91
  - USACE Hylebos
- 3 projects passed dioxin guidelines for all material (Longview Fibre, Silver King, Spokane St. Bridge)



# Biological Testing DY14

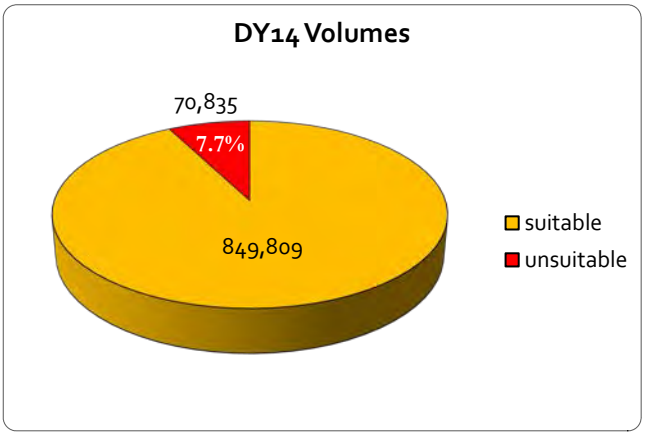
- 2 projects tested:
  - Kittitas County Boat Ramp (cadmium)
  - USACE Snake/Clearwater River (phenol; 4-methylphenol)
- freshwater bioassays conducted
- no hits

# Projects with Unsuitable Dredged Material

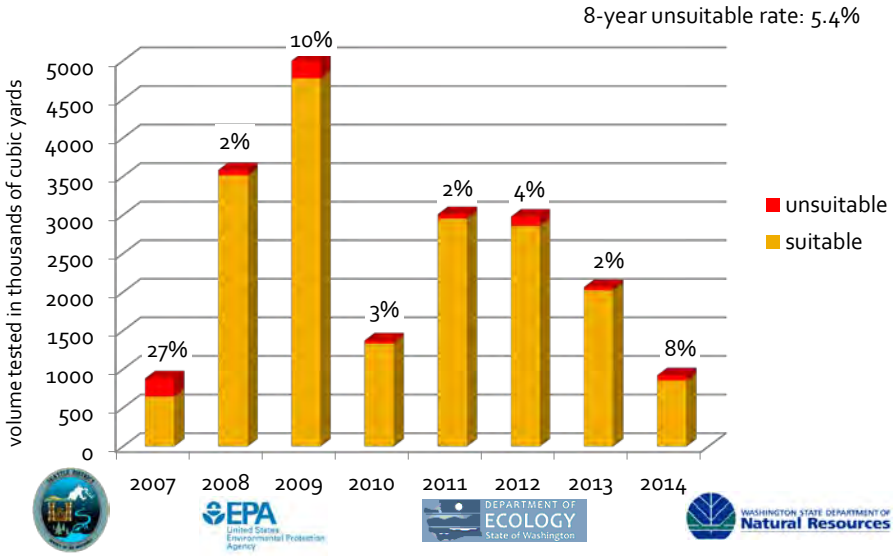
| Project | Suitable (cy) | Unsuitable (cy) | Reason |
|---|---|---|---|
| Duwamish Yacht Club | 20,250 | 7,900 | primarily dioxin |
| MJB Travelift | 0 | 1,350 | dioxin |
| Port of Seattle T5 | 0 | 7,490 | TBT, dioxin, PCBs, Hg |
| Port of Seattle T91 | 0 | 2,200 | TBT, dioxin, PCBs, PAHs, Hg |
| USACE Hylebos | 0 | 47,445 | primarily dioxin |



# Suitability of Volume Tested

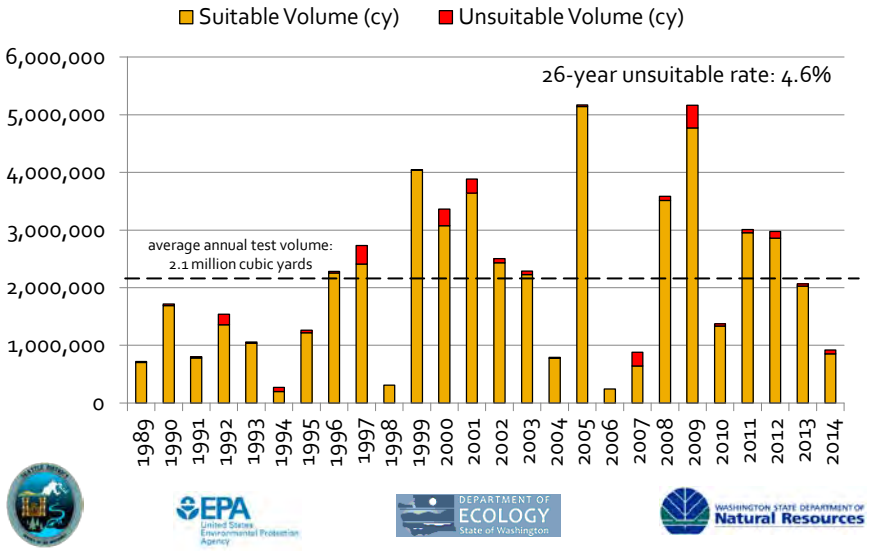


# Multiyear Comparison




pp-4-11

# DMMP Testing History



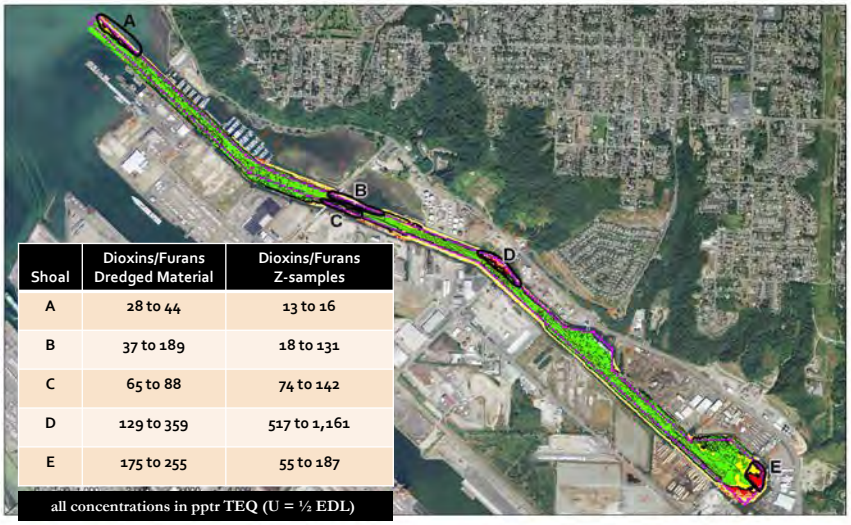

pp-4-12

# Antidegradation Testing

| Project | Outcome | Remedy |
|---|---|---|
| Duwamish Yacht Club | partial failure (one-third of the area) | overdredge and cover |
| Port of Olympia Berths 1,2,3 | fail | overdredge and cover |
| Swantown Boatworks | pass | no action needed |
| Port of Seattle T5 | partial failure (half the area) | overdredge and cover |
| Port of Seattle T91 | fail | to be determined |
| USACE Hylebos | fail | will not be dredged |

pp-4-13

# USACE Hylebos - Dioxin




| Shoal | Dioxins/Furans Dredged Material | Dioxins/Furans Z-samples |
|---|---|---|
| A | 28 to 44 | 13 to 16 |
| B | 37 to 189 | 18 to 131 |
| C | 65 to 88 | 74 to 142 |
| D | 129 to 359 | 517 to 1,161 |
| E | 175 to 255 | 55 to 187 |

all concentrations in pptr TEQ (U = ½ EDL)

pp-4-14

# Projects underway, but incomplete

Cenex Harvest States, Kennewick*
City of Renton, Cedar River
La Conner Marina
Northwest Grain Growers, Wallula*
Port Gamble Restoration
Port of Tacoma Pier 4
Shelter Bay Marina
USACE Kenmore*
USACE Westhaven Cove, Westport*
USACE Willapa Bay*
US Navy Electromagnetic Measurement Ranging

*pre-SAP stage






# DMMO website

- All DMMP evaluation documents
- Biennial reports – including DY12/DY13

- Website URL:
- http://www.nws.usace.army.mil
  - Search for: Dredged Material Management





Questions ?

pp-4-17


DMMP CLARIFICATIONS &
UPDATES
SMARM 2014
Lauran Warner
Dredged Material Management Office

pp-5-1

## Clarification

- Recency/Frequency

pp-5-2

## Recency/Frequency

- **Recency** = duration of time for which chemical and biological characterization data continue to be representative of the material to be dredged

- **Frequency** = extent of time a given dredging project can be maintained with repeated dredging without further testing

pp-5-3

## Recency

| Rank | Present Guidelines | Proposed Guidelines |
|---|---|---|
| Low | 7 | 7 |
| Low-Moderate | 6 | 6 |
| Moderate | 5 | 5 |
| High | 2 | 3 |

pp-5-4

## Frequency

- tested material already dredged
- testing results still considered representative
- additional cycles of dredging without further testing until expiration of the frequency period.
- Proposed change: include concept in "Recency"; drop "Frequency" term

pp-5-5

# Updates

1. Puget Sound Sediment Reference Material (SRM)
2. Ammonia/sulfides in bioassays
3. Status of EIM transition
4. EPA dioxin/furan validation guidelines
5. Larval rockfish genetic species ID

US Army Corps of Engineers | Natural Resources | ECOLOGY | EPA

pp-5-6

# 1. Puget Sound SRM

Technical Memorandum: Development and Production of the Puget Sound Sediment Reference Material SR0431

EPA SRM Manager: Donald Brown
Brown.DonaldM@epa.gov

Updated guidance on DMMP website


pp-5-7

## Puget Sound SRM

| DY | Bottles Requested | # of Projects | Projects from | Data received |
|---|---|---|---|---|
| 2012 | 5 | 3 | 1 DMMP<br>1 EPA<br>1 Ecology | 2/3 |
| 2013 | 38 | 21 | 11 DMMP<br>3 EPA<br>7 Ecology | 13/21 |
| 2014 | 15 | 10 | 7 DMMP<br>1 EPA<br>2 Ecology | 3/10 |

pp-5-8

## SRM: *Required* Deliverables

1. Data Validation Report
2. Electronic Data Deliverable (EDD)
3. SRM Sample Data Summary Report

- CAS numbers
- Laboratory name
- Project number
- Project name
- Sample ID number (SRM bottle bar code)
- Agency sample number (if applicable)
- Laboratory sample number
- Date SRM received by the lab
- Date and time of analysis
- For Aroclor data, lab RLs and MDLs
- For Chlorinated Biphenyl Congener and Dioxin/Furan data, RLs and EDLs
- Laboratory qualifiers and definitions
- Validation qualifiers

pp-5-9

## 2. Ammonia/Sulfides in Bioassays

- Paper presented last year will NOT be implemented programmatically
- Will be addressed on a project/specific basis

US Army Corps of Engineers | Natural Resources | Department of Ecology | EPA

pp-5-10

## 3. DAIS to EIM transition

**FINISHED!**

(For the most part)

- Some bioaccumulation and monitoring data still need to be added
- DMMO PMs submit project data to EIM

US Army Corps of Engineers | Natural Resources | Department of Ecology | EPA

pp-5-11

## 4. EPA Dioxin/Furan Validation Guidelines

Now available:

*Data Validation and Review Guidelines for Polychlorinated Dibenzo-p-Dioxin and Polychlorinated Dibenzofuran (PCDD/PCDF) Data Using Method 1613B and SW846 Method 8209A*

for copies, contact Ginna Grepo-Grove at grepo-grove.gina@epa.gov

pp-5-12

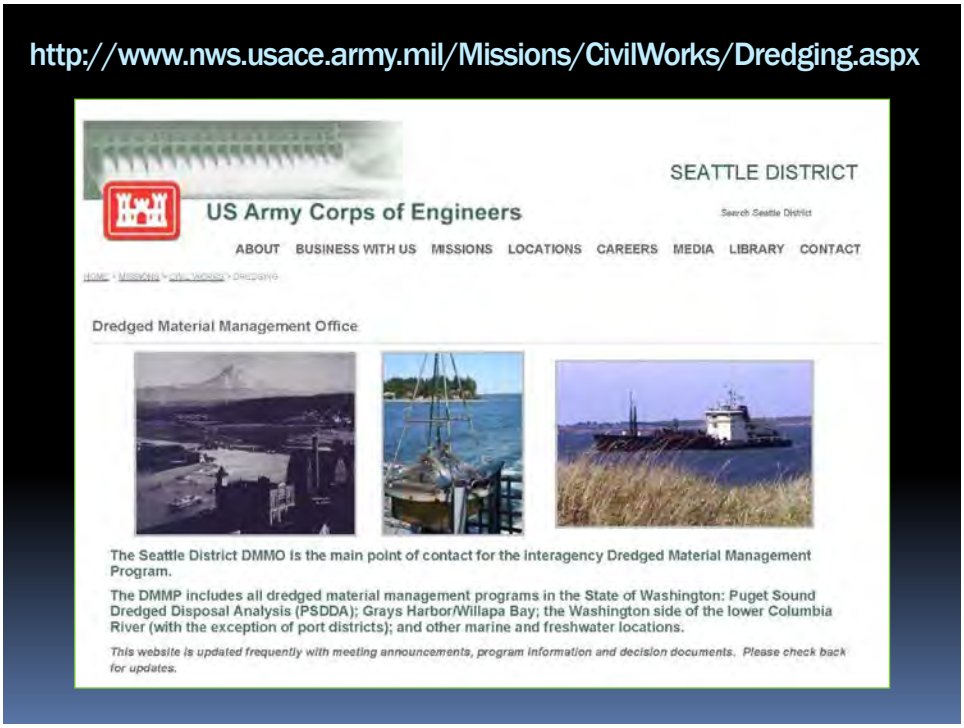
## 5. Larval rockfish genetic species ID

- Disposal effect to ESA-listed species?
- From 2012 study, have 217 preserved larval rockfish
- None are boccacio; no other species ID visually possible

pp-5-13


To be updated after SMARM comment period
Dredged Material Evaluation and Disposal Procedures
USER MANUAL
July 2013
US Army Corps of Engineers
Natural Resources
ECOLOGY
EPA

pp-5-14


http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging.aspx
SEATTLE DISTRICT
US Army Corps of Engineers
ABOUT BUSINESS WITH US MISSIONS LOCATIONS CAREERS MEDIA LIBRARY CONTACT
Dredged Material Management Office
The Seattle District DMMO is the main point of contact for the interagency Dredged Material Management Program.
The DMMP includes all dredged material management programs in the State of Washington: Puget Sound Dredged Disposal Analysis (PSDDA); Grays Harbor/Willapa Bay; the Washington side of the lower Columbia River (with the exception of port districts); and other marine and freshwater locations.
This website is updated frequently with meeting announcements, program information and decision documents. Please check back for updates.

pp-5-15

## Questions?

pp-5-16

# Disposal Site Monitoring Results

Celia Barton, WDNR
David Fox, USACE

SMARM
May 7, 2014

pp-6-1

# Highlights of 2014

- Multibeam and SPI at Elliott Bay and Commencement Bay
- Partial Monitoring at Elliott Bay
- Targeted Disposal at Elliott Bay
- Multibeam at Anderson/Ketron
- Disposal modeling at Anderson/Ketron
- Future trawls at Anderson/Ketron

pp-6-2

Puget Sound:

- 8 disposal sites
  - 5 non-dispersive sites
  - 3 dispersive sites

Grays Harbor / Willapa:

- 4 estuarine and 1 ocean disposal sites
  - All dispersive sites


pp-6-3

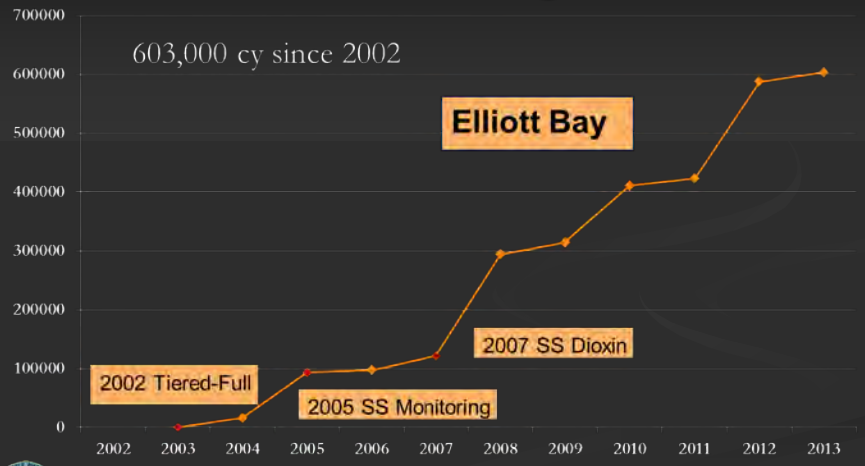
# Site Monitoring

Moved to volume based monitoring trigger in 1997 and reduced frequency and scope of monitoring based on past documented compliance with site management objectives.

- Following 2002 SMARM increased disposal volume trigger to 500,000 cubic yards at Commencement Bay, Elliott Bay and Port Gardner
- Corps lead on Physical Monitoring, DNR lead on Chemical and Biological Monitoring

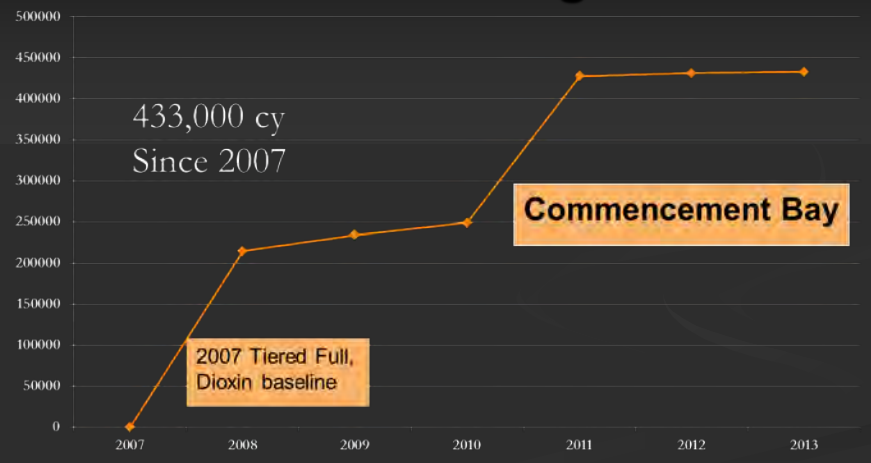
pp-6-4

# Cumulative Volumes Since Last Monitoring




pp-6-5

# Cumulative Volumes Since Last Monitoring

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pp-6-6

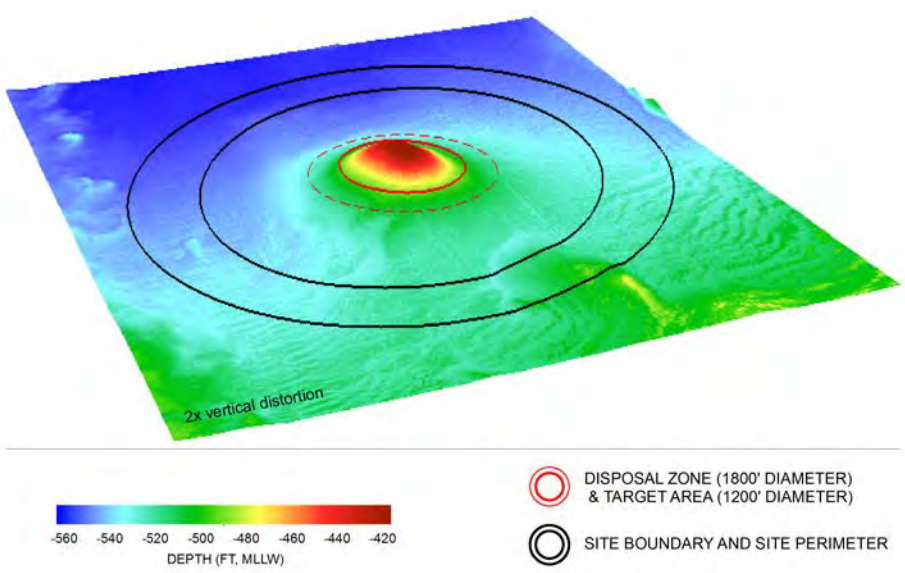
# Monitoring in DY14

- Volume trigger met at Elliott Bay
  - Partial Monitoring
    - 25 year monitoring history, effectiveness of characterization
    - Physical and Environmental monitoring
- Disposal coordinates at Commencement Bay site target were shifted in 2007
  - 565 feet southeast of center
  - Physical monitoring in 2014 to check on effects

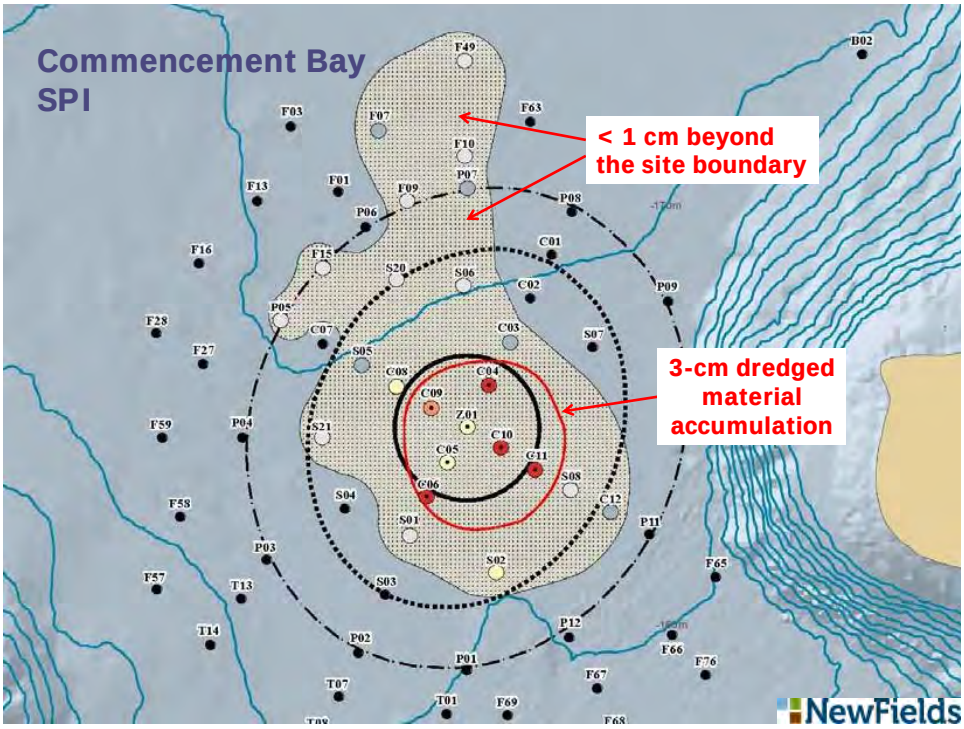
United States Environmental Protection Agency | Department of Ecology | Washington State Department of Natural Resources

pp-6-7

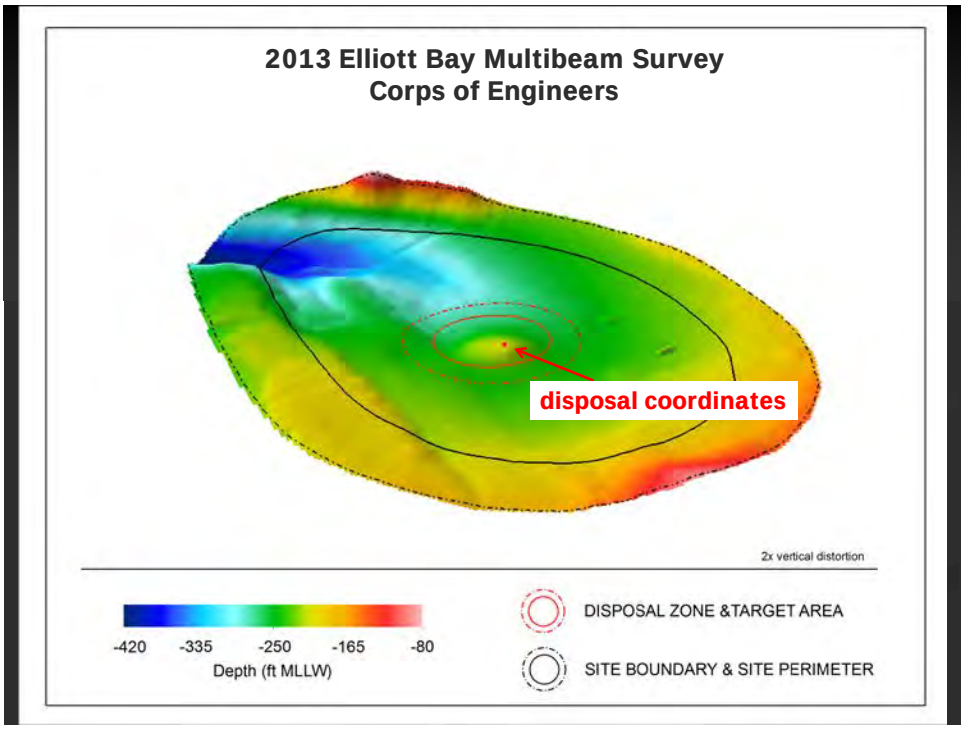
**2013 Commencement Bay Multibeam Survey**
**Corps of Engineers**



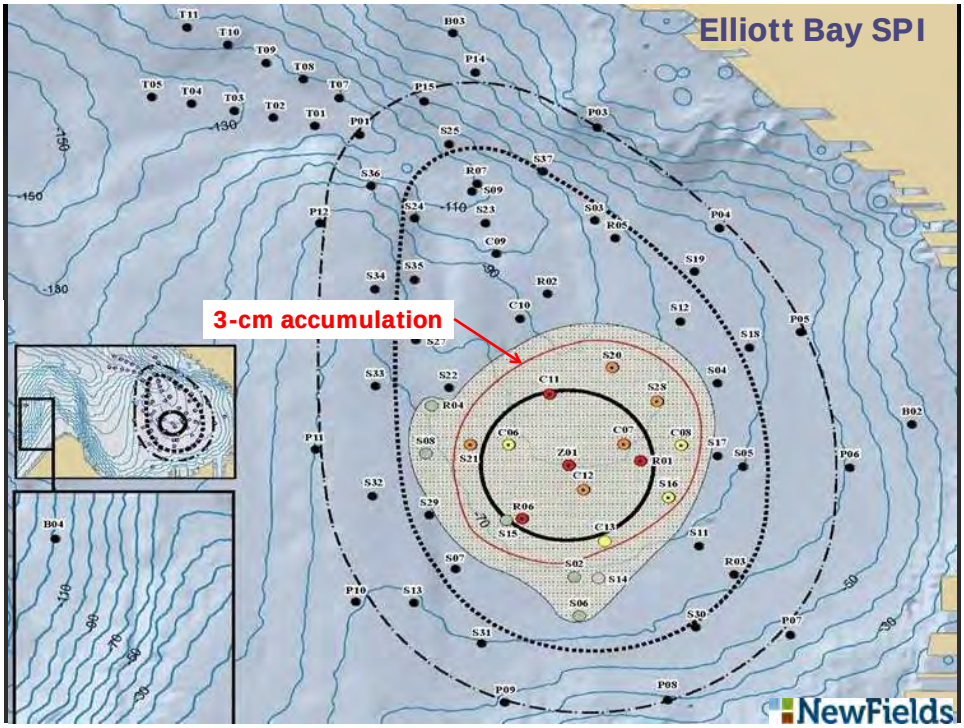

pp-6-8




pp-6-9


2013 Elliott Bay Multibeam Survey
Corps of Engineers
disposal coordinates
2x vertical distortion
-420
-335
-250
-165
-80
Depth (ft MLLW)
DISPOSAL ZONE &TARGET AREA
SITE BOUNDARY & SITE PERIMETER

pp-6-10


Elliott Bay SPI
3-cm accumulation
NewFields

pp-6-11

# 2013 Elliott Bay Partial Monitoring

- PSDDA Monitoring Framework
- 2013 Findings
- Recommendations
- Report finalized and posted after SMARM
- Data is in EIM

United States Environmental Protection Agency | Department of Ecology | Washington State Department of Natural Resources

pp-6-12

# PSDDA Monitoring Framework

1. Does dredged material remain onsite?
2. Have biological effects conditions been exceeded?
3. Any adverse effects to offsite biological resources?

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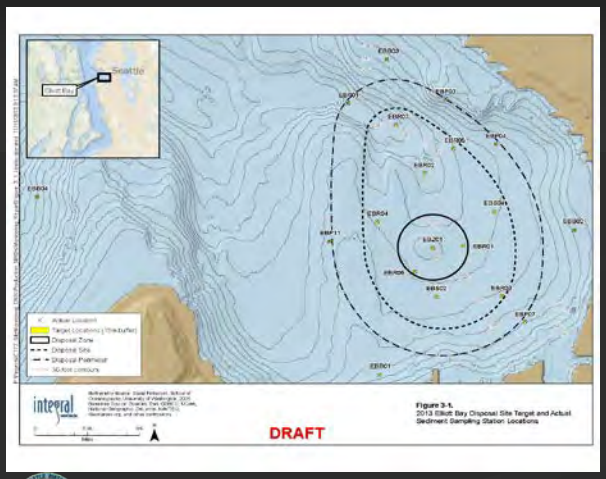
pp-6-13

# 2013 Sediment Sampling



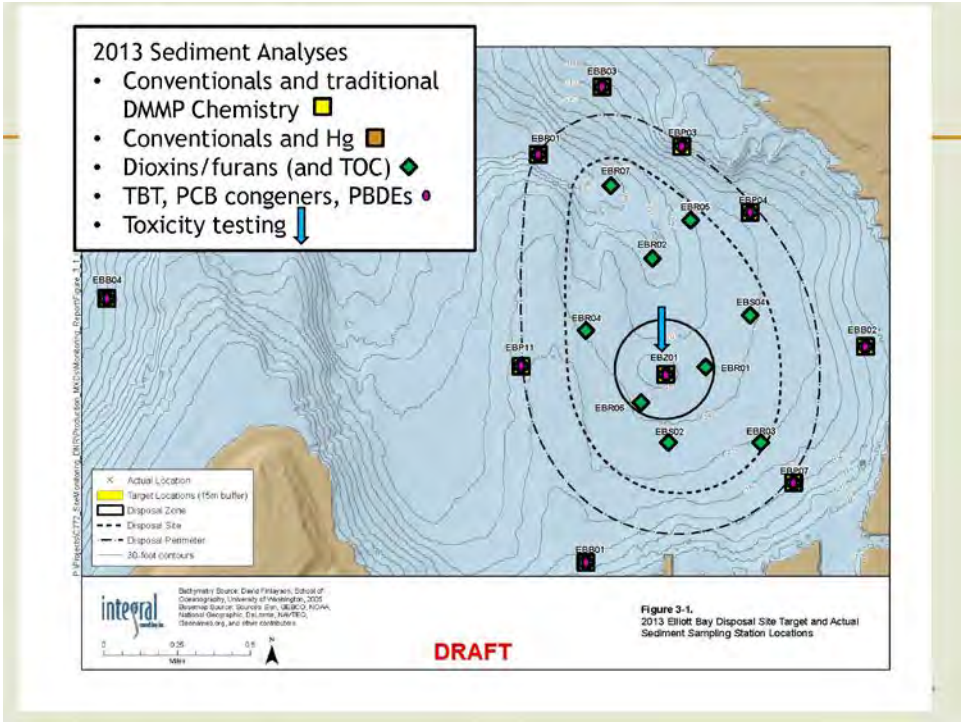

- Integral Consulting, Inc
- Conducted August 5–14
- 19 Elliott Bay Stations
- 2 Carr Inlet Reference Stations

United States Environmental Protection Agency

Department of Ecology

Washington State Department of Natural Resources

pp-6-14




pp-6-15

# 2013 Results – Chemistry

- No SL exceedances at the on-site station Z01
- Mercury > SL at some perimeter and benchmark stations
- PCB Aroclors > SL at some perimeter stations
- Elevated mercury and PCBs are widespread in Elliott Bay and there is no evidence of off-site movement of these chemicals
- Dioxins/furans – addressed on a later slide



pp-6-16

# Chemical Tracking System (CTS) Evaluation

- Statistical time-trend analysis at perimeter stations
- Some statistically significant increasing and decreasing trends for individual chemicals
- Nothing alarming – the chemicals with SL exceedances (Hg and Aroclors) did not show statistically significant increasing trends
- Chemical concentrations are lower in onsite sediment than in perimeter stations on average, suggesting that statistically significant increases are due to sources other than dredged material



pp-6-17

# 2013 Results - Bioassays

- Bioassays test results for Station EBZ01
  - Amphipod mortality: 14 percent
  - Larval normalized combined mortality and abnormality: 10 percent
  - *Neanthes* growth: 0.77 mg/individual-day (or 0.63 mg/individual-day on an AFDW basis)
- EBZ01 passed DMMP non-dispersive disposal site interpretation guidelines.



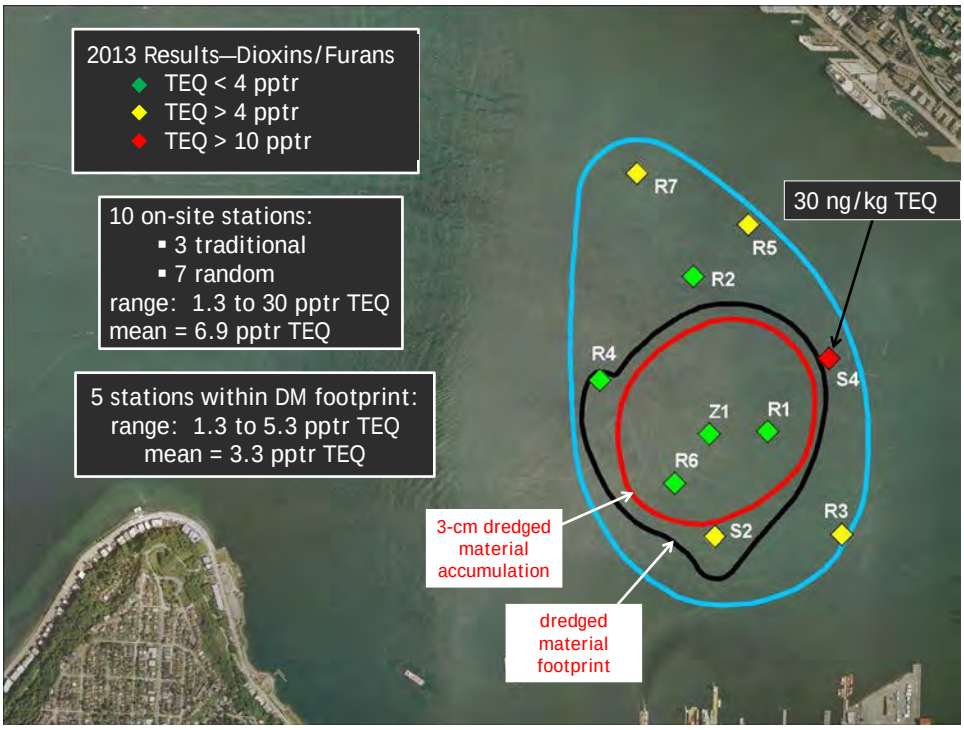
pp-6-18

# 2010 Dioxin Guidelines

- Site management objective = 4 pptr TEQ
- Up to 10 pptr TEQ allowed at non-dispersive sites as long as the project volume-weighted average <= 4 pptr TEQ
- 4 pptr TEQ maximum at dispersive sites
- Updated monitoring design for non-dispersive sites



pp-6-19




pp-6-20

# 2013 Monitoring Conclusions

Hypothesis No.1: Dredged material remains within the disposal site boundary.

- SPI Survey: 3-cm dredged material boundary is within the disposal site perimeter.

*Hypothesis No. 1 is not rejected*

pp-6-21

# 2013 Monitoring Conclusions

Hypothesis No. 2: Chemical concentrations at offsite stations do not measurably increase over time due to dredged material disposal.

- CTS evaluation: dredged material placement is not contributing to increased off-site chemistry

*Hypothesis No. 2 is not rejected*



pp-6-22

# 2013 Monitoring Conclusions

Hypothesis No. 3: Sediment chemical concentrations at the onsite monitoring stations do not exceed chemical concentrations associated with PSDDA Site Condition II guidelines due to dredged material disposal.

- Sediment Chemistry (Onsite station): COCs < MLs,

*Hypothesis No. 3 is not rejected.*



pp-6-23

# 2013 Monitoring Conclusions

Hypothesis No. 4: Sediment toxicity at the onsite stations does not exceed the PSDDA Site Condition II biological response guidelines due to dredged material disposal.

- Sediment Toxicity: Onsite sediment met bioassay interpretive criteria

*Hypothesis No. 4 is not rejected.*



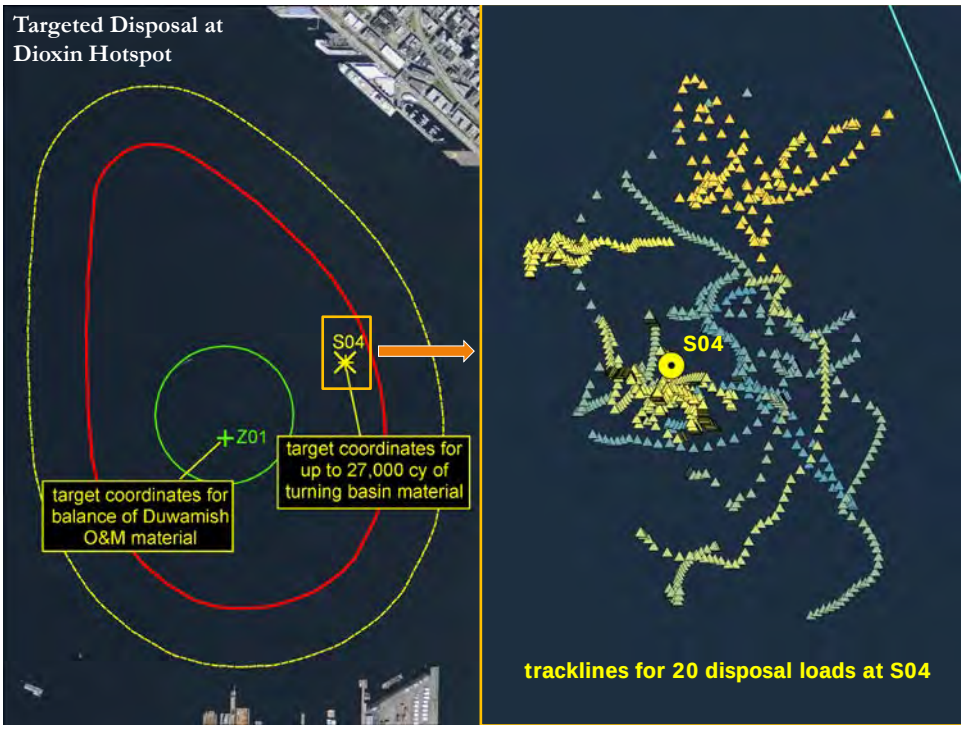
pp-6-24

# Recommendations

1. Consider Replacing Station EBP03 with EBP04
2. Consider update to CTS Software
3. Move disposal target eastward to manage dioxin/furan concentrations (next slide)
4. Look at DMMP disposal site management objectives and revised SMS
5. Comprehensive Program Review



pp-6-25




pp-6-26

# Shoreline Permit

- Anderson/Ketron site (Pierce Co) extended to expire Sept 2014
- Public process to secure new permit
- Have received public comments from use of the site
  - Sand waves
  - Impacts to biological resources
  - Offsite movement due to currents
- Additional work has been / will be done
- Apply for new Shoreline Permit in 2015

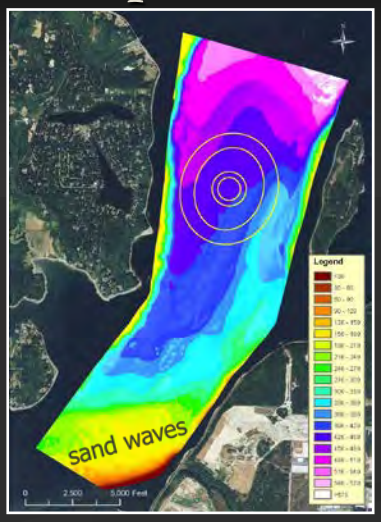
EPA United States Environmental Protection Agency
Department of Ecology
Washington State Department of Natural Resources

pp-6-27

# Anderson/Ketron Disposal Site

Work done in 2014

- Corps Multibeam survey of disposal site and adjacent area
  - Site remains in intact
  - Sand waves to South
- Corps fate and transport modeling (next slides)

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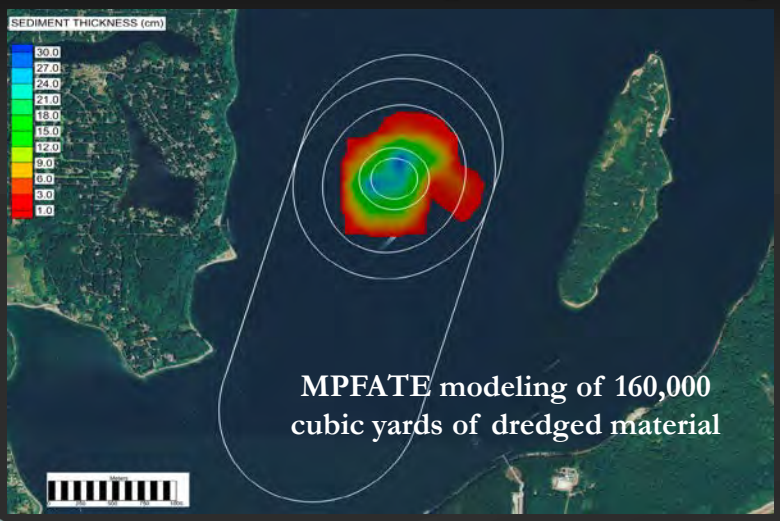
Department of Ecology

Washington State Department of Natural Resources

pp-6-28

# A-K Fate and Transport Modeling

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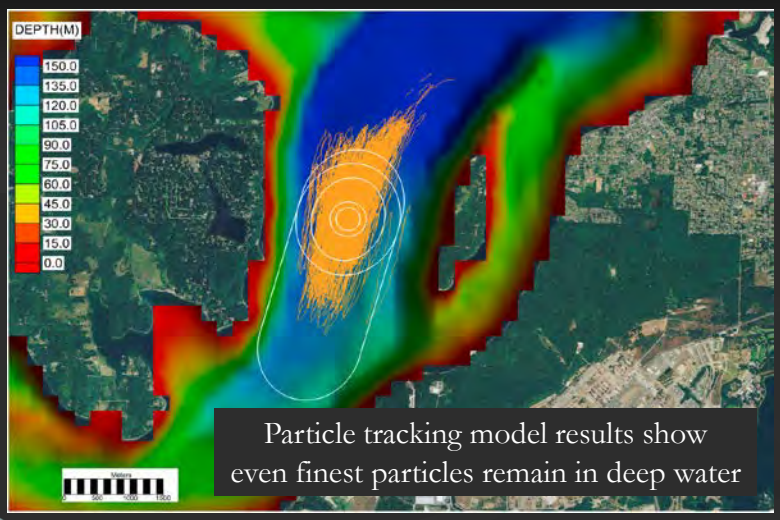
pp-6-29

# A-K Fate and Transport Modeling

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pp-6-30

# Anderson/Ketron Disposal Site

- Corps will conduct a 4 season study of demersal resources in area
  - Based on original siting information
  - Beam trawl
- Working with WDFW
  - ROV survey


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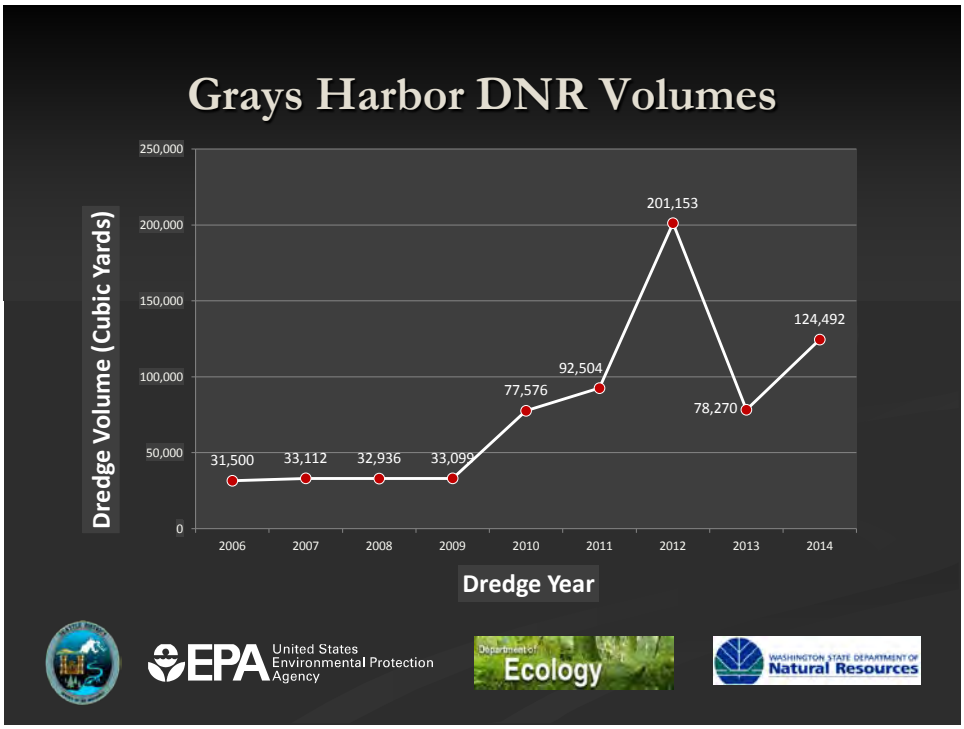
pp-6-31

pp-6-32


Grays Harbor DNR Volumes
Dredge Volume (Cubic Yards)
250,000
200,000
150,000
100,000
50,000
0
31,500
33,112
32,936
33,099
77,576
92,504
201,153
78,270
124,492
2006
2007
2008
2009
2010
2011
2012
2013
2014
Dredge Year
EPA United States Environmental Protection Agency
Department of Ecology
Washington State Department of Natural Resources

pp-6-33


Questions?
EPA United States Environmental Protection Agency
Department of Ecology
Washington State Department of Natural Resources

pp-6-34

# Lower Duwamish Waterway Update

Allison Hiltner
EPA Region 10
May 7, 2014

pp-7-1


pp-7-2

## Key parts of the Duwamish cleanup


pp-7-3

# Lower Duwamish Waterway – what's new

- Boeing Plant 2 cleanup underway
- Terminal 117 cleanup underway
- Jorgensen Forge cleanup to start 2104
- Fishers Study underway
- Clam arsenic laboratory study completed
- Carbon amendment pilot study in initial stages
- Numerous source control activities and studies underway (Ecology)
- EPA is considering public comments on Proposed Cleanup Plan and developing draft Record of Decision

pp-7-4

# Lower Duwamish Waterway Project Team

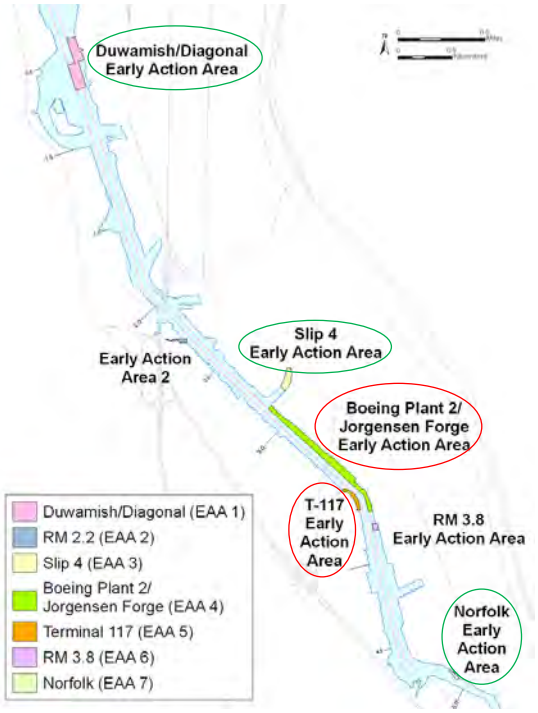
- EPA:
  - Melissa Blankenship - Boeing Plant 2
  - Piper Peterson - Terminal 117
  - Becky Chu - Jorgensen Forge, Fishers Study, Source Control coordination
  - Bruce Duncan – Clam Arsenic study
  - Allison Hiltner - Carbon Amendment Pilot Study, Record of Decision
- Ecology: Dan Cargill, Rick Thomas, Rachel McCrea, Ron Timm and many others – Source Control
- Corps of Engineers tech support: John Wakeman, Kristen Kerns, Veronica Henzi, Mandy Michalsen
- Lower Duwamish Waterway Group: Port of Seattle, City of Seattle, King County, The Boeing Company



# Lower Duwamish Early Action Areas

- Norfolk completed 1999 (King County)
- Duwamish/Diagonal completed 2005 (King County)
- Slip 4 completed 2012 (City of Seattle and King County)
- Boeing Plant 2 to be completed 2015 (Boeing)
- Terminal 117 to be completed 2014 (Port and City of Seattle)
- Jorgensen Forge to be completed 2015

(Green = completed  Red = underway)



# Lower Duwamish Early Action Activity

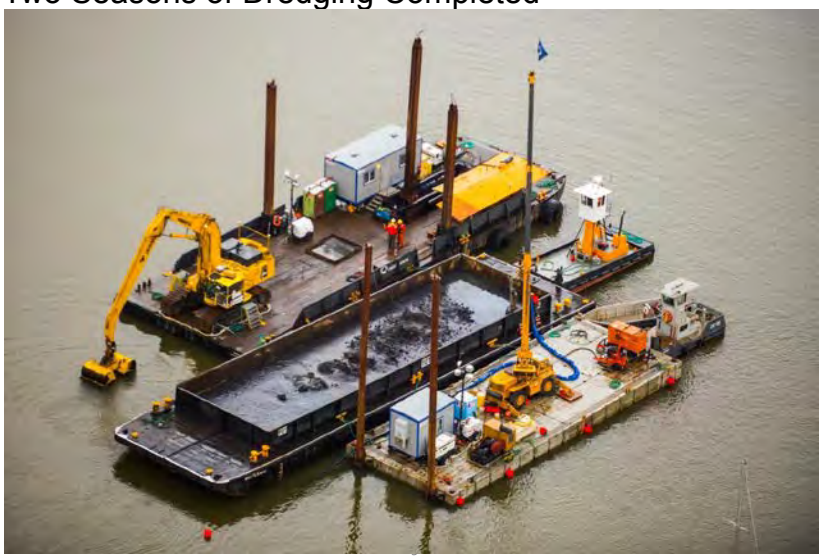
pp-7-7

# Boeing Plant 2 Progress

pp-7-8

# Boeing Plant 2

Two Seasons of Dredging Completed



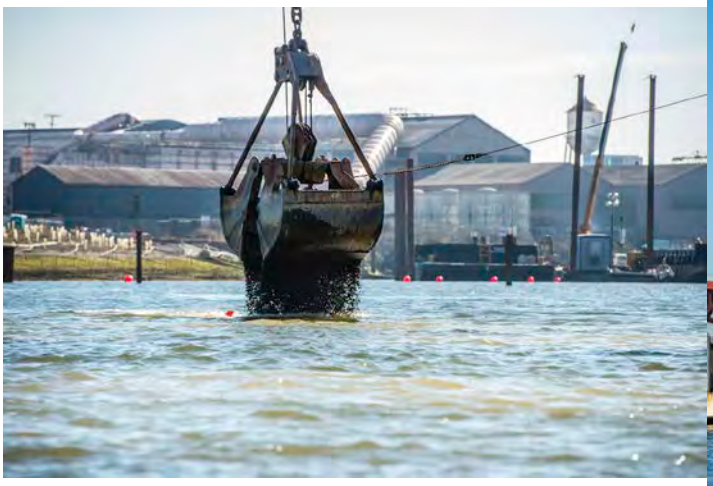
pp-7-9

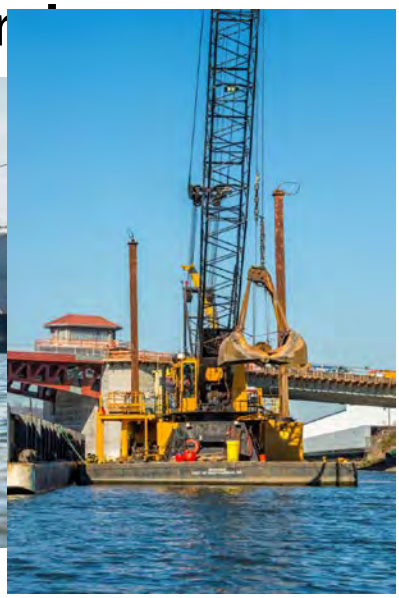
# Boeing Plant 2 | Dredging Overview



pp-7-10

# Backfilling with Clean Sar





11

pp-7-11

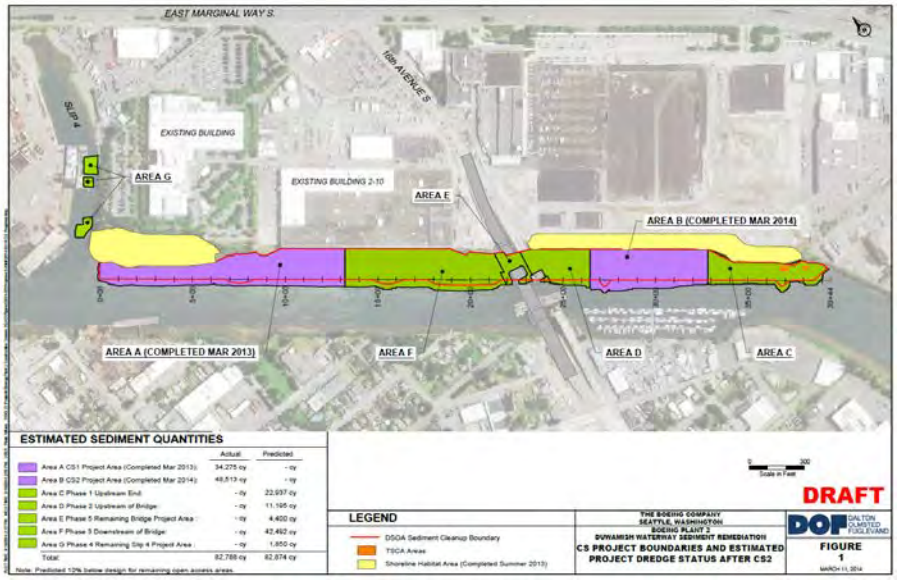
# Boeing Plant 2

Construction Season 2 Production Summary

| Construction Season 2 Production Summary | | |
|---|---|---|
| **Parameter** | **Units** | **Productivity** |
| **Dredging** | | |
| a. Quantity - Actual | CY | 48,513 |
| b. Quantity - Planned | CY | 46,312 |
| | | |
| **Backfilling** | | |
| a. Initial Backfill | Tons | 6,155 |
| b. Average Thickness | Feet | 0.5 |
| c. Intermediate Backfill | Tons | 49,247 |
| | | |
| **Transload** | | |
| a. Barges | Barges | 178 |
| b. Quantity | Tons | 66,990.00 |
| c. Rail Cars to Landfill | Cars | 617 |
| d. Trucks to Landfill | Trucks | 38 |
| | | |
| **Water Treatment** | | |
| a. DRWTS Treated | Gallons | 9,299,800 |
| b. Solids Disposal | Tons | 1705 |

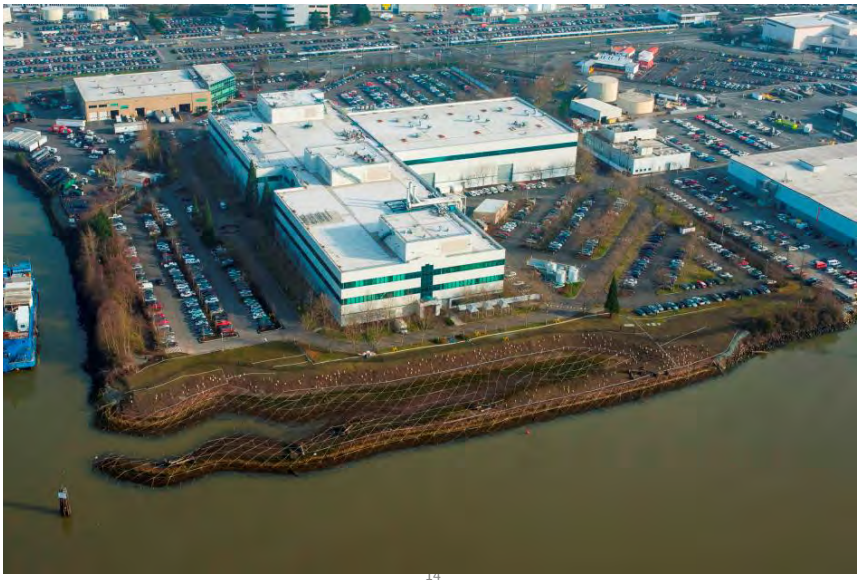
pp-7-12

# Boeing Plant 2 | Project Status




pp-7-13

# New Fish & Wildlife Habitat



pp-7-14

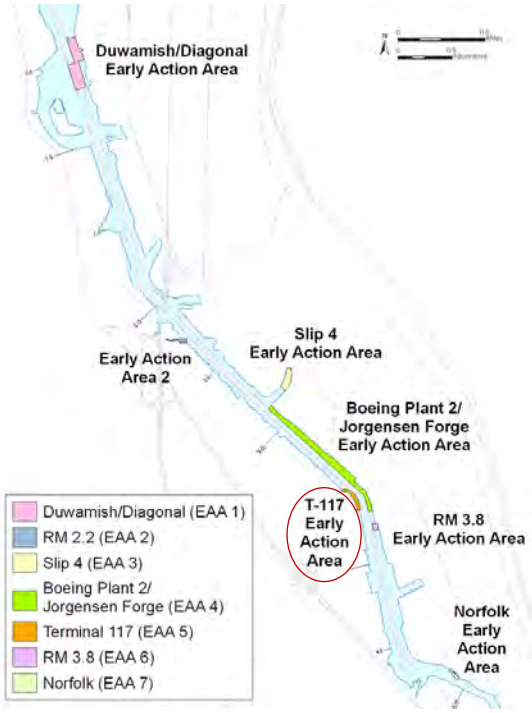
# New Fish & Wildlife Habitat



pp-7-15

# Terminal 117 project status

- Dredged 10,000 cy
- Will complete backfill/capping this year
- 12 acre restoration project to be built summer 2016




pp-7-16

T-117 uplands/sediments cleanup, looking east

pp-7-17

T-117 uplands/sediments cleanup, looking NE to Boeing Plant 2

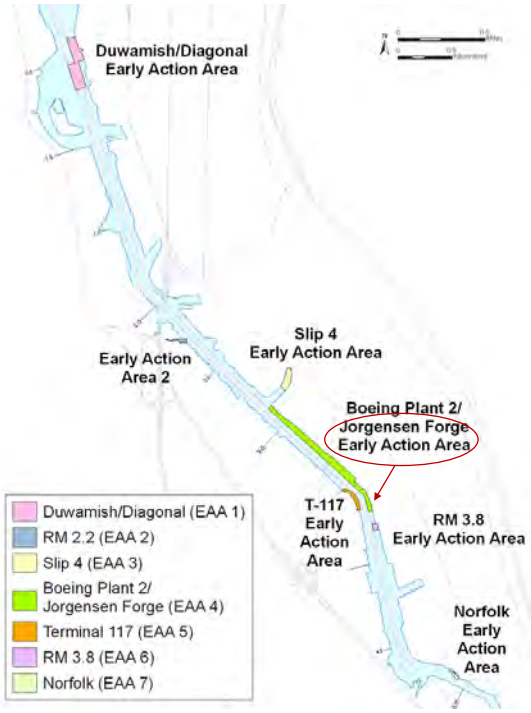
pp-7-18

T-117 uplands/sediments cleanup, looking north to South Park bridge

pp-7-19

# Jorgensen Forge

- Completed a sheet pile wall this spring
- Construction will start July 20; to be completed by Sept 7
- Will dredge 15,000 cy and backfill




pp-7-20

# LDW Early Action Overview

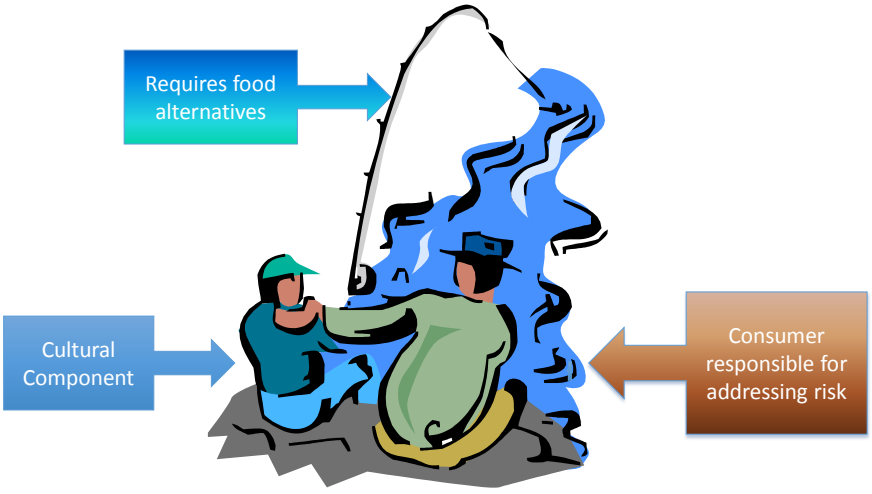
- In 2013/14 dredging season – 48,000 cy contaminated sediments removed from Boeing Plant 2 and 10,000 cy from T-117
- Remaining contaminated sediments will be removed by the end of the 2015/16 dredging season
- Overall, Early Actions will:
  - Clean up 29 acres of contaminated sediments
  - Remove over 300,000 cy of contaminated sediments from the LDW
  - Reduce PCB concentrations in surface sediments by 50%



# Protecting Fish Consumers in EPA's Superfund Cleanup – the LDW Fishers Study


pp-7-23

# Why don't advisories work?




pp-7-24

## What's Next?

Finalize Implementation Plan
Pilot Project
Initiate Study


DRCC

pp-7-25

## What's Next?

Finalize Implementation Plan
Pilot Project
Initiate Study


DRCC

pp-7-26

# Activated Carbon Pilot Study

- LDW proposed plan calls for placing sand + activated carbon (AC) if pilot studies are successful
- EPA, Ecology, and LDWG are discussing doing some of the groundwork to implement pilot studies prior to issuing EPA's Record of Decision
- EPA and Ecology are consulting with Tribes and other stakeholders
- Currently discussing Scope of Work
- Plan is to initiate the pilot studies in 2015/16 dredging season



# Evaluation of Exposure to Arsenic of the Eastern Soft Shell Clam

**Regional Applied Research Effort (RARE):**

"Bioaccumulation of Arsenic in *Mya arenaria* Exposed for 60 Days to Suspended Sediments and Undisturbed Bed Sediments from the Lower Duwamish Waterway"

# Lab-Based Questions

Experimental objective: half of the risk from seafood consumption arises from clam inorganic arsenic; so, lab studies asked:

1. Which is a more important exposure route: suspended material or sediment? (→If sediment, a better likelihood of remedial intervention.)
2. Is high inorganic arsenic a *Mya* pattern or a site-specific pattern? (→Is there something special going on in the LDW?)

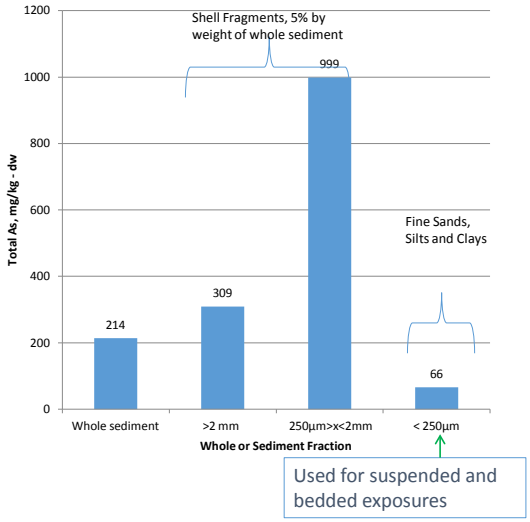


# Sediment Collections Fractions

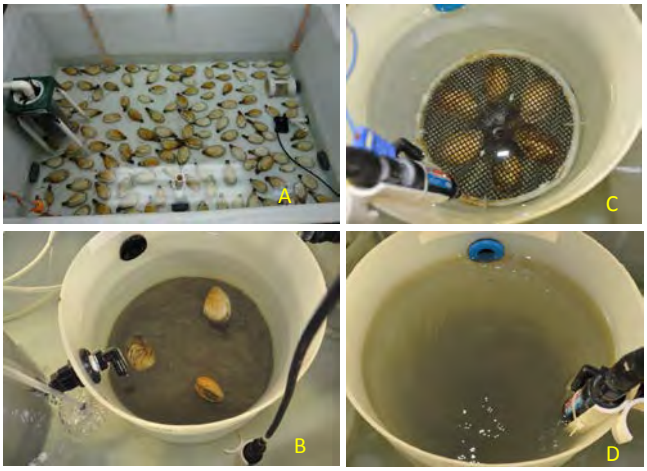
Intertidal collections:

- North of Kellogg Island
- Slip 1
- ~60% inorganic arsenic in composite sample shown
- Bulk of arsenic was in shell fragments!

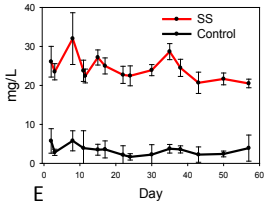
# Sediment



# Exposure Methods




A – Depuration
B – Exposure to "BED"
C – Clam "sandwich"
D – Exposure to Suspended Solids (SS) @ 30 mg/L in FLEES*
E – SS and Control suspended sediment monitoring in FLEES

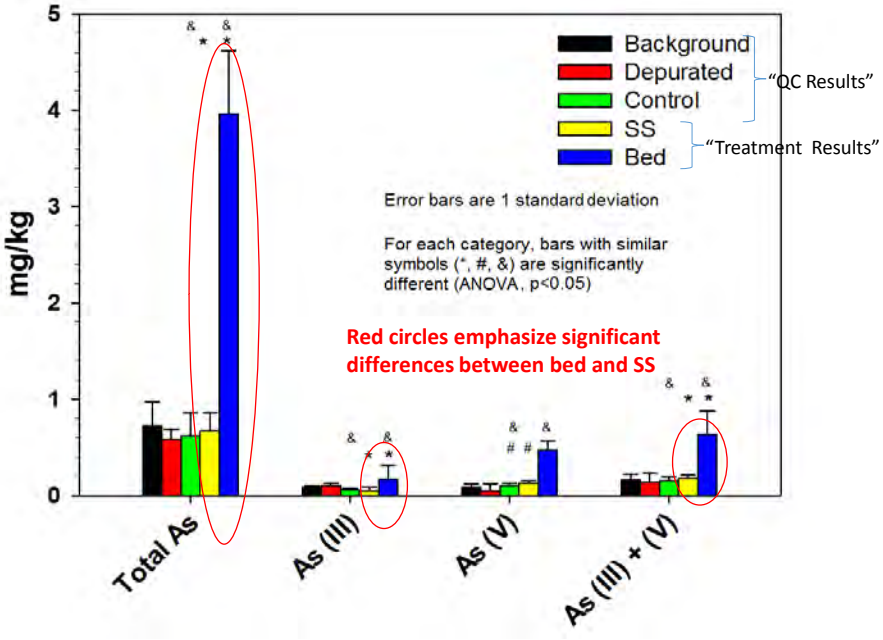



E

*Fish Larvae and Egg Exposure System (FLEES, Lutz et al. 2012): NTU measured by optical backscatter every 3 minutes

pp-7-31

# Tissue Results Comparison (mg/kg ww)




pp-7-32

# Source Control


pp-7-33

## Site Cleanup & Inspections:

### Ecology

**18** facilities with Agreed Orders
- 13 in Toxics Cleanup Program
- 5 in Hazardous Waste Program

**6** site investigations

**4** voluntary cleanup program sites

### EPA

**6** facilities with CERCLA, RCRA or TSCA orders


pp-7-34

## Site Cleanup & Inspections Compliance Assurance

- **Business Inspections – 2013**
- **Seattle – 284** inspections at **177** businesses
- **Ecology Urban Waters – 207** Inspections at **176** businesses
- **King County - 15** Inspections at **12** businesses
- Level III stormwater treatment
- Engineering design reviews

**"Source control is like laundry. It is never finished."** *(Kris Flint, USEPA, retired)*

pp-7-35

## Source Control Studies

- Air Deposition
- Stormwater Pollution Prevention Plans & Outfall Inventory
- Industrial Facilities Stormwater Characterization Study
- Green-Duwamish River Scoping Study
- Green-Duwamish River Loading Study
- Cement Kiln Dust
- Site Hazard Assessments
- King county also conducting numerous studies in Green/Duwamish

pp-7-36

# Record of Decision

- Public comment period on proposed cleanup plan Feb – June 2013
- EPA received 2327 public comments on the Proposed Plan
- We are considering public comments as we develop our Record of Decision (ROD)
- ROD will be issued by the end of 2014
  - Will include summary of all significant comments and responses



# For More Information

- EPA's web site: www.epa.gov/region10/duwamish.html

  (for April 15 presentations, click on "documents", scroll to bottom of page)
- Ecology's web site:

  http://www.ecy.wa.gov/programs/tcp/sites_brochure/lower_duwamish/lower_duwamish_hp.html
- Terminal 117 updates: www.t117.com

# SMS/MTCA Cleanup Projects Update

Kathy Taylor, Supervisor
Aquatic Lands Cleanup Unit
Toxics Cleanup Program

WASHINGTON STATE
Department of Ecology

Sediment Management Annual Review Meeting
May 7, 2014



## Sediment Cleanup Sites

- 172 total state led sediment sites
- 136 in Western Washington (not including NFAs)

WASHINGTON STATE
Department of Ecology

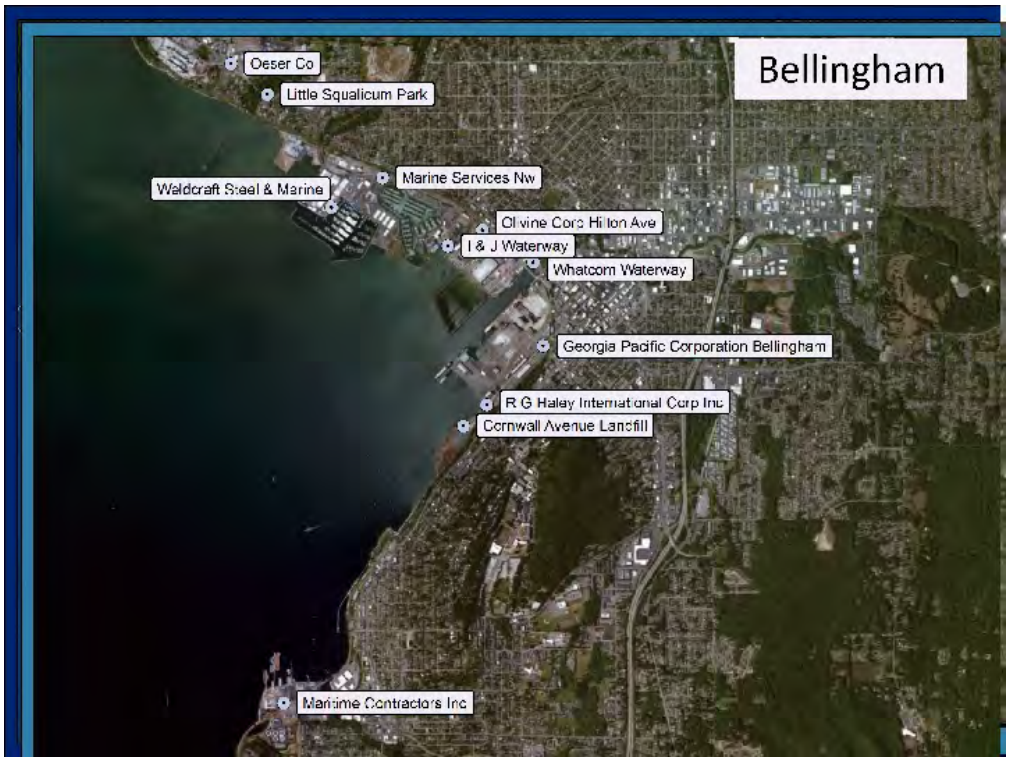
# Major sediment cleanup areas in Puget Sound

- Bellingham Bay
- **Fidalgo & Padilla Bay**
- Port Gardner & Snohomish River Estuary
- Seattle (incl. Harbor Island and Lower Duwamish)
- Commencement Bay
- Olympia
- Port Angeles
- **Port Gamble**

WASHINGTON STATE
Department of Ecology

pp-8-3


pp-8-4


Bellingham
Oeser Co
Little Squalicum Park
Marine Services Nw
Waldcraft Steel & Marine
Olivine Corp Hilton Ave
I & J Waterway
Whatcom Waterway
Georgia Pacific Corporation Bellingham
R G Haley International Corp Inc
Cornwall Avenue Landfill
Maritime Contractors Inc

pp-8-5


Bellingham
Anacortes
Port Angeles
Port Gardner
Port Gamble
Seattle Area
Tacoma and
Commencement Bay
Olympia

pp-8-6


pp-8-7

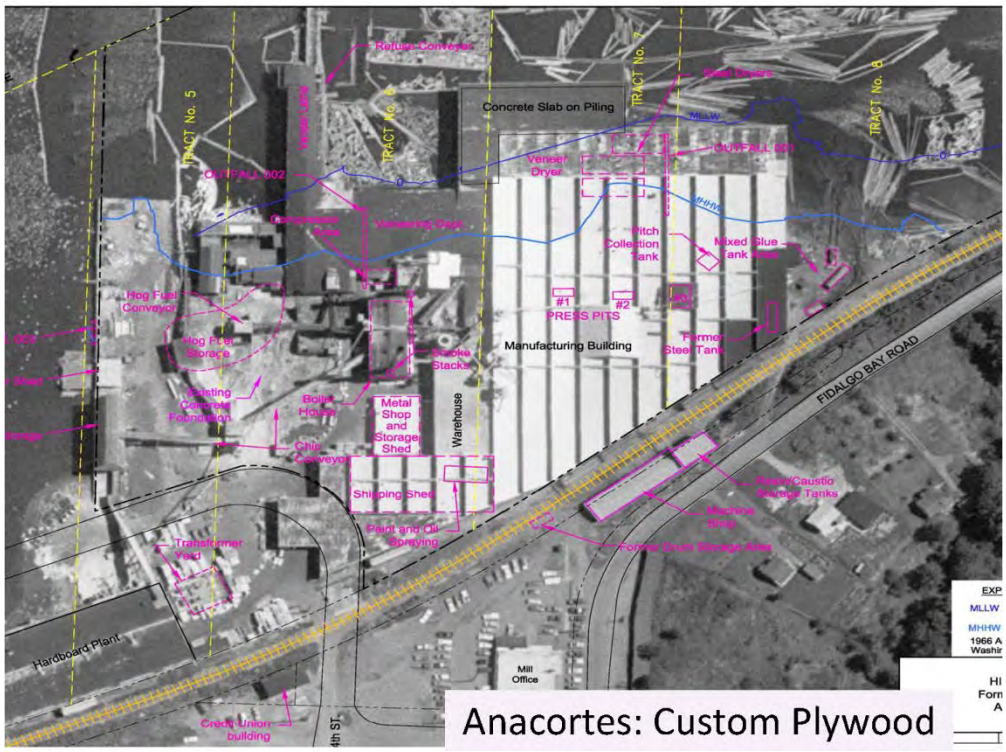
## Anacortes

| ISIS Site Name | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| **Custom Plywood Mill** | Anacortes Port of Q Ave & 15th St Anacortes Plywood, Custom Plywood | Wood, timber, paper | Initial Investigation: Site Discovery/Report Received Completed | MTCA |
| **March Point Landfill** | Texaco PS Offsite Dump, Whitmarsh Dump Texaco PS OFFS, Whitmarsh Landfill ( ) | Landfill | Site Hazard Assessment Completed - Initial Investigation | CWA |
| **MJB Properties** | Scott Paper Mill Former, Port of Anacortes, City of Anacortes, Scott Paper Anacortes | Industrial | Site Hazard Assessment Completed - Initial Investigation | MTCA |
| **Port of Anacortes Dakota Creek** | Dakota Creek Industries Dakota Creek Shipyard | Shipyard, marina, industrial | Early Notice Letter Completed | MTCA |
| **Anacortes Port Log Yard** | | Wood, Timber | Early Notice Letter | |
| | | | | |

pp-8-8


Anacortes Port Log Yard
Anacortes Port Of Q Ave & 15Th St
Scott Paper Mill Former
Anacortes City
Mjb Properties
Custom Plywood Inc
March Point Landfill

pp-8-9


Concrete Slab on Piling
Veneer Dryer
Manufacturing Building
Hog Fuel Conveyor
Hog Fuel Storage
Boiler House
Metal Shop and Storage Shed
Warehouse
Shipping Shed
Paint and Oil Spraying
Transformer Yard
Hardboard Plant
Mill Office
Credit Union building
FIDALGO BAY ROAD
Anacortes: Custom Plywood

pp-8-10

Anacortes: Custom Plywood

pp-8-11

Anacortes: Custom Plywood

# In-Water Cleanup Work

- Removal of Marine Construction Debris and Pilings
- Sediment Remediation – Dioxin and Wood Waste
- Shoreline Protection & Habitat Restoration Work

pp-8-12

pp-8-13

pp-8-14

pp-8-15

pp-8-16

pp-8-17

pp-8-18

# Custom Plywood

## Pete Adolphson (sediments) and Hun-Seak Park

The first phase cleaned up 4 upland acres contaminated with TPH and metals:

- (1) over 24,800 cubic yards of contaminated soil was removed,
- (2) 970 creosote pilings were removed,
- (3) 51,000 cubic yards of clean material was imported,
- (4) an on-site mitigation wetland was created, and
- (5) a damaged storm drain to the site area was repaired and a bioswale system was created and installed.

The second project phase completed early this year

- (1) removed over 45,000 cubic yards of contaminated materials
- (2) removed nearly 1,400 creosote pilings from the waters of Fidalgo Bay, and
- (3) imported 130,000 cubic yards of habitat friendly substrate.

Completed on time and under budget.

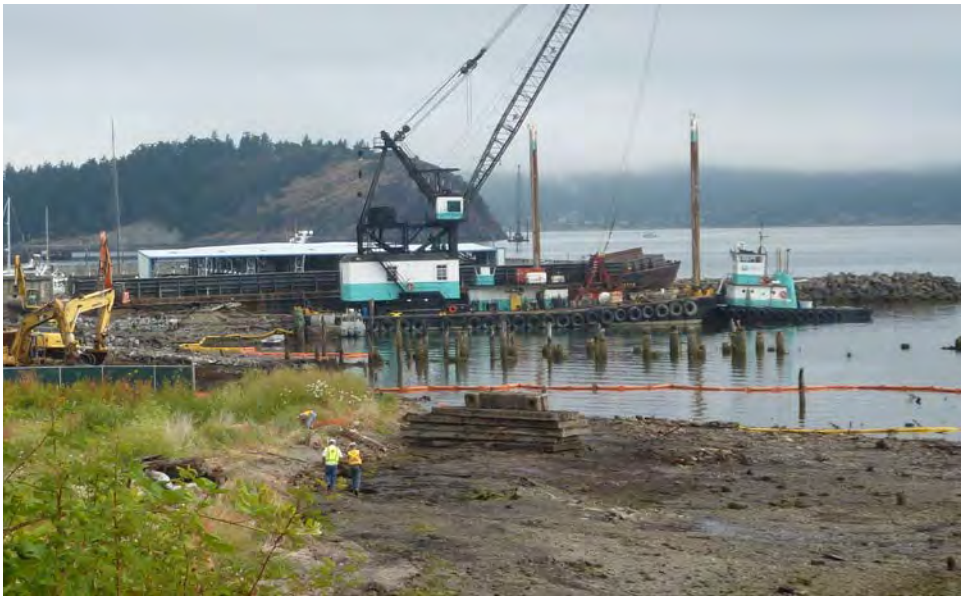
Viable surf smelt spawning returned immediately on the remediated areas.

We are conducting a study at this site on thin layer sediment placement and carbon amendments in existing eelgrass beds located in areas containing lower levels of contaminated sediment.



pp-8-21

pp-8-22



pp-8-23

pp-8-24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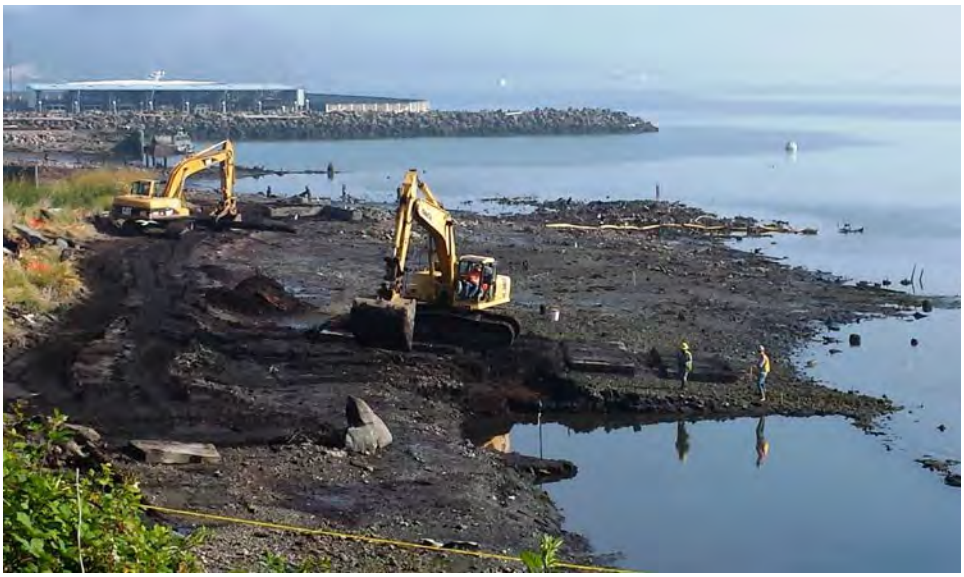
pp-8-26



pp-8-27

pp-8-28

pp-8-29

pp-8-30

pp-8-31

pp-8-32

pp-8-33


Bellingham
Anacortes
Port Angeles
Port Gardner
Port Gamble
Seattle Area
Tacoma and
Commencement Bay
Olympia

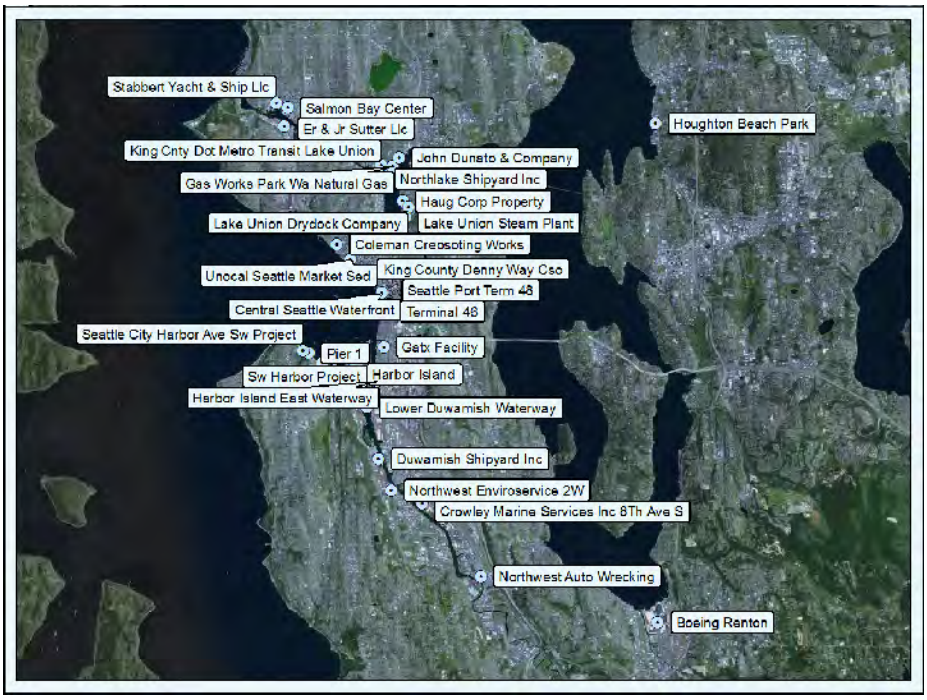
pp-8-34


Bay Wood Products
JELD-WEN
Weyerhaeuser Paper Co Everett
12th Street Marina
North Marina West End
Fishermen'S Boat Shop Inc
North Marina Redevelopment
Kimberly-Clark Worldwide
East Waterway
Weyerhaeuser Mill A Former

pp-8-35


Bellingham
Anacortes
Port Angeles
Port Gardner
Port Gamble
Seattle Area
Tacoma and
Commencement Bay
Olympia

pp-8-36




pp-8-37

| Site Name | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| **Lake Union and Ship Canal** | | | | |
| **Gas Works Park Natural Gas** | Natural Gas | Petroleum, Industrial | Cleanup Operation & Maintenance In Progress | MTCA |
| Gas Works Park East | | Industrial | RI/FS | — |
| Gas Works Park West | | Industrial | RI/FS | — |
| **Haug Corp Property** | Seaboard | Shipyard | Early Notice Letters Completed | MTCA |
| **John Dunato & Co Inc** | Dunato Boatyard, Dunatos Marine Svc | Industrial | Early Notice Letters Completed | MTCA |
| **Lake Union Drydock Co** | | Stormwater, Refueling, Industrial | Initial Investigation, Hazard Site Listing Completed | MTCA |
| **Lake Steam Plant** | | Combined Sewer Overflow, Stormwater, Industrial, Shipyard | Hazard Site Listing, Hazard Assessment Completed | MTCA |
| **NOAA Dockside Facility** | | Shipyard | Initial Investigation | MTCA* |
| **Northlake Shipyard** | Marine Power & Equipment, Unimar United Marine Shipbuilding Inc, United Marine Shipyards, Woodk Family Industries | Shipyard | Remedial Investigation, Feasibility Study In Progress | MTCA |
| **Salmon** | CD Stimson Co, Honeywell Inc, Stimson Marine | Industrial | Initial Investigation Completed | MTCA |

pp-8-38

| Site Name | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| Elliot Bay & Harbor Island | | | | |
| **Coleman Dock Sediments** | | Recontamination of clean cap as result of DOT activities to renovate Seattle Ferry Terminal | RI/FS Completed | MTCA |
| **Central Seattle Waterfront** | Pier 53-55, Waterfront | Industrial, Combined Sewer Overflow, Spill | Remedial Investigation/Feasibility Study In Process | SMS |
| **Coleman Creosoting Works** | EB28- Colman Dock, Pier 58, Crawford Sea Grill, Ivar's Captain's Table, US Vining & The Furnance Oil Company | Industrial, CSO, Stormwater, Spills | Early Notice Letters Completed | MTCA |
| **Crowley Marine Services Inc** | This includes sites known as parcels D and E | unknown | Initial Investigation Completed | MTCA |
| **King Denny Way CSO** | EB26 - Denny Way CSO | Combined Sewer Overflow | Monitoring | MTCA |
| **GATX Facility** | EB17 - East Waterway part of Harbor Island Superfund Site GATX Tank Storage Terminals, GATX Terminals Corp, TOSCO GATX Term Tank S | Petroleum bulk plant | Early Notice Letters Completed | MTCA |
| **Harbor Island East Waterway** | EB8 - , partial T18 | Shipyard, Industrial, Combined Sewer Overflow | Record of Decision (CERCLA) | SMS |
| **Pier 1** | United Marine Shipbuilding Harbor Ave | Industrial, Combined Sewer Overflow | Site Hazard Assessment Completed, Hazardous Site Listing Completed | MTCA |
| **Seattle City Harbor Ave SW Project** | | unknown | Site Discovery, Report Received Completed | SMS |
| **Seattle Term 48** | EB18 - Piers 48-52 | Industrial, Combined Sewer Overflow, Spill | Initial Investigation In Progress | SMS |
| **Seattle Terminal 46** | EB27 - Piers 46-48 Terminal 46 | Combined Sewer Overflow | Early Notice Letters In Progress | SMS |
| **SW Harbor Pier Wharf** | EB6 - Pacific Sound Resources | Industrial | Site Discovery, Report Received | CERCLA |



| Site Name | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| **Lower Duwamish River** | | | | |
| **Duwamish Shipyard Inc** | Marine Lines, Machine Works, DR36 - Duwamish Shipyard | Shipyard | Site Hazard Assessment Completed, Hazardous Sites Listing Completed, Negotiations for AO started Feb 2008 | CWA |
| **Lower Duwamish Waterway acreage unspecified for parcels ()** | Brandon ST CSO; Duwamish River Main Channel; Duwamish Shipyard; Duwamish; Diagonal CSO; Slip 3, MP&E; South Harbor Island; DR31 - Duwamish | Industrial, spill, combined sewer overflow, stormwater run-off | Remedial Investigation/Feasibility Study in process | CERCLA/SMS |
| **Northwest Enviroservice 2W** | | Spill | Awaiting cleanup | MTCA |
| **Boeing Renton** | | Industrial, Metals | Cleanup Started | MTCA |
| **Northwest Auto Wrecking** | Northwest Auto and Truck Wrecking | | Cleanup Started | MTCA |
| **Seattle City Light Steam Plant Georgetown** | Steam Plant, Light | Unknown | Interim Action Completed. Negotiations for AO start April 2008 | MTCA |


Bellingham
Anacortes
Port Angeles
Port Gardner
Port Gamble
Seattle Area
Tacoma and
Commencement Bay
Olympia

pp-8-41


Us Army Wsmc Pier 23
Occidental Chemical Corp
Dickman Mill Sediments
Tacoma Silver Cloud Inn Llc
Cascade Pole Mof Sitcum
General Metals Of Tacoma
Arkema Inc
Hylebos Wood Debris Site Sediments
Tacoma Metals Site

pp-8-42

| Site | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| **Tacoma Silver Cloud Inn LLC** | Silver Cloud Inn LLC, Silver Cloud Inn | Industrial, leaking underground storage tank | Cleanup Operation & Maintenance In Process | MTCA |
| **Cascade Pole MCF Sitcum** | McFarland Sitcum, Sitcum Waterway | Industrial | Interim Action Completed | MTCA |
| **Dickman Mill** | | Wood, timber, paper | Interim Action Completed | MTCA |
| **Hylebos Wood Debris Site Sediments** | Bay Superfund Site, Hylebos Waterway Problem | Industrial | Cleanup Construction In Process | MTCA |
| **Occidental Chemical Corp** | Pioneer Americas Inc, Pioneer Americas LLC, Pioneer Chlor Alkali Co Inc, Hylebos Waterway | Industrial | Remedial Investigation/Feasibility Study In Process | MTCA |
| **US Army WSMC Pier 23** | Pier 23, US Army Reserve | Industrial, Shipyard | Remedial Investigation/Feasibility Study In Process | MTCA |
| **Arkema, Inc** | ATO Chem, ATOFINA Chemicals Inc, Elf ATOCHEM 2901 Taylor Way, Elf ATOCHEM North America Tacoma, Pennwalt Corporation | unknown | Cleanup Operation & Maintenance In Process; Cleanup Action Plan | CWA |
| **General Metals of** | | unknown | Cleanup Complete, periodic review | CERCLA |
| | | | | |

pp-8-43


pp-8-44


pp-8-45

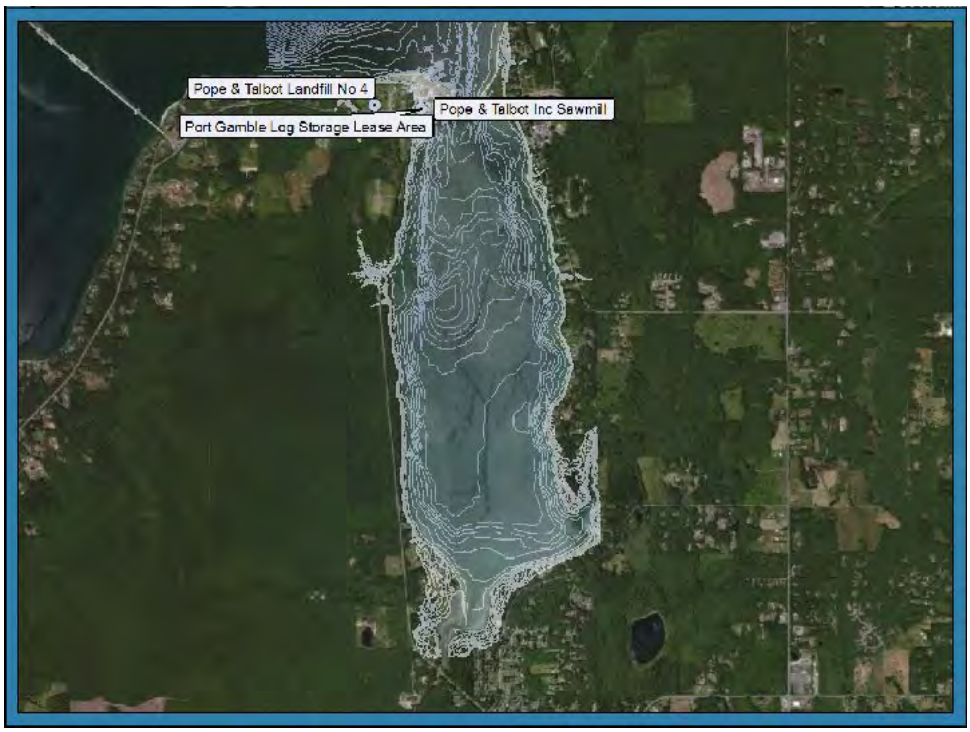
## Port Angeles

| Site Name | Also known as | Causes of Contamination | Site Cleanup Status | Authority |
|---|---|---|---|---|
| **ITT Rayonier PA Finish Rayonier Mill Site** | Rayonier Mill | Wood, paper, timber | Interim Action In Process Marine Remedial Investigation In Process | MTCA |
| **Port of Marine Trades Area** | of Log Yard, of Marine Terminal, | Wood, paper, timber | Remedial Investigation/Feasibility Study In Process | MTCA |
| **Western Port Angeles Harbor** | | | Remedial Investigation/Feasibility Study In Process | MTCA |

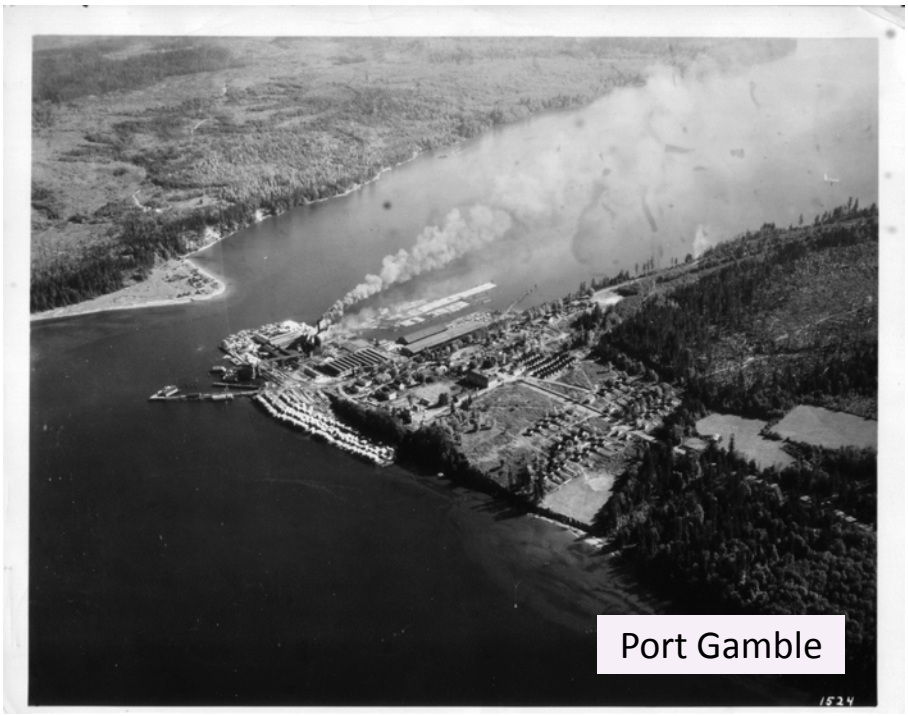
pp-8-46


Bellingham
Anacortes
Port Angeles
Port Gardner
Port Gamble
Seattle Area
Tacoma and
Commencement Bay
Olympia

pp-8-47


Pope & Talbot Landfill No 4
Pope & Talbot Inc Sawmill
Port Gamble Log Storage Lease Area

pp-8-48




pp-8-49

pp-8-50

## Port Gamble Bay Cleanup Actions (Russ McMillan)



- Remove creosoted pilings and overwater structures
- Excavate contaminated intertidal sediments (~14,000 cys)
- Remove and isolate wood waste at Mill Site
  - Dredging from shallow subtidal areas (~30,000 to 45,000 cys)
  - Capping deeper subtidal deposits and (~10 acres)
- Thin layer capping of moderate wood waste impacts (~100 acres, 6" layer)
- Long term monitoring of recovery after removing creosote sources (throughout all of Port Gamble Bay ~600 acres)

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pp-8-51


pp-8-52

pp-8-53

pp-8-54

## Port Gamble Bay Proposed Cleanup

55

**Sediment Management Areas (SMAs)**

- Mill North (6 acres)
- Mill South (19 acres)
- Central Bay (77 acres)
- Former Lease Area (19 acres)
- Background Area (602 acres)


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pp-8-55

## Proposed Site Cleanup Mill Site North

56

**Mill Site North Cleanup, SMA-1**

- Piling and structure removal
- Intertidal excavation/backfill (5,000 cubic yards)
- Dredge wood waste (10,000 to 15,000 cubic yards)
- 1 ft Sand cap (3 acres)
- Long term monitoring

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pp-8-56

## Proposed Site Cleanup Mill Site South

57

**Mill Site South Cleanup, SMA-2**

- Piling and structure removal
- Intertidal excavation (9,000 cubic yards)
- Dredge wood waste (20,000 to 30,000 cubic yards)
- Place 4 ft cap
- Place 6” emnr cap
- Long term monitoring


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pp-8-57

## Proposed Site Cleanup Central Bay

58

**Central Bay Cleanup, SMA-3**

- Place 6” emnr cap (77 acres, 90,000 to 100,000 tons sand)
- Long term monitoring


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pp-8-58

## Proposed Site Cleanup Former Lease Area

59

**Former Lease Area Cleanup, SMA-4**

- Place 6” emnr cap (19 acres, 20,000 to 25,000 tons sand)
- Long term monitoring

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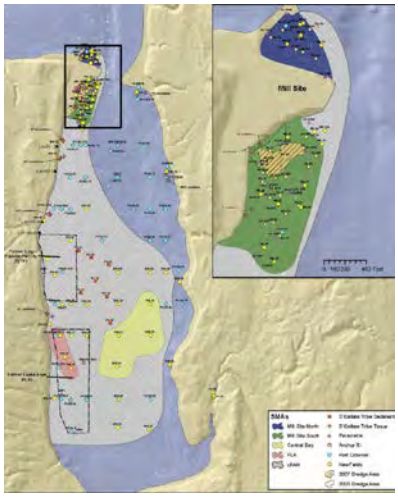
pp-8-59

## Proposed Site Cleanup Background Area

60

**Background Area Cleanup, SMA-5**

- Long term monitoring (602 acres)



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pp-8-60

## Port Gamble Bay Source Control, Habitat Preservation and Cleanup Sustainability (Celina Abercrombie)

61

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pp-8-61

## Restoration and Preservation Projects and

62


- **Western Shoreline Block Land Acquisition**
- **Forested Upland Block Land Acquisition**
- **Pacific Herring Studies**
- **Eelgrass Restoration**
- **Olympia Oyster Enhancement**
- **Baywide Debris and Derelict Gear and Vessel Removal**
- **Riparian Restoration**
- **Point Julia Pier Removal and Beach Restoration**
- **Martha John Estuary Pile Removal (combined with debris removal)**
- **Forage Fish Rebuilding (combined with debris removal)**

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pp-8-62

## Land Acquisition and Preservation

63

### Western Shoreline Block

- Approx. 450 acres of upland and 70 acres of tideland
- Approx. 1.5 miles of shoreline
- Owned by Kitsap County


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pp-8-63

## Pacific Herring Studies

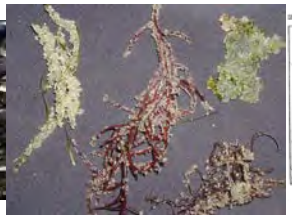
64

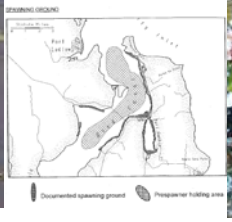
Embryo Mortality Study

- Provide baseline information on herring embryo contamination and health focusing on PAHs
- Provide insight to trend of decreasing herring spawning in the bay

Genetics Study

- Obtain genetics samples from several herring populations to better identify relationships among spawning stocks





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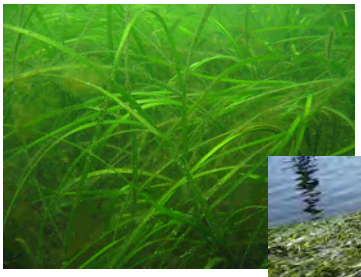
pp-8-64

## Eelgrass Restoration

65

- Restore over 2 acres of eelgrass beds
  - Where does potential eelgrass habitat exist?
  - Where is eelgrass vegetation currently not persistent?

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pp-8-65

## Olympia Oyster Enhancement

66

- Produce 5,000,000 oyster seeds
- Enhance 10 acres of native oyster habitat whole shell and shell hash
- Spread seed over and within shell enhancement area
- Includes funding for construction of NOAA/Manchester Shellfish Restoration Lab to support this work

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pp-8-66

## Debris and Derelict Gear and Vessel Removal

67

- Remove scattered intertidal debris and derelict gear and vessels throughout the Bay
- Remove remaining pilings (not removed as part of cleanup)
- Restore riparian vegetation as appropriate

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pp-8-67

## Upcoming Restoration and Preservation Projects

68

### Purchase Forested Upland Parcels

- 20-acre forested upland lots that contain wetland and stream resources

### Point Julia Pier Removal and Beach Restoration

- Remove the pier and a concrete boat ramp
- Restore beach where pier and boat launch were located

### Riparian Restoration on Western Shoreline Block

- Restore approximately 1.5 acres of degraded riparian habitat

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pp-8-68

# Summary

- Many cleanups are underway in Puget Sound
- We are using innovative approaches, where possible, to restore and protect habitat on cleanup sites.
- Details are available in newly updated Ecology website, Toxic Cleanup Program Web Reporting https://fortress.wa.gov/ecy/tcpwebreporting/Default.aspx and from project managers

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pp-8-69

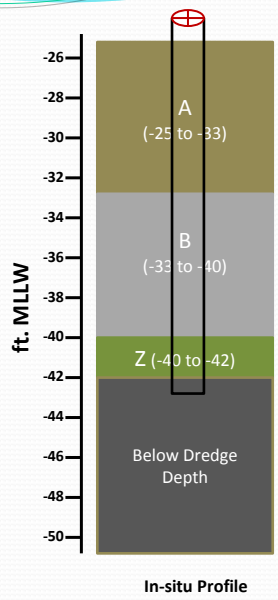

pp-9-1

# Sampling Objectives

- DMMP & PSET regulatory decisions depend on representative sediment characterization data

**CWA** **MPRSA** **Anti-deg.**

- Samples must adequately characterize the intended decision unit(s) (dredge prism & Z-layer)

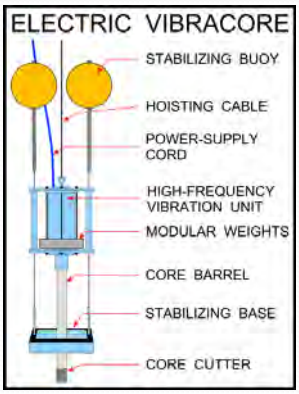



In-situ Profile

pp-9-2

# Core Sampling Objectives

- Sample on station
- Sample the thickest (i.e., most representative) parts of the dredge prism
- Achieve highest possible core recovery
- Collect samples/subsamples from the targeted depths (dredge prism & Z-layer samples)



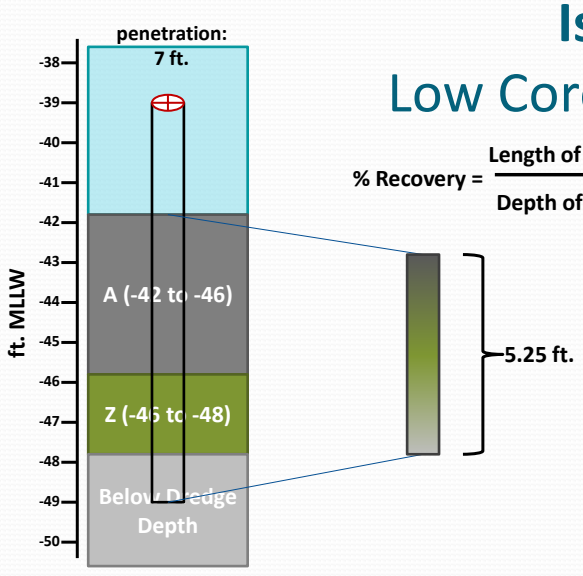

pp-9-3

# Presentation Objectives

- Cover the issues:
  - Low core recovery
  - Human-related error
- Propose guidelines and contingencies for core sampling

pp-9-4

# Issue No. 1:
## Low Core Recovery




$$\% \text{ Recovery} = \frac{\text{Length of Sed. Retrieved}}{\text{Depth of Penetration}} \times 100$$

$$\frac{5.25 \text{ ft.}}{7.0 \text{ ft.}} \times 100$$

**= 75% Recovery**

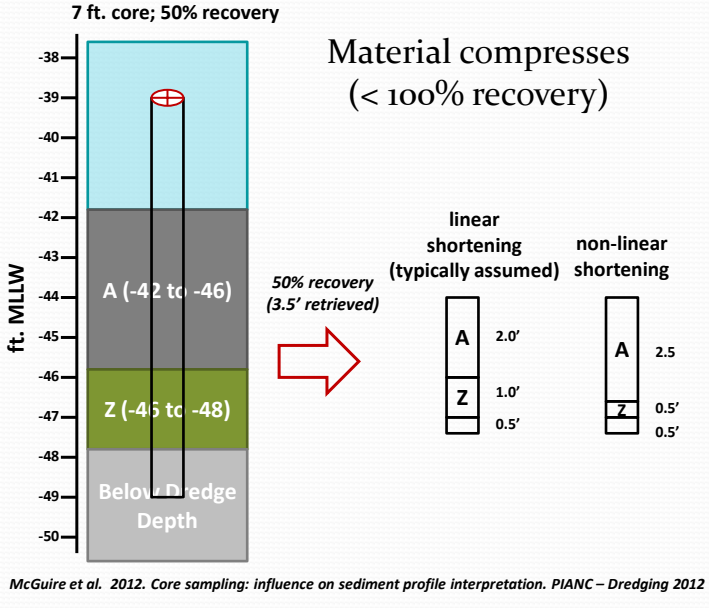
pp-9-5

# Low Recovery: Substrate Limitations

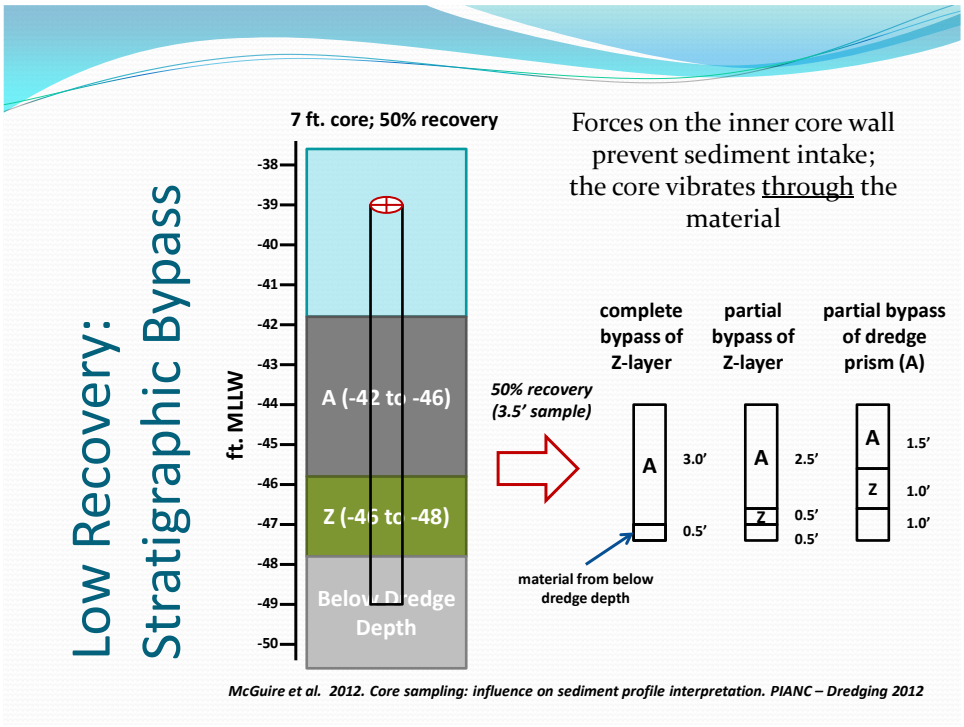
- Refusal (gravelly material, debris, etc.)
- Material loss (core catcher doesn't close):
  - Wood debris
  - Coarse-grained sediment



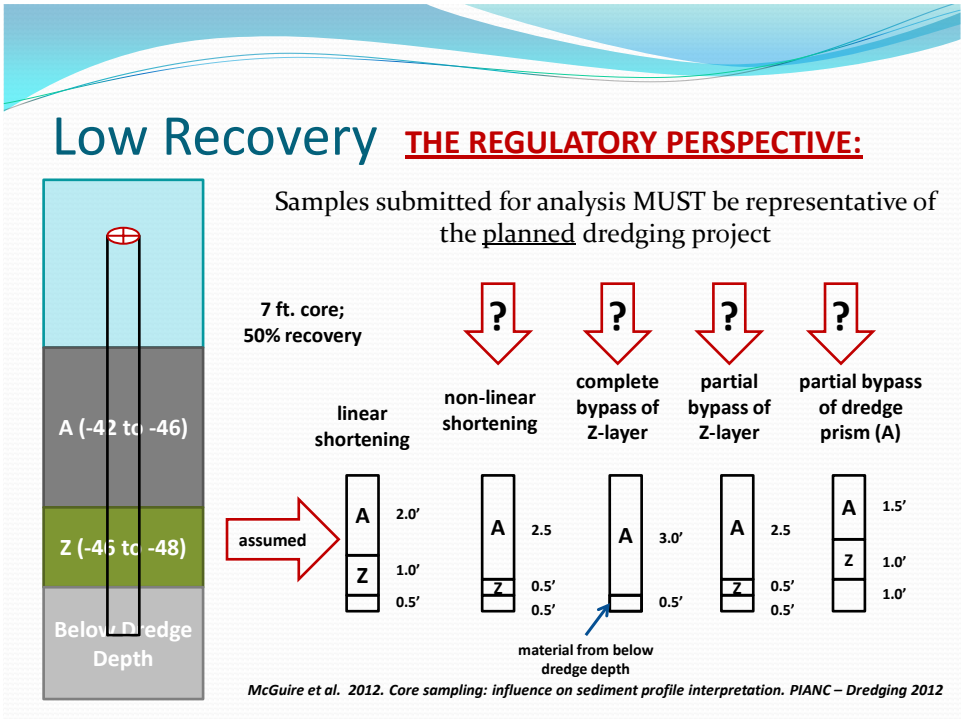
# Low Recovery: Sample Shortening




*McGuire et al. 2012. Core sampling: influence on sediment profile interpretation. PIANC – Dredging 2012*


Low Recovery:
Stratigraphic Bypass
7 ft. core; 50% recovery
ft. MLLW
-38
-39
-40
-41
-42
-43
-44
-45
-46
-47
-48
-49
-50
A (-42 to -46)
Z (-46 to -48)
Below Dredge Depth
Forces on the inner core wall prevent sediment intake; the core vibrates through the material
complete bypass of Z-layer
partial bypass of Z-layer
partial bypass of dredge prism (A)
50% recovery (3.5′ sample)
A
3.0′
0.5′
A
2.5′
Z
0.5′
0.5′
A
1.5′
Z
1.0′
1.0′
material from below dredge depth
McGuire et al. 2012. Core sampling: influence on sediment profile interpretation. PIANC – Dredging 2012

pp-9-8


Low Recovery
THE REGULATORY PERSPECTIVE:
A (-42 to -46)
Z (-46 to -48)
Below Dredge Depth
Samples submitted for analysis MUST be representative of the planned dredging project
7 ft. core; 50% recovery
linear shortening
non-linear shortening
complete bypass of Z-layer
partial bypass of Z-layer
partial bypass of dredge prism (A)
?
assumed
A
2.0′
Z
1.0′
0.5′
A
2.5
Z
0.5′
0.5′
A
3.0′
0.5′
A
2.5
Z
0.5′
0.5′
A
1.5′
Z
1.0′
1.0′
material from below dredge depth
McGuire et al. 2012. Core sampling: influence on sediment profile interpretation. PIANC – Dredging 2012

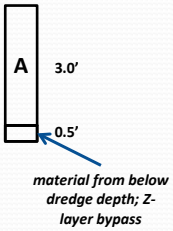
pp-9-9

# Core Sampling Guidelines

- Guideline: MINIMUM CORE RECOVERY **= 75%**
  ***If at first you don't succeed, try, try again***
- Contingency: bring a grab sampler in case of refusal/low recovery in coarse-grained material

- Contingency: post-dredge sampling <u>may</u> be required to characterize Z-layer if:
  - subsurface unit(s) cannot be sampled (refusal)

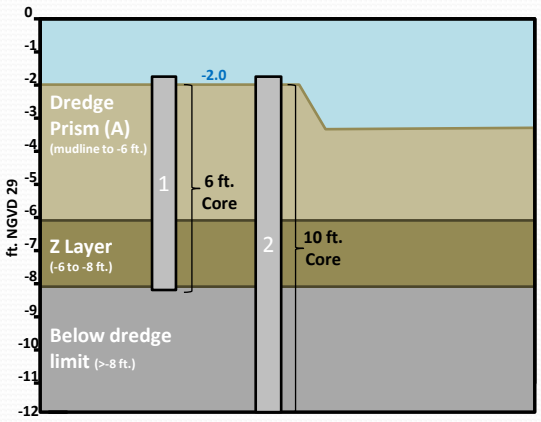
    OR
  - Z-layer sample collection is uncertain (low recovery)

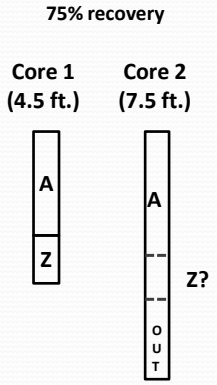





# Core Sampling Guidelines (cont.)

Advance the core nose no more than 1 ft. below the Z-layer



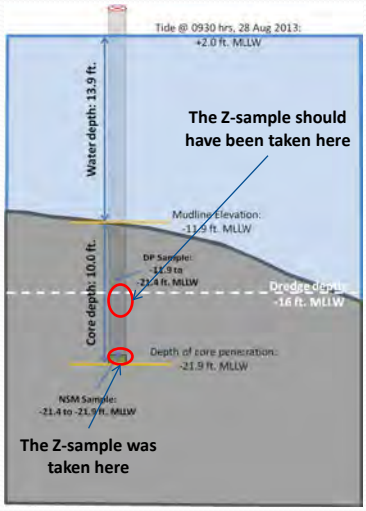



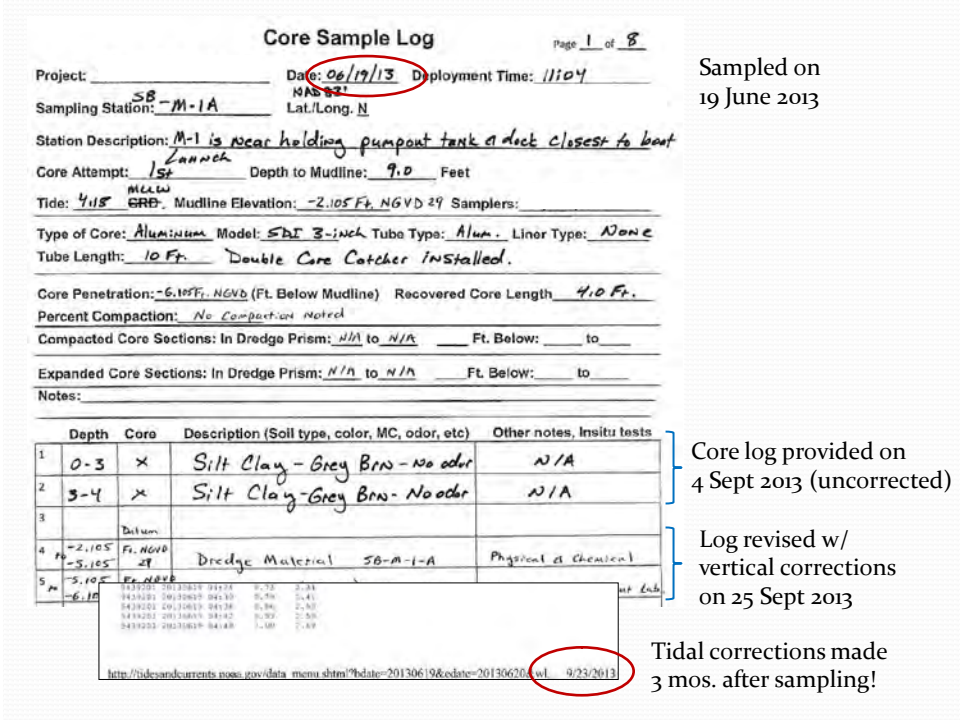
## Issue No. 2: Human Error




## Human Error

- Poor methodology, field notes, core logging practices
  - Vertical correction for tide/river level
  - Depth to mudline
  - Depth of core barrel penetration
  - Not calculating core recovery
  - Incomplete/incorrect data recording/reporting





Core Sample Log

Page 1 of 8

Project: _____ Date: 06/19/13 Deployment Time: 11:04

Sampling Station: SB-M-1A Lat./Long. N

Station Description: M-1 is near holding pumpout tank & dock closest to boat launch

Core Attempt: 1st Depth to Mudline: 9.0 Feet

Tide: 4.18 ~~CRD~~ MLLW Mudline Elevation: -2.105 Ft. NGVD 29 Samplers: _____

Type of Core: Aluminum Model: SDI 3-inch Tube Type: Alum. Liner Type: None

Tube Length: 10 Ft. Double Core Catcher Installed.

Core Penetration: -6.105 Ft. NGVD (Ft. Below Mudline) Recovered Core Length 4.0 Ft.

Percent Compaction: No Compaction Noted

Compacted Core Sections: In Dredge Prism: N/A to N/A Ft. Below: ____ to ____

Expanded Core Sections: In Dredge Prism: N/A to N/A Ft. Below: ____ to ____

Notes: _____

| | Depth | Core | Description (Soil type, color, MC, odor, etc) | Other notes, Insitu tests |
|---|---|---|---|---|
| 1 | 0-3 | X | Silt Clay - Grey Brn - No odor | N/A |
| 2 | 3-4 | X | Silt Clay - Grey Brn - No odor | N/A |
| 3 | | Datum | | |
| 4 | -2.105 -5.105 | Ft. NGVD 29 | Dredge Material SB-M-1-A | Physical & Chemical |
| 5 | -5.105 -6.10 | Ft. NGVD | | |

http://tidesandcurrents.noaa.gov/data_menu.shtml?bdate=20130619&edate=20130626&wl 9/23/2013

Sampled on 19 June 2013

Core log provided on 4 Sept 2013 (uncorrected)

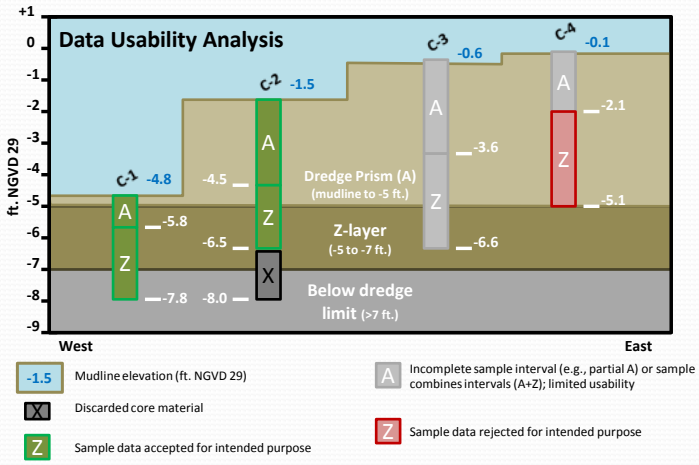
Log revised w/ vertical corrections on 25 Sept 2013

Tidal corrections made 3 mos. after sampling!

pp-9-14

# Human Error

## Contractor collected Z-sample from the core bottom




pp-9-15

# Human Error: What We're Going to Do About It

- Preventive measures:
  - Pre-sampling meetings w/ DMMP/PSET
  - Standardize fields in core (and grab) sample logs
  - Develop field checklist for samplers
- Negligent sampling = err on the side of resources
  - Longer review times
  - Reject some or all sample data
  - Re-sample project (& re-analyze samples)
  - Post-dredge characterization

pp-9-16

# We Need Your Help

Please provide comments to help us improve our core sampling guidelines


pp-9-17

## Reference

McGuire, C., P. McGuire, D. Richardson, & J. Holmstadt. 2012. Core sampling: influence on sediment profile interpretation. *Presentation by* TetraTech staff at the PIANC-COPRI Dredging 2012 Conference, 24 October 2012, San Diego, CA.

http://dredging12.pianc.us/agd_detailss.cfml?ssid=166

pp-9-18

# Questions?

pp-9-19

# PCB Alternative Analysis

Comparison of Aroclor to low and high-resolution GCMS

Laura Inouye (Ecology)
Kelsey Van der Elst (USACE)



## Introduction

- Aroclor analysis is standard for sediments, but has its issues
  - Weathering and mixtures: impact to identification of Aroclors
  - Detection limits (Ecology background issue)
  - Cannot calculated dioxin-like TEQs
- High resolution gas chromatograph/mass spectra (HR-GCMS) is the "gold standard" of analysis, but is expensive. Is an alternative available?
- This study investigated low resolution GC-MS (LR-GCMS) methods and its potential as a surrogate for total PCB and for calculating dioxin-like PCB TEQs

# Approach

- Two different studies were initiated in 2012.
  - USACE Duwamish
    - 9 samples from the Duwamish plus PS-SRM
    - HR-GCMS (EPA 1668), LR-GCMS (EPA 680), and Aroclor
    - Total PCB HR-GCMS concentration range 12-1744 ppb
  - Ecology Study: freshwater and marine sediments from region
    - 3 marine samples from 3 different locations, 5 FW samples from 2 locations, plus PS-SRM
    - HR-GCMS (EPA 1668), LR-GCMS (EPA 8270C/D GC/LRMS), and Aroclor
    - Total PCB HR-GCMS concentration range from 4-191 ppb

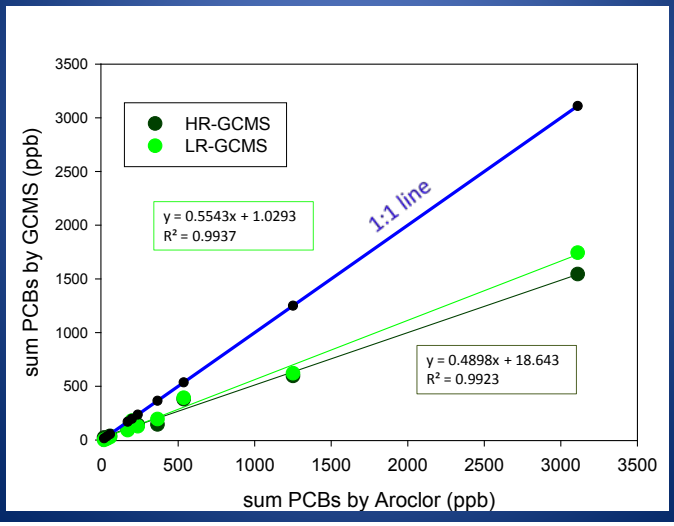


# USACE Study, Total PCBs

- Initial LRMS results confounded by sulfur
- Sulfur clean-up added and samples re-analyzed.
- Total PCB HR-GCMS concentration range
  12-1744 ppb
- Aroclor results always higher than GC-MS results.
- HR and LR-GCMS methods correlated well
  ($y = 1.13x - 19.417$; $R^2 = 0.998$)

# USACE Total PCB Results

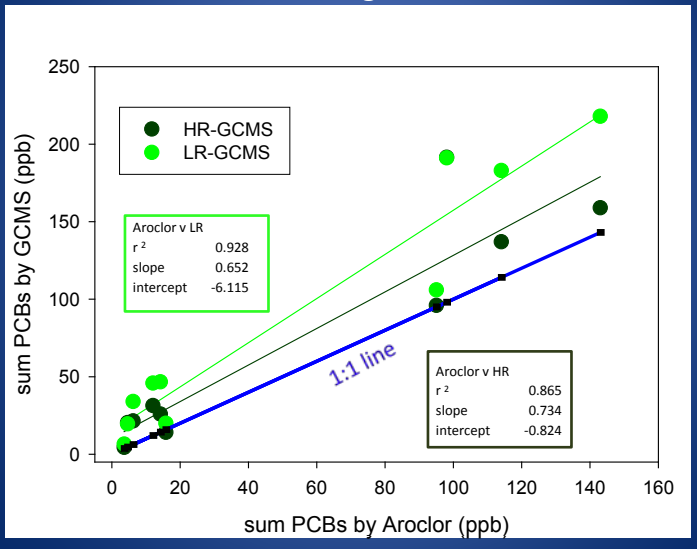
Regression of (1) sum of the HR-congeners (U=1/2 RL) vs. total Aroclors and (2) sum EPA 680 LR-homologs vs. total Aroclors




pp-10-5

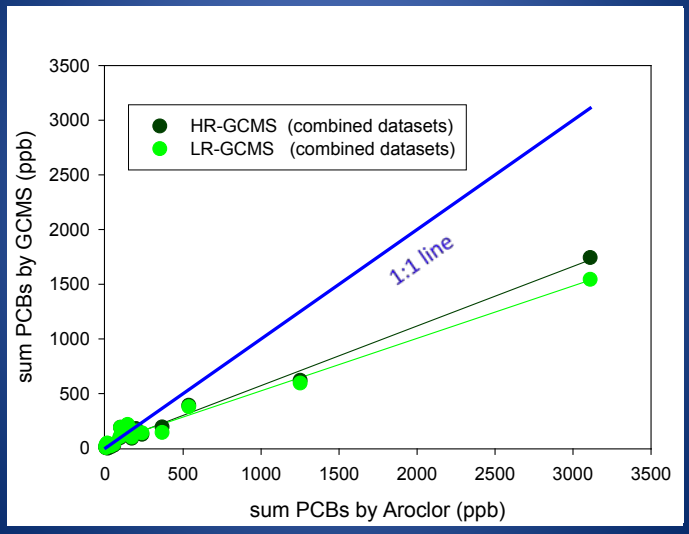
# Ecology Study, Total PCBs

**Sum PCBs, Aroclors v HR-GCMS congeners and LR-GCMS homologs**




pp-10-6

# Combined Studies, Total PCBs




pp-10-7

# Ecology Study, Total PCBs

- Total PCB HR-GCMS concentration range 4-191 ppb
- Aroclor results always equal to or lower than GC-MS results.
- HR and LR-GCMS methods correlated well ($y = 1.1384x - 7.27$; $R^2 = 0.952$)

pp-10-8

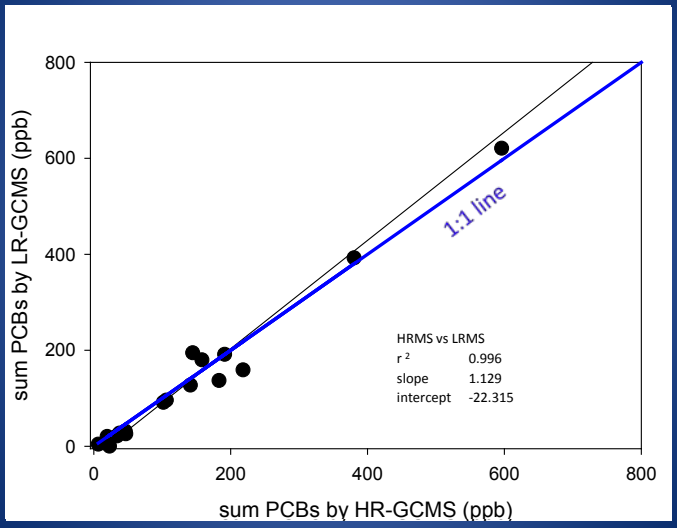
# Comparison of Studies, Total PCBs

COE: Aroclor > GC-MS  ECY: Aroclor ≤ GC-MS

- Different concentrations ranges?
- Differences in lab Aroclor analysis?
- Differences in sample mixture composition?

pp-10-9

# Combined Studies, Total PCBs




pp-10-10

## Total PCBs summary

- Sulfur cleanup is essential for EPA680
- Both studies showed good correlation between HRMS and LRMS.
- Even though different LRMS methods were used, combined comparison of Aroclor vs HRMS and HRMS vs LRMS resulted in good correlations.
- When samples have lower concentrations, Aroclor NDs become an issue. This becomes problematic if a large part of the dataset is ND (i.e. background determinations).



## Developing PCB Homolog TEFs

- Given HRMS and LRMS results are well correlated, can TEFs be developed for homologs?
  - All dioxin-like PCBs fall into 4 homolog groups
- Overview development of homolog TEFs based on HR-GCMS dioxin-like congeners, and sum homologs for tetra, penta, hexa, and heptachlorinated PCBs.

## TEQ definition

Congener-based TEQ:

$$TEF_{cong} \times Conc_{cong} = TEQ$$

Homolog-based TEQ:

$$TEF_{homo} \times Conc_{homo} = TEQ_{homo}$$

pp-10-13

## Homolog-TEF derivation

Since

$$TEF_{homo} \times Conc_{homo} = TEQ_{homo}$$

and from HR-GCMS, we can obtain

$Conc_{homo}$ and $TEQ_{homo}$

then we can solve for $TEF_{homo}$ using

$$TEF_{homo} = TEQ_{homo} / Conc_{homo}$$

pp-10-14

## Sample-specific homolog TEF calculations: ECY HRMS data

1. For each sample, sum all congeners (both dioxin-like and non-dioxin like) for each homolog group.

**1. gather HR homolog data**

| | HRMS |
|---|---|
| | RM01 |
| Monochlorobiphenyl | 43.9 |
| Dichlorobiphenyl | 5710 |
| Trichlorobiphenyl | 11000 |
| Tetrachlorobiphenyl | 32600 |
| Pentachlorobiphenyl | 62800 |
| Hexachlorobiphenyl | 44900 |
| Heptachlorobiphenyl | 15600 |
| Octachlorobiphenyl | 1010 |
| Nonachlorobiphenyl | 99.2 |
| Decachlorobiphenyl | 739 |
| SUM | 171502 |

pp-10-15

## Sample-specific homolog TEF calculations: ECY HRMS data

2. For each sample, HR-MS TEQs summed for each homolog group with dioxin-like PCBs (tetra, penta, hexa, and heptachlorinated PCBs). Can't use KM, so used ND=DL, which was closest to KM sum.

**2. Gather the HRMS dioxin-like PCB congeners, calculated TEQs, and sum based on homolog groups.**

| HRMS | # chlorines | Actual TEQs RM |
|---|---|---|
| 77 | 4 | 0.012 |
| 81 | 4 | 0.001 |
| 105 | 5 | 0.034 |
| 114 | 5 | 0.002 |
| 118 | 5 | 0.095 |
| 123 | 5 | 0.013 |
| 126 | 5 | 1.380 |
| 167 | 6 | 0.010 |
| 169 | 6 | 0.570 |
| 156/157 | 6 | 0.022 |
| 189 | 7 | 0.005 |

pp-10-16

## Sample-specific homolog TEF calculations: ECY HRMS data

3. For each homolog group and each sample, the sample-specific TEF is calculated for each homolog group by dividing the homolog congener-based TEQ by the sum homologs.

| HRMS | Step 1 Homolog | Step 2 Sum TEQ |
|---|---|---|
| | RM01 | RM01 |
| Tetrachlorobiphenyl | 32600 | 0.013 |
| Pentachlorobiphenyl | 62800 | 1.52 |
| Hexachlorobiphenyl | 44900 | 0.602 |
| Heptachlorobiphenyl | 15600 | 0.0049 |

**3. Divide sum homolog TEQ (step 2) by sum homolog PBC (step 1) to generate sample-specific TEF.**

| | HRMS Homolog TEF calculations |
|---|---|
| | RM |
| Tetrachlorobiphenyl | 4.0E-07 |
| Pentachlorobiphenyl | 2.4E-05 |
| Hexachlorobiphenyl | 1.3E-05 |
| Heptachlorobiphenyl | 3.1E-07 |

pp-10-17

## Average homolog TEF : ECY HRMS data

5. After generating sample-specific homolog TEFs for all 10 samples, generate AVERAGE TEFs for each of the four homolog groups by averaging sample-specific homolog TEFs.

| Sample ID | Tetrachlorobiphenyl | Pentachlorobiphenyl | Hexachlorobiphenyl | Heptachlorobiphenyl |
|---|---|---|---|---|
| RM01 | 4.0E-07 | 2.4E-05 | 1.3E-05 | 3.1E-07 |
| MC01 | 6.3E-07 | 4.2E-05 | 7.7E-06 | 2.7E-08 |
| FWA01 | 7.8E-07 | 3.0E-05 | 1.5E-05 | 1.1E-07 |
| FWA02 | 1.1E-06 | 5.6E-05 | 1.3E-05 | 1.2E-07 |
| FWA03 | 4.5E-07 | 4.2E-05 | 8.4E-06 | 1.4E-07 |
| FWA03dup | 5.2E-07 | 3.0E-05 | 9.6E-06 | 1.0E-07 |
| MA01 | 8.2E-07 | 3.1E-05 | 7.4E-06 | 1.2E-07 |
| MA02 | 8.2E-07 | 3.5E-05 | 1.0E-05 | 9.2E-08 |
| MB01 | 1.4E-06 | 8.5E-05 | 8.9E-06 | 6.5E-08 |
| FWB01 | 1.8E-06 | 9.8E-05 | 2.0E-05 | 1.2E-07 |
| FWB02 | 1.1E-06 | 5.6E-05 | 1.0E-05 | 1.6E-07 |
| average TEF | 9.0E-07 | 4.8E-05 | 1.1E-05 | 1.2E-07 |

pp-10-18

# $TEF_{homo}$ Analysis

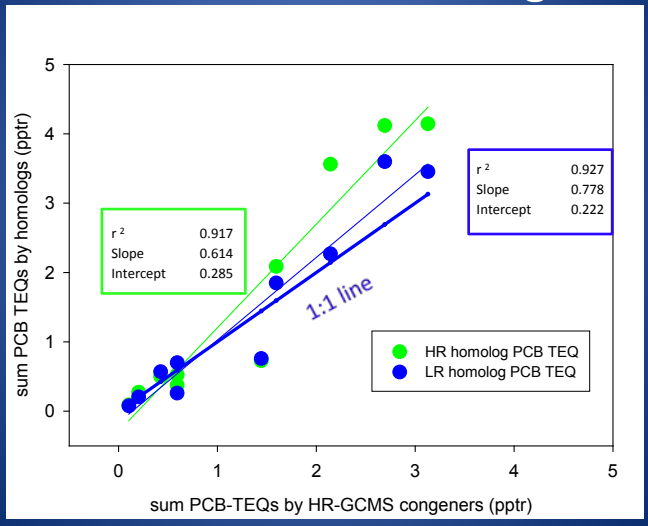
**Compare TEQs for:**

1. HRMS congeners, using congener-specific TEFs
2. HRMS homologs, using average homolog TEF
3. LRMS homologs using average homolog TEF

| | congener TEF | homolog TEFs | |
|---|---|---|---|
| | HRMS sum TEQ | HRMS sum TEQ | LRMS sum TEQ |
| RM01 | 2.1 | 3.6 | 2.3 |
| MC01 | 0.4 | 0.5 | 0.6 |
| FWA01 | 0.2 | 0.3 | 0.2 |
| FWA02 | 0.1 | 0.1 | 0.1 |
| FWA03 | 3.1 | 4.1 | 3.5 |
| MA01 | 2.7 | 4.1 | 3.6 |
| MA02 | 1.6 | 2.1 | 1.8 |
| MB01 | 0.6 | 0.4 | 0.3 |
| FWB01 | 1.4 | 0.7 | 0.8 |
| FWB02 | 0.6 | 0.5 | 0.7 |

pp-10-19

# HR-GCMS congener sum TEQ vs sum TEQ from homolog TEF




pp-10-20

## How Robust is the Homolog TEF?

- Use other datasets to compare actual HRMS TEQ to homolog generated TEQ
- Comparison with Corps data difficult due to high DLs for PCB 169 and PCB 126, the highest TEF congeners.
- PS SRM analyzed in both COE and ECY studies
- Compare sum TEQ from both studies using HR and LR data

pp-10-21

## Homolog TEF and PS-SRM results:

- Comparison of PS-SRM for Ecology and USACE study.

| | |
|---|---|
| Ecology data | |
| HR-GCMS congener (KM sum) | 2.1 |
| LR-GCMS using homolog TEF | 2.3 |
| Corps data | |
| HR-GCMS congener (KM sum) | 8.4 |
| LR-GCMS using homolog TEF | 2.1 |

pp-10-22

## Homolog TEF summary

- Used a set of 10 samples from ECY study of widely distributed water bodies.
- Sum TEQ calculated using average homolog TEFs correlate well with HR-GCMS sum TEQs ($R^2$>0.9)
- Need more samples from different areas to check performance (N=10 is insufficient)

pp-10-23

## So What?

DMMP disposal sites in the dawn of the new sediment rule.

- Need to stay below CSL
- Regional and natural background: what does it look like?
- No answers now, but if PCBs are below standard Aroclor analytical limits, GCMS may be required and LRMS may offer a lower cost alternative to HRMS.

pp-10-24

# So What?

Summed PCB and dioxin TEQ approach

- PCB contribution to TEQ
  - Preliminary Port Gardner Regional Background dataset:
    - PCB = 0.008 to 0.38 pptr TEQ
    - Dioxin = 0.1-3.6 pptr TEQ.
    - PCB % of total TEQ ranges from 4-11%
  - Port Angeles Regional Background dataset (90/90UTL, 5 areas)
    - PCB = 0.12 – 0.39 pptr TEQ
    - Dioxin = 1.9-6.0 pptr TEQ.
    - PCB % of total TEQ ranges from 4-8%
- Other concerns- non-dioxin-like PCB carcinogenicity

pp-10-25

# Next Steps

- NO PROPOSAL AT THIS TIME, but potential approaches are being discussed
  - If no "reason to believe" PCBs would be detected, use Aroclor analysis.
  - If "reason to believe" use LRMS and the sum PCB dioxin TEQ approach.
- Initial studies are promising, but we need more information for the homolog TEF approach

pp-10-26

# COMMENTS? QUESTIONS?

pp-10-27

# Sediment Bioavailability Assessment Using Passive Porewater Samplers


**Mandy Michalsen, PhD, PE**
**Kristen Kerns; John Wakeman**
***Seattle District USACE***

**Prof. Phil Gschwend, PE; Eric Adams; Katherine von Stackelberg**
***Massachusetts Institute of Technology***

**Howard Orlean RPM, Ravi Sanga RPM, Allison Hiltner RPM, Justine Barton, Rene Fuentes, Maja Tritt, Sean Sheldrake**
***EPA Region 10***

**Prof. Danny Reible, PE; Xioang Lu**
***University of Texas at Austin***

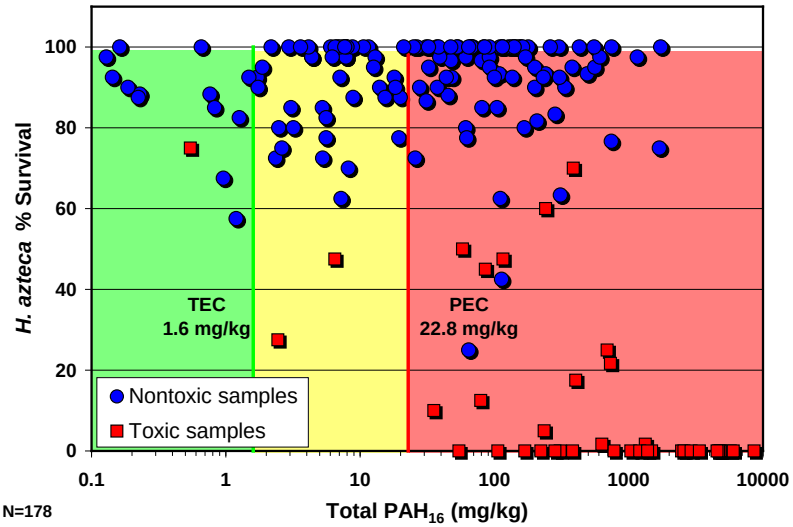

**5/7/2014**

US Army Corps of Engineers®




pp-11-1

# Bulk Sediment Concentrations Are Poor Predictors of Toxicity




Source: Survey To Characterize PAH Toxicity and Bioavailability at MGP and Al Smelter Sites, accomplished by Alcoa and SCBA. http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/FINAL_2006_SMARM_minutes.pdf

pp-11-2

# Estimating Bioavailability from Bulk Sediment Has Limitations

- Prediction of toxicity – from EPA (2003) and EPA (2007):
  - Use Equilibrium Partitioning (EqP) to determine concentration
  - Calculate the ratios of individual PAHs to their Final Chronic Values ("Toxicity Units", TU)
  - Add these to determine ΣTU
  - Compare to a ΣTU of 1.0 – the probable effect level using the narcosis model
- Caveats:
  - EqP overestimates toxicity by 100x.
  - Also, "black carbon" adjusted EqP tends to under predict toxicity (Gschwend, et al. 2010)

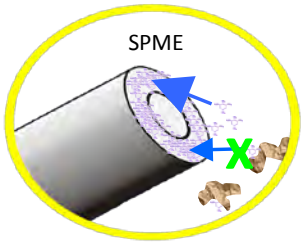
http://www.itrcweb.org/contseds-bioavailability/

pp-11-3

# Measuring Porewater Contaminants

- Solid Phase MicroExtraction (SPME)
  - Sorbent Polymer: PDMS (poly-dimethylsiloxane)
    - Thickness of glass core: 114-108 µm
    - Thickness of PDMS coating: 30-31 µm
    - Volume of coating: 13.55 (±0.02) µL PDMS per meter of fiber
  - ng/L detection with 1 cm resolution

http://www.caee.utexas.edu/reiblegroup/reible-materials/PassiveSamplingofPorewaterfortheIn-situAssessment.pdf




- Polyethylene (PE) Sampler
  - Sorbent Polymer: Polyethlyene (PE)
  - Thickness of PE: ~ 51 µm
  - ng/L detection with 1 cm resolution

http://www.clu-in.org/download/contaminantfocus/sediments/sediment-er-1496-fr.pdf

Polyethylene (PE) Sampler



# Porewater Sampler Demonstration, Lower Duwamish Waterway Superfund Site, EPA Region 10

http://yosemite.epa.gov/r10/cleanup.nsf/sites/lduwamish

# Polyethylene (PE) Porewater Sampler Field Demonstration Objectives

- Do the measured $C_{pw}$ PCBs at five sites representative of the Lower Duwamish Waterway compare well to values estimated using equilibrium partitioning

$$C_{pw} = C_{sed} / (f_{oc} * K_{ow})$$

- Do measured $C_{pw}$ PCB porewater concentrations compare well to values estimated using black carbon adjusted estimate below?

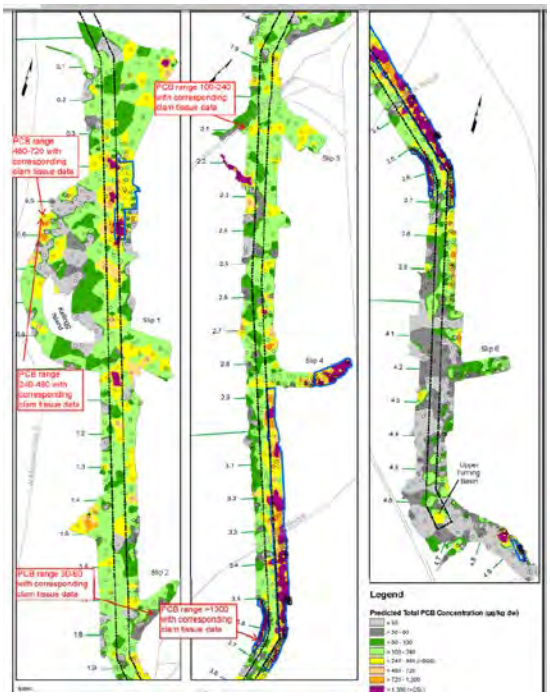
$$C_{pw} \approx C_{sed} / K_d \approx C_{sed} / (f_{oc} * K_{oc} + f_{bc} * K_{bc} * C_{pw}^{n-1})$$

$K_{bc}$ is fraction of sediment OC which is black carbon

*n* is the Freundlich exponent (0.7) to account for nonlinearity

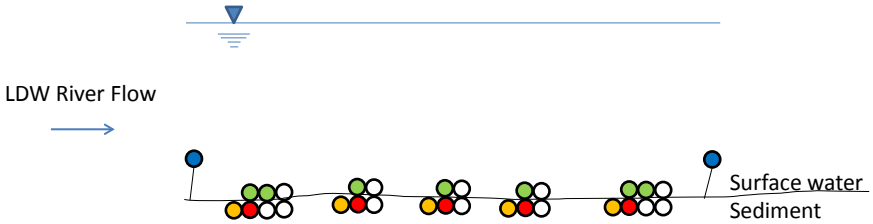
pp-11-6

# PE Deployment Locations in Lower Duwamish Waterway




pp-11-7

# Sampling/Analysis Program Schematic




- Bulk sediment
- Porewater samplers (-10 to 0 cm)
- Bottom water samplers (0 to 10cm)
- Near-surface surface water samplers
- Archive



# PE Sampler Visuals

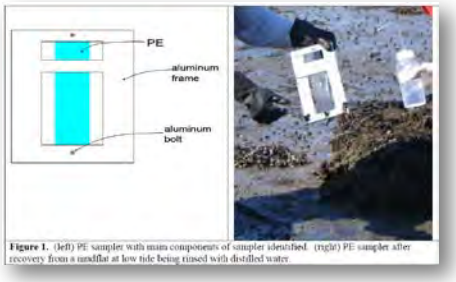
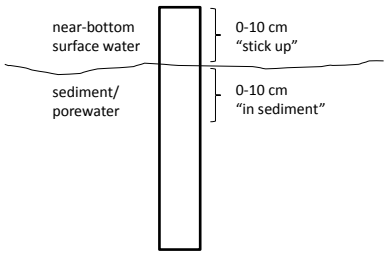



Figure 1. (left) PE sampler with main components of sampler identified. (right) PE sampler after recovery from a mudflat at low tide being rinsed with distilled water.

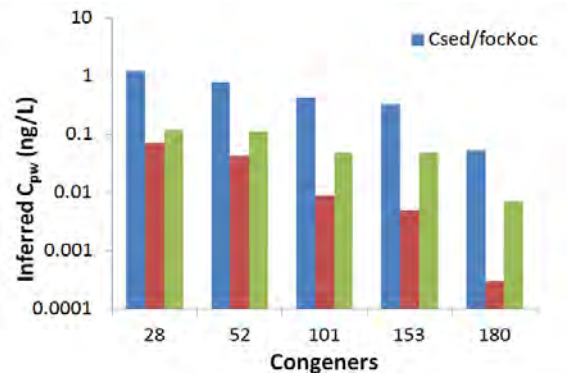
Conceptual In-Place PED Sampler with Collection Intervals Identified in LDW Project




Passive sampler retrieval by divers in Lower Duwamish Waterway

Post-retrieval processing of passive samplers in on-shore laboratory

# Results by Key Congeners




Comparison of PW concentrations of individual PCB conger sets estimated by sediment concentration divided (1) $f_{oc}$*$k_{oc}$ (**blue**), (2) estimate of the sorption coefficient expressed as funciton of $f_{oc}$ and $f_{bc}$ (**red**), and (3) PE concentrations divided by $K_{pew}$ (**green**)

→ Traditional Equilibrium Partitioning overestimates $C_{pw}$ by about 7 times

→Using an EqP adjustment with standard black carbon $K_{bc}$ underestimates the observed $C_{pw}$ by 3-4 times

→The predominant form of black carbon is coal/coke derived

pp-11-10

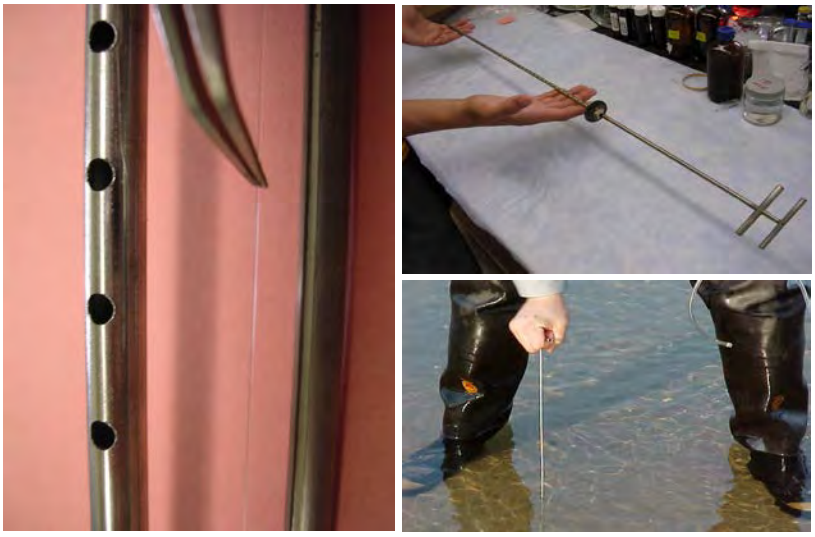
# Pacific Sound Resources (PSR) Superfund Site, EPA Region 10

- Site Background
  - Wood Treatment Operation 1909-1994
  - Upland area unit 25 acres
  - Marine sediment unit 58 acres
  - Remedial action included dredging, capping and institutional controls and upland source control measures
- Study Objectives
  - Measure near-surface porewater concentrations
    - *Exceedance of surface water quality criteria?*
  - Measure porewater concentrations with depth in the sediment cap
    - *Concentration gradients indicate contaminant migration through cap?*


11

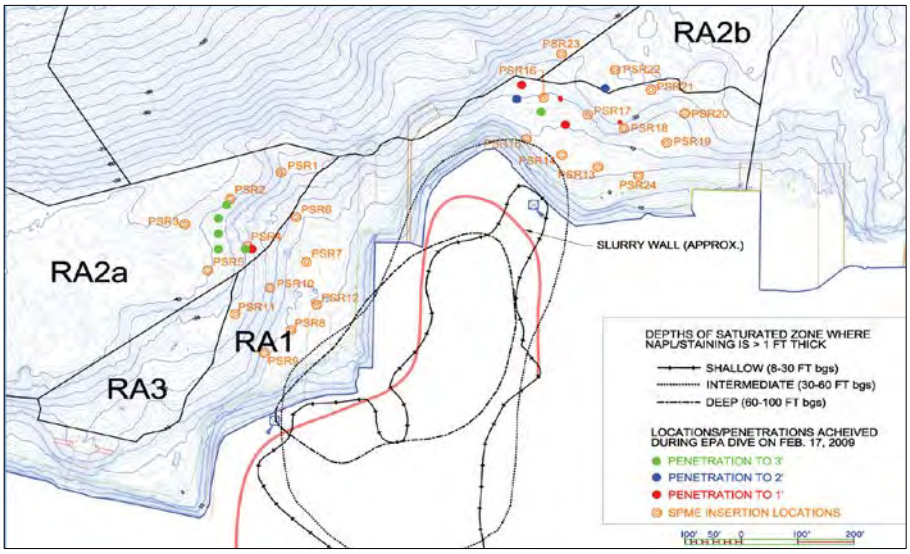
pp-11-11

# Solid-Phase Microextration (SPME)



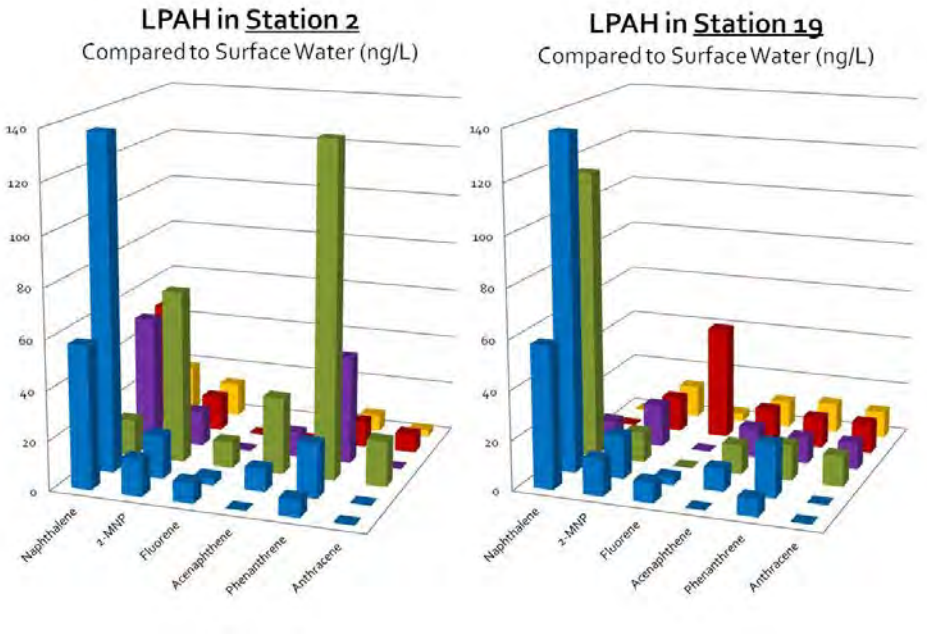
pp-11-12

# SPME Fiber Field Demonstration at PSR



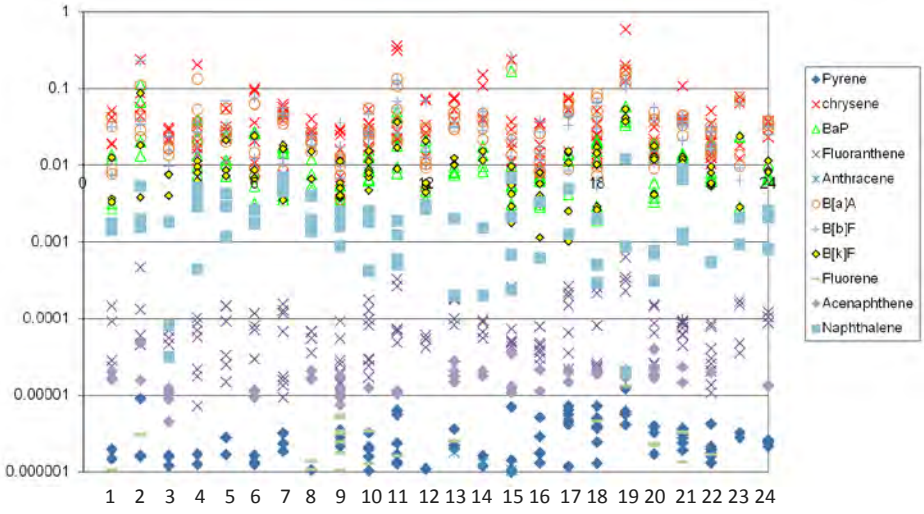

pp-11-13

# SPME Fiber Results




pp-11-14

# SPME Fiber Results




15

pp-11-15

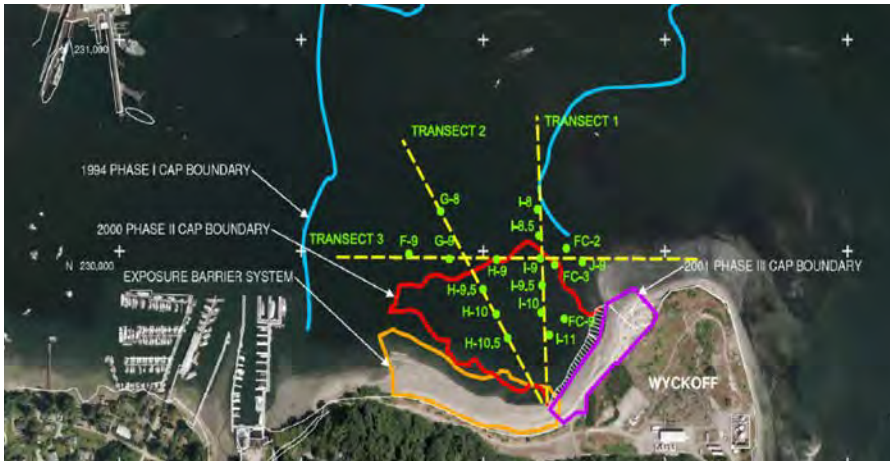
# SPME Porewater Sampler Demonstration at Wyckoff/Eagle Harbor Superfund Site, EPA Region 10

- Site Background
  - Wood treatment operation
  - Added to NPL in 1987
  - COCs include PAHs, PCP and metals
  - Remedial actions included capping ~ 70 acres with clean sediment in addition to upland source control measures
- SPME Study Objectives
  - Measure near-surface porewater concentrations
    - *Exceedance of surface water quality criteria?*
  - Measure porewater concentrations with depth in the sediment cap
    - *Concentration gradients indicate contaminant migration through cap?*
  - Compare colocated bulk sediment and porewater results
    - *Would the two methods support different conclusions if used alone?*

16



# SPME Fiber Field Demonstration at Wyckoff/Eagle Harbor




17

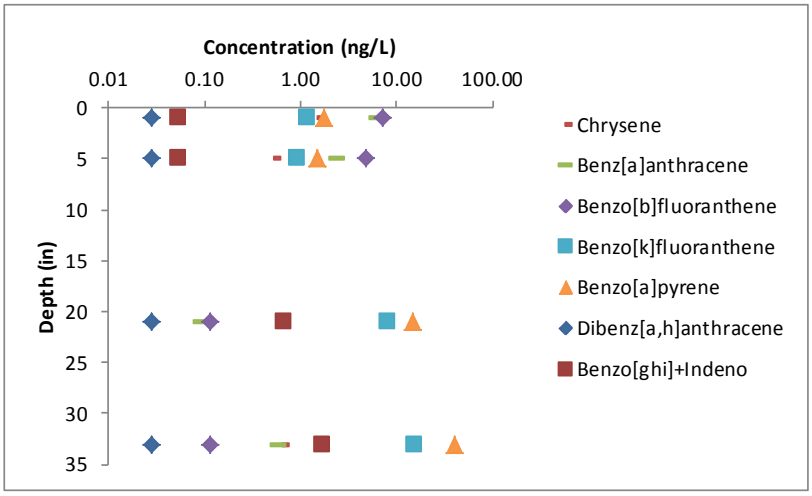
# Corrections for Steady State

- Deuterated PAHs are ideal performance reference compounds (Gschwend et al. 2009)
  - fluoranthene-d10
    chrysene-d12
    benzo[b]fluoranthene -d12
    and
    dibenz[a,h]anthracene -d14

| Compound | logKow | Correction Factor for 1000/1071µm fiber | Correction Factor for 1000/1060 µm fiber |
|---|---|---|---|
| Naphthalene | 3.37 | 0.90 | 0.91 |
| Acenaphthene | 3.92 | 0.84 | 0.87 |
| Fluorene | 4.18 | 0.81 | 0.84 |
| Anthracene | 4.54 | 0.76 | 0.79 |
| Phenanthrene | 4.57 | 0.75 | 0.79 |
| Pyrene | 5.18 | 0.64 | 0.68 |
| Fluoranthene | 5.22 | 0.63 | 0.67 |
| Benzo[b]fluroanthene | 5.8 | 0.51 | 0.56 |
| Chrysene | 5.86 | 0.50 | 0.54 |
| Benz[a]anthracene | 5.91 | 0.49 | 0.53 |
| Benzo[k]fluroanthene | 6 | 0.47 | 0.51 |
| Benzo[a]pyrene | 6.04 | 0.46 | 0.50 |
| Benzo[ghi]perylene +Indeno(1,2,3-cd)pyrene | 6.5 | 0.36 | 0.41 |
| Dibenz[a,h]anthracene | 6.75 | 0.32 | 0.36 |

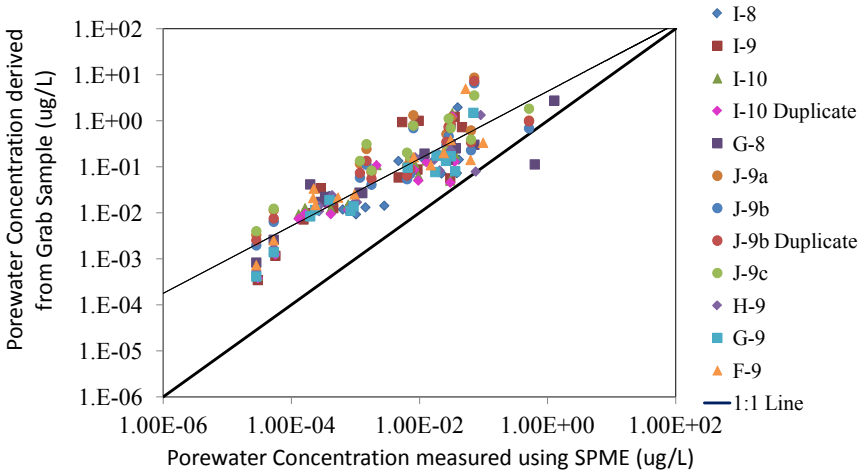
pp-11-18

# Concentration Depth Profiles Allow Assessment of Through-Cap Migration




pp-11-19

# Bulk Sediment Estimated Porewater vs. Measured Porewater



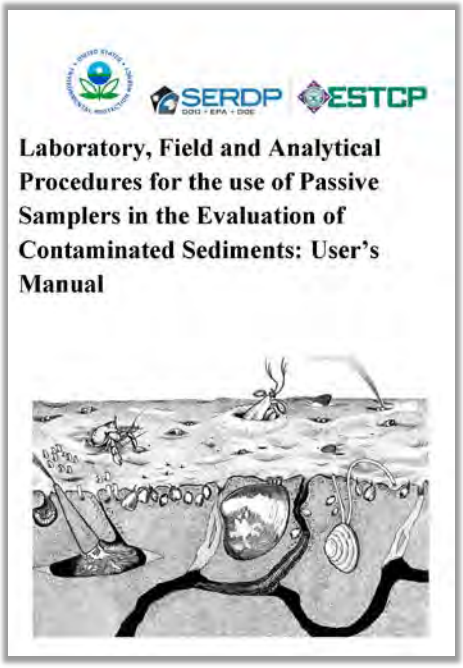



# Take Home Messages

- Benefits of direct porewater measure
  - Better proxy for bioavailability
  - Deployable in near surface sediment/surface water column
  - cm-level depth resolution and ng/L DLs allow assessment of concentration gradients/migration potential
  - Not cost prohibitive compared to bulk sediment analysis, though commercial laboratories offering passive porewater samplers/analysis is limited
- Ideal approach for monitoring activated carbon-amended sediments
  (Gidley et al. *Environ. Sci. Technol.* 2012, 46, 5032−5039)

## Standard Methods and Laboratories

- EPA and SERDP/ESTCP Guidance Document
- Accredited Labs
  - Axys (BC)
  - ALS
  - Pace Analytical
  - Test America




**Contact for User's Manual:**

**Tim Thompson**
**tthompsonseellc@gmail.com**

# APPENDIX V

## CLARIFICATION PAPERS & ISSUE PAPER

1. Recency Guidelines Modifications (Clarification)
2. Freshwater Bioassays (Clarification)
3. Implementation of Revised Freshwater Sediment Screening Values (Issue)

Based on comments received, this Issue Paper is being revised and will be provided later.

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June 6, 2014 - Final

DMMP Clarification Paper: **Recency Guideline Modifications**

Prepared by David Fox (Corps) for the DMMP agencies

## INTRODUCTION

The DMMP User Manual (DMMP 2013) provides "recency" guidelines for dredged material characterization data. These guidelines apply to material that has been sampled and tested for open-water disposal or beneficial-use placement, but not yet dredged. The recency guidelines specify the duration of time for which chemical and biological characterization data continue to be representative of the material to be dredged. For high-ranked projects, the recency guidelines allow characterization data to be valid for a period of 2 years. The recency periods for moderate, low-moderate and low-ranked projects are 5, 6 and 7 years respectively.

A related concept is addressed by the DMMP "frequency" guidelines. Frequency guidelines specify the extent of time a given dredging project can be maintained with repeated dredging without further testing. Once the sampled and tested material has been dredged, the frequency guidelines apply. Time durations for the frequency guidelines are the same as for the recency guidelines: two years for high-ranked areas; and 5, 6 and 7 years for moderate, low-moderate, and low-ranked areas respectively.

## PROBLEM IDENTIFICATION

There are two problems with the current recency/frequency guidelines addressed by this clarification paper. The first is the length of time required for high-ranked projects to complete the permitting process prior to dredging. The second is general confusion over the difference between, and applicability of, the two related concepts of recency and frequency.

*Recency guidelines for high-ranked projects:*

The 2-year recency period for high-ranked projects was established when the Puget Sound Dredged Disposal Analysis (PSDDA) program was implemented in 1988 (PSDDA 1988). The complexity and duration of the regulatory process for dredging projects has increased over the years, in large part due to the number of species that have been designated under the Endangered Species Act (ESA). Due to the increased length of the permitting process, some high-ranked projects cannot be dredged prior to expiration of the DMMP recency period. When this occurs, the DMMP agencies must decide whether to require supplemental sampling and testing to verify the continued representativeness of the original characterization data, or grant an extension of the recency period. Supplemental testing generally takes several months to complete and would further delay the dredging. Therefore, if upon examination of project details, there has been no change in conditions at the dredging location, the DMMP agencies will generally approve reasonable extensions (e.g. one year in high-ranked areas) to the recency period without additional characterization to allow the dredging to proceed more expeditiously.

*Recency vs. frequency:*

As defined in the introduction, recency and frequency are terms that apply to two different dredging scenarios. Recency applies to a scenario in which dredged material has been tested, but not yet dredged. Frequency applies to a scenario in which the tested material has already been dredged, but the testing results are still considered representative of additional material that accumulates after the first cycle of dredging has been completed. Under the frequency guidelines, additional cycles of dredging may occur without further testing until the expiration of the frequency period.

While these two concepts have distinct meanings, there is often confusion about the difference between the two. From a practical standpoint maintaining this distinction is unnecessary, because the ultimate consequence from application of the recency and frequency guidelines is exactly the same. Both determine the length of time a specific project can go without sampling and testing. Or, put another way, both dictate how often a dredging proponent needs to characterize the dredged material for their project.

## PROPOSED CLARIFICATION

### *Increase the recency period for high-ranked projects*

The DMMP agencies propose increasing the recency period for high-ranked projects from two to three years to accommodate longer permit processing times. The following table lists the proposed recency periods by rank:

| Rank | Recency Period (years) |
|---|---|
| High | 3 |
| Moderate | 5 |
| Low-Moderate | 6 |
| Low | 7 |

The agencies recognize that high-ranked projects are located in areas with active sources of contamination, so are more prone to changed conditions than projects in lower-ranked areas. However, the DMMP User Manual already includes a provision that applies to this situation. The manual states that the recency guidelines do not apply when a changed condition (e.g. accidental spills or new discharges) has occurred since the most recent samples were obtained. Therefore, if changed conditions warrant, the DMMP agencies may require supplemental testing prior to the expiration of the recency period.

### *Expand the definition of recency to include frequency*

The DMMP agencies propose using the term “recency” to include the dredging scenario currently covered separately by “frequency”. Therefore, the term “recency” will be used more generically to indicate how often sediment characterization needs to be conducted for a specific

project. The terms “frequency guidelines”, “frequency period”, “frequency extension” and “frequency determination” will no longer be used.

This modification of terminology will not affect the notification procedure in place for multiyear maintenance dredging permits. At least four months prior to each maintenance dredging activity, the permittee must contact the U.S. Army Corps of Engineers, Dredged Material Management Office to determine whether additional sediment characterization is required. If additional characterization is required, no disposal of dredged material will be allowed at a DMMP open-water disposal site or placement at a beneficial-use site until the material has been determined suitable by the DMMP agencies.

**REFERENCES:**

DMMP (2013). *Dredged Material Evaluation and Disposal Procedures – User Manual*; prepared by the Corps of Engineers for the Dredged Material Management Program, July 2013.

PSDDA (1988). *Evaluation Procedures Technical Appendix – Phase I*; prepared by the Army Corps of Engineers, Environmental Protection Agency, Department of Ecology and Department of Natural Resources for the Puget Sound Dredged Disposal Analysis Program, June 1988.

June 6, 2014 - Final

DMMP/RSET Clarification Paper: **Freshwater Bioassays**

Prepared by Laura Inouye (Washington Department of Ecology) for the DMMP and RSET agencies.

## INTRODUCTION

The Washington State Sediment Management Standards (SMS) and DMMP/RSET dredging guidance regards bioassay results as more informative of potential resource impacts than exceedence of numeric chemical sediment standards, including the new freshwater benthic SLs (DMMP/RSET 2014). Thus bioassay results always take precedence over chemical results. This structure exists largely because chemical standards are informed by biological observations from some of the same suite of biological tests used to evaluate dredged material. The floating percentile model (FPM) used to develop the new Washington State freshwater sediment standards (WAC 173-204-563) used input from both acute (10-day *Chironomus* and *Hyalella*) and chronic (28-day *Hyalella*) tests. The standards were based on the most sensitive test, which was often the chronic 28-day *Hyalella* growth bioassay.

Currently, the Sediment Evaluation Framework for the Pacific Northwest (SEF 2009) and the DMMP User Manual (DMMP 2013) require only short-term bioassays using either *Hyalella* or *Chironomus*. Since the standards were often based on the results from a chronic bioassay, however, it is imperative that at least one of the bioassays conducted to override exceedances of the numeric standards should evaluate a chronic exposure measuring a sublethal endpoint.

## PROBLEM STATEMENTS

1. Current freshwater guidance requires only 10-day acute endpoint bioassays to override the chemical testing results, although the freshwater benthic screening levels (FW benthic SLs) were often based on longer-term exposures and sublethal endpoints.
2. When the new Washington State freshwater sediment chemical standards (WAC 173-204-563) were implemented in September 2013, chronic tests with sublethal endpoints for *Chironomus* and *Hyalella* were added to the list of approved SMS bioassays. Testing under SMS now requires a chronic test and a sublethal endpoint to be included in the suite of three bioassays used to identify toxicity in test sediments. Current DMMP/RSET guidance for conducting freshwater bioassays is inconsistent with the revised state standards.

## PROPOSED PROGRAM MODIFICATION

In order to address the issues identified above, the DMMP/RSET agencies propose making the freshwater bioassay testing requirements for dredged material consistent with WAC 173-204-563.

**Bioassay Selection:**

The SMS rule includes the following requirements for freshwater sediment:

- Two different test species
- Three endpoints
- One chronic test; and
- One sublethal endpoint

Table 1 indicates which bioassay endpoints fall into which of the categories.

**Table 1. Freshwater biological tests, species, and applicable endpoints.** These tests and parameters were developed based on the most current American Society for Testing and Materials and EPA protocols for establishing appropriate biological test.

| Species, biological test, and endpoint | Acute effects biological test | Chronic effects biological test | Lethal effects biological test | Sub-lethal effects biological test |
|---|---|---|---|---|
| Amphipod: *Hyallela azteca* | | | | |
| 10-Day mortality | X | | X | |
| 28-Day mortality | | X | X | |
| 28-Day growth | | X | | X |
| Midge: *Chironomus dilutus* | | | | |
| 10-Day mortality | X | | X | |
| 10-Day growth | X | | | X |
| 20-Day mortality | | X | X | |
| 20-Day growth | | X | | X |

**Bioassay Methods:**

The bioassays should follow the protocols specified below:

**Acute Effects Tests**

- *Hyalella azteca* 10-day mortality: ASTM E1706-05 (2010)/EPA Method 100.1 (US EPA, 2000)
- *Chironomus dilutus* 10-day mortality: ASTM E1706-05 (2010)/EPA Method 100.2 (US EPA, 2000)
- *Chironomus dilutus* 10-day growth: ASTM E1706-05 (2010)/EPA Method 100.2 (US EPA, 2000)

**Chronic Effects Tests**

- *Hyalella azteca* 28-day mortality: EPA Method 100.4 (US EPA, 2000)
- *Hyalella azteca* 28-day growth: EPA Method 100.4 (US EPA, 2000)
- *Chironomus dilutus* 20-day mortality: EPA Method 100.5 (US EPA, 2000)
- *Chironomus dilutus* 20-day growth: EPA Method 100.5 (US EPA, 2000)

Unlike marine biological criteria, the freshwater biological criteria are based on a comparison to control treatments; therefore, it is not necessary to collect reference sediments for freshwater bioassays. This is due to the lack of established reference sites in Washington. Dredging projects wishing to use reference sediments must have the reference location approved prior to collection of the reference sediments.

**Bioassay Performance Standards and Interpretation:**

The table below specifies the bioassay performance standards and the hit definitions.

**Table 2. Freshwater biological criteria (test performance standards; 2-hit and 1-hit interpretation criteria) for each biological test.**

| Biological Test/ Endpoint * | Performance Standard* | | Sediment Cleanup Objective for each biological test (2 hit criteria) | Cleanup Screening Level for each biological test (one hit criteria) |
|---|---|---|---|---|
| | Control* | Reference | | |
| ***Hyalella azteca*** | | | | |
| 10-day mortality | $M_C \leq 20\%$ | $M_R \leq 25\%$ | $M_T - M_C > 15\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 28-day mortality | $M_C \leq 20\%$ | $M_R \leq 30\%$ | $M_T - M_C > 10\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 28-day growth | $MIG_C \geq 0.15$ mg/individual | $MIG_R \geq 0.15$ mg/individual | $(MIG_C - MIG_T)/MIG_C > 0.25$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.40$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |

**Table 2. Freshwater biological criteria (test performance standards; 2-hit and 1-hit interpretation criteria) for each biological test.**

| Biological Test/ Endpoint * | Performance Standard* | | Sediment Cleanup Objective for each biological test (2 hit criteria) | Cleanup Screening Level for each biological test (one hit criteria) |
|---|---|---|---|---|
| | Control* | Reference | | |
| ***Chironomus dilutus*** | | | | |
| 10-day mortality | $M_C \leq 30\%$ | $M_R \leq 30\%$ | $M_T - M_C > 20\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 30\%$ And $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 10-day growth | $MIG_C \geq 0.48$ mg/individual | $MIG_R/MIG_C \geq 0.8$ | $(MIG_C - MIG_T)/MIG_C > 0.20$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.30$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |
| 20-day mortality | $M_C \leq 32\%$ | $M_R \leq 35\%$ | $M_T - M_C > 15\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) | $M_T - M_C > 25\%$ and $M_T$ vs $M_C$ SD ($p \leq 0.05$) |
| 20-day growth | $MIG_C \geq 0.60$ mg/individual | $MIG_R/MIG_C \geq 0.8$ | $(MIG_C - MIG_T)/MIG_C > 0.25$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) | $(MIG_C - MIG_T)/MIG_C > 0.40$ and $MIG_T$ vs $MIG_C$ SD ($p \leq 0.05$) |

**Notes:**

M = Mortality; C = Control; R = Reference; T = Test; F = Final; MIG = Mean Individual Growth at time final; mg = milligrams.

[a] These tests and parameters were developed based on the most updated American Society for Testing and Materials protocols.

[b] Reference performance standards are provided for sites where the department has approved a freshwater reference sediment site(s) and reference results will be substituted for control in comparing test sediments to criteria.

[c] An exceedance of the sediment cleanup objective and cleanup screening level requires statistical significance at $p = 0.05$.

[d] The control performance standard for the 20 day test (0.60 mg/individual) is more stringent than for the 10 day test and the agencies may consider, on a case-by-case basis, a 20 day control has met QA/QC requirements if the mean individual growth is at least 0.48 mg/individual.